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Industrial cluster formation in European regions. U.S. cluster templates and Austrian evidence.

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Expanded Abstract

Introduction

Industrial cluster research is by now widely diffused over many partially related concepts and literatures far too numerous to mention here. The particular concept that propels this paper is based on the interdependencies that arise among firms that are positioned somewhere along-- and engage in trade with other members of-- their value-chain(s). We call these 'industrial trade clusters.' A national version is the foundation for ongoing work at OECD to analytically evaluate industrial clusters within which technological innovations arise and are propagated.

The specific approach to be applied here has been developed (Bergman, Feser and Sweeney, 1997) and distinguished from other approaches elsewhere (Bergman, 1998a). We will focus on one of its main features in this paper: *industrial trade cluster templates as practical devices for comparing regional clusters over time and across national industrial systems*. The value-chains that bind these trade clusters are powerful forces that bring firms into frequent and intimate contact concerning contractual exchanges of all kinds. Particularly powerful are the highly integrative bonds between suppliers and buyers who jointly design and specify the goods exchanged along the value chain. This has profound implications for the adoption and use of production technologies, as well as the joint development of innovative products. Exchanges of key personnel, joint training, coordinated investment plans (Williamsonian asset-specific), technology coaching and licensing, etc. are among the subtle connections carried along various trading channels. Less intense versions of this may also occur even over considerable distances, when aided by IT and digital platforms, that permit reliable exchange among highly specialized and segmented clusters of activity. But the most intense collaboration occurs within various cluster segments, particularly in regions that offer extraordinary advantages to specific segments of one or more larger industrial trade clusters.

A deep vein of provocative interpretations can be drawn from the rich lode of regional cluster case studies, but we assert that serious theoretical and empirical work on this exploratory concept remains obstructed in the absence of generalizable constructs which can be tested in and across regional laboratories of different national systems. We intend to demonstrate the utility of industrial trade cluster templates for these purposes.

The paper will be organized in the following manner. We first provide a concise review of how industrial trade clusters were developed from available I/O coefficients (see box), including how regional industrial data may be embedded within their 'templates'. Second, we will review the steps taken, using available industrial concordances, that permit regional data from other advanced national industrial systems to be embedded within these templates. Third, we will illustrate the results of applying the U.S. template for the motor vehicle industrial trade cluster to regions in both Austria and North Carolina over 5-10 year time periods. Finally, we will offer some speculative observations about what the results may indicate about regional cluster development in these two regions.

Deriving Industrial Trade Cluster Templates

As the boxed overview below indicates, 23 industrial trade clusters result from the original research (Bergman, Feser and Sweeney, 1997; Feser and Bergman, forthcoming), which consist of comparatively homogenous groupings of the most likely trading partners. Clusters may consist of only a few sectors whose trade is totally dominated by its other *primary* members (e.g., tobacco), or include a large mixture of sectors whose trade varies widely: totally internal trade among other primary sectors, plus secondary sectors that trade internally *and* with sectors in other industrial trade clusters (e.g., motor vehicles). Trading behavior of secondary sectors provides useful clues to the region's common assets and its overall structure of cross-linked clusters, although these points will not be pursued here (for which, see Bergman, 1998b).

It is important to emphasize that relatively few culturally homogenous European and only the very smallest U.S. regional economies are dominated by elements of a single production cluster, even though assumptions of cluster dominance appear to animate the majority of micro case studies in the cluster literature (Bergman, 1998a). It is far more common that each region hosts *two to several* ***partial*** *clusters* whose segments rely upon or perhaps derive directly from unique mixtures of regional assets and path-dependencies. This statement reveals two key implications. First, growing tendencies for inter-industry trade and specialized agglomeration rarely favors a single location for all the sectors that comprise a given cluster: *an industrial trade cluster logically segments itself into sub-clusters that thrive in specific regions, from which its members engage in what we observe as interregional trade.* Second, and of more direct methodological interest to us, is that the full set of sectors that comprise such a cluster serves as a provisional 'template' that permits us to examine the cluster composition of regional economies. Since the method of derivation also reveals approximate correlation's of each sector's trade with the full cluster, all regional clusters can also be weighted accordingly.

Overview of Industrial Trade Cluster Estimation Methodology

The basic methodology for clustering manufacturing industries consisted of factor analysis on a data matrix constructed from the 1987 U.S. input-output (I-O) coefficients. Factor analysis treats each given industry as a variable, with a measure of the linkages between the industry and all other industries treated as observations. The analysis then seeks to reduce the number of variables by exploiting the common variation among them, i.e. it groups industries together based on similarities of inter-industry trade, as revealed by their input-output coefficients. The result is a set of input-output based industrial clusters. A detailed analysis of the all methods, as well as the criteria developed for identifying clusters from the statistical output, is available in other sources (Bergman, Feser and Sweeney, 1997; Feser and Bergman, forthcoming).

