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Book Part

European Integration, regional structural change and cohesion in France

EURECO

The Impact of European Integration and Enlargement on Regional Structural Change and Cohesion

Workpackage No. 2

Regional Structural Change and Cohesion in the EU

European Integration, Regional Structural Change and Cohesion in France

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The Impact of European Integration and Enlargement on Regional Structural Change and Cohesion

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Table of contents:

Executive Summary

The present country study summarizes stylized facts for France about the general topographic, demographic, economic and political conditions as well as about the evolutions of industrial concentration and regional specialization during the last about 20 years. The study summarizes the results of the initial phase of Workpackage 2 within the EURECO project "The impact of European integration and enlargement on regional structural change and cohesion". The main purpose of the EURECO project is to assess the relevance of European integration in general, and the recent eastern enlargement of the EU in particular, derogating the process of economic cohesion among European regions. On the background of new trade theories and theories of new economic geography, the project analyses empirically (i) the impact of European integration on the specialization of regions, and (ii) the impact of regional specialization on regional income, employment and growth. Workpackage 2 within this project, focusing on the incumbent EU Member States, summarizes and analyzes the experiences to be drawn from the European integration process so far, laying particular emphasis onto previous EU enlargements. Subsequent phases of Workpackage 2 will analyze the links between economic integration and regional specialization more rigorously.

The present paper analyses regional specialization and spatial concentration in France during the time period 1973 to 2000. The period is sufficiently long for capturing important milestones of the European integration process, including various enlargement rounds as well as the completion of the Single Market in 1992.[1] The analysis distinguishes 22 French NUTS 2 regions and 4 sectors (agriculture, manufacturing, construction, services; value added), respectively 35 industries within the manufacturing sector (employment). Several statistical concentration and specialization measures are employed. The concentration of a sector or industry is measured either relative to land surface (reference: uniform distribution across space; labelled "topographic concentration"), or relative to the uniform distribution (reference: uniform distribution across regions; labelled "absolute concentration"), or relative to the distribution at the EU15 or the country level (reference: aggregate average distribution; labelled "relative concentration"). Similarly, the specialization of a region is measured either relative to a uniform distribution (reference: uniform distribution across sectors or industries within a region; labelled "absolute specialization"), or relative to the specialization pattern at the EU15 or the country level (reference: aggregate average specialization; labelled "relative specialization").

[1] The latest milestones, however, the north enlargement in 1995 and the creation of the European Monetary Union in 1999/2002, are too recent for being covered by the present analysis.

The results can be summarized as follows:

1. *Level of industrial concentration*. On the backdrop of a generally low degree of topographic concentration of population and economic activity in the EU as a whole, France was among the EU countries exhibiting the highest topographic concentration of economic activity in the early 1980s at both the aggregate as well as the sectoral levels. This can be traced to the dominance of the country's outstanding center, Île de France (Paris), that covers only 2% of the country's acreage but accounts for almost 30% of total output. Within the manufacturing sector, resource dependent industries and some industries with increasing returns to scale (IRS industries) were somewhat more concentrated than the manufacturing sector as a whole (relative concentration).

2. *Evolution of industrial concentration*. In the course of the European integration process during the 1980s and early 1990s, the concentration patterns changed very slowly throughout Europe. While a weak tendency towards topographic deconcentration of economic activity prevailed in the EU15 as a whole,[2] France experienced a slighly increasing topographic concentration, mainly driven by agrigulture and service industries. The manufacturing sector deconcentrated in terms of employment but not in terms of value added. This form of increasing specialization of economic centers in high-quality, high-productivity manufacturing activities is well known from other developed countries like the U.S. or Germany. Within the manufacturing sector, the deconcentration of employment extended to almost all groups of industries, including IRS industries.

3. *Path dependence of industrial concentration*. There is no evidence of a significant effect of initial concentration of sectors onto the subsequent development of these sectors at the national or regional level in France: Sectors or industries that were concentrated comparatively highly in topographic terms in the early 1980s exhibited neither higher nor lower country-wide growth rates during the subsequent 1½ decades than topographically dispersed sectors.[3] Likewise, there is no indication of path dependence in the evolution of concentration of sectors or industries: There is no systematic relationship across sectors or industries between the initial degree of concentration of the sector or industry and the subsequent evolution of its concentration.

4. *Level of regional specialization*. In general, French regions did not exhibit strong sectoral or industrial specialization patterns in the early 1980s compared to both average

[2] Nonetheless, the topographic concentration measure assumed a slightly higher value in 1995 than in 1980. The reason was a temporarily increasing concentration in the early 1990s caused by the unification boom in Germany. The unification boom in Germany increased the inequality between the EU member states but did not affect the regional concentration patterns within countries to a notable extent.

[3] There is, however, some evidence of sectors that were comaparatively highly concentrated in relative terms (i.e., relative to economic activity as a whole) having performed worse than sectors the spatial distribution of which was similar to that of economic activity as a whole. But this negative correlation is biased by the slow growing agricultural sector. Being located outside the economic centers the agricultural sector appears to be concentrated in relative concentration measures.

specialization of the EU15 as a whole, and average specialization of the French economy. In the European context, France was, in fact, among the countries with the lowest degree of specialization. Among the French regions, there were a few exceptions of somewhat higher specialized regions: In Lorraine, resource dependent industries played a more significant role, in the Île de France it was corporate services, and in Champagne-Ardennes agriculture.

5. *Evolution of regional specialization*. As to the evolution of specialization patterns over time, a weak tendency towards de-specialization prevailed among French regions. During the 1980s and the first half of the 1990s, the sectoral specialization patterns of most regions tended to converge even closer to the EU15 average, and the specialization patterns within the manufacturing sector tended to converge even closer to the national average. Increasing specialization prevailed only in some old industrialized regions like Lorraine.

6. *Path dependence of regional specialization*. No evidence was found for a path dependence in the degrees of specialization of French regions: A region's initial degree of specialization apparently had no significant impact on the subsequent evolution of its specialization.

7. *Specialization and regional performance*. As to the impact of a region's initial degree of specialization on its subsequent output or employment growth there is some evidence of regions with higher initial sectoral specialization having grown faster subsequently. This result should be interpreted with care, however, because the degree of specialization of French regions was generally very low. Consequently, there is no evidence of a single sector or industry group having shaped a region's aggregate value added or employment growth to a significant extent. Whenever a region's initial degree of specialization in a specific industry group had a significant impact on subsequent growth, this impact was limited to this very industry group. E.g., resource intensive industries and IRS industries tended to grow slower in those regions where they were concentrated in the early 1980s. But this comparatively poor performance of single industries did not translate into a poor aggregate performance of the region as a whole.

Map of France and its NUTS2 regions (“régions”)

Part A. Introduction

In May 2004, the first round of the EU east enlargement was completed. This new integration step is likely to increase trade and factor mobility thereby increasing interregional competition and affecting the interregional division of labor within the enlarged EU. From this, worries arise that cohesion between countries and regions might deteriorate. Against this background the EURECO project "The impact of European integration and enlargement on regional structural change and cohesion" was conceptualized drawing on trade theories, inter alia the new economic geography (NEG). These theories supply us with different predictions of possible effects of integration on the concentration pattern of industries and the specialization patterns of regions, some of them supporting, others contradicting such worries (cf. EURECO paper on Workpackage 1: Bode, Bradley et al. 2003). The EURECO project is assigned to provide empirical answers, particularly regarding (i) the impact of European integration on the specialization of regions, and (ii) the impact of regional specialization on regional income, employment and growth.

Within the EURECO project, Workpackage 2 aims at providing empirical evidence on the experiences of *incumbent EU Member States* with the European integration process, particularly with previous enlargements of the EU. Changes in regional specialization pattern observed during this process may help predict future changes in the regional specialization pattern of new member states. WP 2 will

- *describe* the evolution of regional specialization pattern since the 1970s,
- *analyse* the impact of integration on the degree and nature of regional specialization,
- *analyse* the impact of the degree and nature of regional specialization on regional income, employment and growth.

In pursuing the first of these three steps, a series of country studies is provided of which the present study for French regions is one. Others concern Austrian, British, German, Greek, Irish, Italian, Portuguese, and Spanish regions. All taken together will constitute a basis for comparing various different regional experiences with European integration. The country studies describe the specialization of the respective regions over time, taking into consideration the specific concentration characteristics of each country's sectors and industries. Moreover, to distinguish further, exogenous influences on industrial concentration and regional specialization, distinct from the integration induced economic forces, basic information on the topographic situation, history of settlement, orientation of economic policies of the respective countries and their regions is provided as well.

The present country paper on French regions is organized as follows: Part B gives some general background information on the topographic and economic characteristics of these regions (chapter 1) as well as on the economic policy pursued in the country (chapter 2). Part C represents the central part of the paper. It contains the description of regional specialization pattern and their evolution in France since the early 1970s. Part D summarizes and concludes.

Part B. Stylized characteristics of France

1. Stylized country characteristics

1.1. Population and space

The country of France, situated at the West of Europe, covers an area of about 550 thousand square kilometers and inhibits a population of about 55 million people (table 1). The population density in France broadly decreases from north east to south west and from the coastal areas to the central highlands of the Massif Centrale. Most populated are, however, the region Île de France, the metropolitan area of Paris, and some of the surrounding regions in the “Bassin Parisien”. Also, one major string of settlement follows the course of the river Rhône in the east part of the country.

France is divided into 22 “régions” (regions at NUTS2 level), one being made up of the island of Corse. Corse, being part of the region of Provence-Alpes-Côte d’Azur for several years of our observation period, is treated as being part of this latter region for the other years, too, in order to allow comparisons. The thus defined 21 regions vary considerably with respect to size and population density. There are densely populated regions, some small by acreage, like Nord-Pas de Calais, Haute Normandie, Alsace and Île de France, others large, like Rhône-Alpes, Lorraine and Provence-Alpes-Côte d’Azur-Corse. And there are sparsely populated regions, some small, like Auvergne, Limousin and Poitou-Charentes, others large by acreage, like Midi-Pyrénés, Aquitaine, Centre and Bourgogne. The other regions are medium both with respect to population and acreage. Accordingly, all these regions do not easily compare to each other.

Table 1-1: Population and space in France

	Acreage	Population	Population change last decade	Population density	Employment potential (pop15-65)	Participation rate (workforce) 2000
	sqkm	Mio.	average annual	persons/sqkm	% of pop	% of potential
Île de France	12.0	11.0	0.3	914.0	68.1	78.0
Champagne-Ardennes	25.6	1.3	0.0	52.4	65.1	67.1
Picardie	19.4	1.9	0.3	96.0	65.2	61.9
Haute Normandie	12.3	1.8	0.3	145.1	65.2	66.7
Centre	39.2	2.4	0.3	62.6	63.8	68.1
Basse Normandie	17.6	1.4	0.3	81.1	63.6	68.6
Bourgogne	31.6	1.6	0.0	51.0	63.4	68.6
Nord-Pas de Calais	12.4	4.0	0.1	322.6	64.8	63.3
Lorraine	23.5	2.3	0.0	98.2	65.6	61.0
Alsace	8.3	1.7	0.7	211.0	66.8	65.5
Franche-Comté	16.2	1.1	0.2	69.1	65.0	66.4
Pays de la Loire	32.1	3.2	0.6	101.1	64.4	69.8
Bretagne	27.2	2.9	0.4	107.3	63.8	68.1
Poitou-Charentes	25.8	1.6	0.3	63.8	63.1	67.9
Aquitaine	41.3	2.9	0.4	70.8	64.0	68.7
Midi-Pyrénées	45.3	2.6	0.5	56.6	64.1	68.9
Limousin	16.9	0.7	-0.2	42.0	62.3	68.2
Rhône-Alpes	43.7	5.7	0.6	129.9	65.5	69.5
Auvergne	26.0	1.3	-0.1	50.4	64.3	66.9
Languedoc-Roussillon	27.4	2.3	0.9	84.5	63.2	63.4
Provence-Alpes-Côte d'Azur	31.4	4.5	0.6	144.4	63.6	66.3
Corse	8.7	0.3	0.4	30.0	64.5	61.0
France	544.0	58.7	0.4	108.0	65.1	69.0

1.2. Economic geography

France is a centralist country, and hence it is characterized largely by the predominance of the central region Île de France. The surrounding regions of this center in the Northern part of the Bassin Parisien, in addition enjoy very fertile soils (particularly for growing wheat), and favorable conditions for the development of transport infrastructure. Accordingly, these regions offer a solid basis for economic development (e.g., Haute Normandie, Picardie, Champagne-Ardennes). Since France is a geographically open country where most areas are easily accessible without major geographic barriers, the mere proximity to central Europe also fosters the development of several French regions. This applies in particular to the regions situated most closely to the borders of Belgium, Germany, Switzerland, also to the Channel, the transport route to Great Britain: Haute Normandie, Nord-Pas de Calais, Lorraine, Alsace. Moreover, the influence from central Europe spreads along the course of the rivers Rhein and Rhône and influences the regions situated at this traditional transport route: Alsace, Rhône-Alpes, Provence-Alpes-Côte d'Azur. In the border triangle of France, Germany and Switzerland, there also emerged a traditional cross-border cluster of handicraft and industries specialized on the production of clocks and precision instruments (in France located in Alsace and Franche-Comté).

By contrast, the south central highlands of France, the Massif Centrale with its mountainous landscape, traditionally resisted the development of transport infrastructure. The regions of this area, Limousin, Auvergne, and Midi-Pyrénées, are hence less accessible, and, also, they owe less fertile soils. Accordingly, these regions remain relatively sparsely populated. They offer, however, opportunities for single enterprises to grow remarkably large and to shape significantly the whole economy of the regions (e.g. in particular, the tire producer Michelin in the region of Auvergne).

With respect to specific resource facilities, most obvious are the coal deposits to be found in Nord-Pas de Calais, and the iron ore deposits in Lorraine. Accordingly, these two regions became the location of the French iron-and-steel industry. All other deposits are of minor significance.

1.3. Economic activities in space

The density of economic activities quite closely follows along the lines alleged by the conditions of geography and the spatial distribution of the population. Most prominently, the economic geography of France is characterized by the overwhelming dominance of the region Île de France, the metropolitan area of the city of Paris. It is the region with by far highest the economic density, the highest per-capita income and the highest density of transport infrastructure.

Table 1-4: Economic activities in space in France

	Unemployment rate	GDP	Economic density	Per-capita income	Productivity	Growth rate	Employment change	Sectoral structure GDP:		Sectoral structure employment		Export rate	Investment	Foreign direct investment
						last decade	last decade	Agriculture	Services	Agriculture	Services			
	% of workforce	Mio €	€/ sqkm	€/ population	€/ employment	average annual %	average annual %	%	%	%	%	% of GDP	% of GDP	% of GDP
Île de France	7.6	402824	33535	36691	74994	4.1	0.5	0.2	82.3	0.4	82.8			
Champagne.-Ardennes	9.2	29366	1147	21874	55137	3.0	0.2	11.0	59.6	7.0	65.3			
Picardie	10.2	35515	1831	19065	53753	3.6	0.5	4.7	63.4	4.3	66.1			
Haute Normandie	9.7	39407	3199	22056	56906	3.3	0.6	2.2	60.7	2.8	68.2			
Centre	6.6	51521	1316	21036	52551	3.6	0.6	4.2	64.7	4.9	66.7			
Basse Normandie	9.4	28203	1603	19768	49689	4.1	0.4	4.7	65.6	7.5	66.0			
Bourgogne	7.7	34571	1095	21450	53640	3.9	0.6	6.6	66.9	6.1	66.6			
Nord-Pas de Calais	12.6	74780	6024	18671	52725	3.4	0.9	2.0	67.6	2.3	72.0			
Lorraine	6.7	44676	1897	19319	52790	3.3	0.5	2.9	67.5	2.6	69.0			
Alsace	4.8	41732	5040	23889	57808	4.5	1.3	2.4	65.6	2.1	67.4			
Franche-Comté	5.2	22722	1402	20295	50393	3.5	0.9	3.2	60.3	3.9	62.7			
Pays de la Loire	7.5	67785	2113	20906	50383	4.4	1.4	4.8	64.7	6.2	64.7			
Bretagne	6.6	58380	2146	19995	49876	4.6	1.2	5.3	69.9	7.0	68.2			
Poitou-Charentes	9.2	31656	1227	19226	49463	4.3	1.1	5.5	68.4	7.4	67.9			
Aquitaine	8.3	61284	1484	20965	52908	4.0	0.9	5.9	71.8	7.3	71.2			
Midi-Pyrénées	9.0	52755	1163	20549	51579	4.5	0.8	3.8	72.5	6.5	71.2			
Limousin	6.4	13484	796	18959	47713	4.0	0.2	4.3	71.0	7.4	68.1			
Rhône-Alpes	7.0	135893	3110	23937	57218	4.4	0.9	1.5	67.6	2.7	69.1			
Auvergne	8.2	26217	1008	20010	50613	4.3	0.5	3.9	65.9	7.1	65.5			
Languedoc-Roussillon	14.1	41770	1526	18053	52667	4.5	1.1	4.7	77.0	6.0	76.5			
Provence- Côte d'Azur	13.2	95584	3044	21081	57120	3.9	0.9	2.3	78.9	2.9	80.0			
Corse	12.5	4593	529	17610	50691	3.6	1.0	2.6	83.5	4.7	80.1			
France	8.5	1394719	2564	23740	58218	4.0	0.8	2.8	72.5	3.8	72.6			

2. Stylized policy characteristics

2.1. General economic policy orientation

The economic structure of any country and the structural change that is taking place within the country are likely to be influenced deeply by the respective economic policy in the country. Hence, when assessing the impact of European integration on regional structural change, it is necessary to allow for the influences of national economic policy.

France has a tradition as centralistic state with exclusive legislative power for the central government. However, since 1982 the state is partly devolving responsibilities for spatial planning to the lower tiers of administration in the 22 regions, 95 départements and 36,433 communes. Industrial policy has a long tradition in the French economy. It can be traced back to Jean-Baptiste Colbert, who served as minister under Luis XIV. (1643-1715). Mercantilist thought of an active role of the state in the development and shaping of the economy was still at the root of economic policy in France of the 20th century. Unlike in most other western countries, French governments were convinced that the state should take an active role in economic planning. As Dormois (1999, p. 58) states: “The French ordinarily claim precedence in inventing the concept of industrial policy.”

Even though the state always played an active part in the economy, France has not been known for a lax budgetary discipline. Between 1974 and the early 1992, the budget deficit only once exceeded 3%. An exception in this respect were the years between 1992 and 1996, where the deficit consecutively exceeded 3%. However, after five years of narrow deficits, a recent trend towards more expansive fiscal policy has led to an increasing deficit in 2002 and 2003. Traditionally, France experienced relatively high levels of inflation, often fairly above 10%. In 1982 however, France turned towards a disflation-policy, which continuously brought down inflation to levels below 3% at the beginning of the 1990s. Through the participation in the Currency Union, and the common monetary policy, inflation in France has been very low throughout the last five years.

2.2. Trade policy

For long, France pursued a tradition of restricting trade to protect the national economy. In the early 1950s, French companies were heavily protected from international competition. The volume of trade with the European countries was less than with the French colonies. But as a founding member of the European Community in 1957 and the commitment to the full free movement of goods, services, capital, and people with EU member states, this changed rapidly. In the 1970s, the European market already had become the major market for French products. The successive liberalization of the capital account led to increased FDI activity by

large French companies, many of which was accomplished by cross-boarder acquisitions and mergers within the Single Market.

2.3. Regional policy

Competences for regional planning in France had been highly centralized but are nowadays shared between the state and the lower tiers of administration. However, the degree of power of the regional councils is very limited, since it is the state who spends the by far largest share for regional development. Via the five-year plans, the central government sets priority aims for industrial and infrastructural development in the regions. Through the deployment of préfets in the regions, the central government attempts to maintain control over the use of land nationwide. Elected regional councils co-ordinate major investment schemes and produce planning contracts (contrats de plan) which concentrate on the issue of regional imbalances. Even though the departments lost some of their responsibilities to the regions in 1992, they play an important part in regional planning. By the distribution of social budgets, the responsibility for rural planning and the possibility of supplying technical advice to communes, the départments have powerful measures for spatial planning at hand. At the lowest level of administration, communes can produce strategic plans, schema directeurs (SD), which define economic and infrastrucutral priorities. The SDs have to take into account all projects of higher tiers of administration, which is why these plans are usually produced in intercommunal co-operation with the involvement of the state, other public bodies, and chambers of commerce. Communes with a population of over 50,000 are empowered to produce land-use-plans (Plan d'occupation des Sols (POS)). They are also responsible for the development of sensitive areas, such as historic town centers, mountains and coastlines, and for the development of areas of economic depression. Moreover, communes have the right to intervene in the land market, so as to ensure that development plans can be fulfilled. Smaller communes depend on the local office of the ministry of planning in the département, which then fulfills these planning duties.

There are two main incentive based instruments for regional industrial development: the regional policy grant PAT (prime d'aménagement du territoire), existing since 1982, and the local tax concession.

- The regional policy grant PAT is a centrally administered grant which gives awards for investments to enterprises which fulfill certain eligibility criteria. Eligibility mainly depends on the location, the industry, and the type of the project as well as on job creation and financial viability. The height of the grant varies between €8000 and €11000 for each job created or between 11.5% and 33% of the total investment sum. The area of the country, eligible for funding represents 40.9% of the total population.

- As another instrument, local tax concession may be given to businesses in eligible areas who fulfill eligibility criteria, such as investment sum, job creation and viability of the project. Eligible enterprises are exempted from the local business tax up to five years. However, as the height of the tax varies throughout the country, so does the actual height and duration of the concession, which is decided upon on the local level.

3.4. Industrial and technology policy

Until very recently, pronounced industrial policy and state participation were a common feature of the French economy. Dormois (1999) identifies three different, albeit not completely separable, strands of economic policy in France. First substitution strategies, in which the state substitutes itself for the market through central planning activities and broad nationalization programs. Second, sector specific policies in which the state actively intervened in specific sectors, either in a reactive or proactive fashion. Third, influential tactics, which are more indirect and selective.

Central planning has been a major instrument of economic policy in post-war France. Since 1947, governments create 5-year plans, in which they accentuate the aims of economic and industrial policy for that time-span. This planning is closely connected to the notion of indicative-planning. With *consultation* and *contractualization* policies (Foucauld 1994) through official plans, tripartite commissions (officials, employers and unions) and contracts between the involved parties, French governments try to reduce the extent of uncertainty and risk which entrepreneurs in a free-market-setting face and to disperse as much information as possible between the state, the regions and businesses. Also the feature of widespread cross-shareholdings in the French economy has been encouraged by various governments, so as to reduce the possibilities of hostile takeovers of French firms from abroad.