Input-Output Based Industrial Trade Clusters. Because interindustry trade linkages involve extremely complex networks, the task of aggregating industries into mutually exclusive clusters risks masking key input-output relationships. In reality, many industries trade with others in more than one cluster, and their trade linkages across clusters vary accordingly in degree or strength; i.e. an industry may be tightly linked to one group of sectors and weakly or moderately linked to one or more additional groups. Such interrelationships can make interregional or intertemporal comparison of clusters difficult, since a significant amount of double counting may arise when calculating sectoral aggregations. Factor analysis provides a useful way around this problem by generating a set of "loadings," which measure relative degrees or strength of linkage between a given industry and the cluster of which it is a part. Loadings closer to 1.0 indicate tighter linkages of the primary industries.

Secondary industries are defined as those sectors with cluster loadings of between .35 and .60. By focusing the overall analysis first on the primary industries, one obtains 23 mutually exclusive clusters that may be used for cross-comparison purposes. However, the full value of clusters requires the presence of both primary and secondary industries to provide the most complete picture of interindustry and interfirm trade. Linkages between clusters are best revealed through an examination of their secondary industries.

Primary vs. Secondary Cluster Industries. Loadings have been used to designate whether a cluster's sectors are considered "primary" or "secondary." In general, *primary* industries are those that are most tightly linked to a given cluster while *secondary* industries are those that are only moderately or weakly linked to the cluster. Specifically, primary industries for a given cluster are defined as those sectors 1) that achieved a loading of at least .60 on that cluster; *and* 2) that did not achieve a higher loading on any other cluster.

Weakly Clustered Industries. Not all industries trade within sufficiently deep supply chains to exhibit distinct trade clustering tendencies. Of 362 input-output sectors, 44 failed to achieve any loading of .60 or higher. These sectors are classified as purely secondary industries in their respective clusters. Although 22 sector loads did exceed .50 on at least one cluster, the 318 industries classified as primary industries achieved loadings of .80 or higher on one or more clusters. Three sectors (SICs 328--cut stone and stone products, 387--plumbing fixture, fittings and trim, and 3432--watches, clocks, watchcases, and parts) achieved maximum loadings below .35 and thus fall short of secondary industry thresholds, according to the criteria above. Nevertheless, to ensure that all manufacturing sectors are included in regional analyses, the weakest loadings are also included as secondary industries in the cluster where they attained their maximum loading.

(Bergman, 1998a)

Applying Templates to Regions

We have elected to represent the complex structure of industrial trade clusters in visual form. This takes two steps. First, basic information needed to create our templates is drawn from the original cluster derivation (see Appendix 1for output summary). The visual template then consists of trading sectors drawn from the full cluster, which we choose to array on a simple spoke-graph. The spokes array clockwise, each of which represents a key sector at its lowest available level of data aggregation, in decreasing order of intra-cluster trading tendencies ('load inverse,' or correlation). The load-inverse markers on each spoke spiral out from the highest to lowest trade correlations between any sector and the cluster as a whole. This is therefore a graphical mapping of the full set of each cluster's sectors and their average trading tendencies (see Figure 1).

Because it is a line-graph, we can also scale the spokes for entry of available regional data of sectoral activity (employment, output, value-added, wage bill, etc) within each cluster. After plugging in the data for any particular region, one should expect to observe shapes that reveal high relative concentrations of a few sectors, a scattering of activity across others, and many sectors with no activity at all (Bergman, 1998b). When repeated for two or more regions, contrasting patterns of sectoral concentration form visual 'Rorschach' results that might gain interpretive meaning if examined repeatedly across a large sample of known regional economies.

We, however, have experimented here with other visual applications of the basic template in ways that permit useful time comparisons of cluster segmentation. First, we reorganize the sectoral spokes of a region in declining levels of activity in the base year, which we measure with employment levels. The sector with the highest employment concentration is presented first, followed by declining levels of other sectors. This draws immediate attention the region's strongest initial concentrations. Declining arrays of sectoral activity are presented first for primary, and then for secondary, sectors to distinguish between markedly different levels of intra-cluster trading potential; the load-inverse marker is also retained for each sector to reveal its basic trading behavior. Multiple-year data can then be plotted on the base year template to reveal which initial concentrations expanded or contracted in the regional economy.

If, for example, we followed Krugman's line of reasoning, we should expect to see the most highly concentrated segments of an industrial trade cluster expand the most, at least in absolute terms. This is by now the situation in much of the U.S. On the other hand, if we suspect that regional growth or change are based only in part on processes of market-driven trade and agglomeration, then many kinds patterns of sectoral change might result. Restructuring of the industrial system might still be underway, including repercussion of severe shocks from technological, economic and related trade adjustments of the sort Austria has experienced since the opening of the east and its recent membership in the EU. These possibilities are not posed here as hypotheses for many reasons, not least of which is the fact that we are mainly concerned with illustrating a simple approach to comparing industrial trade clusters over time and between the regions of different national systems.

Comparing U.S. and Austrian Regions: Carolinas and Upper Austria

This brings us to the choice of regional comparisons that we have selected to illustrate the templates. Since the templates were derived from U.S. I/O trading behavior to analyze the industrial trade clusters of North Carolina, we select its largest region. The 'Carolina*s*' region is so-named because it borders and influences heavily its South Carolina neighbor; it is home to several small cities and the city of Charlotte, North Carolina's largest city, which is now one of the nation's largest financial centers, although the regional economy was historically based upon apparel, textiles and furniture production, and still reveals strong concentrations in these clusters. The other region is Upper Austria, home to many small cities and the Danube-straddling city of Linz, one of the country's historical centers of heavy industry and manufacturing, although furniture, textiles, ceramics and other industrial clusters are also present in the region.