Moreover, the role of the state as direct participant in the economy through state owned enterprises has been one of the most visible traits of the French economy. Particularly relevant in this respect was the acquisition (or creation through mergers) of large enterprises. Nationalizations were achieved in waves, of which the first took place immediately after the war, affecting mainly firms in the financial, energy, utilities and transport sectors. The last wave of nationalizations took place between 1981-84, concentrating once again on financial institutions, but also on producers of chemicals, pharmaceutics and electronics. Since then, the share of the state in the economy has been decreasing. Through the continuing process of privatizations, the state nowadays no longer has a significant position in the banking and insurance sectors, nor among the most important industrial sectors. However, the state has not been reluctant to bail out failing formerly SOEs, such as Crédit Lyonnais and Air France. The still tight connection between the government and the SOEs can be seen in the

numerous job swaps between high government officials and managers of SOEs (see: Dormois 1999, p. 92).

Sector specific policies summarize policies in which the state directly tries to foster economic development in a specific sector (as opposed to a more general approach under substitution strategies). Main instruments are loans and subsidies, mainly given to public enterprises. Sector-specific policies oscillated between reactive policies (sheltering sectors in crisis) and proactive policies (facilitate the development of new industries/sectors). Under the fourth republic, subsidies were scattered among many branches, main beneficiaries were sectors which were supposed to have strong externalities like public utilities, transport and telecommunication and basic industries but also agriculture. After the implementation of the treaty of Rome and the introduction of the fifth republic, sector specific industrial policy became more proactive, promoting sectors with military appliances (aeronautics and nuclear industries), but still giving high assistances to traditional sectors like steel making and shipbuilding. In the late 70s and early 80s, the focus shifted towards the telecommunication sector.

Influential tactics refer to more traditional, indirect forms of assistance, such as state procurement and R&D financing. This form of assistance has been traditionally selective. Government procurement contracts mainly went to large enterprises in which the state had major holdings. In 1974, only two industries (electrical equipment and ship and aircraft manufacturing) received government orders, accounting for more than 5% of their turnover. The provision of R&D funding was even more concentrated. In 1975, two thirds of state R&D funds went to the aerospace industry, and almost one quarter to the electronics sector.

Part C. Descriptive Analysis of Structural Change in France

1. Introduction

1.1 Subject and structure of the work

This part describes and analyses the extent and evolution of industrial specialization of French regions, and of the spatial concentration of French industries during the past about two decades. From the perspective of the EURECO project as a whole, the predominantly descriptive analysis will develop stylized facts about the general patterns of structural change during the process of European integration. On the background of theoretical models of trade and economic geography, surveyed in Workpackage 1 (Bode, Bradley et al. 2004), the stylized facts shall help formulate hypotheses about the effects of economic integration on regional specialization and economic growth.

The analysis will focus on the following guiding questions:

- What have been the specific characteristics of the industrial specialization of French regions, and of the spatial concentration of French industries in the early 1970s, before the south enlargement and further EU integration steps took place? Did there exist an explicit core-periphery system?
- How have the specialization and concentration patterns changed during the subsequent process of European integration?
- To what extent can the directions and magnitudes of these changes be attributed to the initial conditions: Did highly concentrated / highly dispersed industries get more concentrated or more dispersed during the observation period? Did highly specialized / highly diversified regions get more specialized or more diversified? Did peripheral regions evolve differently than central regions?
- To what extent can the subsequent development of regional and industrial performance be attributed to the initial conditions: Do concentration or dispersion trends of industries and specialization or diversification trends of regions coincide with growth or decline, with job gains or losses of respective industries and regions? Did peripheral regions perform differently than central regions?
- In particular, to what extent has a specific industry mix of regions, such as a historically high specialization on agriculture or on so-called increasing returns (IRS) industries or on industries with a high dependency on localized resources, affected the subsequent evolution of industrial specialization and economic development in these regions? Did such regions exhibit a characteristic evolution distinct from other regions?

The analysis addresses the specialization of French regions with respect to large economic sectors as well as to detailed manufacturing industries. The time period covered by the subsequent investigation, 1973 to 2000, is sufficiently long for capturing important milestones of the integration of the EU integration process: the south enlargement in 1981/1986, the completion of the Single Market in 1992, and the north enlargement in 1995.[4]

The investigation is divided into five chapters, dealing with methodological and data issues (section1.2.), the spatial concentration of industries (chapter 2), the industrial specialization of regions (chapter 3), and the structural change in more detail (chapter 4). Part D concludes.

Chapters 2 and 3, dealing with the spatial distribution of industries and the industrial specialization of regions, will start from a European perspective by identifying the specific position of French regions in the European division of labour, and comparing the extent and evolution of sectoral specialization of French regions to that of other European regions. In a second step, the two chapters will focus on industries within the French manufacturing sector, exploiting a national data base which allows for a deeper sectoral breakdown. In doing so, the analysis of the spatial distribution of industries in chapter 2 will identify groups of industries of similar (exogenous) characteristics related to trade theories. The purpose of this exercise is to investigate to what extent trade and new economic geography theories may help explain the observed spatial concentration of industries in France in the initial year of the observation period, the changes in concentration over time during the subsequent integration process, and the consequences on the rise or decline of such industries. The characterisation of these industry groups will be used as input to chapter 3. Chapter 3, dealing with industrial specialization of French regions, will identify classes of regions according to their specialization on sectors and on those industry groups with similar characteristics. It will describe the characteristics of the specialization patterns of regions, resp. classes of regions, in the initial year of the observation period, will investigate the evolution of the specialization patterns during the subsequent integration process, and the consequences on the rise or decline of these region classes.

Chapter 4 will investigate structural change in more detail disentangling the interaction between industrial concentration and regional specialization. It will look for the specialization of specific regions on specific industries (IRS industries, resource dependent industries), and for the consequences it has on the subsequent evolution of these regions, with respect to their further increase or decrease of specialization, as well as to their economic performance relative to other regions. The main goal is to help formulate hypotheses about causal

[4] The latest milestone, however, the creation of the European Monetary Union in 1999/2002, is too recent for being covered by the present analysis.

relationships between specialization and regional performance, which are to be tested in subsequent phases of the EURECO project.

1.2. Methodology and database

Methodology

For measuring industrial concentration or regional specialization, a large number of measures has been used in the literature, including the Herfindahl, Theil and Gini indices, the coefficients of variation and of specialization, and the "dartboard" measures (Ellison-Glaeser, Maurel-Sédillot coefficients). Appendix 2.1. gives a comparative overview. The decision upon which measure is most appropriate for a specific investigation depends to a great deal on the purpose of the investigation with respect to weighting observations of different magnitudes, data availability, and specific properties of the respective measures.

Not withstanding the merits of other indicators, this paper suggests to use Theil indices, recently proposed by Brülhart and Träger (2004). For comparison, the Herfindahl index and the Krugman index will also be presented. Formally, the Brülhart/Träger Theil index in a generalized form can be written as

$$T_{(j)}^{BT} = \sum_{i=1}^{I} \frac{n_i}{N} \frac{a_i(j)}{a_i} \ln\left(\frac{a_i(j)}{a_i}\right)$$

j denotes the unit investigated which, in the present paper, is either a specific region – in the analysis of the industrial specialization of regions – or an industry – in the analysis of the spatial concentration of industries; *I* the number of observations the distribution of which shall be investigated (either industries *i* in region *j*, or regions *i* where industry *j* may be located); $a_i(j)$ the "local" share of observation *i* in unit *j* (in terms of employment or value added); and a_i the corresponding "global" share at a super-regional or super-industrial level which serves as a benchmark for the $a_i(j)$. n_i/N is the weight given to the *i*-th observation, such that $\Sigma_i n_i/N = 1$; n_i denotes the absolute number of basic units (e.g., workers, EUROs of value added, square kilometres) in observation *i*, and *N* the corresponding total number of basic units at the super-regional or super-industrial level. Different benchmarks may be applied: One possible benchmark may be the uniform distribution of industries or regions ($a_i=1/I$) transforming the Brülhart/Träger Theil index into the well-known Theil index:

$$T_{(j)} = \sum_{i=1}^{I} a_i(j) \ln\left(I\, a_i(j)\right)$$

Another possible benchmark may be the topographic distribution yielding the topographic Theil index (as a concentration measure, only).

Depending on their specific properties, different measures may produce different results, and may suit, or not suit for the question to be investigated. A marked parting line runs between so-called absolute and relative measures. Absolute measures are, i.a., Herfindahl index and Theil index, relative measure are, i.a., Krugman index and Brülhart/Träger Theil index. Absolute measures are based on shares which they refer to a zero distribution or a uniform distribution (1/*I*). In the context of industrial specialization of a region, e.g.,[5] the Herfindahl index, referring to a zero distribution, assigns higher weights to big than to small industries:

$$H_{(j)} = \sum_{i=1}^{I} (a_i(j))^2$$

The Herfindahl index may be useful for comparing regions with respect to their quantitatively most important industries. It is, however, rather insensitive to the issue of arbitrary definition of industries: A broadly defined industry is given a higher weight than a comparable industry with was – for whatever reason – split up into several small sub-industries. Similarly, the Herfindahl index may be useful for analyzing changes in a region's industry structure over time, if changes in big industries are judged more relevant than changes in small industries.

Other absolute measures, like the coefficient of variation, the Gini or Theil index, use the uniform distribution rather than zero as a reference. In a comparison of regional specialization patterns, they tend to deal more symmetrically with big and small industries than the Herfindahl index. Assigning higher weights to both very big and very small industries, they may draw a more balanced picture of specialization. This property does, however, not imply neutrality with respect to arbitrarily defined industries. Though drawing a more balanced picture, they still employ the same kind of – mechanical – weights as the Herfindahl index. An industry that happens to be mediocre within a specific region does not affect the measures, irrespective of how big or small it is in other regions. As to the analysis of the evolution of specialization patterns over time, the major merit of absolute measures is that the reference is constant. The measures are able to capture what happens within a region, irrespective of what happens elsewhere. But again, this comes at the cost in the context of interregional comparisons of structural change: A change of given magnitude (say, a gain of 1% of total regional employment) in a big or small industry is given a higher weight than the same change in a mediocre industry. Consequently, the measures may respond differently to quantitatively and qualitatively similar changes.

[5] The following discussion of the merits and drawbacks of different measures will be confined to the specialization issue. The arguments can easily be transposed to the issue of spatial concentration of industries.

Relative measures are based on localization coefficients or analogues[6] that refer "local shares" to "global shares" (this is the usual procedure) or to any other reference shares. One example, besides the Brülhart/Träger Theil index, is the Krugman index:

$$SC_{(j)} = \sum_{i=1}^{I} \left| a_i(j) - a_i \right|$$

The relative measures allow for specifying explicitly of what size an industry is expected to be. They thus allow for dealing appropriately with arbitrary statistical definitions by tailoring the benchmark. As a consequence, however, information from the sheer absolute size of industries is lost: Relative measures assign regional deviations from (nationally) small industries essentially the same value than deviations of similar magnitude from big industries. As to the analysis of the evolution of specialization patterns over time, relative measures allow for netting out national trends. This may be helpful if the national trends should be assumed exogenous, or if the focus is on regional evolution within the country. It may be helpful as well when different regions are compared because the same global trend is removed everywhere. But if the focus is on absolute changes, relative measures tend to draw an incomplete picture.[7]

Similar trade-offs are relevant when choosing between different absolute, or relative measures. Some measures, like the coefficient of variation, tend to put more emphasis on big deviations from the reference distribution, while others, like the Theil index, tend to put more emphasis on small deviations. The question of which measure to prefer depends, i.a., on the focus of the analysis, and on the relevance of outliers. As analyzed in detail by Cowell (….), the former are particularly sensitive to variations in the tails, while the latter are less sensitive. In some cases, the choice may be made in favor of measures that are somewhere in-between as a compromise. One of those measures is the coefficient of specialization, the projection function of which is uniformly linear.

The major advantage of the Brülhart/Träger Theil index, as compared to the other measures, is that it tends to downgrade the influences of outliers and of indivisibilities in firm sizes. Moreover, it is suitable for addressing a wide variety of questions, , may be used for assessing the statistical significance of differences, and can be interpreted in a fairly straightforward manner.[8] It allows for meaningful international, interregional and intertemporal comparisons by its decomposition property: any Theil index can be decomposed into additive components for subgroups of the sample. That is, the overall concentration of a specific industry across European regions can be traced to a component that is due to the

[6] I.e., the Krugman index is defined as a difference instead of a quotient.

[7] In the context of measuring the spatial distribution of industries, this potential drawback of relative measures can be avoided by choosing as a reference a distribution that is constant over time, such as total area, or area available for economic use.

[8] For a more detailed analysis of the advantages of the Theil indices, cf. Appendix 2.1.

concentration across countries and another that is due to the concentration across regions within countries. Also, the overall specialization of a region can be traced to the component that is due to the specialization on industry groups and another that is due to the specialization on industries within these groups. These properties will be used in particular to give an idea of the position of French sectors and industries, as well as of French regions in the overall European division of labor.

Database

For the purpose of the present study, two different databases are exploited:

- annual real value added by 17 sectors 1980 to 1995 from the Eurostat database, revised and amended by Hallet (2000).[9]
- annual employment by 35 manufacturing industries 1973 to 2000 from the enterprise surveys database of the French SESSI.

For the first database, Hallet (2000) completed the Eurostat dataset, reporting gross value added at current prices in ECU from national sources, to cover 17 sectors for NUTS 2 regions in Belgium, Spain, France, Italy, Netherlands, and Portugal, and for NUTS 1 regions in Germany and the UK. The sectors include agriculture, 10 manufacturing and energy sectors, and 6 service sectors. The dataset allows us to compare the specialization French regions and concentration of French sectors on a European yardstick. The data include, however, data breaks that seem to be due to statistical problems rather then real world evolutions. We do not dispose of any information on the background to such breaks. They will, therefore, largely remain uncommented.

Since 1973, the “Services des Statistiques Industrielle (SESSI)” offers yearly data on employment (persons employed) in manufacturing for 21 “régions” from the “Enquête Annuelle d’ Entreprises”. The depth of the sectoral breakdown varies, and since 1993, a new industrial classification system was adopted. Yet, it is possible, to provide a more or less coherent data set for 35 manufacturing branches from 1973 to 2000. There are several missing values in the data due to confidentiality restriction, but as there are also several figures available on totals and cross totals and for precedent or subsequent years, these missing values can be estimated by an iterative interpolation procedure. The data set applied for the present paper yet does not include any year between 1973 and 2000; the further completion of the data set will be continued. Corse, though being a separate region since the 1980s, is treated here as part of the region Provence-Alpes-Côte d’Azur in order to allow for comparisons from the early 1970s on.

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[9] We would like to thank Martin Hallet for the generous provision of his data.

2. Concentration of industries

The purpose of this chapter is to set out the major characteristics of large French sectors, as well as of French manufacturing industries, with respect to their concentration pattern and their economic performance, in order to enter the results into the analysis of French regions. Given the distortions of the various concentration measures stemming from the arbitrariness of any chosen benchmark, the analysis starts from a European perspective at the French economy, and proceeds stepwise to more detail.

The analysis will rely mainly on simple Theil indices (as an absolute concentration measure), on weighted Theil indices referring to economic concentration (as a relative concentration measure), and on weighted Theil indices referring to topographic concentration. Correlation analyses will demonstrate the conformity of these measures with other, absolute and relative concentration measures.

2.1. Position of the French economy in the European division of labor

Spatial concentration in the early 1980s

To get an idea of the spatial concentration of economic activity in Europe, two weighted Brülhart/Träger Theil indices are calculated: The first one employs area as a reference, the second aggregate economic activity. The two indices characterize spatial concentration of specific sectors from different angles: The first index is used to measure *topographic concentration* of both aggregate and sector-specific economic activities. The measure allows for assessing which sectors are more and which are less concentrated in space than economic activity as a whole. The second index measures *economic* concentration. It measures directly the deviation of the location pattern of a specific sector from that of aggregate economic activity but is not informative as to the direction of the deviation. The two Theil indices are decomposed by countries to distinguish between-country to within-country concentration patterns.[10]

The values obtained for the *topographic concentration* measure in 1980 are summarized in the upper panels of Table 2.1. The Theil value for topographic concentration of economic activity as a whole across the 118 EU15 regions is 0.69 which is at the lower end of the range of the index: If all economic activity would have been concentrated on a single square kilometre, the value had been 14.93 (“upper bound” in Table 2.1); if all economic activity would have been distributed uniformly across space, the value had been 0. Among the four sectors, manufacturing (0.74) and services (0.76) exhibited a slightly higher topographic concentration, while agriculture (0.27) was distributed more evenly across space. The

[10] The analysis is based on data on valued added by four sectors (agriculture, manufacturing, construction and services) in 118 regions from 15 EU countries (Hallet dataset). The data base covers the period 1980–1995. The spatial distribution of industries within the manufacturing and the service sectors will be analyzed in more detail in the subsequent scetions.

comparatively low extent of topographic concentration of economic activity indicates that the spatial division of labor within Europe was not too distinct in the early 1980.[11]

Table 2.1-1 — Topographic concentration of four sectors across 118 regions in EU15 countries 1980: Total, between and within components of Brülhart/Träger Theil indices, reference: area

Index-component/ Country-specific within	All sectors	Agriculture	Manufac-turing	Construc-tion	Services	upper bound
Total	0.69	0.27	0.74	0.59	0.76	14.9
Between	0.36	0.19	0.41	0.35	0.37	14.9
Within	0.33	0.08	0.33	0.24	0.37	—
Austria	—	—	—	—	—	—
Belgium	0.59	0.16	0.43	0.40	0.73	10.3
West-Germany	0.20	0.03	0.18	0.15	0.24	12.4
Denmark	—	—	—	—	—	—
Spain	0.56	0.12	0.68	0.48	0.63	13.1
Finland	—	—	—	—	—	—
France	**0.55**	**0.06**	**0.52**	**0.42**	**0.67**	**13.2**
Greece	—	—	—	—	—	—
Ireland	—	—	—	—	—	—
Italy	0.19	0.12	0.36	0.09	0.18	12.6
Luxembourg	—	—	—	—	—	—
The Netherlands	0.24	0.09	0.20	0.18	0.33	10.4
Portugal	0.45	0.13	0.48	0.34	0.58	11.4
Sweden	—	—	—	—	—	—
United Kingdom	0.47	0.16	0.41	0.40	0.54	12.4

About one half of the observed total topographic concentration of economic activity can be attributed to concentration at the country level: The ‘between’ component of the Theil index is 0.36, which is 53% of the total value. That is, given the regional grid used in the present investigation, only half of the observed topographic concentration of activities within Europe was due to the co-existence of city- and peripheral regions within the countries. The other half was due to differences in country-average densities of economic activity.[12] The differences between sectors in the between and within-country concentrations are notable: The landscape of agricultural production was dominated by differences in the concentration patterns between countries, indicating that in agricultural production the international division of labor was more significant than the interregional one: No less than three fourth of the total concentration (0.19/0.27) observed in agricultural production were due to differences between

[11] This general conclusion does not change fundamentally if the manufacturing sector is split up into 10 and the service sector into 5 industries. The Theil value does not exceed 1.2 in any of these manufacturing or service industries.

[12] The contribution Luxembourg to the between-country concentration measure in the geographic distribution is negligible. Note that the contributions of countries to the Theil measure are weighted by their relative size.

countries.[13] For the other sectors, the shares of the between components in total observed concentration were lower, ranging between 49% and 59%.[14]

The extent of the within-country concentration of economic activity differed by the factor of three between the countries. Belgium (0.59) exhibited the highest and Italy (0.19) the lowest spatial concentration (Table 2.1, lower panel). With a within value of 0.55, France was among the countries exhibiting the highest intra-national topographic concentration. The manufacturing and construction sectors were even higher concentrated than in any of the other countries under consideration.

Economic concentration in 1980 was generally much lower than topographic concentration in the three non-agricultural sectors (Table 2.2). None of these sectors deviated markedly from the distribution of overall economic activity. Only for agriculture the results suggest a somewhat higher "concentration" which, however, just reflects the fact that agricultural production usually takes place outside the economic centers.

Table 2.1-2 — Economic concentration of four sectors across 118 regions in EU15 countries 1980: Total, between and within components of Brülhart/Träger Theil indices, reference: total value added

Index-component/ Country-specific within	All sectors	Agriculture	Manufac-turing	Construc-tion	Services	upper bound
Total	—	0.32	0.03	0.02	0.01	14.6
Between	—	0.15	0.01	0.00	0.00	14.6
Within	—	0.17	0.03	0.01	0.01	14.6
Austria	—	—	—	—	—	—
Belgium	—	0.30	0.02	0.02	0.01	11.3
West-Germany	—	0.17	0.01	0.00	0.00	13.2
Denmark	—	—	—	—	—	—
Spain	—	0.26	0.05	0.02	0.01	12.0
Finland	—	—	—	—	—	—
France	**—**	**0.31**	**0.02**	**0.02**	**0.01**	**13.0**
Greece	—	—	—	—	—	—
Ireland	—	—	—	—	—	—
Italy	—	0.14	0.06	0.04	0.01	12.7
Luxembourg	—	—	—	—	—	—
The Netherlands	—	0.10	0.07	0.03	0.02	11.6
Portugal	—	0.14	0.03	0.04	0.01	9.8
Sweden	—	—	—	—	—	—
United Kingdom	—	0.20	0.03	0.01	0.01	12.7

Again, the total Theil values can be decomposed into within and between components to observe that economic concentration is a cross-regional rather than a cross-national

[13] Again, this conclusion is subject to the definition of regions. A different result would probably obtain from a finer spatial grid that allows to observe the heterogeneity between cities and peripheral regions in more detail. Notetheless, recall from Appendix 2 that the weighted measure used in the present investigation is the best measure available, i.e., the measure that minimizes the bias resulting from incomplete information on intraregional heterogeneity.

[14] Figures of similar magnitude, which are not reported here, are obtained for all of the 10 manufacturing and 5 service industries distinguished in the underlying Hallett data set.

phenomenon. In the manufacturing sector, e.g., differences between countries accounted for only about 19% of the total concentration measure (e.g., 0.006/0.031). Recall from Table 2.1-1 that the respective area-relative between components accounted for 49-59%. This difference suggests that there was no marked specialization of specific countries in any of the sectors. The sectoral shares by country corresponded very closely to the shares of overall economic activity.