Our choices have two implications that require immediate comment. First is data availability. The only consistent measure of sectoral activity available for both is employment, but it is not available for consistent periods. This is less of a problem than it may appear, since the 1981-91 period for Austria captures quite well a significant period in which the country steadily shed its state-sectors, opened more of its industries to privatization and global trade, and began large cross-border investments permitted by the 1989 opening of the east. So this is a period of rather dramatic adjustments in the industrial reorganization of production and the internationalization of investment. For North Carolina, we use the five year period from 1989-94, during which the economy began its post-recession (and post-restructuring) boom that has propelled many of its remaining core industries to new heights. This was also a period in which a substantial share of motor vehicle production had consolidated in the mid-South along its key transport corridors shared by North Carolina, including the recent BMW investments just inside its South Carolina borders.

The second implication is largely technical: the cluster templates require conversion to permit the use of sectoral data organized according to the Austrian industrial classification system. As in North America, the European system is now being harmonized to create a common industrial classification system among all continental trading partners, although only the less-detailed Austrian classification system applied to information available at these particular dates. As a consequence, a considerable amount of cross-coding from industrial concordances was necessary, and this resulted in a slightly lower overall resolution of industrial detail for our comparative templates (contrast Figures 2 &3 with 1) , simply because certain sectors lack a one-to-one match in both classifications (Appendix 2 includes concordance details). The task of concordance revision undertaken here is onerous and unnecessary for future data classified according to NACE, so we have selected only one industrial trade cluster with which to illustrate our templates: motor vehicles.

Before moving to the visual results, a bit more background detail will be provided about the motor vehicle cluster being analyzed. In 1994, about 60,000 of a total 400,000 manufacturing employees were counted in the Carolinas region's vehicle manufacturing cluster, thereby accounting for some 15% of regional manufacturing employment.. In contrast, about 58,000 worked during 1991 in the same cluster of Upper Austria, which comprised some 11% of total regional employment (nearly 508.000). Upper Austria lost about 1% of its vehicle manufacturing cluster employment in the ten-year span, while the Carolinas region cluster gained at about 1% over its shorter, more recent 5-year period. Even though one regional cluster was expanding and the other contracting by similar proportions, coefficients of sectoral variation within the motor vehicle clusters of both regions decreased by some 10%, leaving the Carolinas region with slightly more sectoral variation (1.62 in '94 vs. 1.34 in '91)[1]. Although different in many obvious regards, these regions qualify quite well for comparative purposes.

Recall that our cluster templates are organized by declining size of sectoral employment (using SIC classifications). For example, the largest sector of the Carolinas' motor vehicle

[1] Calculated net of large wood processing sectors shared with other key clusters in both regions. As the wood processing sector is a major component of both regional economies, the result would be biased in favor of more variation, leaving the overall picture, however, the same.

cluster is 3714 (motor vehicle parts & accessories), while the largest sector in Upper Austria is sector 3711 (motor vehicles and car bodies). As both regional templates indicate, the remaining sectors drop off dramatically in size and number, and large portions of the total cluster map of both regions are totally uninhabited (sectoral definitions in Appendix 2). The sectoral representation of Upper Austria's cluster might be somewhat affected by concordance artifacts that arise when using two national industrial classification schemes, but it is far likelier that our depiction is generally accurate in both regions, particularly their depiction of heavy concentrations in very few sectors, a minor presence in several, and absence of many others.

Upper Austria lost significant employment shares in the vehicle manufacturing sector (SIC 3711, 3716) and engine components (carburetors, pistons, rings, valves:3952), whereas its vehicle parts and accessories (3714) production gained employment. These shifts are unlikely to have occurred as simple classification artifacts, as the regional classification remained stable in both years. A decade-long restructuring away from larger or state-owned firms of a dominant classification into smaller firms of different but more precise classification in 1991 is more likely responsible, even though it is impossible to know if this happened or whether such a case would imply a true shift in the types of goods produced. In the Carolinas Region, the sectors most closely tied to this cluster grew strongest from 1989 to 1994, including the secondary sectors producing technology and equipment (welding and soldering equipment, machine tools, and metal cutting: SICs 3548, 3541) used in vehicle and parts production.

The same clusters differ quite obviously in their composition, and their host regions differ markedly in overall economic structure as well. But the regional templates yield even stronger hints about the formation processes taking place *within* each region. The Carolinas region template indicates that its vehicle manufacturing cluster is expanding in nearly all its 1989 sectors, with more absolute growth in the largest. Its vehicle manufacturing cluster seems to have reached an optimal growth composition in '89 and expanded in the following five years along, perhaps, an increasing returns trajectory.

The template suggests a quite different growth process for Upper Austria: sectors described above expanded dramatically, while others, even very large sectors, contracted equally dramatically. Both interpretations offered earlier imply considerable restructuring underway in Upper Austria's motor vehicle cluster over the ten year period. It is possible that Upper Austria's remaining cluster segments may repeat some version of the story told from by the Carolinas region template, particularly if the remaining sectors are well niched into the regional economy in ways that permit them to cross-trade competitively with EU and other regions to the east, yet produce efficiently in Upper Austria.