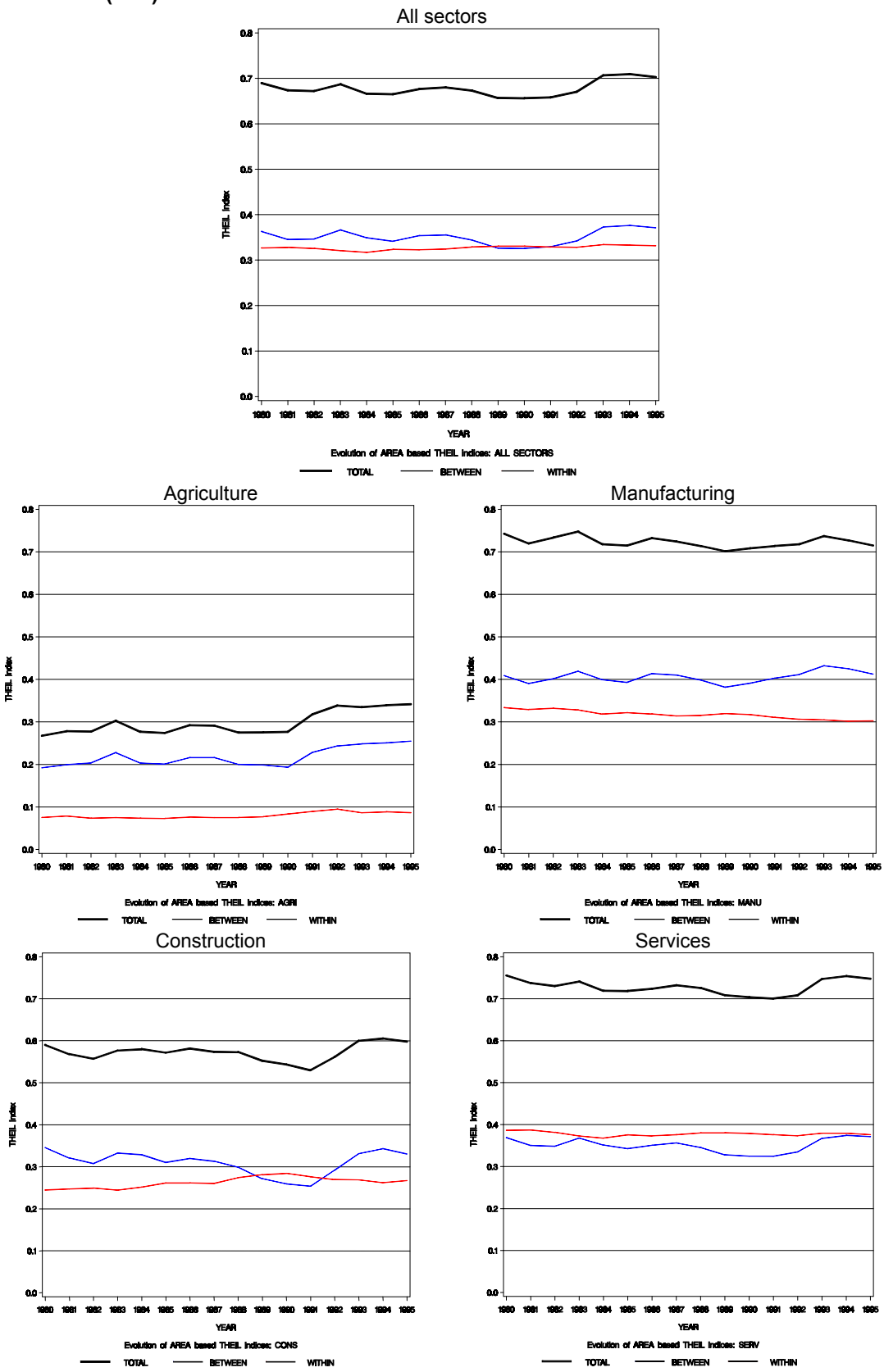
There were, however, some differences between the distributions of sector-specific and total activities within countries, as indicated by the country-specific within components of the Theil index. Except for agriculture, France did not differ notably from other EU member states in the degrees of sector-specific economic concentration.

Evolution of spatial concentration 1980 – 1995

The evolution over time of the spatial concentration pattern of economic activity as a whole, and of the four sectors can be analysed by exploring the time series of the Theil indices measuring geographic and economic concentration. In the present investigation the focus is on changes in the topographic concentration because the reference (area) is constant over time. The evolutions of the Theil measures for topographic concentration are depicted in Figure 2.1. The first, upper graph shows the evolution of topographic concentration of economic activity as a whole as well as the respective within and between components. It indicates that economic activity in the EU as a whole tended to deconcentrate throughout the 1980s but to re-concentrate again in the early 1990s (see also Hallet 2002; Brülhart and Träger 2004).[15] The topographic concentration ended up at about the same level in the mid-1990s than it has had in the early 1980s. Both the decreasing topographic concentration during the 1980s and the increasing concentration in the early 1990s were driven by differences between countries, as the between-component of the index indicates. The level of concentration within countries did not change to a notable extent during the whole period under investigation, by contrast.

[15] Based on the Cambridge Econometrics data set, Brülhart and Träger (2004) report a similar evolution of the topographic concentration of total employment. The changes are, however, not statistically significant, as indicated by bootstrap tests.

Figure 2.1-1: Evolution of topographic concentration across 118 regions in EU15 countries by four sectors 1980–1995: Total, between and within components of Brülhart/Träger Theil indices 1980-1995, reference: area (km²)



The deconcentration in the 1980s was mirrored by all sectors except agriculture. The services and construction sectors, in particular, were distributed more evenly across space in the late 1980s than they had been in the early 1980s.[16] In both sectors, the driving forces were decreasing inequalities between countries: The country-average densities tended to become more similar over time (see also Brülhart and Träger 2004). The manufacturing sector showed a somewhat different evolution in two respects: First, its geographic deconcentration occurred at a slower pace. And second, the deconcentration of manufacturing was driven mainly by deconcentration within countries rather than between countries.[17] The country-specific within Theil values, which are not reported here in detail, indicate that manufacturing industries deconcentrated in most of the countries under consideration, except France and The Netherlands where there was some concentration going on in the early 1980s.

The re-concentration in the early 1990s was also mirrored by all sectors, including agriculture, and it was also driven by an increasing concentration at the country level in the first line.[18] The process can be attributed to the German re-unification to a good deal. Experiencing a re-unification boom in the early 1990s, the (West-) German economy disconnected temporarily from the international business cycle which shows up as a rising concentration at the national level, as measured by the index.

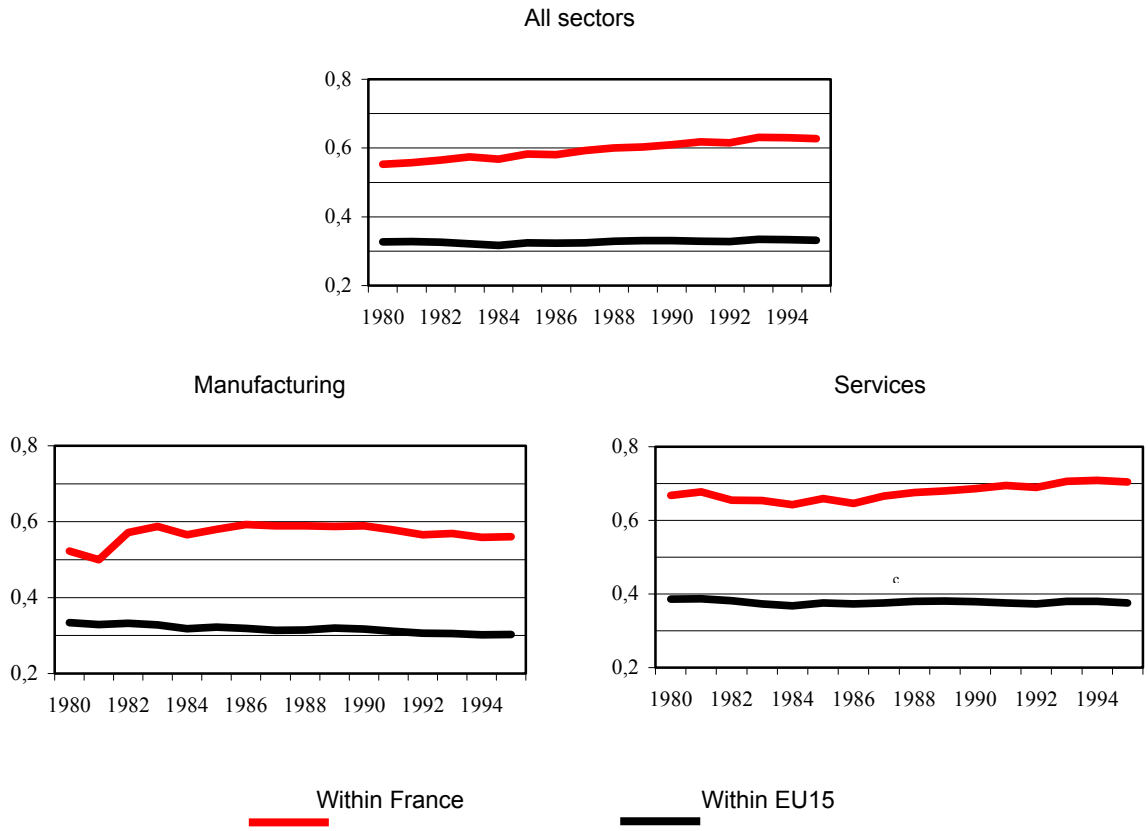
The evolution of the topographic concentration of economic activity within France was characterized by an increasing regional inequality during the whole period under consideration. (Figure 2.2). Among the countries comprising more than one region in the underlying dataset, France showed the highest increase of spatial concentration of economic activity as a whole (upper panel in Figure 2.2). In the early 1980s, this concentration was driven by manufacturing industries in the first line (lower panel). In the late 1980s, the concentration was driven by the service industries.

[16] These results are broadly in line with those reported by Brülhart and Träger (2004) for sector-specific employment. The tendencies towards increasing topographic concentration of agriculture, and towards decreasing topographic concentration of manufacturing were even stronger in terms of employment than in terms of vale added. Both were found to be statistically significant by Brülhart and Träger (2004).

[17] In terms of exports, Brülhart (2001) reported no significant changes in the concentration patterns of industries at the national levels. In terms of employment, however, Brülhart and Torstensson (1998) and Brülhart (2001) reported evidence of an increasing concentration of manufacturing industries at the country level.

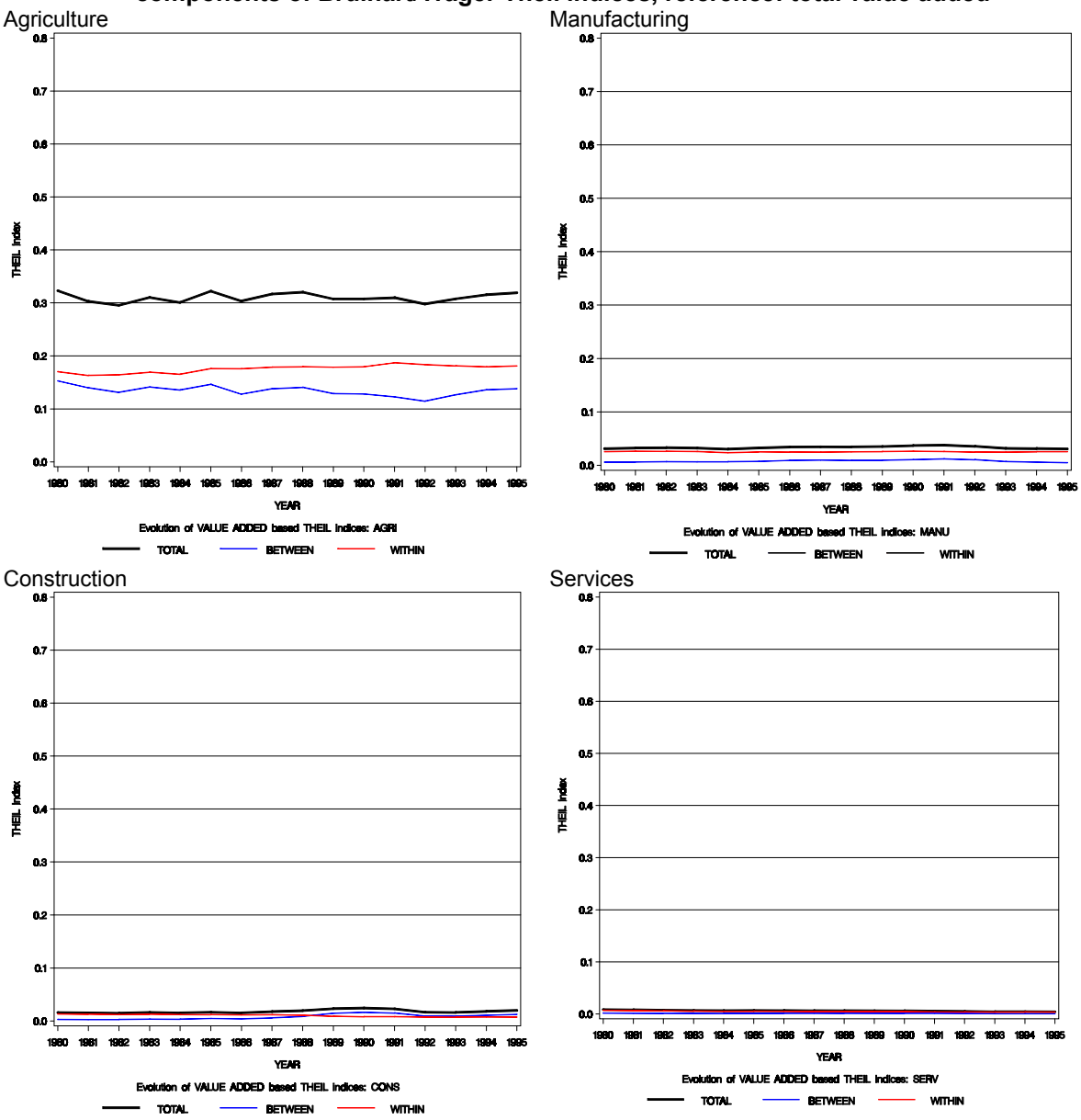
[18] According to Aiginger and Pfaffermayr (2004), the increase in concentration of manufacturing industries in the early 1990s did, in fact, interrupt the long-term trend towards deconcentration of these industries only temporarily.

Figure 2.2 — Evolution of topographic concentration of manufacturing and service sectors within France and within EU15 countries 1980–1995: within components of Brülhart/Träger Theil indices, reference: area (km²)



Turning to the evolution of economic concentration in Europe, as evidenced by value added-relative Theil indices (Figure 2.3), no significant changes could be observed. The only sector which, according to this measure, exhibits some economic concentration, is agriculture because agricultural production is concentrated outside the economic centers. The remaining sectors are distributed very much in line with economic activity as a whole. Consequently, both the levels and the changes in the respective economic concentration measures are negligible.

Figure 2.1-3: Evolution of economic concentration across 118 regions in EU15 countries by four sectors 1980–1995: Total, between and within components of Brülhart/Träger Theil indices, reference: total value added



Summing up, France is found to be among the EU countries exhibiting the highest concentration of sectors in terms of topographic concentration but not in terms of economic concentration. In particular, the manufacturing and services sector are more spatially concentrated than in most other EU countries reflecting a similarly high concentration of overall employment, whereas agriculture is highly dispersed across space. At any rate, the concentration was low regarding the range of values of the indices. Over time, concentration change of French sectors occurred by and large in line with the overall European trends albeit more reluctantly, with agriculture getting more concentrated, and with manufacturing getting less concentrated (the latter referring to area only).

2.2. Groups of industries and their characteristics

Trade theories and new economic geography hold that different types of sectors/ manufacturing industries shape regions in different ways. Most remarkably, the existence of increasing returns to scale (IRS) for specific industries, and the dependency of specific industries on the availability of specific highly localized resources are likely to affect the spatial allocation. Hence, in order to assess the impact of integration on regions that are differently equipped with sectors /industries at a given starting point, some preparative work on groups of sectors /industries with similar characteristics related to trade theory is required. It would be desirable to identify such types of sectors / industries for all parts of the economy, yet due to insufficient data this exercise is restricted to manufacturing industries only. Preferably, this identification of characteristic industry groups should be accomplished for all industries of the French economy. Yet, due to insufficiently disaggregated data for all other sectors, the analysis is restricted here to the (73) industries of the manufacturing sector.

The concentration pattern differ remarkably between *sectors*. On the one hand, the agricultural sector proves to be highly concentrated in terms of relative concentration, i.e., compared to the distribution of overall employment, yet little concentrated in terms of absolute and topographic concentration (table 2.2-1). By contrast, credit and insurance services, other market services and transport and communication services reveal to be highly concentrated in terms of absolute and topographic concentration, but, at least the latter two, not in terms of relative concentration. The other services sectors and the building and construction sector are to be found somewhere between these extremes, yet more resembling the credit and insurance sector than the agricultural sector. The different messages between these indicators reflect the fact that manufacturing and services are where the people are (in urban areas with higher population densities), whereas agriculture is where the land is. Referring to the employment of people (i.e., to the relative concentration measures), the results show France to be an industrialized country with a broad dispersion of manufacturing, and also of sectors complementary to manufacturing or necessary for supplying basic needs like construction and most services sectors.

Table 2.2-1: Concentration of French sectors in 1980

Economic sectors	Theil index	Weighted Theil index	Topographic Theil index
Agricultural, forestry and fishery products	0,0803	0,3069	0,0497
Manufacturing	0,3124	0,0119	0,5144
Building and construction	0,2924	0,0203	0,4088
Recovery, trade, lodging and catering services	0,4218	0,0113	0,6157
Transport and communication services	0,4873	0,0279	0,7208
Services of credit and insurance institutions	0,7607	0,0859	1,0694
Other market services	0,5124	0,0206	0,7394
Non-market services	0,3178	0,0175	0,4665

Source: Hallet (2000).

These messages from the chosen three concentration measures are confirmed when comparing them to other absolute and relative measures. Table 2.2-2 depicts the correlations between the various measures for the case of French sectors – it reveals the high correlation between the absolute Theil and Herfindahl measures, on the one hand, and between the relative, weighted Theil and specialization measures, on the other hand. Moreover, it indicates a relatively high correlation between topographic and absolute measures.

Table 2-1: Correlation matrix for concentration measures of French sectors in 1980 – Pearson correlation coefficients (error probabilities in parentheses)

	Theil index	Weighted Theil index	Herfindahl index	Krugman index	Topographic Theil index
Theil index	1.00000	-0.14831 (0.5700)	**0.94446 (<.0001)**	-0.19831 (0.4455)	0.98457 (<.0001)
Weighted Theil index		1.00000	-0.27819 (0.2796)	**0.963342 (<.0001)**	-0.23723 (0.3592)
Herfindahl index			1.00000	-0.28054 (0.2754)	0.93976 (<.0001)
Krugman index				1.00000	-0.27520 (0.2850)
Topographic Theil index					1.00000

The classification of groups of French industries is conducted for the year 1973, the initial year of the database. It is based on three characteristics: (i) the dependency on *highly localized resource deposits* (drawing on an OECD, 1987, classification of resource intensive industries, yet applying it only to those industries where resources are localized and not ubiquous; cf. table A3-5 in Appendix 3), (ii) the existence of *internal IRS* (drawing on Pratten, 1988, who identified industries with different levels of technical IRS; cf. table A3-4 in Appendix 3), (iii) the *observed concentration* in the initial year 1973, measured by a weighted Theil index – for comparison, the simple Theil and the topographic Theil index are also presented.[19]

The classification proceeds in three steps yielding four groups of French manufacturing industries (table 2.2-1):

- *Resource intensive industries*: includes all industries depending on highly localized resources, i.e., mining, coal mining and coke ovens, iron and steel works, production and transformation of non-ferrous metals and non-metal minerals, petroleum refining. These industries are usually characterized by high internal IRS. The observed concentration of these industries is usually quite high, which fits both traditional trade theory (more particularly, a Ricardo setting) and NEG.

[19] The reasons for deciding to use these indices to measure industrial concentration are laid down in section C.1.2.