To use the U.S. vehicle manufacturing cluster as a template for the Austrian vehicle cluster it was necessary to find a concordance between the U.S. SIC 1987 classification and the Austrian industrial classification called "Betriebssystematik 1968" (in short: BS 68). The less detailed BS 68 was favored to the European classification NACE 1995 due to the lack of data regarding the latter. The procedure taken to receive a mapping from the much more detailed U.S. SIC into the highly aggregated BS 68 exhibits to some extent an arbitrariness due to the different classification schemes and the different levels of aggregation. However, having two points in time for each region under observation yields at least a consistent framework for analyzing the cluster formation inside each region. And to some extent it will also allow us to make some comparisons between the regional cluster, using the U.S. vehicle manufacturing cluster as a template.

Now I would like to go into some more detail about the construction of the concordance table. In the first step, the concordant sectors classified by NACE Rev.1 to the U.S. sectors belonging to the U.S. vehicle manufacturing cluster classified by U.S. SIC 1987 were identified using the ISIC Rev.3 as a mediator. The conversion was done on the 4 digits level, were the ISIC Rev.3 just served as a working tool for translating the U.S. sectors into European NACE sectors. This is mainly the due to the different levels of aggregation - on the 4 digits level the SIC encompasses 1005, the ISIC Rev.3 292, and the NACE Rev.1 503 sectors – revealing that a more meaningful conversion can be done by mapping directly from the SIC into the NACE. Although the conversion from the SIC to the NACE is not straightforward it is still seems to be a workable task. Once a concordance table between the SIC and the NACE (on the 4 digits level the ÖNACE – the Austrian version of the NACE – is equal to the NACE) was established, in the second step, the conversion of the NACE into the BS 68 had to be undertaken. This caused more difficulties than the first conversion because of the strong differences in the classifications. Whereas in the first step the degree of aggregation have seemed to be the major problem, caused the different classification schemes in the second step most of the troubles. The aggregation levels on the 4 digits level of the BS 68 (452 sectors) and the NACE (503 sectors) are nearly similar, but the description of the 4 digits sectors changed dramatically. Thus, some heuristics was leading the process of converting the sectors classified by NACE into BS 68 classification. In the third step, the resulting indirect concordance table between SIC and BS 68 was revised to receive the best possible concordance. Summarizing, it can be said that mapping certain sectors of one classification into the corresponding sectors of the other classification was accompanied by divers difficulties in some cases but has also served appropriate in many others. Testing for sensitivity left me with the impression that with some caution the different regional clusters (U.S. – Austria) can be compared with each other.

Results

To analyze the difference in the cluster formation process Carolina in North Carolina (U.S.) served as the template region and Upper Austria (Austria) as the comparison region. The time periods for the comparison have been determined by the existing data, resulting in quite different periods. The U.S. data base spans over five years between '89 and '94, whereas the Austrian data series includes a ten year time horizon ('81 – '91). Thus, by comparing the different cluster formations one has to integrate the different processes into the right environments. This can be easily done by embedding the comparison in a historical frame.

However, at that point I would like to give more detail on the straightforward results and their underlying figures. In 1994, about 60.000 people of a total from 400.000 employees were counted in the vehicle manufacturing cluster in Carolina accounting for some 15% of total regional employment.. In contrast in 1991, about 58.000 workers in the same cluster in Upper Austria comprised some 11% of total regional employment (nearly 508.000). Whereas Upper Austria has experienced a decrease in the employment share of vehicle manufacturing about 1%, Carolina has gained vehicle employment about the same dimension. Over the different time spans the coefficient of variation in both regions decreased by some 10%, with Carolina

exhibiting slightly more variation. (1,62 in ’94 to 1,34 in ’91[2]). Although different in some regards these regions qualify quite well for a comparison.
Before passing to the results of the comparison I would like to mention the major regional difference in the employment in the core auto sectors. Whereas, in Carolina’s auto cluster the sector with the single most employment is represented by the U.S. SIC sector 3714 – motor vehicle parts & accessories – in Upper Austria the sector 3711 - motor vehicles and car bodies – takes over this role (see figures in the appendix). In addition, does the respectively other of these both sectors in both region show minor but significant employment. This peculiarity might, too some extent, be driven by the differences in the national industrial classification schemes. However, does it not obstruct a meaningful comparison of the regional cluster development in the follow.

Although the regional clusters differ quite obviously in their composition a first glance at the figures in the appendix already yields some hints about the formation processes taking place in both regions. The figure for Carolina indicates that the vehicle manufacturing cluster in Carolina is expanding in nearly all sectors with more or less emphasize. The vehicle manufacturing cluster seems to have reached its optimal composition in ’89 and expanded in the following years. For Upper Austria the figure suggest a quite different growth process - certain sectors expanded dramatically, others contracted in the same way. Overall the ten year period in Upper Austria has seen a restructuring of the vehicle manufacturing cluster. Thus the story told from the U.S. template region Carolina may reveal some aspects for the future for the auto cluster in Upper Austria. The restructuring process of the vehicle cluster in Upper Austria shows some interesting features. First of all, lost the vehicle manufacturing sector (3711;3716) a significant amount of employment, whereas the production of vehicle parts and accessories (3714) could gain considerable new employment. However, it would be to shortsighted to induce a shift of employment from this facts alone. As we see from the figure also the production of carburetors, pistons, rings & valves (3952) was faced with decreasing employment. Thus, a combination of a shift of employment from vehicle to parts manufacturing and a specialization on certain products resulting in a reclassification into another SIC sector might has taken place. Second, we can observe by comparing the figure of Carolinas with the one of Upper Austria that in Carolinas the closely with the vehicle cluster related sectors are much more emphasized – showing higher employment. In Upper Austria these sectors are not that much occupied with employment, with a secondary sector even possessing the second biggest employment number. And third, by examining the loosely tied sectors we realize that the secondary sector exhibiting the strongest increases in employment has much to do with the technology and equipment used in the vehicle and parts production (SIC 3548;3541 – welding &soldering equip., and machine tools, metal cutting type).

Beside this first conclusion from the comparison of the regional clusters there are several other stories regarding the formation process inside the regions. Especially, in Upper Austria certain shifts took place, some sectors expanded more dramatically than others, still some others contracted over even disappeared. There are lots of other facts to observe, however, the above stated result seems to be the most obvious and also interesting one.

[2] Calculated without the inclusion of the wood processing sectors. As the wood processing sector is a major component of both regional economies the result would be biased in favor of more variation, leaving the overall picture, however, the same.

References

Bergman, Edward M., 1998a, "Industrial Trade Clusters in Action: Seeing Regional Economies Whole," in Michael Steiner (ed), *Clusters and Regional Specialisation: On Geography, Technology, and Networks*, European Research in Regional Science, Vol 8. London: Pion.

Bergman, Edward M., 1998b, "Regional Economic Coherence and Industrial Trade Clusters," paper presented at International Workshop on Theories of Regional Development, June 14-16, Uddevalla, Sweden.

Bergman, Edward, Edward Feser, Stuart Sweeney (1997). *Targeting North Carolina Manufacturing: Understanding a State Economy through National Industrial Cluster Analysis*. IIR-Discussion Paper 55. Vienna: IIR-University of Economics and Business Administration:

Executive Office of the President Office of Management and Budget, Statistics Canada, Statistical Office of the European Communities (n.d.). *International Concordance between the Industrial Classifications of The United Nations (ISIC Rev.3), and Canada (1980 SIC), The European Union (NACE Rev.1), and The United States (1987 SIC)*. Washington, DC: U.S. Bureau of the Census.

Österreichisches Statistisches Zentralamt (1983). *Arbeitsstättenzählung 1981 – Hauptergebnisse Steiermark*. Heft 650/6. Österreichische Staatsdruckerei: Wien

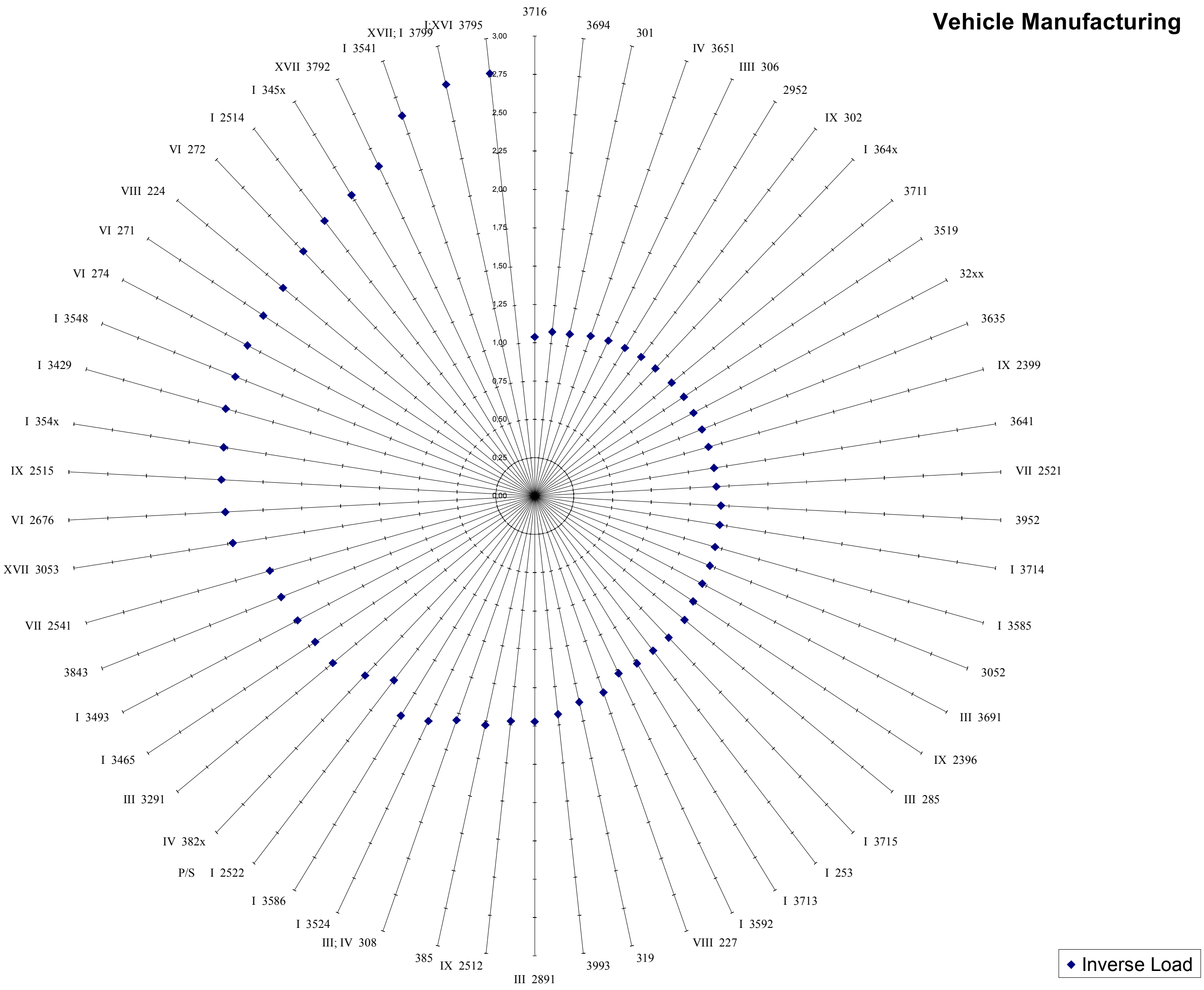
Österreichisches Statistisches Zentralamt (1983). *Arbeitsstättenzählung 1981 – Hauptergebnisse Oberösterreich*. Heft 650/4. Österreichische Staatsdruckerei: Wien