Table 2.1-1: Groups of French industries – Result of classification

Ind. Class.	Industry	Resource depend.	Internal IRS	Weigh-ted Theil index	Theil index	Topogr. Theil index
	Resource dependent industries					
09	Extraction et préparation de minerai de fer	1	high	2.4553	2.5387	2.6435
14	Prod. de min. div.	1	low	2.3258	2.0472	2.9180
12	Extraction de minerais non ferreux	1	medium	2.0343	1.5921	1.2703
04	Comb.min.sol.,coképfact.	1	high	1.2437	1.6067	1.9678
10	Sidérurgie	1	high	1.0229	1.2533	1.4489
130	Prod. de mét. non-ferr.	1	medium	0.7488	1.0656	1.0069
1105	Fabr. de tubes	1	low	0.7292	1.1755	1.6007
11./.1105	Tréfilage, étirage, profilage, laminage	1	high	0.4564	0.5781	0.7833
05	Pétrole,gaz naturel	1	high	0.3978	0.8522	1.1568
131	Transf. de mét. non-ferr.	1	medium	0.2997	0.6191	0.9026
	Industries with high internal IRS					
3401	Horlogérie	0	high	1.7256	1.6417	2.0399
33	Constr. aéronautique	0	high	0.7045	1.2231	1.3790
5112,30	Édition	0	high	0.6335	1.7922	2.3532
27	Mach. de bureau, mat. de trait. de l'inform.	0	high	0.5225	1.3372	1.7514
3121	Mat. ferroviaire	0	high	0.4441	0.8029	1.1729
3403-05	Instr. optique	0	high	0.4224	1.0578	1.3098
2911-14	Mat. d' équipement courant faible	0	high	0.3804	1.2059	1.6603
2915-22	Mat. dest. au grand public	0	high	0.3092	0.7331	0.9345
3402,06-07	App. de mesurer, méc. de haute préc.	0	high	0.2532	0.9329	1.1864
172	Chimie organique	0	high	0.2343	0.6541	0.8346
5101,20	Imprimerie de presse	0	high	0.2275	0.8617	1.2494
3111-15	Constr. automobile	0	high	0.2084	0.7086	1.1050
171	Chimie minéralique	0	high	0.2048	0.4642	0.6844
1506	Chaux et ciments	0	high	0.1724	0.4692	0.5535
5110-11	Imprimerie de labeur	0	high	0.1342	0.7755	1.1575
1501-1505,07-09	Mat. de constr.	0	high	0.1143	0.2221	0.3347
	Footloose industries, concentrated					
5204	Prod. amiante	0	medium	1.5224	1.3264	1.6869
32	Constr. navale	0	medium	1.4326	1.2651	1.2228
3907	Prod. amylaces	0	medium	1.2274	1.9950	2.6617
52./.5204	Caoutchouc	0	medium	0.8440	0.7627	0.8400
5405	Instr. de musique	0	medium	0.8010	1.9114	2.5221
3116,17	Cycles et motorcycles	0	low	0.7902	0.8863	1.1863
46	Chaussures	0	low	0.7120	0.5666	0.4683
37	Fabr. de conserves	0	low	0.6387	0.4983	0.5654
1811	Parfumerie	0	medium	0.6217	1.6208	2.1129
43	Fils et fibres artific. et synthétiques	0	medium	0.5750	1.1399	1.2712
30	Équipement ménager	0	medium	0.4981	0.5719	0.7174
	Footloose industries, dispersed					
22	Mach. agricoles	0	medium	0.4013	0.3547	0.4647
19	Pharmacie	0	medium	0.4005	1.2030	1.5070
44	Ind. textile	0	low	0.3759	0.6605	0.9113
4011,12	Corps gras	0	low	0.3716	0.8706	1.1504
45	Cuir	0	low	0.3647	0.4423	0.4418
35	Ind. de la viande	0	low	0.3532	0.3753	0.4030
4904	Literie	0	low	0.3336	0.5344	0.6633
5406,07, 09,10	Ind. div.	0	low	0.3237	0.5884	0.6042
5408	Brosserie	0	low	0.3169	0.6596	0.8570
41	Boissons, alcools	0	low	0.2981	0.3832	0.6086
36	Ind. laitière	0	low	0.2877	0.2050	0.3100
1510-13	Ind. céramique	0	medium	0.2852	0.2366	0.3920
5404	Bijouterie	0	low	0.2842	1.0363	1.3066
5001, 02	Prod. de papier	0	medium	0.2380	0.4889	0.6349
38	Boulangerie, Pâtisserie	0	low	0.2346	0.8470	1.2115
5401-03	Jeux, Jouets	0	medium	0.2274	0.4534	0.4884
48	Trav. mécanique du bois	0	low	0.2270	0.1337	0.1933
2101-05	Métallurg., Act. de sous-traitance	0	low	0.2236	0.6963	0.8339
1801-10	Parachimie	0	medium	0.2203	0.9710	1.3460
16	Verre	0	medium	0.2097	0.6032	0.9108
40./.4011-2	Alimentaires div.	0	low	0.1982	0.5493	0.8486
07	Distrib. de gaz	0	medium	0.1950	0.7966	1.1088
49./4904	Ameublement	0	low	0.1692	0.1750	0.2560
25	Mat. de manut., pour les mines, sidérurgie	0	medium	0.1690	0.5108	0.6946
2810-16	Mat. électrique	0	medium	0.1686	0.5447	0.7403
23	Machines-outils	0	medium	0.1644	0.7498	0.9658
20	Fonderie	0	medium	0.1544	0.3821	0.5535

to be continued

Table 2.2-3 continued

Ind. Class.	Industry	Resource depend.	Internal IRS	Weighted Theil index	Theil index	Topogr. Theil index
39./.3907	Travail du grain	0	low	0.1379	0.2104	0.3344
4708-15	Ind. annexes	0	low	0.1352	0.5554	0.7718
2817-22	Mat. d' install.	0	low	0.1264	0.6952	0.9780
5003-06	Transf. de papier	0	medium	0.1114	0.4028	0.6143
06	Électricité	0	medium	0.0934	0.4521	0.6338
53	Transf. de mat. plastiques	0	medium	0.0929	0.4172	0.5545
4701-07	Confection	0	low	0.0775	0.2745	0.4373
2106-17	Articles métallique	0	low	0.0766	0.4076	0.6060
24	Équipement ind.	0	medium	0.0513	0.5501	0.7767

- *High IRS industries*: includes the remaining industries as far as they reveal high internal IRS according to Pratten, i.e., optical and professional instruments industries, office and computing machinery, aircraft industry, automotive industry, some branches of the machinery, chemical and electronic material industries, some food industries. According to NEG, it is the existence of such internal IRS that also generates external IRS and acts towards a concentration of the respective industries. Different to such expectations, however, the observed concentration varies considerably from high to extremely low, and this is true for whatever measure is drawn upon.
- *Footloose industries*: includes all remaining industries, and assumes them to be footloose, as they owe none of the properties linking them to specific locations. Accordingly, their pattern of concentration should fit into a Heckscher-Ohlin setting. This large group is structured according to the observed degree of concentration:
    - Some industries are *concentrated*, i.e, rubber and asbestos industry, shipbuilding, footwear industry, some food industries.
    - Other industries are fairly *dispersed*, like some branches of machinery, the pharmaceutical industry and the textiles industry, foundries and metal finishing, plastic materials industries, ceramic, construction material and glass industries, gas, water and electricity supplies, paper industries, clothing, wood and other consumption goods industries.

The two alternative measures also presented in table 2.2-1 reveal a high overall similarity to the weighted Theil index, although differing considerably in specific cases. In fact, they exhibit high correlations with the weighted Theil index (table 2.2-2). Also, once more, the high correlation between different absolute measures (i.e, Theil and Herfindahl index), on the one hand, and different relative measures (i.e., weighted Theil index and Krugman index), on the other hand, is confirmed. The results from other concentration measures thus largely support the impression drawn on the basis of the weighted Theil index.

Table 2.2-2: Correlation matrix for concentration measures of French manufacturing industries in 1978 – Pearson correlation coefficients (error probabilities in parentheses)

	Theil index	Weighted Theil index	Herfindahl index	Krugman index	Topographic Theil index
Theil index	1.00000	0.77156 (<.0001)	**0.94213 (<.0001)**	0.80374 (<.0001)	0.97253 (<.0001)
Weighted Theil index		1.00000	0.75399 (<.0001)	**0.92546 (<.0001)**	0.72086 (<.0001)
Herfindahl index			1.00000	0.72714 (<.0001)	0.97467 (<.0001)
Krugman index				1.00000	0.71164 (<.0001)
Topographic Theil index					1.00000

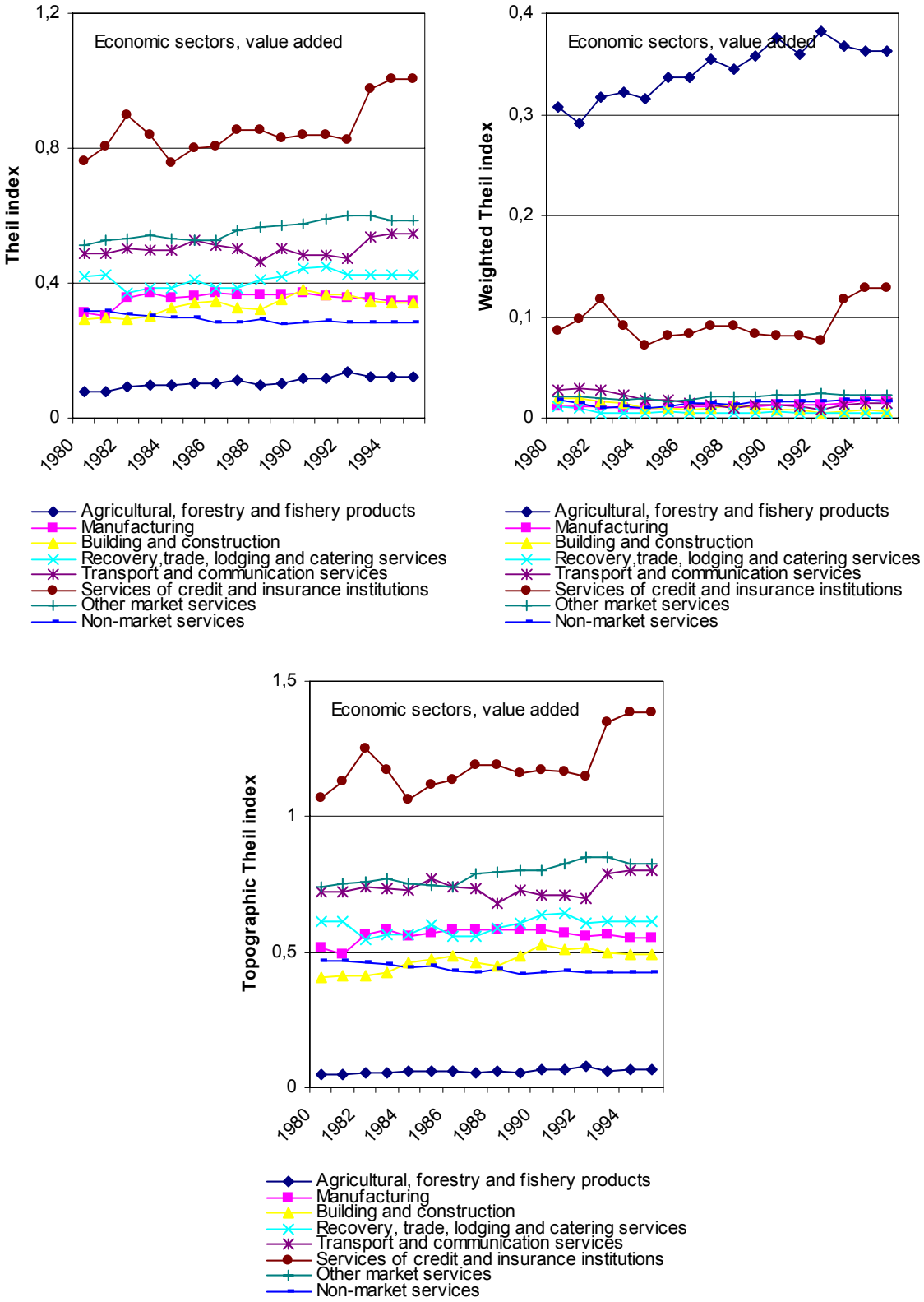
These results are not in all cases as one might have expected them to be. On the one hand, one would expect, for instance, modern industries with a high dependency on human capital, and on R&D facilities, such as the chemical, machinery, automotive and electro-technical industries, to be highly concentrated (depending in particular on external IRS), yet in France, this is not the case. On the other hand, one would expect such foot-loose industries as, e.g., footwear and rubber industries, to be fairly dispersed, yet again, in France, this is not always the case. Some of these are even quite highly concentrated like ship-building, the asbestos, and rubber industry.

2.3. Evolution of concentration over time by sectors/industry groups

Given these *groups of industries* with similar characteristics related to trade theory, the next questions concern their concentration behavior over time that may in turn shape the evolution of regions specialized on these group of industries: how do the identified resource intensive industries and the industries with high internal IRS develop? Do highly concentrated / highly dispersed industries get more concentrated or more dispersed during the observation period?

Before turning to analyze these question for the manufacturing industries, an overall assessment concerns the general concentration trends of *sectors*. Again, Theil indices weighted Theil indices, and topographic Theil indices are provided demonstrating the divergent messages from these concentration measures (figure 2.3-1): the high absolute and topographic concentration of some services and manufacturing, and the high relative concentration of the agricultural sector.

Figure 2.3-1: Evolution of concentration by economic sectors, value added

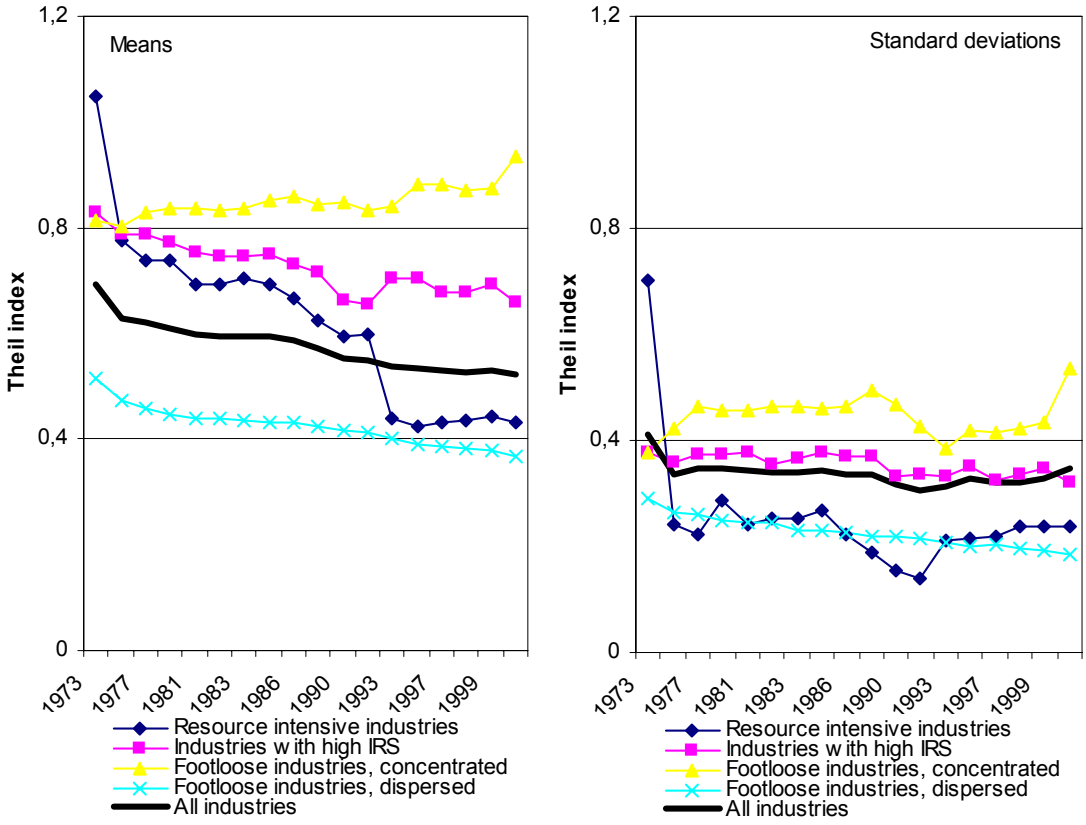


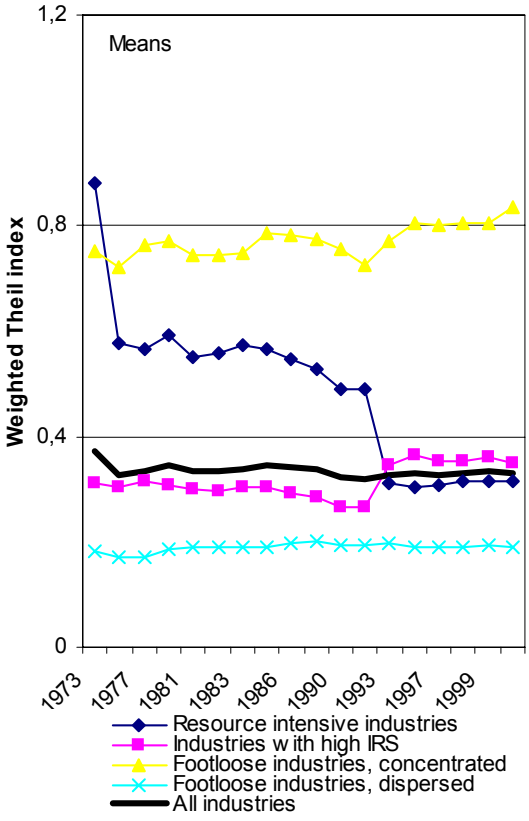
Source Hallet (2000).

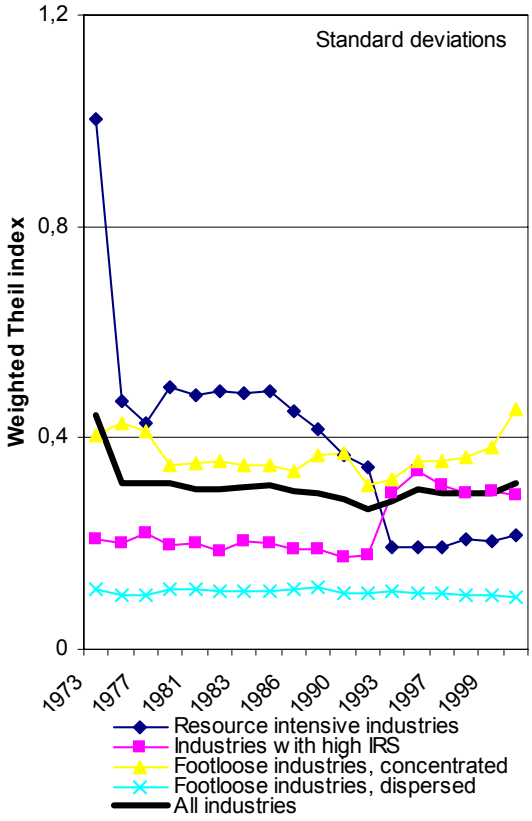
Over time, the message of the three indicators is more coherent: There seems to be small change of the concentration of sectors, yet there is a tendency for the agricultural and several services sectors (credit and insurance services, market services) to get more concentrated, and of the non-market services sector to get less concentrated. All other sectors, particularly manufacturing as a whole, are without very considerable changes.

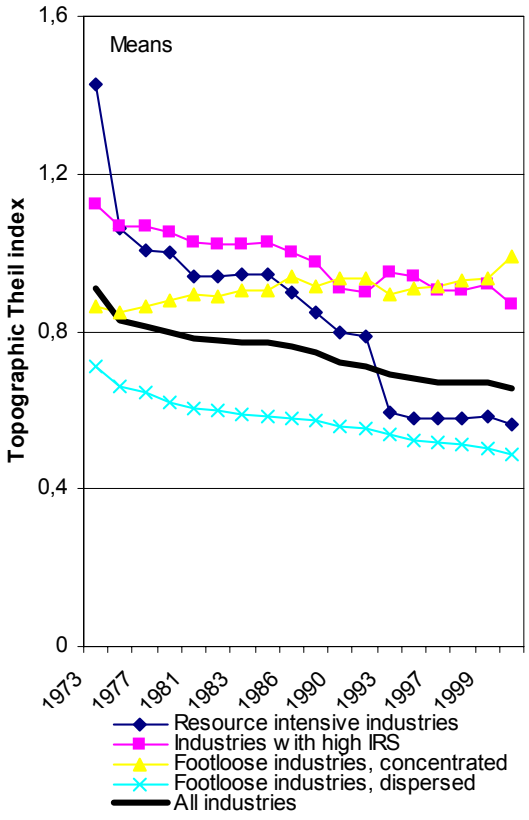
The concentration behavior of *manufacturing industries* is also analyzed on the basis of weighted Theil indices in comparison to Theil indices and topographic Theil indices. To offer a comprehensive view on the evolution of all industries without getting lost in details, means and standard deviations are calculated across industries for each industry group (figure 2.3-2). As discussed in the previous section, the figures demonstrate the high average concentration of resource intensive industries in the initial year, the low average concentration of industries with internal IRS, the concentration degrees of concentrated and dispersed footloose industries in accordance to their definition, and the respective high within-group variations of the industry groups.

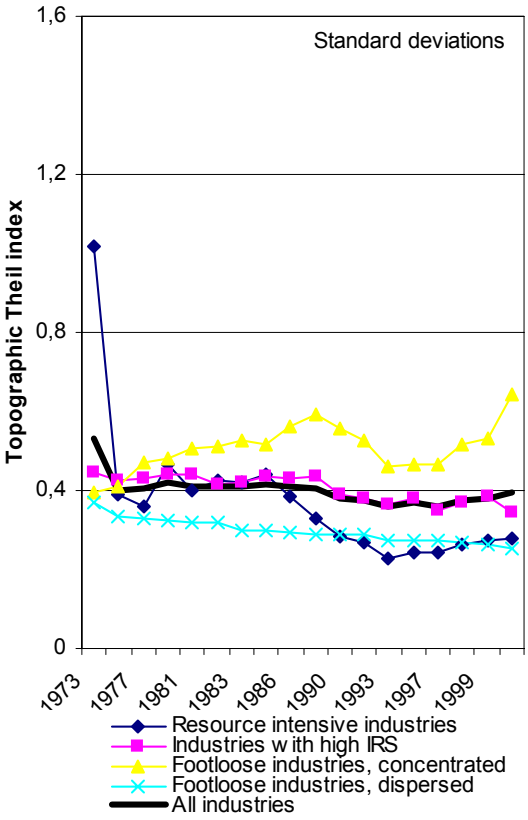
Figure 2.3-2: Evolution of industrial concentration by type classes, employment











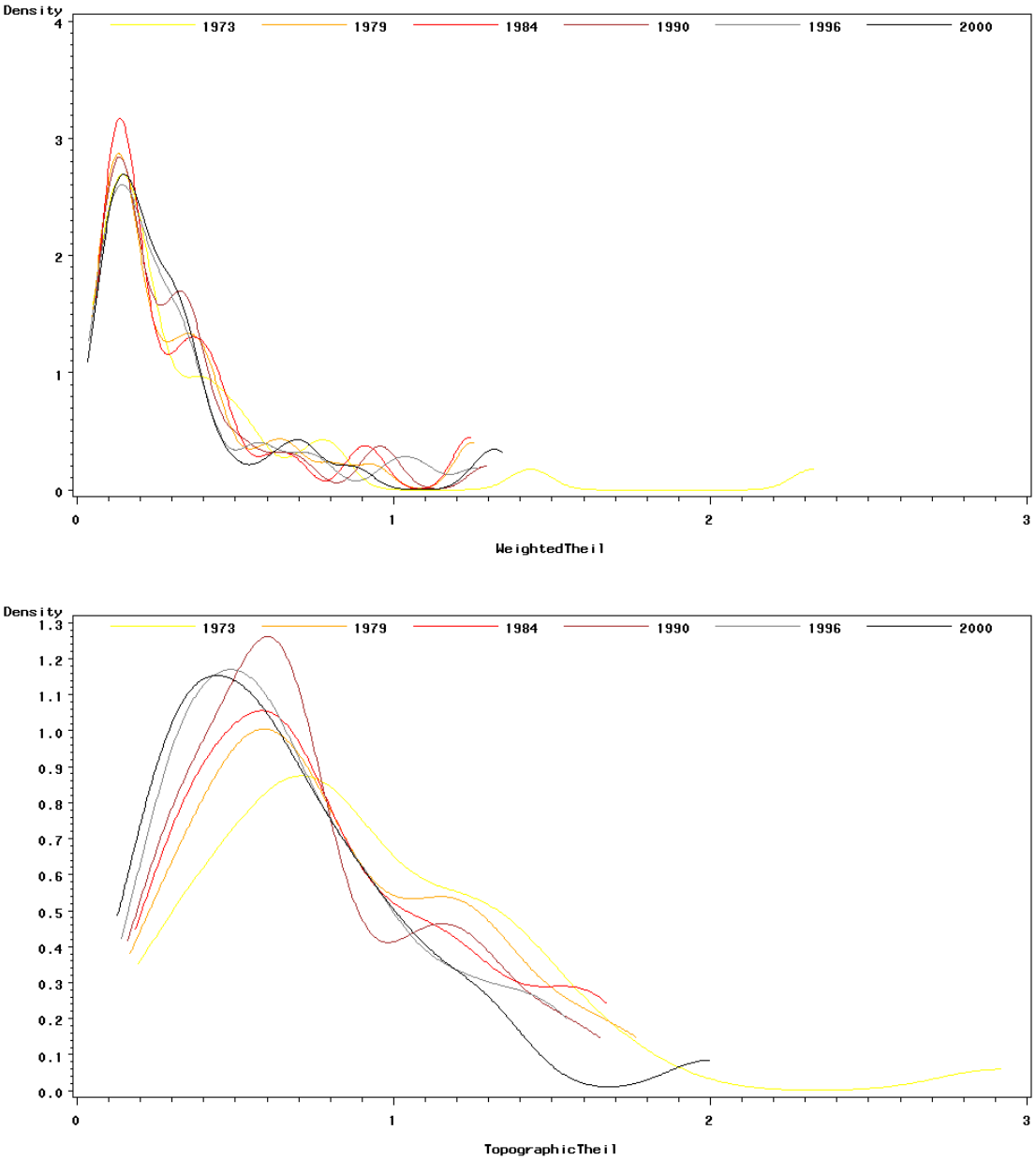
Source: SESSI, Enquête annuelle des enterprises.

Unfortunately, in order to analyze the evolution of concentration *over time*, it is necessary to resort to a reduced industrial break-down of 35 branches instead of 73 branches, due to data restrictions. The figure 3.3-2 derived from these data presents quite straightforward results.

- For resource dependent industries, concentration decreases dramatically on average and in most cases (the data break between 1991 and 1993 may in part result from the modification of the industrial classification system), turning it from the most concentrated to a highly dispersed sector.
- For high IRS industries and dispersed footloose industries, concentration seems to decrease in absolute and topographic terms, and remains constant in relative (economic) terms.
- For concentrated footloose industries, concentration seems to increase.
- No obvious pushing influence of major integration steps (i.e., in the aftermath of the 1986 EU entry of directly neighboring Spain) can be detected.

This view of a broad dispersion of most industries across space, seemingly in line with a similar dispersion of manufacturing activity (indicated by the constancy of the weighted Theil indices) is confirmed by kernel density functions of industrial concentration provided for several years (figure 2.3-3). Based on the *topographic* Theil index, they reveal the peak of the concentration distribution to move downward from about 0.75 points to about 0.4 points while becoming somewhat steeper at the same time as more industries converge towards the same peak value of concentration. By contrast, Kernel density estimates based on *weighted* (economic) Theil indices exhibit a peak value of about 0.2 points (and another weak peak at about 0.4 points) but not clear direction for the change over time. From 1973 to the mid 1980s, the peak became higher and steeper indicating a more uniform concentration pattern of industries, thereafter it became lower and flatter, then, in the 1990s, once again, higher and steeper. Thus, there is no explicit and coherent trend for all industries regarding their economic concentration.

Figure 2.3-3: Kernel density estimates of industrial concentration for various years



2.4. Sectoral/industrial concentration and the performance of sectors/industries

At the end of this chapter, we turn to the question in how far the evolution of sectoral and industrial concentration is to the detriment or advantage of the French economy – and may accordingly be also to the detriment or advantage of French regions hosting these sectors /industries. Do concentration or dispersion trends coincide with growth or decline, with job gains or losses of respective sectors and industries?

Again, the first view is on sectors in France and their overall performance (table 2.4-1). During the observation period, non-market services, other market services, credit and insurance services and recovery, trade and lodging services seem to grow the most quickly in terms of

value added. By contrast, agriculture, building and construction, and, to a lesser degree, manufacturing seem to drag behind. This is broadly in line with the well-known international trends of structural change from agriculture via manufacturing towards the services sector. Relating this information to the above notations on the concentration of sectors, it appears that concentration coincides with slow growth, and dispersion with quick growth, when adopting weighted Theil indices, but denies any clear relation, when adopting simple or topographic Theil indices. The impression is confirmed by correlation coefficients calculated across all sectors of the database (table 2.4-1): The correlation between initial concentration degree and subsequent performance is highly negative and significant when applying relative concentration measures (weighted Theil index or Krugman index), though positive and insignificant when applying the absolute or topographic concentration measures. Accordingly, sectors common to, and dispersed across, densely populated areas grow faster then sectors common to sparsely populated areas (e.g., in particular agriculture).

Table 2.4-1: Concentration and average annual growth rates of sectoral value added

Economic sectors	Relative concen-tration in 1980	Shares in 1980	1980-1985	1985-1990	1990-1995	1980-1995
Agricultural, forestry and fishery products	0.307	4.32	6.79	3.64	-2.77	2.48
Manufacturing	0.012	30.96	4.81	5.24	2.78	4.27
Building and construction	0.020	7.05	2.62	6.24	1.84	3.55
Recovery, trade, lodging and catering services	0.011	14.12	9.58	7.38	4.44	7.11
Transport and communication services	0.028	5.68	10.87	5.17	4.05	6.66
Services of credit and insurance institutions	0.086	4.07	12.70	4.68	4.49	7.22
Other market services	0.021	20.49	7.03	10.58	6.24	7.93
Non-market services	0.017	13.31	14.21	4.77	6.64	8.46
Total economy	.	100.00	8,02	6,58	4,47	6,34

Correlation between initial concentration (1980) and subsequent value added growth (1980-1995)		
Concentration measures	Pearson correlation coefficients	Error probabilities
Theil index	0.37516	0.1379
Weighted Theil index	**-0.68147**	**0.0026**
Herfindahl index	0.51649	0.0338
Krugman index	**-0.69563**	**0.0019**
Topographic Theil index	0.38296	0.1292

Source: Hallet, revised and amended Eurostat figures.

Turning to employment figures for manufacturing industries (table 2.4-2), manufacturing as a whole obviously loses employment throughout the observation period. Dispersed footloose industries and industries with high internal IRS experience the weakest job losses – even some job gains in the late 1990s. Judging from the figures on industry groups, it seems that high concentration coincides with comparatively strong job losses (=relative decline of industries) and dispersion with weak job losses (=relative growth of industries). Calculations of correlation coefficients based on all industries, however, rebuts this impression and reveals correlations to be weakly positive and not significant (table 2.4-2).

Table 2.4-2: Concentration and average annual rates of change of industrial employment

Groups of industries	Rela-tive concen-tration in 1973	Shares in 1973	1973-1979	1979-1984	1984-1990	1990-1996	1996-2000	1973-2000
Resource intensive industries	0.88	11.16	-1.21	-2.58	-4.48	-0.75	-1.76	-2.18
Industries with high IRS	0.31	28.29	-0.85	-2.72	-1.70	-3.68	-0.19	-1.92
Footloose industries, concentrated	0.75	6.70	-2.10	-4.12	-4.35	-3.71	-1.72	-3.28
Footloose industries, dispersed	0.18	53.85	-2.25	-2.57	-1.14	-1.59	0.45	-1.52
Total manufacturing	.	100.00	-1.71	-2.71	-1.85	-2.22	-0.06	-1.80

Correlation between initial concentration (1973) and subsequent employment change (1973-2000)		
Concentration measures	Pearson correlation coefficients	Error probabilities
Theil index	0.18808	0.2793
Weighted Theil index	0.11632	0.5058
Herfindahl index	0.37813	0.0251
Krugman index	0.00491	0.9777
Topographic Theil index	0.29354	0.0870

Source: SESSI, Enquête Annuelle d'entreprise

The general conclusion on industrial concentration is thus: while French *sectors* exhibit considerable variation as to their concentration pattern and not much change over time, French *manufacturing industries* appear relatively equally distributed and get even more equally distributed during the observation period. No clear influence of concentration on sectoral/industrial performance can be detected. For France as a whole these tendencies may add up to a mixed result where sometimes the dispersion and sometimes the concentration tendencies preponderate.

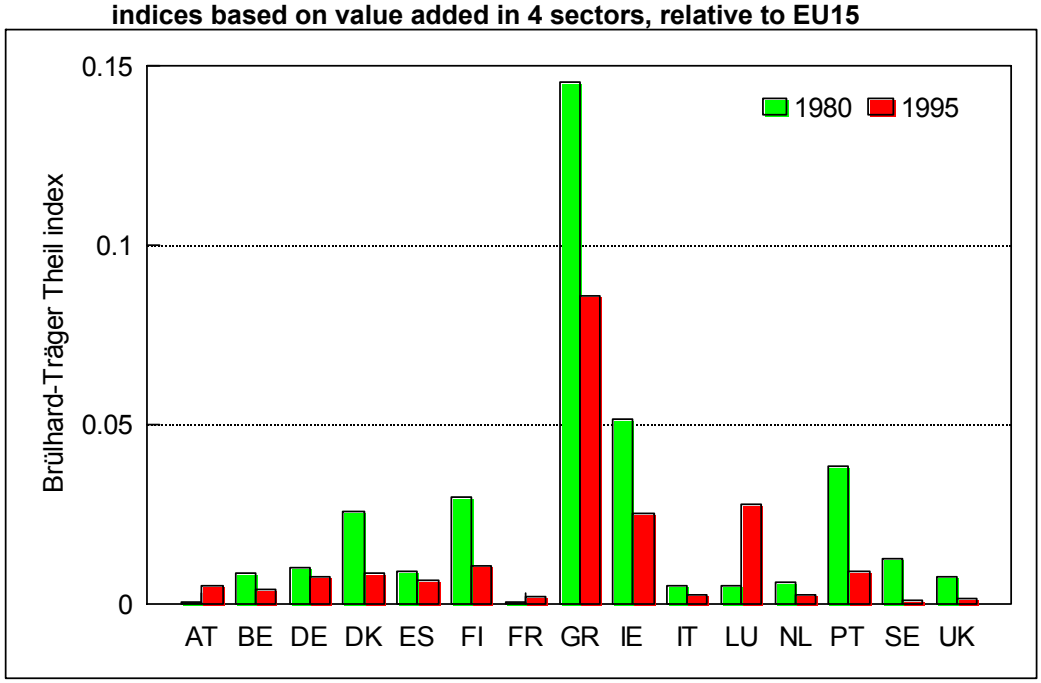
3. Specialization of regions

3.1.1 Position of the French regions in the European division of labor

To put the specialization patterns of French regions into a broader, European perspective, this section will briefly describe the position of France as a whole, and of the French regions within the EU-wide division of labor.

Investigating the national specialization patterns within the EU15 by means of the four sectors by an Brülhart-Träger Theil index (reference: value added at EU15 level) we find generally low levels of sectoral specialization throughout the EU (Figure 3.1-1). Even the highest Theil value of about 0.15, obtained for Greece in 1980, is very low, compared to the theoretical upper bound of the measure (about 15). The differences in the extent of specialization between the countries are mostly due to the specialization of Greece (GR), Ireland (IE) and Portugal (PT) in agriculture.

Figure 3.1-1 Specialization of EU15 countries 1980 and 1995 – Brülhart-Träger Theil indices based on value added in 4 sectors, relative to EU15



During the 1980s and early 1990s, the sectoral specialization of most European countries converged towards the EU average.[20] The only notable exception is Luxembourg (LU) which witnessed significant losses in manufacturing industries. The structural convergence towards the EU average seems to have been a general tendency in the 1½ decades under consideration.[21] The results do not unambiguously point to specific reasons: Neither was the

[20] Similar results are reported in Hallet (1999) for the same data set, employing a GDP-weighted average of regional specialization measures.

[21] There is, however, some empirical evidence suggesting that specialization of EU member states onto industries within the manufacturing sector increased during the 1980s (Amiti 1999).

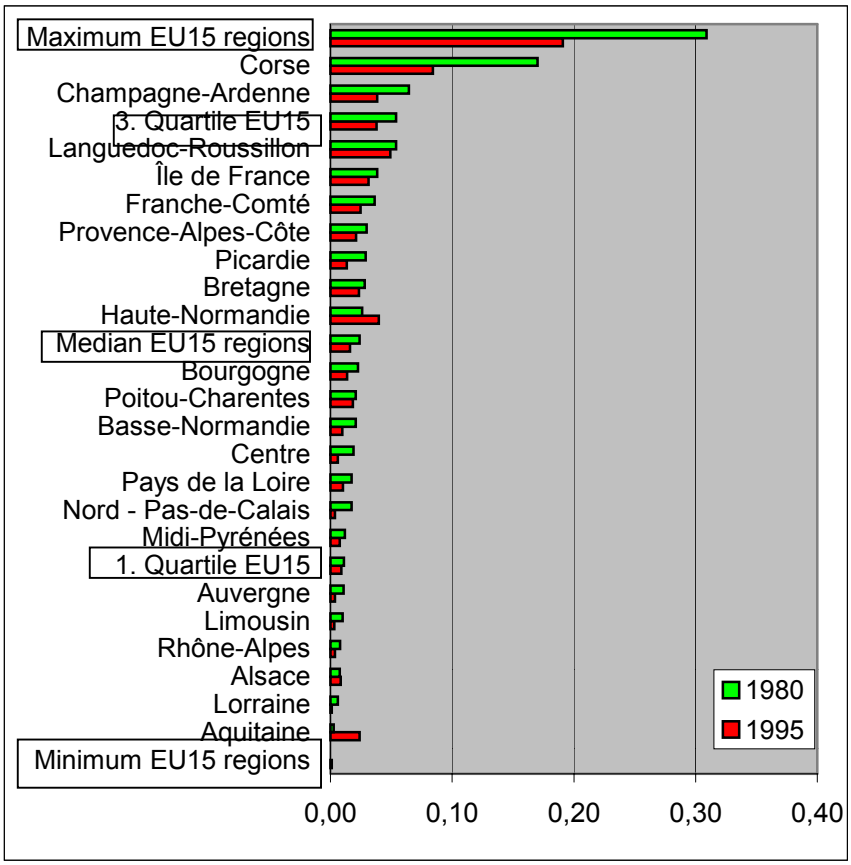
convergence generally stronger for newcomers than for incumbent member states, nor was it generally stronger for poor than for rich countries.

The sectoral specialization in France was almost similar to that of the EU15 as a whole in 1980, as indicated by the extremely low values of the Theil index depicted in Figure 3.1-1. During the subsequent 1½ decades the specialization diverged somewhat from the European average (see also Figure A?-1). This divergence was, however, bare noticeable.

Specialization of French regions

To assess the degree of specialization of the 22 French NUTS 2 regions in comparison to all 118 EU 15 regions, the EU-relative weighted Theil index was calculated for each region. Figure 3.1-2 gives the values of the Theil index in 1980 and 1995 for each of the French regions. For comparison, Figure 3.1-3 also reports the quartiles of the distribution of the Theil indices across all 118 EU15 regions. The Figure shows that 13 of the 22 French regions

Figure 3.1-2 Specialization of French regions 1980 and 1995 – value added in 4 sectors relative to EU15



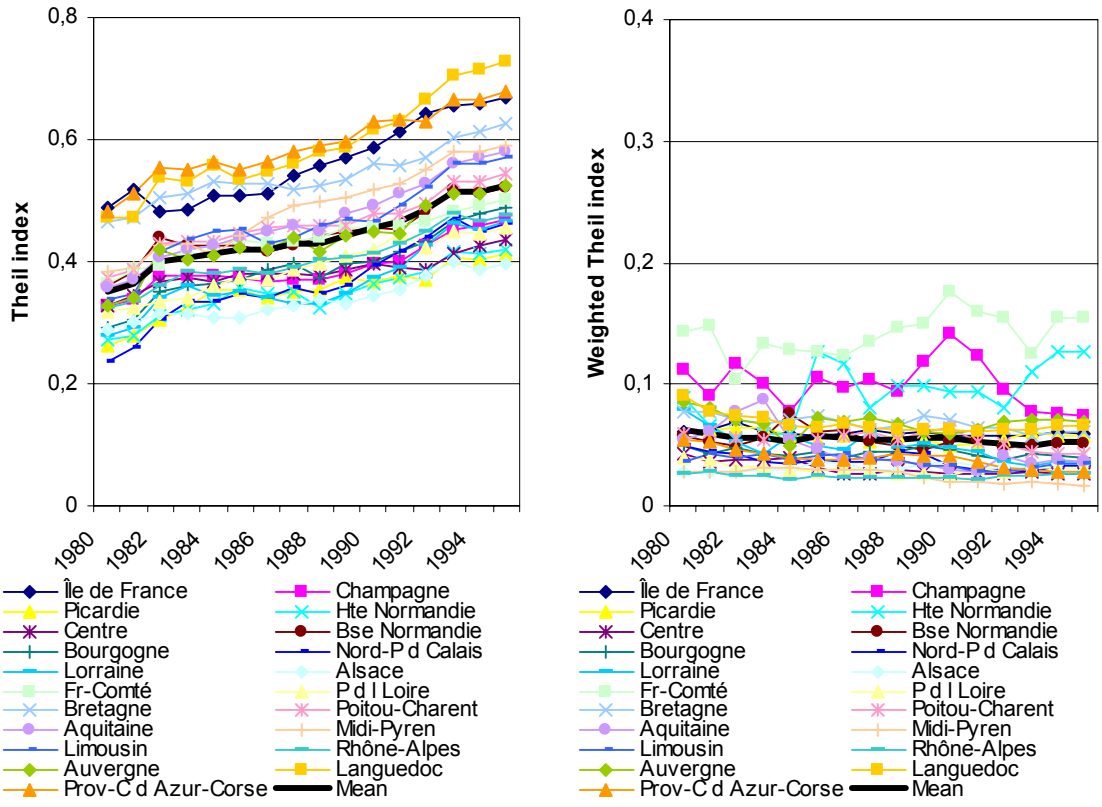
exhibited a degree of specialization below the EU15 median in 1980; the remaining 9 regions were above the median. It also shows that only three regions experienced an increase in specialization relative to the EU15 average during the period under investigation (1980–1995), namely Haute-Normandie, Alsace and Aquitaine.

3.1.2 Overview on the specialization of French regions

As an introduction to the specialization part of the paper, an overview on the specialization pattern of *all* 21 French regions is provided,[22] whereas in the following parts the focus will be on *classes of regions* with typical attributes in order to get more insights into the forces driving specialization.

Figure 3.1-3 presents the absolute and relative specialization of French regions referring to the 17 *sectors* of the Hallet data set, as measured by Theil indices and weighted Theil indices. The figure indicates French regions to be quite similarly specialized, particularly in terms of absolute specialization. Over time, the figures indicate a clear and parallel increase of specialization for all regions in absolute terms, which implies the constancy of specialization in relative terms, i.e., compared to the national average.

Figure 3.1-3: Specialization of French regions, sectors, 1980-1995



Source: Hallet, revised and amended Eurostat figures.

[22] Corse is treated as part of the region Provence-Alpes-Côte d'Azur, cf. section C.1.2.

These results for the Theil and weighted Theil indices are confirmed by similar results for respective other absolute and relative specialization measures. Table 3.1-1 depicts the high and significant correlation between absolute Theil and Herfindahl indices and relative weighted Theil and Krugman indices. It also reveals the particularly low correlation between absolute and relative measures that reflects the divergent messages of these indicators.

Table 3.1-1: Correlation matrix for measures of sectoral specialization of French regions in 1980 – Pearson correlation coefficients (error probabilities in parentheses)

	Theil index	Weighted Theil index	Herfindahl index	Krugman index
Theil index	1.00000	0.13346 (0.5641)	**0.97142 (<.0001)**	0.11352 (0.6242)
Weighted Theil index		1.00000	-0.01146 (0.9607)	**0.86571 (<.0001)**
Herfindahl index			1.00000	-0.05364 (0.8174)
Krugman index				1.00000

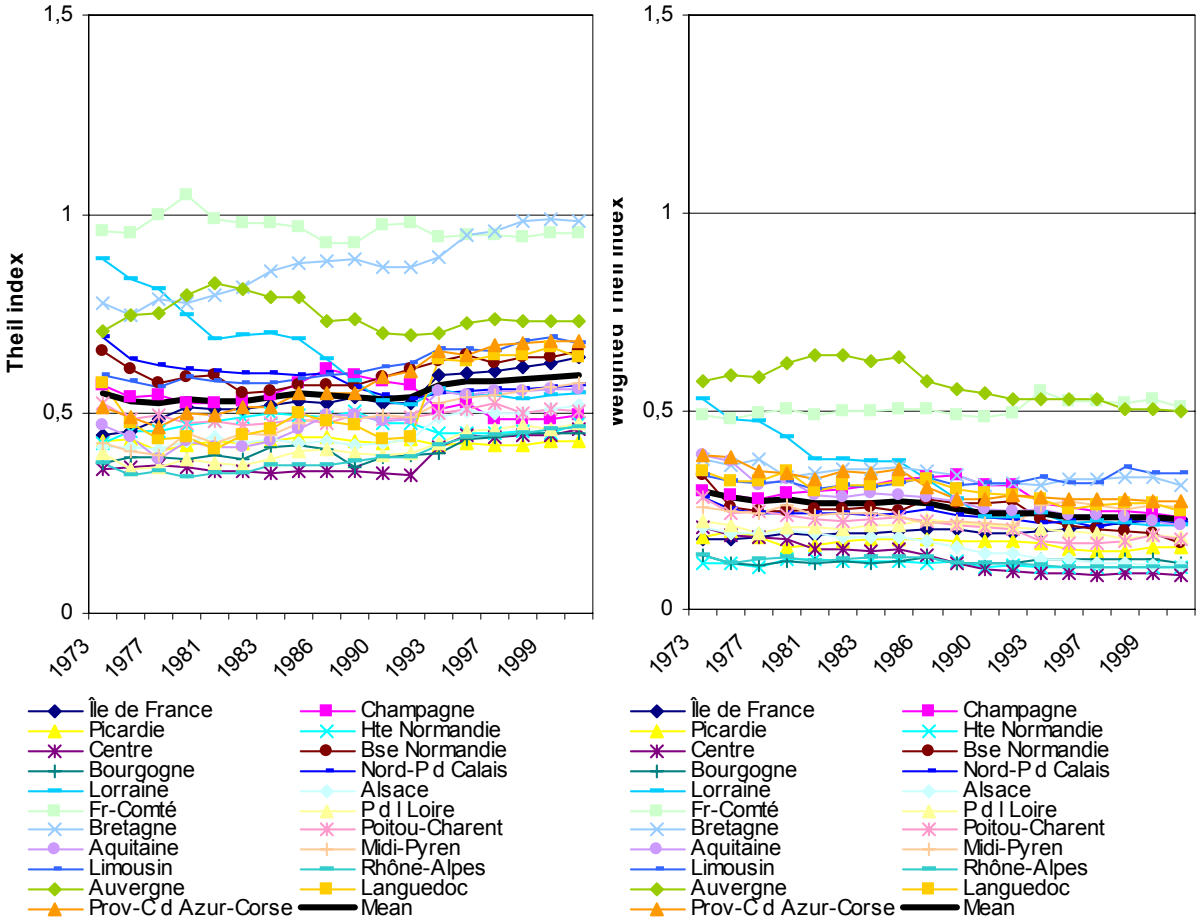
Source: Hallet, revised and amended Eurostat figures.