Österreichisches Statistisches Zentralamt (1994). *Arbeitsstättenzählung 1991 – Hauptergebnisse Steiermark*. Heft 1050/6. Österreichische Staatsdruckerei: Wien

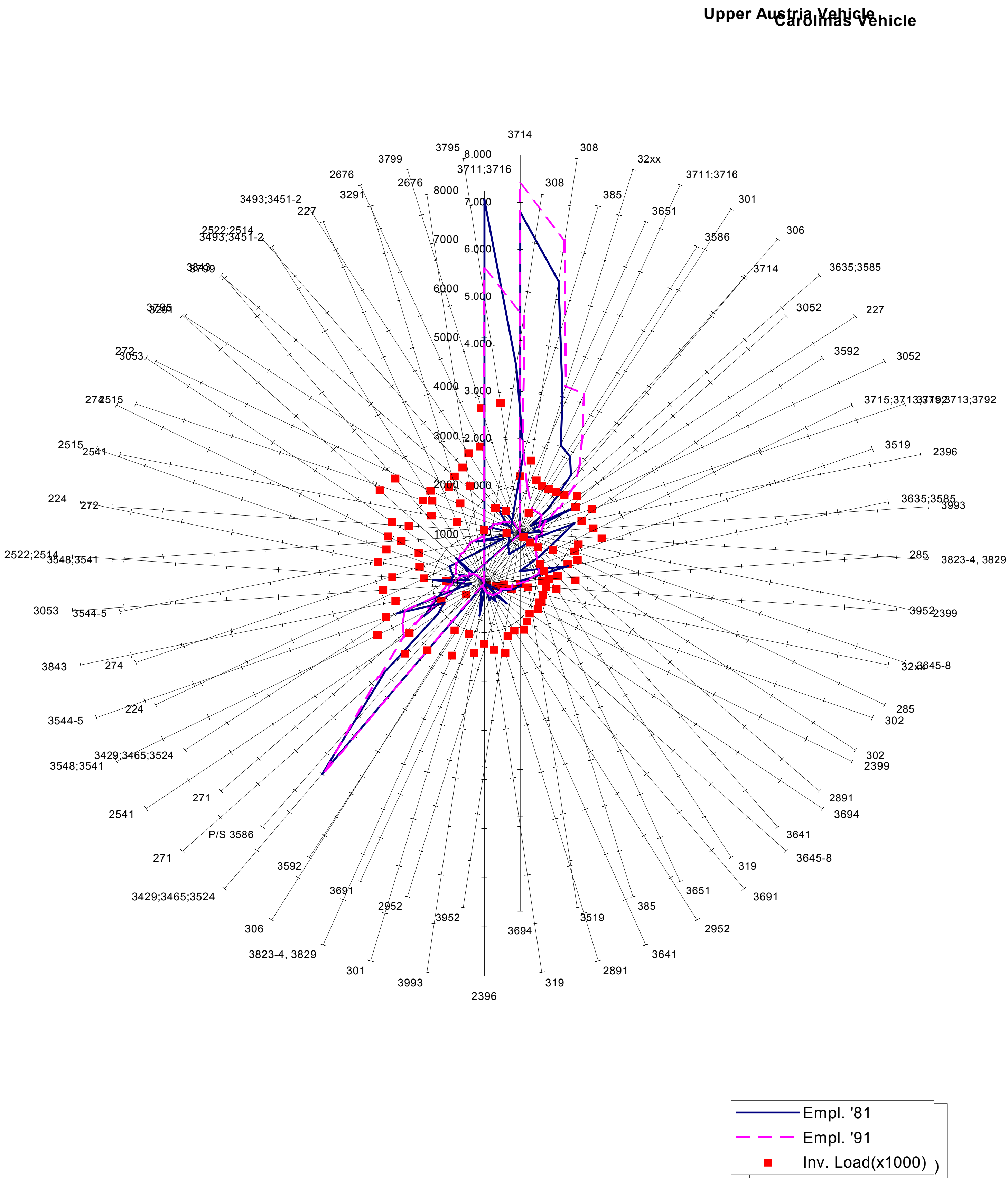
Österreichisches Statistisches Zentralamt (1994). *Arbeitsstättenzählung 1991 – Hauptergebnisse Oberösterreich*. Heft 1050/4. Österreichische Staatsdruckerei: Wien