The general assessment of the specialization of all French regions on large sectors is now supplemented by a glance on their specialization regarding *manufacturing industries*. For comparison, Theil indices and weighted Theil indices are provided and visualized in figure 3.1-4.

The graphs confirms the view of very similar specialization of French regions both in terms of absolute and relative specialization. Somewhat more specialized than most French regions are Franche-Comté, Auvergne, Bretagne and Lorraine. The similarity of results is confirmed by high correlations between all specialization measures, but most particularly between the two absolute measures (Theil and Herfindahl index) and the two relative measures (weighted Theil index and Krugman index; table 3.1-2).

Over time, the same message emerges from both indices: Change is small, even over this period of 28 years. Only some regions exhibit some movement over time: Lorraine gets more diversified, Bretagne and Languedoc-Roussillon more specialized (in terms of absolute specialization only). A slight tendency towards convergence of absolute specialization degrees after 1992 is likely to be generated by the modification of the French industrial classification scheme between 1991 and 1993. This should be made subject to econometric testing.

Figure 3.1.-4: Specialization of French regions, manufacturing industries, 1973-2000



Source: SESSI, Enquête annuelle d'entreprise

Table 3.1-2: Correlation matrix for measures of industrial specialization of French regions in 1973 – Pearson correlation coefficients (error probabilities in parentheses)

	Theil index	Weighted Theil index	Herfindahl index	Krugman index
Theil index	1.00000	0.81863 (<.0001)	**0.96167 (<.0001)**	0.80922 (<.0001)
Weighted Theil index		1.00000	0.79763 (<.0001)	**0.83310 (<.0001)**
Herfindahl index			1.00000	0.69513 (0.0005)
Krugman index				1.00000

Source: SESSI, Enquête annuelle d'entreprise.

To sum up, French regions appear quite lowly specialized or highly diversified, both with regard to sectors and manufacturing industries. Integration seems to have increased regional specialization on sectors yet not on manufacturing industries. Moreover, for neither indicator, a pushing influence of major integration steps on specialization (e.g., neighbouring Spain's EU entry in 1986) becomes obvious. Yet, this overall conclusion overrides considerable

variation between the regions, which gives rise to expectations on perhaps more conclusive results for specific groups of regions.

3.2. Classes of regions and their characteristics

In order to analyze the specialization pattern of French regions according to their specific sectoral characteristics, *types of regions* with similar structural composition are identified by means of a cluster analysis drawing from the above classification of industries. For the years 1973 and 1980, respectively, the initial years of the data bases, eleven discriminating variables are applied: (i) seven variables characterizing each region's structural composition with respect to economic sectors (i.e., each region's value added shares of the agricultural, the construction, and five services sectors), and (ii) four variables characterizing each region's structural composition within the manufacturing sector with respect to industry groups (i.e., each region's employment shares of resource intensive, high IRS, concentrated footloose, and dispersed footloose industries).

Applying a Ward's minimum cluster analysis (based on standardized values for each variable, six types of French regions can be distinguished. Although classified solely according to their structural composition, several of them exhibit further common characteristics, e.g., with respect to their geographic situation and their level of economic development. This observation by itself indicates the spatial reference of a region's industrial mix, and allows labeling these type classes with some associative names (cf. table 3.2-1, figure 3.2-1) :

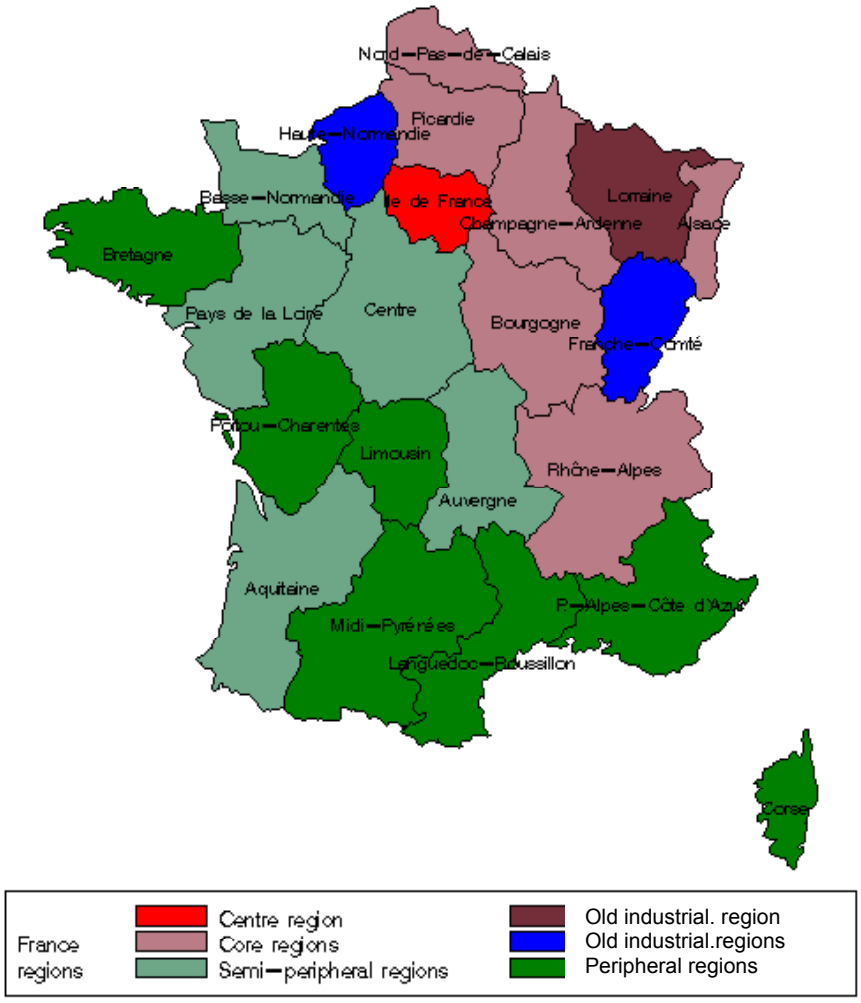
- *Old industrialized regions*: characterized by relatively high share of manufacturing, with a focus on resource dependent or high IRS industries; contains Haute Normandie, Franche-Comté and Lorraine (which in fact forms a cluster of its own). These regions are situated at the north of France, close to the border of Belgium and the channel.
- *Center region*: characterized by relatively high shares of credit and insurance and other market services sectors, and of high IRS industries; contains the country's capital region Île de France.
- *Core regions*: characterized by relatively high shares of agriculture and of manufacturing, with a focus on dispersed footloose industries; contains Champagne-Ardennes, Picardie, Bourgogne, Nord-Pas de Calais, Alsace, and Rhône-Alpes. These regions are situated in a belt stretching from the channel to south east France between the old industrialized regions and the center region.

Table 3.1-1: Classification of French regions

Regions	Agricultural forestry and fishery products	Building and construc-tion	Recovery, trade, lodging and catering services	Transport and communi-cation services	Services of credit and insurance institutions	Other market services	Non-market services	Manufac-turing	Resource dependent industries	Industries with high IRS	Footloose industries, concen-trated	Footloose industries, dispersed
Old industrialized regions												
Lorraine	3.72	7.28	11.84	5.76	2.78	18.13	14.37	**36.12**	**39.68**	11.47	3.90	44.95
Hte Normand	3.16	6.57	11.35	9.45	2.11	15.20	10.29	**41.87**	7.19	**29.81**	8.72	54.28
Fr-Comté	5.16	5.80	10.57	4.00	2.86	15.79	12.61	**43.21**	1.74	**48.56**	5.44	44.25
Centre region												
Île de France	0.48	5.61	15.44	6.56	**6.71**	**25.82**	12.24	27.14	3.68	**43.39**	5.05	47.88
Core regions												
Champagne	**12.15**	5.51	11.77	4.35	2.55	16.07	12.55	**35.05**	7.16	11.24	4.41	**77.19**
Picardie	**7.41**	5.78	11.89	4.78	2.45	17.32	11.56	**38.81**	5.39	17.65	12.62	**64.34**
Bourgogne	**8.36**	6.76	13.74	4.54	2.79	16.04	13.26	**34.51**	13.78	18.91	6.72	**60.58**
Nord-PdC	**2.49**	6.82	13.35	5.87	2.99	17.46	11.70	**39.32**	21.53	12.51	4.60	**61.36**
Alsace	**3.55**	6.26	14.60	4.85	3.43	18.37	12.16	**36.78**	7.51	23.73	4.97	**63.78**
Rhône-Alpes	**3.05**	7.60	13.54	4.94	3.22	19.67	11.50	**36.48**	5.47	19.92	5.83	**68.78**
Semi-peripheral regions												
Centre	**8.29**	7.75	12.96	4.30	3.33	17.22	13.86	**32.29**	1.23	**27.55**	**11.10**	60.12
Bsse Norman	**8.65**	7.93	13.34	3.83	3.11	18.60	13.55	**30.99**	8.47	**28.82**	**13.81**	48.90
Pdl Loire	**7.43**	8.73	13.06	4.57	2.49	18.99	11.04	**33.69**	3.23	**24.46**	**19.16**	53.15
Aquitaine	**5.72**	7.18	14.02	5.18	3.32	18.67	14.89	**31.02**	5.27	**21.67**	**15.16**	57.90
Auvergne	**6.77**	6.63	12.42	4.10	2.58	18.66	14.71	**34.13**	5.52	**18.95**	**31.03**	44.50
Peripheral regions												
Bretagne	**8.36**	8.92	**15.15**	4.63	3.42	**19.30**	16.64	23.58	1.87	**31.54**	16.03	50.56
Poitou-Ch	**8.49**	8.30	**14.93**	4.40	3.68	**17.34**	15.84	27.02	0.98	**22.32**	9.26	67.44
Midi-Pyrén	**6.57**	7.85	**14.74**	4.69	3.76	**20.27**	16.51	25.61	9.23	**26.30**	4.16	60.31
Limousin	**7.15**	7.88	**13.60**	4.33	3.24	**18.83**	16.41	28.56	2.01	**20.09**	6.40	71.51
Languedoc-R	**9.75**	8.69	**14.24**	5.69	3.52	**21.30**	17.09	19.72	13.04	**18.84**	9.93	58.18
Prov-CdA-Co	**3.22**	9.54	**16.80**	7.72	3.73	**21.51**	17.11	20.37	8.58	**26.96**	15.04	49.43

Source: Hallet. – SESSI, Enquête annuelle d'entreprise.

Figure 3.1-1: Region classes in France



- *Semi-peripheral regions*: characterized by relatively high shares of agriculture and of manufacturing with a focus on concentrated footloose industries, and – a bit surprisingly – on high IRS industries; contains Basse Normandie, Centre, Pays de la Loire, Aquitaine and Auvergne. These regions are situated in the western part of the country, south of the center region.
- *Peripheral regions*: characterized by relatively high share of agriculture, and of low IRS industries; contains Bretagne, Poitou-Charentes, Limousin, Midi-Pyrénées, Laguedoc-Roussillon, and Provence-Alpes-Côte d'Azur-Corse. These regions are very distant from the center at the utmost west and south of the country.

3.3. Evolution of specialization over time by region classes

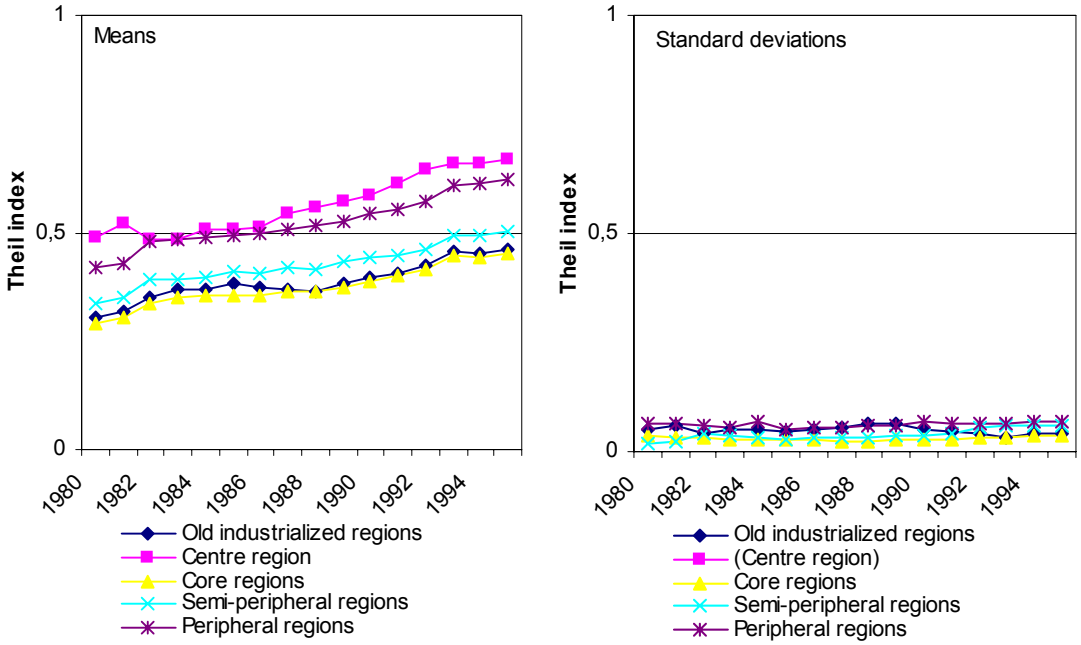
As trade theories hold that the initial structural mix of a region matters for its further economic development, the evolution of regional specialization within these classes of regions should reveal similar characteristics. Questions are, what region classes get more specialized, what more diversified, over the observation period? Do regions of a region class exhibit a characteristic evolution distinct from other region classes? What interaction is there in space between different region classes with respect to specialization?

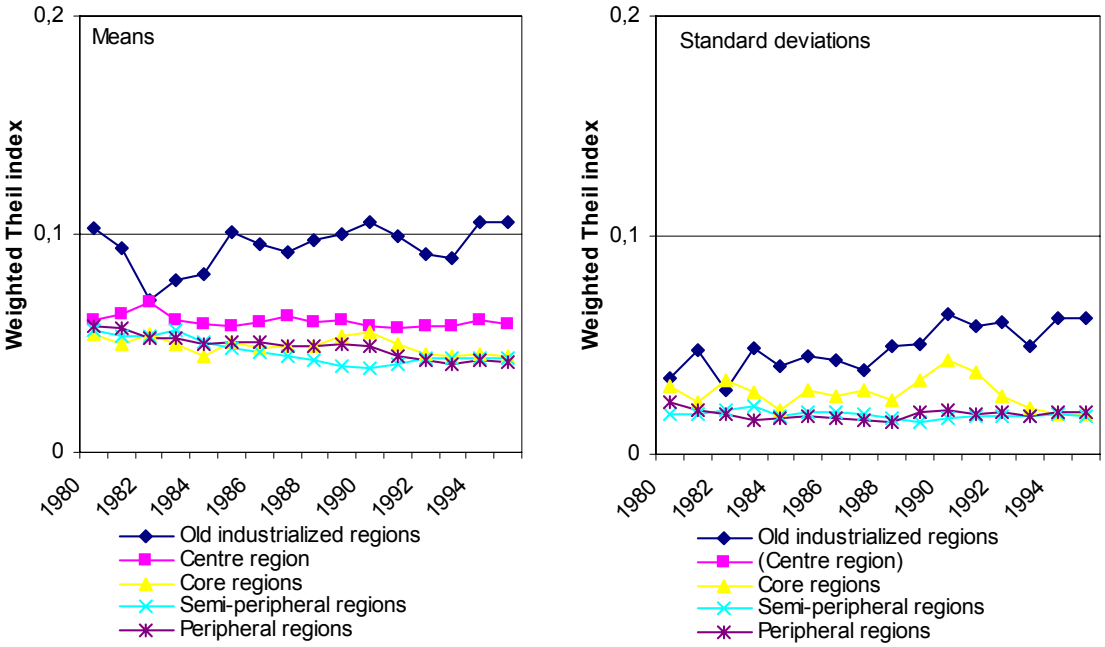
Regional specialization is once again analyzed by means of the Theil and weighted Theil index. On the basis of these indicators, means and standard deviations for region classes are calculated over time.

Figure 3.3-1 presents these class means and standard deviations referring to *sectors*. Accordingly:

- all region classes exhibit rather similar specialization with only the center region (in terms of absolute specialization), and the old industrialized regions (in terms of relative specialization) standing out;
- all regions seem to envisage an increase of absolute specialization during the observation period, yet a decrease of relative specialization, indicating an increase of specialization for France as a whole.

Figure 3.3-1: Evolution of specialization by region classes, sectors





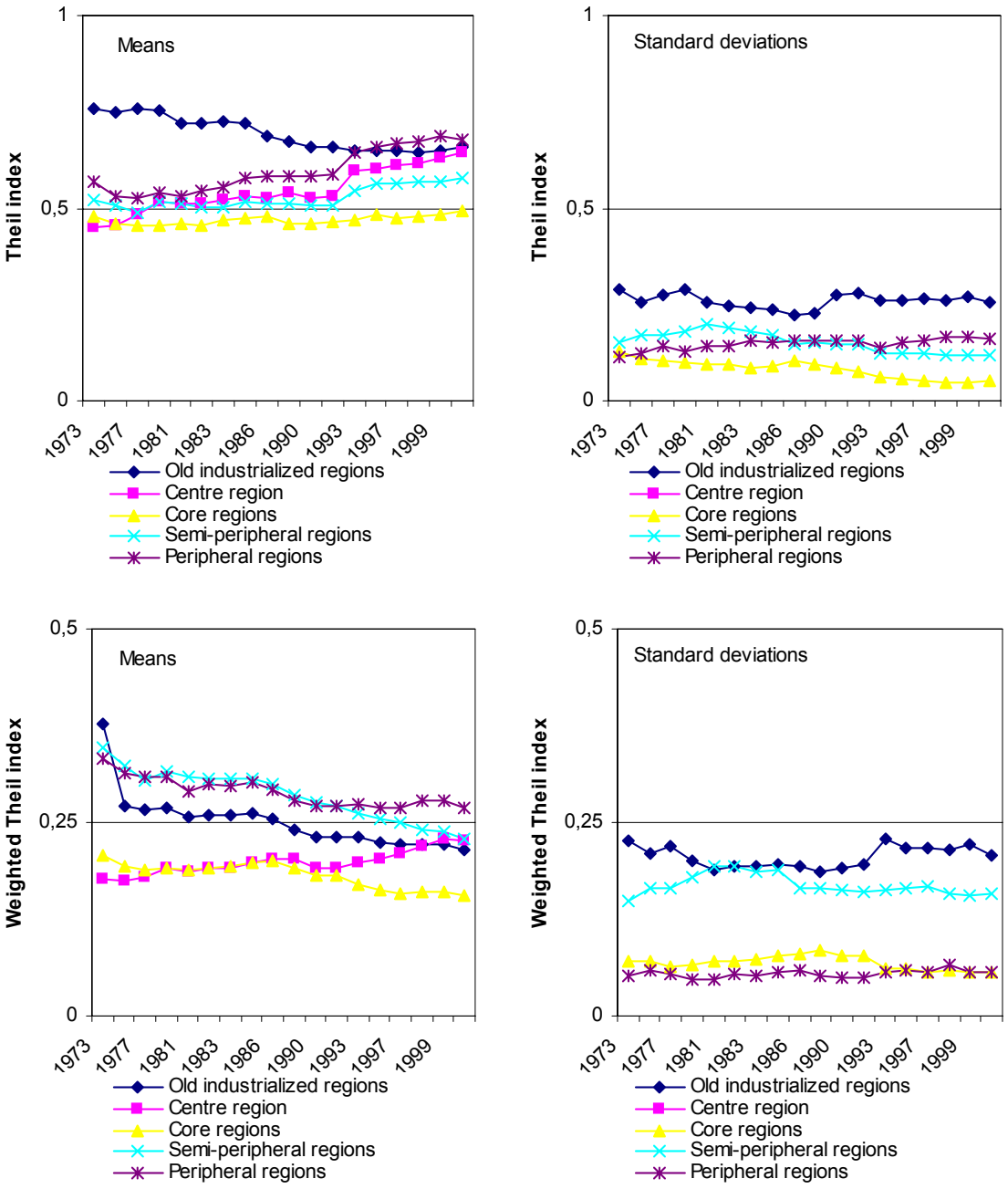
Source: Hallet, revised and amended Eurostat figures.

To complete the pattern of specialization for region classes, figure 3.3-2 presents means and standard deviations of specialization measures referring to *manufacturing industries*. Quite broadly, the results are here:

- Initially, the old industrialized regions (in terms of absolute specialization), and the semi-peripheral and peripheral regions (in terms of relative specialization) appear particularly specialized. Apart from this, rankings from both indices are quite similar. The standard deviations of the region classes are low (at least in terms of absolute specialization), indicating the homogeneity of the classes.

- Over time, a significant change of specialization is to be observed. According to both, absolute and relative specialization measures, higher specialized region classes seem to get more diversified, and lower specialized regions seem to get more specialized: Specialization seems to converge. This trend seems to be more explicit for region classes then for the regions taken separately (cf. figure 3.1-2). Yet, for both absolute and relative indices, the standard deviations of the region classes reveal some movement but no marked direction of change.

Figure 3.2-1: Evolution of regional specialization by region classes, manufacturing industries

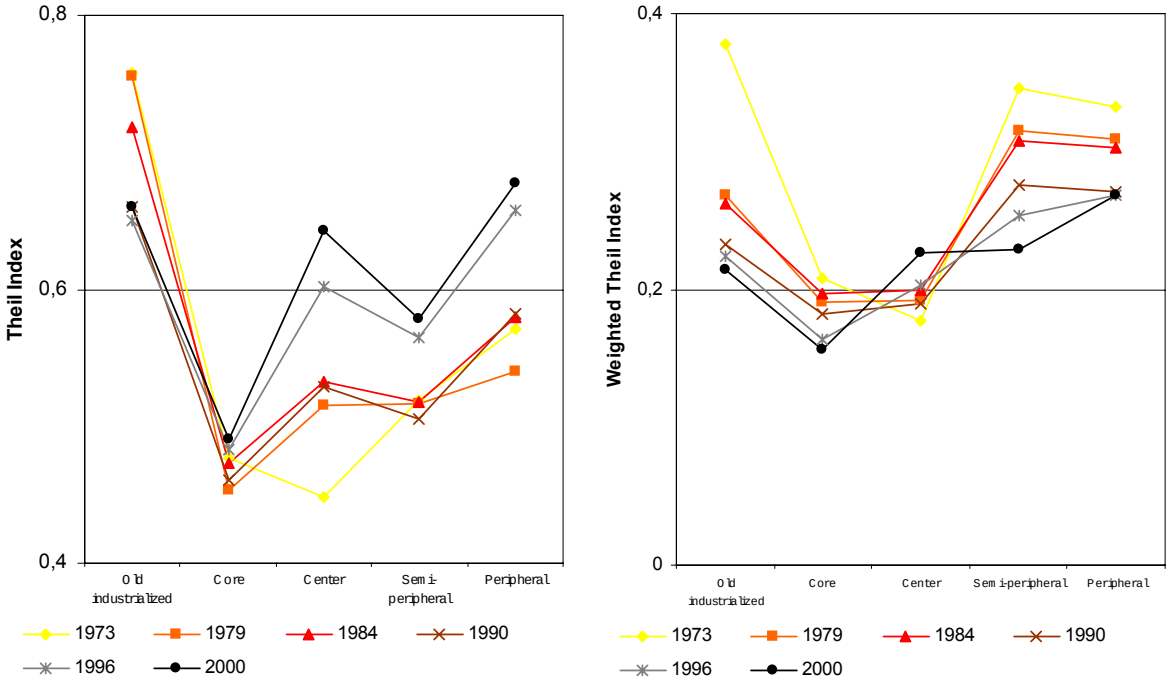


Source: SESSI, Enquête annuelle d'entreprise

The same issue is addressed from a different angle in figure 3.3-3 that visualizes the specialization and diversification relations in space. Again, average specialization measures for region classes are displayed. The region classes are, however, arranged according to their approximate topographic situation from north to south and west of France. If only focusing on the absolute measures, the Theil index, and on the years after 1973, this figure seems to tell an appealing story: Regional specialization is high at the periphery of the country, and it is elevated at the center, whereas it is relatively low for regions between center

and periphery.[23] Over time, specialization of the center increases. This story would comply to some NEG models suggesting a high specialization of the center (on IRS industries), a high specialization of the periphery (on non-IRS industries), and no particular specialization for areas in-between due to the competition from the neighboring region. Yet however appealing the story, differences between center region and neighboring regions are small and most certainly not significant, as is the movement over time. What is worse, when considering the relative measures the argument is more or less converted, particularly with respect to specialization relative to other regions.

Figure 4.3.2-3: Spatial processes of specialization/diversification of French regions (average Theil indices)



3.4. Regional specialization and performance of regions

At the end of the chapter, we turn to the question in how far the specialization of French regions and its evolution over time is to the detriment or advantage of these regions. Do specialization or diversification trends coincide with growth or decline, with job gains or losses of the respective regions?

The first view is on *sectoral* specialization of French regions and their subsequent performance (table 3.4-1). During the observation period, the center region and the peripheral regions seem to grow the most quickly in terms of value added. By contrast, the old industrialized regions seem to drag behind. Relating this information to the above notations

[23] Similar pattern can also be detected for Spanish and German regions.

on the concentration of sectors, it appears that specialization coincides with quick growth, and diversification with slow growth. The impression is confirmed by correlation coefficients calculated across all regions of the database (table 3.4-1): The correlation between initial concentration degree and subsequent performance is highly positive and significant (at least at the 5% level) when applying absolute concentration measures (Theil or Herfindahl index), though negative and insignificant when applying relative measures (weighted Theil or Krugman index).

Table 3.4-1: Specialization and average annual growth rate of regional value added

Region types	Absolute speciali-zation in 1980	Shares in 1980	1980-1985	1985-1990	1990-1995	1980-1995
Old industrialized region Lorraine			5.70	5.79	4.31	5.26
Old industrialized regions	0.30	9.20	7.15	5.50	4.62	5.75
Centre region	0.49	26.55	9.06	7.42	4.78	7.07
Core regions	0.29	26.50	7.25	6.37	4.19	5.93
Semi-peripheral regions	0.34	17.04	8.27	5.92	4.40	6.18
Peripheral regions	0.42	20.72	8.05	6.62	4.41	6.35
France	.	100.00	8.02	6.58	4.47	6.34

Correlation between initial specialization (1980) and subsequent value added growth (1980-1995)		
Specialization measures	Pearson correlation coefficients	Error probabilities
Theil index	**0.63831**	**0.0018**
Weighted Theil index	-0.37702	0.0920
Herfindahl index	**0.67489**	**0.0008**
Krugman index	-0.37655	0.0925

Source: Hallet, revised and amended Eurostat figures.

Turning to *manufacturing employment*, we find this sector to register overall job losses in France throughout the observation period. The highest job losses occur to the center region and the old industrialized regions (table 3.4-2). Some of these region classes are those with high, others with low specialization. Accordingly, there are no obvious and significant correlations between specialization and regional performance.

To sum up, the region classes, identified by cluster analysis, reveal some initial differences regarding their specialization, particularly within manufacturing industries, with the old industrialized regions standing out. The subsequent integration process increases specialization on sectors remarkably for all regions leaving the differences between them more or less unchanged. Within manufacturing, specialization seems to converge towards a medium degree similar to all regions. Sectoral specialization seems to coincide with high growth of regional value added, while specialization within manufacturing industries seems to coincide with a higher probability for regional job losses. No explicit impact of any major integration step can be detected.

Table 3.4-2: Specialization and average annual rates of regional employment change in manufacturing

Type classes of industries	Absolute specialization in 1973	Shares in 1973	1973-1979	1979-1984	1984-1990	1990-1996	1996-2000	1973-2000
Old industrial. region Lorraine			-2.08	-3.73	-3.83	-2.36	-0.30	-2.58
Old industrialized regions	0.76	12.54	-0.75	-3.39	-1.66	-1.99	-1.24	-1.79
Centre region	0.45	23.48	-3.27	-3.18	-2.53	-3.96	-1.73	-3.02
Core regions	0.48	35.07	-1.94	-3.13	-1.87	-2.09	0.04	-1.89
Semi-peripheral regions	0.52	16.14	-0.24	-1.79	-1.09	-1.56	0.78	-0.86
Peripheral regions	0.57	12.77	-0.67	-1.42	-1.27	-1.25	1.07	-0.82
France	.	100.00	-1.71	-2.71	-1.85	-2.22	-0.06	-1.80

Correlation between initial specialization (1973) and subsequent employment change (1973-2000)		
Specialization measures	Pearson correlation coefficients	Error probabilities
Theil index	-0.14825	0.5213
Weighted Theil index	-0.02969	0.8983
Herfindahl index	-0.20525	0.3721
Krugman index	0.01153	0.9604

Source: SESSI, Enquête annuelle d'entreprise.

4. Structural change in interaction of sectors /industries and regions

This final chapter investigates structural change in more detail disentangling the interaction between industrial concentration and regional specialization. To do this, it looks for the specialization of specific regions on specific sectors and industries (agriculture, manufacturing, services, IRS industries, resource dependent industries), and for the consequences this has on the subsequent evolution of these regions, with respect to their further increase or decrease of specialization, as well as to their economic performance relative to other regions. Questions concerned are: Do, e.g., IRS industries (or agriculture, services, resource intensive, footloose industries, respectively) concentrate further in regions in which they are already highly located, and thus increase the specialization of these regions? What implications has a high localization of such industries on the performance of the regions concerned?

In order to answer these questions, correlations are presented for large sectors and for manufacturing industries, respectively: Localization coefficients for sectors and industry groups in the initial year are correlated to (i) the change over time of the various specialization measures in each respective region, (ii) the performance of the respective sector /industry group in the respective region; (iii) the overall performance of the respective region. Such correlations are provided across all regions and, as far as possible, also for region classes in which the respective sector /industry group has been found to be particularly localized.

The analysis is restricted here to manufacturing industries. Table 4-2 shows the correlations localization coefficients for groups of these industries (identified by the classification procedure of section C.2.2) and the subsequent evolution of specialization and of performance. It appears that the localization of resource intensive industries and of high IRS industries in a region influences the subsequent evolution of specialization of this region: It decreases regional specialization in the case of resource intensive industries and increases it in the case of high IRS industries. Significant correlations can also be detected to the performance of these respective sectors in each respective region, and they are all negative. That is to say, the more a specific industry group is already localized in a specific region, the more it tends to decline in terms of employment in the very region. This is even true for industries with high IRS, contradicting familiar NEG perceptions that such industries would get increasingly localized. However, this backlash trend is most pronounced for resource intensive industries (and least pronounced for dispersed footloose industries). And this backlash trend does not determine the overall employment development of this very region, as is indicated by the insignificant correlations in the last column of table 4-2.

Table 4-2: Impact of highly localized industry groups on the respective regions – Pearson correlation coefficients (error probabilities in parentheses)

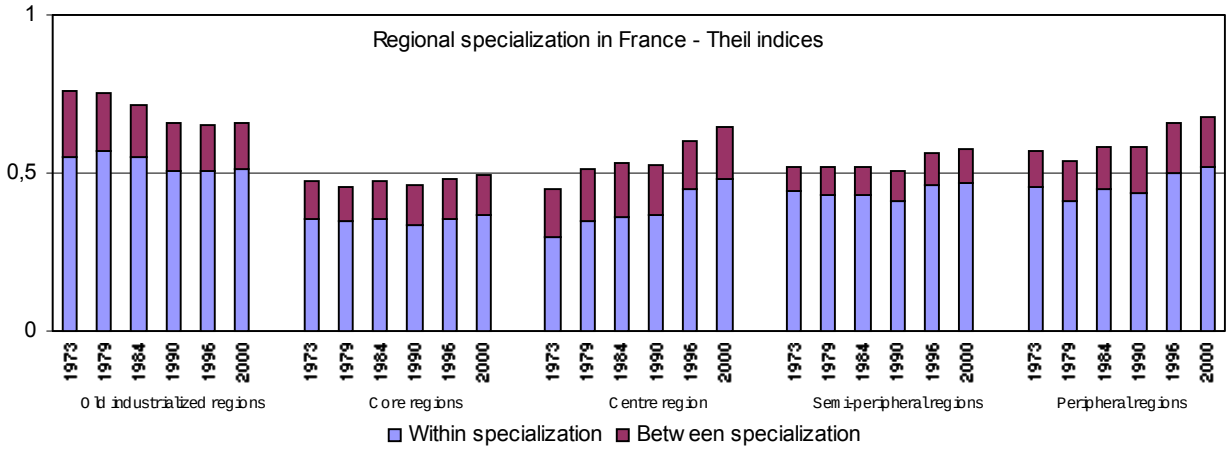
Localization coefficients	Correlation to change of regional specialization				Correlation to regional employment change	
	Theil index	Weighted Theil index	Herfindahl index	Krugman index	of resp. ind. group	of all manufact. industries
Resource intensive industries						
Old industrialized regions[a]	-	-	-	-	-	-
All regions	**-0.67098 (0.0009)**	**-0.61779 (0.0028)**	**-0.63182 (0.0021)**	**-0.46036 (0.0357)**	**-0.93690 (<.0001)**	-0.41163 (0.0637)
Industries with high IRS						
Center region[a]	-	-	-	-	-	-
All regions	**0.50569 (0.0194)**	**0.49533 (0.0224)**	0.31668 (0.1619)	**0.50541 (0.0194)**	**-0.76049 (<.0001)**	0.12718 (0.5828)
Concentrated footloose industries						
Semi-peripheral regions	-0.43841 (0.9621)	0.54476 (0.5871)	-0.60744 (07743)	0.84337 (0.1979)	-0.85824 (0.0627)	-0.40665 (0.4969)
Peripheral regions	0.40985 (0.4197)	-0.40582 (0.4247)	0.07543 (0.8871)	0.56645 (0.2412)	-0.69727 (0.1236)	-0.09306 (0.8608)
All regions	0.18171 (0.4305)	-0.15040 (05152)	0.13848 (0.5494)	0.00919 (0.9685)	**-0.88872 (<.0001)**	0.33078 (0.1430)
Dispersed footloose industries						
Core regions	-0.34898 (0.4978)	-0.00099 (0.9985)	-0.13953 (0.7921)	-0.45787 (0.3612)	-0.63414 (0.1763)	-0.21104 (0.6881)
All regions	-0.01974 (0.9323)	0.18679 (0.4175)	0.17800 (0.4401)	-0.09847 (0.6711)	-0.38176 (0.0877)	0.02192 (0.9248)

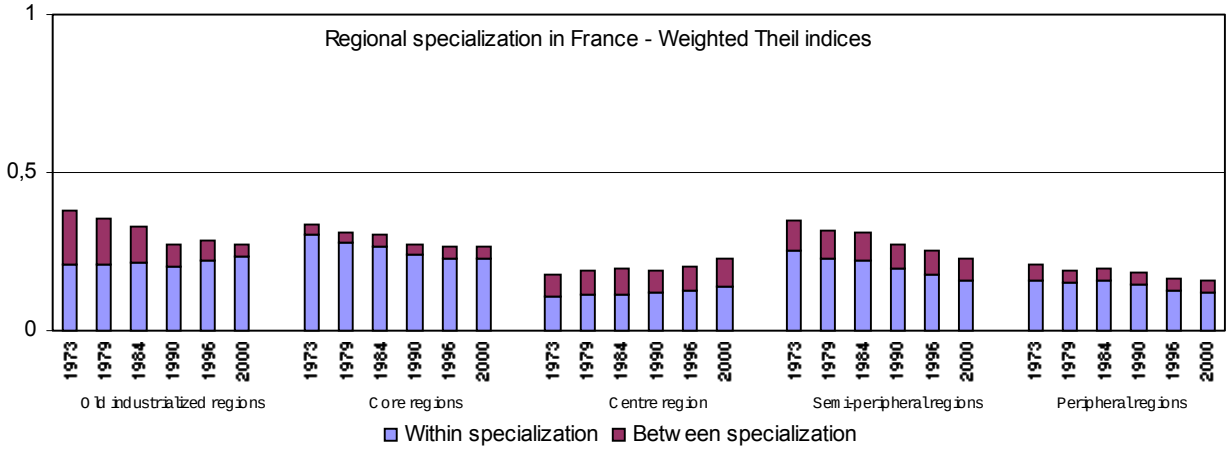
[a] Too few regions in region class to calculate correlations.

Source: SESSI, Enquête annuelle d'entreprise

Finally, in order to detect whether the specialization of the French regions is driven at all by the groups of industries with similar trade related characteristics or rather by the specialization on industries within these groups, the decomposition property of the Theil index is once again exploited (figure 4-1): The total regional specialization is decomposed in a component describing the specialization degree on the four groups of industries (between index), and a component describing the specialization degree within these type classes of industries (within index). The results for the different region classes is surprisingly clear: almost all variation of total specialization stems from specialization within the industry types; specialization with respect to the four industry types offers not much explanation for total specialization (and this result holds whether applying the absolute or the relative measure). Moreover, in the case of the old industrialized, the center region and the peripheral regions, the contribution of between specialization is a bit higher than in the case of the remaining two region classes. This leaves some though small space for the presumption that industrial characteristics derived from trade theories shape the subsequent evolution of regions.

Figure 4. -1: Decomposition of regional specialization – Influence from specialization within and between industry types





5. Summary and conclusion

Picking up the questions from the introduction, we may summarize, drawing from our findings for French industries and regions:

- France is found to be among the EU countries exhibiting the highest concentration of sectors in terms of concentration across space but not in terms of concentration across people. In particular, the manufacturing and services sector are more spatially concentrated than in most other EU countries, but this simply reflects a similarly high concentration of all employment. Within the manufacturing sector, industries appear relatively equally distributed in the initial year, although most resource dependent industries and some IRS industries are highly concentrated. Accordingly, French regions are quite equally specialized. The centre region Île de France stands out from other regions not by its degree of specialization yet by its particular industry mix.
- Integration, which can be said to be continuously growing during the observation period, seemingly has a mixed influence on the concentration and specialization in France. Some concentration change of French sectors occurs by and large in line with the overall European trends, but, all in all, the concentration of sectors does not change substantially. By contrast, concentration of industries across space decreases considerably during the observation period, mirroring a similar dispersion of all manufacturing employment. With respect to specialization of regions, the integration process seems to increase the sectoral specialization of all regions remarkably leaving the differences between them more or less unchanged. Within manufacturing, specialization seems to converge towards a medium degree similar to all regions. No explicit impact of any major integration step can be detected.
- Initial concentration of sectors and industries seems to exert little influence on the subsequent evolution of this concentration. Sectoral specialization of regions, too, seems to exert little influence on the subsequent evolution of sectoral specialization of regions, yet, region classes with high initial specialization within manufacturing industries (e.g., old industrialized regions) get more diversified, and regions with low initial specialization get more specialized. There is no clear distinction of trends for peripheral versus central regions.
- Initial concentration of sectors and industries also does not seem to influence the performance of sectors and industries. By contrast, specialization of regions does seem to influence the regional performance: sectoral specialization seems to coincide with high growth of regional value added (positive influence), while specialization within manufacturing industries seems to coincide with a higher probability for regional job losses (negative influence).

- It appears that the localization of resource intensive industries and of high IRS industries in a region influences the subsequent evolution of specialization of this region: It decreases regional specialization in the case of resource intensive industries and increases it in the case of high IRS industries. Significant correlations can also be detected to the performance of these respective sectors in each respective region, and they are all negative. That is to say, the more a specific industry group is already localized in a specific region, the more it tends to decline in terms of employment in the very region. This trend is particularly relevant and highly significant for resource intensive industries, and in this case, there seems to be an influence on the overall performance of the respective region.

Appendices

Appendix 1: Data

The “EU Statistical Office (Eurostat)” offers the electronic statistical compendium “NewCronos” including the REGIO dataset with data on European regions at various NUTS levels. For NUTS 2 level regions, REGIO is designed to offer yearly data on regional employment (persons employed) since the 1960s with a sectoral breakdown of 17 economic activities, including agriculture, 10 manufacturing and 6 services industries. The actual coverage, however, varies considerably between countries with respect to both periodicity and sectoral disaggregation.

We would like to thank Martin Hallet for the generous provision of an additional data base. For the period 1980-1995, Hallet (2000) completed the Eurostat dataset on gross value added from national sources to cover 17 sectors for NUTS 2 regions in Belgium, Spain, France, Italy, Netherlands, and Portugal, and for NUTS 1 regions in Germany and the UK. The sectors are agriculture, construction, 9 manufacturing and energy industries, and 6 services industries.

Since 1973, the “Services des Statistiques Industrielle (SESSI)” offers yearly data on employment (persons employed) in manufacturing for 21 “régions” from the “Enquête Annuelle d’ Entreprises”. The depth of the sectoral breakdown varies, and since 1993, a new industrial classification system was adopted. Yet, it is possible, to provide a more or less coherent data set for 35 manufacturing branches from 1973 to 2000. There are several missing values in the data due to confidentiality restriction, but as there are also several figures available on totals and cross totals and for precedent or subsequent years, these missing values can be estimated by an iterative interpolation procedure. The data set applied for the present paper yet does not include any year between 1973 and 2000; the further completion of the data set will be continued. Corse, though being a separate region since the 1980s, is treated here as part of the region Provence-Alpes-Côte d’Azur in order to allow for comparisons from the early 1970s on.

Appendix 2: **Measures of concentration and specialization**

This appendix discusses the merits and drawbacks of several statistical measures on the background of the aim of the present investigation. In principle there is a large number of indices available for measuring the spatial concentration of industries, or the industrial specialization of regions. To limit the complexity of the exercise, we will focus on measures that have been used most frequently in the related literature, and that may be used for measuring both concentration of industries and specialization of regions.[24] The measures are summarized in Table A2–1. Most of them are functions of the deviations of a specific, or local, distribution to a reference, or global, distribution. The indices differ in three respects: the characteristics of the projection functions which determine the weighting scheme for observations depending on their deviations from an expected value, the restrictions upon – or the flexibility of – the choice of the reference distribution, and data requirements. Since the differences may affect the empirical results to a great deal, the choice of an appropriate index depends upon the purpose of the specific investigation at hand, and upon available data.

These aims of the present investigation, as outlined in chapter C.1, give rise to seven general requirements for the measure to be employed:

(i) The measure should be suitable for measuring both the spatial concentration of industries and the industrial specialization of regions. Being two sides of the same medal they are highly interdependent: Given a (IxR) matrix of annual (employment or value added) data by industry – indexed by i (i = 1, …, I) – and region – indexed by r (r = 1, …, R) – spatial concentration of industries addresses the distribution within rows while industrial specialization of regions addresses the distribution within columns. Drawing a comprehensive picture of the general patterns of structural change within a country should not be complicated by inconsistencies of results originating from differing properties of the measures employed.

(ii) The measure should be suitable for measuring both the extent of concentration and specialization at a given point in time, and evolution of concentration and specialization patterns over time. It should allow to determine the effects of initial conditions onto subsequent evolutions.

(iii) The measure should be suitable for an international comparison of the national patterns and evolutions of concentration and specialization. It should allow for assessing the characteristic differences between incumbent and accession countries in the run-up to

[24] In particular, the measures of spatial concentration of industries based on continuous firm-level data proposed recently by Duranton and Overman (2002) and Marcon and Puech (2003a; 2003b) will not be discussed. From a theoretical point of view such measures share several advantages vis-à-vis measures for aggregate regional data. The main advantage is that they are not subject to the "modifiable area unit problem" (MAUP), i.e., are biased by an arbitrary choice of a regional grid. The measures require, however, detailed data on the location of firms which are not available in the present context.

the latter's accession, and the specific pressures on structural adjustment due to EU accession. Above all, this requires the measure to be independent of the levels of territorial and industrial aggregation which differ markedly between the countries under investigation.

(iv) The measure should use all available statistical information relevant for the purpose of the investigation.

(v) The measure should control for exogenous characteristics of industries and regions as far as possible. One of these characteristics is plant size. The concentration and specialization patterns may, e.g., be affected to a significant extent by the industries' average, or minimal optimal plant size. This is particularly true for small industries where big plants prevail.

The measure should allow for a rigorous, reliable testing of the statistical significance of changes in index values over time, and of differences between regions and industries.

In addition to these requirements, the values of the measure should be straightforward to interpret with respect to the economic question at hand.

The general requirements can be translated into the following basic properties of the statistical measure:

(a) *Scale invariance and population principle*: The general requirements (i) through (iv) are related to the two of the four general principles of inequality measures discussed in the income distribution literature:[25] scale invariance, i.e., independence of the size of the cake, and population invariance, i.e., independence of the number of cake receivers.

In the present investigation, the two principles require the measure to refer to basic units of analysis that are independent of the sizes of countries, regions and industries.[26] These properties were clearly violated if regions and industries would be chosen as basic units, or treated as if they were individuals. The regional and industrial aggregates in the underlying data sets are defined arbitrarily in terms of the questions of interest in the present paper, and differ markedly in size.[27] As a consequence, the measure would be biased. The bias would be

[25] See, e.g., Cowell (1995: 56 ff.). The remaining two principles are the principle of transfers which is not addressed here, and decomposability which will be addressed below.