Österreichisches Statistisches Zentralamt (1995). *Systematik der Wirtschaftstätigkeiten – ÖNACE 1995.* Österreichische Staatsdruckerei: Wien

Figures



Vehicle Manufacturing
3,00
2,75
2,50
2,25
2,00
1,75
1,50
1,25
1,00
0,75
0,50
0,25
0,00
3716
3694
301
IV 3651
IIII 306
2952
IX 302
I 364x
3711
3519
32xx
3635
IX 2399
3641
VII 2521
3952
I 3714
I 3585
3052
III 3691
IX 2396
III 285
I 3715
I 253
I 3713
I 3592
VIII 227
319
3993
III 2891
IX 2512
385
III; IV 308
I 3524
I 3586
P/S I 2522
IV 382x
III 3291
I 3465
I 3493
3843
VII 2541
XVII 3053
VI 2676
IX 2515
I 354x
I 3429
I 3548
VI 274
VI 271
VIII 224
VI 272
I 2514
I 345x
XVII 3792
I 3541
XVII; I 3799
I;XVI 3795
Inverse Load


Upper Austria Vehicle
Carolinas Vehicle
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
8000
7000
6000
5000
4000
3000
2000
1000
Empl. '81
Empl. '91
Inv. Load(x1000)

Appendix 1

Vehicle Manufacturing Cluster – U.S. Template

	SIC Sector	Industry Description	Load
Primary:	3716	Motor homes	0,96
	3694	Electrical equip. for internal combustion eng.	0,93
	301	Tires & inner tubes	0,93
	3651	Household audio & video equip.	0,91
	306	Fabricated rubber products, n.e.c.	0,89
	2952	Asphalt felts & coatings	0,89
	302	Rubber & plastics footwear	0,88
	3645-8	Lighting fixtures & equip.	0,88
	3711	Motor vehicles & passenger car bodies	0,87
	3519	Internal combustion engines, n.e.c.	0,86
	321, 3229, 323	Glass & glass products, except containers	0,86
	3635	Household vacuum cleaners	0,86
	2399	Fabricated textile products, n.e.c.	0,86
	3641	Electric lamp bulbs & tubes	0,86
	2521	Wood office furniture	0,86
	3952	Lead pencils & art goods	0,83
	3714	Motor vehicle parts & accessories	0,83
	3585	Refrigeration & heating equip.	0,83
	3052	Rubber & plastics hose & belting	0,82
	3691	Storage batteries	0,82
	2396	Automotive & apparel trimmings	0,81
	285	Paints & allied products	0,80
	3715	Truck trailers	0,79
	253	Public building & related furniture	0,79
	3713	Truck & bus bodies	0,78
	3592	Carburetors, pistons, rings, & valves	0,78
	227	Carpets & rugs	0,74
	319	Leather goods, n.e.c.	0,73
	3993	Signs & advertising specialties	0,70
	2891	Adhesives & sealants	0,68
	2512	Upholstered household furniture	0,68
	385	Ophthalmic goods	0,66
	308	Miscellaneous plastics products, n.e.c.	0,65
	3524	Lawn & garden equip.	0,62
	3586	Measuring & dispensing pumps	0,60
Secondary:	2522	Office furniture, except wood	0,66
	3823-4, 3829	Mechanical measuring devices	0,62

	3291	Abrasive products	0,59
	3465	Automotive stampings	0,59
	3493	Steel springs, except wire	0,58
	3843	Dental equip. & supplies	0,57
	2541	Wood partitions & fixtures	0,56
	3053	Gaskets, packing, & sealing devices	0,51
	2676	Sanitary paper products	0,50
	2515	Mattresses & bedsprings	0,50
	3544-5	Special dies & tools & machine tool accessories	0,49
	3429	Hardware, n.e.c.	0,48
	3548	Electric & gas welding & soldering equip.	0,48
	274	Miscellaneous publishing	0,48
	271	Newspapers	0,48
	224	Narrow fabric mills	0,47
	272	Periodicals	0,46
	2514	Metal household furniture	0,45
	3451-2	Screw machine products, bolts, etc.	0,44
	3792	Travel trailers & campers	0,42
	3541	Machine tools, metal cutting types	0,38
	3799	Transportation equip., n.e.c.	0,36
	3795	Tanks & tank components	0,36

Source: Bergman, Feser and Sweeney, 1997.

Appendix 2

Data Concordance

To use the U.S. vehicle manufacturing cluster as a template for the Austrian vehicle cluster it was necessary to find a concordance between the U.S. SIC 1987 classification and the Austrian industrial classification called "Betriebssystematik 1968" (in short: BS 68). The less detailed BS 68 was necessary, due to the lack of data in European NACE 1995. The procedure taken to convert the mapping of much more detailed U.S. SIC into the highly aggregated BS 68 exhibits to some extent an arbitrariness brought about by different classification schemes and the different levels of aggregation. However, having two points in time for each region under observation maintains a consistently meaningful framework for analyzing cluster formation inside each region. To some extent, it will allows some comparisons between the regional clusters, using the U.S. vehicle manufacturing cluster as the base template.

Now, some further details about the construction of the concordance table. In the first step, the concordant sectors classified by NACE Rev.1 to the U.S. sectors belonging to the U.S. vehicle manufacturing cluster classified by U.S. SIC 1987 were identified using the ISIC Rev.3 as an intermediary. The conversion was done at the 4-digit level, where the ISIC Rev.3 served as a working tool for translating the U.S. sectors into European NACE sectors. This is mainly the due to the different levels of aggregation: the SIC encompasses 1,005 4-digit industries, the ISIC Rev.3 includes 292, and the NACE Rev.1 includes 503 sectors. Obviously, more meaningful conversion can be done with future mapping directly from the SIC into the NACE. Although the conversion from the SIC to the NACE is not straightforward, it is appears to be a wholly workable task.

Once a concordance table between the SIC and the NACE (ÖNACE – the Austrian version–– is equal to the NACE at the 4-digit level) was established, a second step of converting the NACE into the BS 68 was necessary. This caused more difficulties than the first conversion because of the strong differences in the classifications. Whereas in the first step the degree of aggregation have seemed to be the major problem, rather different classification schemes in the second step caused most of the troubles. The aggregation levels at the 4-digit level of the BS 68 (452 sectors) and the NACE (503 sectors) are apparently similar, but *definitions* of the 4-digits sectors changed dramatically. Thus, some heuristics lead our process of converting the sectors classified by NACE into BS 68 classification.

In the third step, the table shown below of *indirect* concordance between SIC and BS 68 was revised and further refined to obtain the best possible equivalency. Summarizing, it can be said that mapping certain sectors of one classification into the corresponding sectors of the other classification presented diverse but manageable difficulties, but some were entirely equivalent with very little revision necessary. Preliminary sensitivity tests leave us with the impression that with some caveats, different regional clusters (U.S. – Austria) can be compared with each other.

Industrial Concordance Table

SIC Sector	BS 68	Industry Description
3694	579.5	Electrical equip. for internal combustion eng.
301	441.1/2	Tires & inner tubes
3711;3716	583.1	Motor Vehicles
3651	572.0*	Household audio & video equip.
306	442.0*(.1)	Fabricated rubber products, n.e.c.
2952	462.0*	Asphalt felts & coatings
302	442.0*(.9)	Rubber & plastics footwear
3645-8	579.4*	Lighting fixtures & equip.
3519	551.1	Internal combustion engines, n.e.c.
321, 3229, 323	480.1*,480.3*	Glass & glass products, except containers
2399	339.1*	Fabricated textile products, n.e.c.
3641	579.2/3	Electric lamp bulbs & tubes
3635;3585	571.0,532.2,552.1/2	Cooling & ventilation equipment; domestic appliances n.e.c.
3952	384.2*	Lead pencils & art goods
3714	583.3	Motor vehicle parts & accessories
3052	452.1	Rubber & plastics hose & belting
3691	579.1*	Storage batteries
2396	338.0*(.8)	Automotive & apparel trimmings
285	455.0*	Paints & allied products
3592	553.2	Carburetors, pistons, rings, & valves
2512,2521;253	381.3*	Wooden Office furniture & upholstered household furniture
227	338.0*(.2)	Carpets & rugs
319	360.3/4	Leather goods, n.e.c.
3993	563.0	Signs & advertising specialties
2891	459.3*,459.6*	Adhesives & sealants
3715;3713;3792	583.2,589.1	Bodies & trailers & campers
385	593.1/2	Ophthalmic goods
308	448.0*	Miscellaneous plastics products, n.e.c.
3823-4, 3829	591.1*	Mechanical measuring devices
3586	551.2*	Measuring & dispensing pumps
3291	479.1	Abrasive products
3429;3465;3524	542.3*,541.1	Hardware, n.e.c.; Automotive stampings; Agricultural equip.
3843	453.2*,592.1	Dental equip. & supplies
2541	381.1/2	Wood partitions & fixtures
2522;2514	532.1	Non-wooden office & household furniture
3493;3451-2	539.2	Steel springs, except wire; Screw machine products, bolts;
3053	549.9*(.1)	Gaskets, packing, & sealing devices
2676	412.2	Sanitary paper products
2515	345.0*	Mattresses & bedsprings
3544-5	531.1/2	Special dies & tools & machine tool accessories
274	430.0*;421.0(.1)	Miscellaneous publishing
271	430.0*;421.0(.8)	Newspapers

224	339.9*	Narrow fabric mills
272	430.0*;421.0(.1))	Periodicals
3548;3541	562.0*	Welding & soldering equip.; Machine tools, metal cutting;
3799	589.9*	Transportation equip., n.e.c.
3795	531.3	Tanks & tank components

Source: Authors' concordance splicing; see text for source documents.

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