[26] For a measure of industrial specialization a region, scale invariance addresses the size of the region while the population principle addresses the number of industries. For a measure of spatial concentration of regions, it is the other way around. For the regional level, this kind of aggregation bias, labeled "modifiable area unit problem" (MAUP), has been discussed extensively in the literature (see, e.g., Arbia 1989; Brülhart and Träger 2004).

[27] In general, the choice of the basic units depends on the purpose of the investigation: In an analysis of specific policies adopted by regional governments, e.g., a measure referring to regions as basic units would not be biased because regions would be the level where the policies of interest are decided upon. Since the respective policies affect all parts of the region to the same extent, any intraregional heterogeneity in the variable of interest would introduce a bias.

particularly high in the levels: Comparing concentration patterns across regions and countries, or comparing specialization patterns across industries and countries would be unreliable. In first differences over time, time-independent biases would net out. Nonetheless, time-dependent biases induced, e.g., by migration, would still derogate reliability of the inferences in an unpredictable way.[28] An alternative is to use an individual worker, a unit of area or a unit of value added as a basic unit. These basic units are, in principle, consistent with scale and population invariance.

In the present investigation, even these basic units do not allow for achieving full scale and population invariance because information on the heterogeneity among the basic units within the statistical aggregates is not available. But the bias can be minimized by preferring a *weighted measure* (Brülhart and Träger 2004), i.e., a measure that controls for differences in the frequencies of (unobserved) basic units within the observed units by assigning higher weights to bigger observed units. Note that any of the measures surveyed in Table A2–1 applies a specific, well-defined weighting scheme, at least implicitly. The question of whether to use a measure labeled “unweighted” or one labeled “weighted” is essentially a question of deciding upon the appropriate weighting scheme.

Of the measures in Table A2–1, all but the Herfindahl index are, in general, suitable for minimizing the biases from scale and population invariance.[29] All of them can be defined in terms of individual workers, units of area or of value added as basic units by introducing respective weighting schemes. The Herfindahl index is suitable only if it is standardized by the population size.

(b) *Decomposability*: Comparing measures across related units of analysis (regions, industries or countries) in a consistent way requires accounting for the links between the measures for the related units. This requirement is met by measures that are decomposable, i.e. measures that can be expressed as (weighted) averages or sums of groups within the population covered by the measure. All entropy measures share this property (Cowell 1995), including the Herfindahl and Theil indices, the coefficients of variation and of specialization, and the Finger-Kreinin index. The Gini index is decomposable only if the regions or industries do not overlap with respect to the characteristic analyzed. In the context of the present investigation this condition certainly will not be met.

[28] Several authors focusing on changes in the measures have preferred unweighted measures, arguing that the problem of scale invariance is irrelevant. The lack of information on the magnitude of a bias is, however, not sufficient for ignoring it, if alternative measures are available that minimize the bias.

[29] There is, however, some uncertainty as to the suitability of the two dartboard measures (Ellison-Glaeser, Maurel-Sédillot), with has not been checked in detail because they are not applicable anyway in the present investigation (see below).

(c) *Reference (benchmark) distribution*: The index should allow for some flexibility as to the choice of the reference, or benchmark, distribution in order to be able to tailor the measure to the specific question at hand. This issue is particular relevant for (i), requiring the measure to suit for concentration as well as specialization issues. Moreover, there may be scope for using different benchmark distributions at the same time even within the two groups. It may, e.g., be informative to compare the spatial distribution of an industry to both the distribution of area and that of total economic activity. In fact, the choice of an appropriate reference distribution is among the most important issues in investigations as the present one because it frequently dominates the outcome. A careless choice of an inappropriate reference may easily produce inconsistent results and/or inappropriate inferences. Note that any of the measures surveyed in Table A2–1 refers to a specific, well-defined benchmark distribution – at least implicitly. The question of whether to use a measure labeled “absolute” or one labeled “relative” is essentially a question of deciding upon the appropriate reference distribution.

Of the measures in Table A2–1, all except the Herfindahl index allow for a fairly flexible choice of a reference distribution. Possible reference distributions include the uniform distribution as well as distributions based on aggregate employment, value added or area. The Herfindahl index uses zero as a reference which is pretty awkward in the presence of significant differences in the sizes of regions and industries. By mixing up the size of an industry or region, as indicated by the reference (or expected) distribution just discussed, and the deviation of the specific observation from the reference distribution, the Herfindahl index assigns a far higher value to a given deviation in an industry or region just because that industry or region happened to have be defined as big in the underlying data set.

(d) *Projection function*: Another aspect that may affect the results severely is the internal weighting scheme, i.e., the projection function transforming the observed value of an observation into a value of in terms of the index. Some measures, like the Theil index, use theoretically well-founded projection functions satisfying specific axioms, while others, like the Gini index, employ persuasive ad-hoc criteria. The major problem with the projection function is that the relative weights are debatable. The weighting scheme is necessarily a matter of individual preferences. Although measures employing theoretically well-founded projection functions may be preferred in general because of their theoretical background, the interpretation of their values may be more demanding because the underlying axioms may form an obstacle for tailoring the lower and upper bounds. The ad-hoc measures, by contrast, are usually tailored to appealing bounds (e.g. between 0 and 1) but are silent when it comes to justifying theoretically why one distribution *should* be assigned a lower or a higher index value than another, and why the value *should* be that much lower or higher.

Requirement (v), demanding to deal appropriately with exogenous influences like an industry's minimal optimal firm size, and to limit the influence of outliers, may be addressed by the choice of the weighting scheme. In general, this requirement suggests preferring one of the dartboard measures, i.e. the Ellison-Glaeser or Maurel-Sédillot index, which control explicitly with the firm-size distribution. Dartboard measures can, however, not be employed in the present investigation because statistical information on the firm-size distributions are not available. As some sort of a second-best solution, this issue can nonetheless be dealt with by preferring a measure that tends to downgrade extreme observations. Biases from indivisibilities at the firm level can be expected to be particularly relevant, and manifest themselves in small industries or regions in the first line. A few observations will assume high deviations from their expected values.[30] Similarly, outliers are characterized by high deviations from their expected values.

Of the measures surveyed in Table A2–1, only the Theil index involves some downgrading of extreme observations. Being based on information-theoretic considerations, it explicitly evaluates the information content of an observation – in an information-theoretic context, or the probability of its occurrence – in a probability-theoretic context. Somewhat exaggerating the issue, the Theil index can be perceived of as evaluating the probability of, say, a big plant being located in a small region, and reducing the impact to this observation onto the index value if the occurrence is held to be rather obscure. More specifically, the weight assigned to a specific observation in the Theil index depends on the information content of the occurrence of this observation: The information content of a strong deviation from the expected value, i.e., the respective value of the reference distribution, is held more obscure than that of a weak or moderate deviation. Consequently, the weights given to the observations increase less than linearly with increasing deviation from their expectation.

For illustration, recall from Table A2–1 that the contribution of a specific observation to the Theil index,

$$\frac{a_i(j)}{a(j)} \ln\left(\frac{a_i(j)}{a(j)}\right),$$

consists of a linear and a logarithmic term.[31] The linear term does essentially the same as the respective terms of most other measures: it assigns a weight to observation *i* that is increasing linearly in the deviation of the relative frequency of observation *i*, $a_i(j)$, from the

[30] For an investigation of the spatial distribution of an industry, e.g., the indivisibility problem can be expected to be more relevant for industries that are small at the national level. If such an industry consists of only, say, two big firms located in two regions, the shares of the industry within the two regions, $a_i(j)$ in Table A???, would be significantly higher than the expected value, a_i, which is the industry's share at the national level. Consequently, the observed values for these two regions would be very high. The observed values for all other regions would be zero.

[31] In an evaluation of the spatial concentration of an industry *j* across regions, $a_i(j)$ may represent the industry's share in region *i*'s employment; $a(j)$ may represent the industry's share in national employment.

corresponding expected, or reference frequency *a*(*j*). Whether this comparison is done by subtraction or division is secondary. The second term is unique, however. The logarithm tends to downgrade more extreme deviations relative to moderate deviations.

It is this second term that makes the Theil index more suitable for coping with indivisibilities in firm sizes and outliers than the other measures listed in Table A2–1.[32] Take, for example, the coefficient of variation: By squaring all observations, the coefficient of variation magnifies the influence of extreme observations onto the index value. Only the sum of all squared deviations is downgraded by the root to make them comparable in size to the mean. Or take the Herfindahl index, which is an extreme case of a measure magnifying outliers – at least among the measures listed in Table A2–1.

Statistical testing: Statistical tests assessing the significance of the differences between two values of a measure for different points in time or different sets of observation in the cross-section dimension have usually employed bootstrap techniques (see, e.g., Cowell 1995; Brülhart and Träger 2004).

The issue of straightforward interpretation of the index values has been addressed briefly in the context of the weighting scheme (point (d) above). While most of the ad hoc measures like the Gini index do have appealing lower and upper bounds, the lower bound of the Herfindahl index ($1/N \leq \mathbf{H} \leq 1$), and the upper bounds of the Theil index ($0 \leq \mathbf{T} \leq \ln N$) and the coefficient of variation ($0 \leq \mathbf{CV} \leq (N\text{-}1)^{½}$) depend on the number of observations (regions, industries) under consideration. The bounds of the Balassa-Aquino index and the dartboard measures are even infinite. To get an idea of the relative distance of the observed value of the measure and the lower or upper bound, the measure may be standardized to the interval (0, 1) by dividing the observed index value by its respective upper bound:

$$T_{(j)}^{BT} = \frac{1}{\ln N} \sum_{i=1}^{I} \frac{n_i}{N} \frac{a_i(j)}{a(j)} \ln\left(\frac{a_i(j)}{a(j)}\right).$$

This percentage measure may be used for comparisons over time, but it may give some indication of differences in the cross-section dimension as well. In should be noted, however, that this is not a rigorous procedure proposed in the literature but rather a kind of back-of-the-envelop calculation which should be made used of very carefully.

[32] These is, notwithstanding, a large number of measures that is, in general, able to do a similar job. Among these measures are the members of the generalized entropy family of measures for which the sensitivity parameter α is somewhere between –1 and +1 (see, e.g., Cowell 1995). The Theil index is the member of this family for which $\alpha = 1$.

Summing up, among the measures reviewed for the purpose of the present investigation (see Table A2–1) the weighted Theil index, proposed by Brülhart and Träger (2004) and defined as

$$T_{(j)}^{BT} = \sum_{i=1}^{I} \frac{n_i}{N} \frac{a_i(j)}{a(j)} \ln\left(\frac{a_i(j)}{a(j)}\right),$$

appears to be the most suitable measure. Minimizing the biases resulting from scale dependence by using individual workers, units of area or of value added as references, it allows for international, interregional and intertemporal comparisons of index values. Being fairly flexible with respect to the choice of a reference distribution, it can be used for answering different kinds of questions. And having the property of downgrading extreme observations, it is more suitable than other measures to cope with outliers and indivisibilities in firm sizes. Moreover, its values can be interpreted in a fairly straightforward manner although the upper bound decreases with sample size. And finally, test statistics assessing the statistical significance may be obtained by bootstrapping.

Table A2–1 — Measures of regional specialization and/or industrial concentration

	Coefficient of specialization	Finger-Kreinin index	Coefficient of conformity	Balassa-Aquino index	Gini coefficient	(weighted) Theil index	(weighted) Coefficient of variation
Formally[a]	$\sum_{i=1}^{I}\lvert a_i(j)-a_i\rvert$	$\sum_{i=1}^{I}\min\left(a_i(j),a_i\right)$	$\frac{\sum_{i=1}^{I}\left(a_i(j)a_i\right)}{\sqrt{\sum_{i=1}^{I}a_i(j)\sum_{i=1}^{I}a(j)}}$	$\sqrt{\sum_{i=1}^{I}a_i\left(\frac{a_i(j)}{a_i}-1\right)^2}$	$1-\sum_{k(i)=1}^{I}a_{k(i)}\left(a_{k(i)}(j)+2\sum_{m}^{k-1}a_{k-1(i)}(j)\right)$	$\sum_{i=1}^{I}\frac{n_i}{N}\frac{a_i(j)}{a_i}\ln\left(\frac{a_i(j)}{a_i}\right)$	$\frac{1}{a(j)}\sqrt{\sum_{i=1}^{I}\frac{n_i}{N}\left(a_i(j)-a(j)\right)^2}$
Bounds:							
identical distr.	0	1	1	0	0	0	0
complete spec/conc.	2	0	0	∞	1	ln*N*	$(N-1)^{1/2}$
scale invariant	no	no	no	no	no	yes	yes
reference distributions	several	several	several	several	several	several	several
decomposable	yes	yes	yes	yes	restricted	yes	yes

[a] *j*: unit under investigation (region in the analysis of the industrial specialization of regions; industry in the analysis of the spatial concentration of industries; *I*: number of observed units in the distribution for the *j* (industries *i* in region *j*, or regions *i* where industry *j* may be located); $a_i(j)$: "local" share of observation *i* in unit *j*; a_i: corresponding share in the reference distribution, expected value for $a_i(j)$; $a(j)$: (weighted) average of the $a_i(j)$ across all *i*; n_i: number of basic units (workers, units of value added, km²) in observed unit *i*; *N*: ($=\Sigma_i n_i$) total number of basic units; k(*i*): *k*-th rank assigned to observed unit *i* when observations ranked by location coefficients in increasing order; *H*: Herfindahl index of firm-size structure.

to be continued

Table A2–1 continued

	Herfindahl index	Ellison-Glaeser index[c]	Maurel-Sédillot index[c]
Formally[a]	$\sum_{i=1}^{I}(a_i(j))^2$	$\dfrac{\dfrac{\sum_{i=1}^{I}(a_i(j)-a_i)^2}{\left(1-\sum_{i=1}^{I}a_i^2\right)}-H}{1-H}$	$\dfrac{\dfrac{\sum_{i=1}^{I}(a_i(j))^2-\sum_{i=1}^{I}a_i^2}{\left(1-\sum_{i=1}^{I}a_i^2\right)}-H}{1-H}$
Bounds:			
identical distr.	N^{-1}	0	0
complete spec.	1	∞	∞
scale invariant	no	no	no
reference distributions	0 only	several	several
decomposable	yes	no	no

Appendix 3: Additional figures and tables

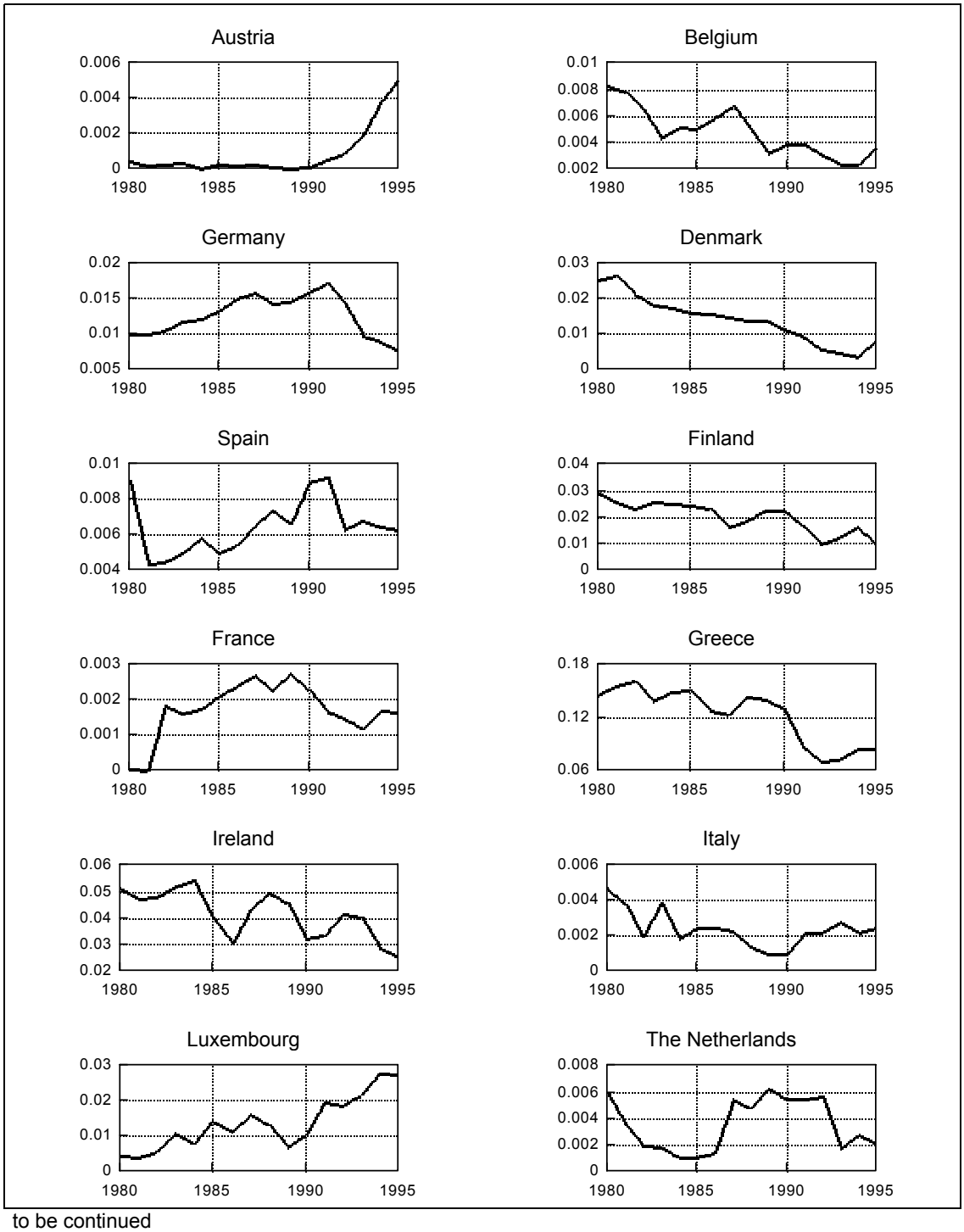
Table A3–1 — Geographic concentration of four sectors across 118 regions in EU15 countries: Absolute changes in total, between and within components of Brülhart/Träger Theil indices 1980-1995, reference: total area

Index-component/ Country-specific within	All sectors	Agriculture	Manufacturing	Construction	Services
Total	+0.013	+0.075	–0.027	+0.008	–0.007
Between	+0.008	+0.063	+0.003	–0.015	+0.002
Within	+0.005	+0.012	–0.030	+0.023	–0.009
Austria	—	—	—	—	—
Belgium	–0.051	–0.014	+0.008	–0.034	–0.109
West-Germany	–0.025	+0.031	–0.031	–0.025	–0.042
Denmark	—	—	—	—	—
Spain	+0.054	+0.088	–0.034	+0.045	+0.036
Finland	—	—	—	—	—
France	+0.074	+0.016	+0.038	+0.082	+0.036
Greece	—	—	—	—	—
Ireland	—	—	—	—	—
Italy	–0,000	–0.034	–0.038	+0.048	–0.001
Luxembourg	—	—	—	—	—
The Netherlands	–0.006	+0.063	–0.056	+0.017	–0.030
Portugal	–0.021	–0.033	–0.067	+0.074	–0.074
Sweden	—	—	—	—	—
United Kingdom	–0.009	–0.021	–0.072	–0.001	–0.010

Table A3–2 — Economic concentration of four sectors across 118 regions in EU15 countries: Absolute changes in total, between and within components of Brülhart/Träger Theil indices 1980-1995, reference: total value added

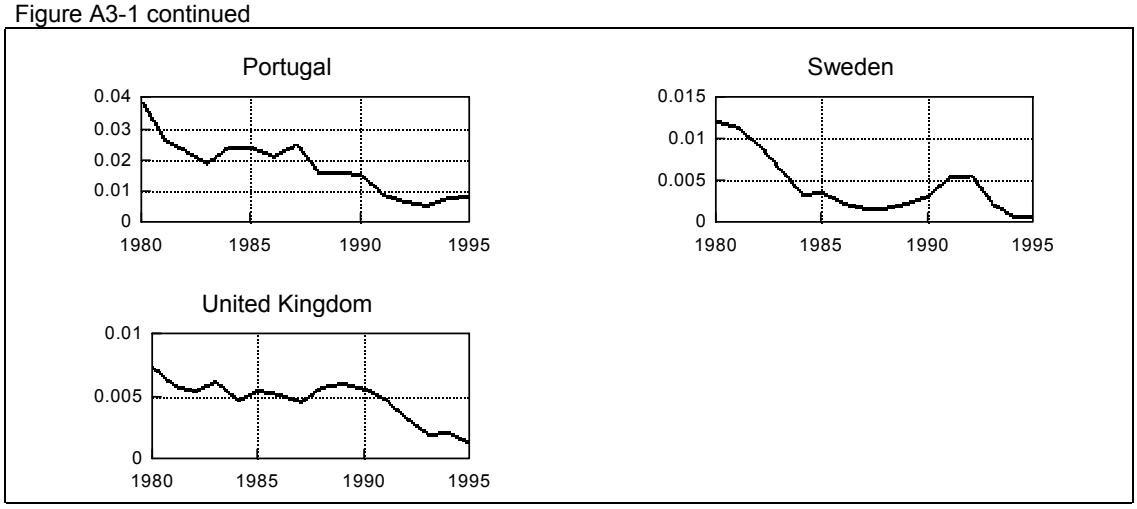
Index-component/ Country-specific within	All sectors	Agriculture	Manufac-turing	Construction	Services
Total	—	–0.004	–0.000	+0.004	–0.005
Between	—	–0.015	–0.001	+0.010	–0.002
Within	—	+0.011	+0.001	–0.006	–0.003
Austria	—	—	—	—	—
Belgium	—	–0.040	+0.028	+0.002	–0.000
West-Germany	—	–0.009	–0.000	+0.001	–0.001
Denmark	—	—	—	—	—
Spain	—	+0.084	–0.001	–0.004	–0.005
Finland	—	–0.000	–0.000	–0.000	–0.000
France	—	+0.056	+0.006	–0.009	–0.004
Greece	—	—	—	—	—
Ireland	—	—	—	—	—
Italy	—	–0.029	–0.012	–0.021	–0.005
Luxembourg	—	—	—	—	—
The Netherlands	—	–0.016	–0.025	–0.015	–0.011
Portugal	—	+0.042	+0.023	–0.026	–0.002
Sweden	—	—	—	—	—
United Kingdom	—	+0.010	+0.008	–0.002	–0.002

Figure A3-1 Specialization of EU15 countries 1980–1995 – Brülhart/Träger Theil indices for value added in 4 sectors relative to EU15



to be continued

Figure A3-1 continued



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