2001 – n° 14
December

CEPII
CENTRE D'ÉTUDES PROSPECTIVES ET D'INFORMATIONS INTERNATIONALES

The French-German Productivity Comparison Revisited: Ten Years after the German Unification

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SUMMARY

This study compares manufacturing output and productivity levels between France and Germany since the German unification. The use of a suitable conversion factor to express output in a common monetary unit is the major difficulty in international comparisons of output levels. CEPII comparisons are based on the so-called *industry-of-origin* method of the International Comparisons of Output and Productivity project network (ICOP). Producer unit value ratios (UVR) are used as conversion factors. A representative basket of goods, common to different countries is defined and valued at national unit values for each country. The conversion rate results from the confrontation of the national goods baskets.

The common basket of manufactured products of the present France-Germany comparison is built by matching the goods produced in both countries at the finest level of the PRODCOM classification (8 digits). In the production surveys, we have counted 2045 French products and 3 586 German ones for which both quantities and sales value were available in benchmark year 1997. From these two databases, the 1 151 products which could be matched between the two countries, constitute the basket of common products to France and Germany. In 1997, its share amounts to 35% of the whole manufacturing sales in France and 32% in Germany.

The average unit value ratio for the manufacturing sector, which could be considered as a producer price parity between France and Germany, is 3.41 FF to 1 DM in 1997. The use of hedonic prices for cars contributes to increasing the producer price parity. This figure is even so very close to the value of the nominal exchange rate (3.37). Then, the French level of industrial prices, which compares the UVR to the nominal exchange rate, is slightly above the German one (101%).

In 1997, French real value added in manufacturing is twice as small as the one of Germany (47%). The relative levels of the French inputs (total hours worked and capital stock) are higher than the output ratio (respectively 51 and 58%). Then, French relative hourly labour productivity (92%), capital productivity (81%) and total factor productivity (88%) levels are lower than the German ones. Nonetheless, when labour is considered, France takes advantage of weaker unit labour costs thanks to a quite lower compensation of labour. Indeed, the nominal cost that must be supported by an investor in order to produce one unit of value added that can be compared in both countries is in average 20% less in France than in Germany in the manufacturing sector.

These results stand out against the levels displayed in the former comparison achieved at the CEPII ten years ago. For the 1987 benchmark, the level of manufacturing prices was by far lower in France than in west Germany (92%). The endearing of the common basket of products between the two benchmark years detrimental to France and in favour of Germany is not imputable to the relative price evolution. National accounts statistics show on the contrary that, in the wake of the German unification, the growth of manufacturing prices have been significantly lower in France than in Germany. Moreover, the pegging of the French franc to the deutschmark in the framework of the *désinflation compétitive* policy has involved a real depreciation of the French currency since the end of the eighties.

The reason why the composition of the French-German common basket of goods has been affected must then be explored further. The gap between the two successive benchmark estimates, that could be puzzling at first sight, enhances very likely the quality upgrading of the French products as can be shown in trade statistics: the share of the high quality/price range flows has increased by 20% between 1988 and 1999 in the French sales whereas the increase in Germany was bounded to 9%.

In France, the *désinflation compétitive* policy has been designed to step up the internationalisation of the economy through wiping out inflation. In the 90s, negative effects on growth and employment have been counterbalanced by positive ones as the reinforcing of competitiveness based on productivity. The positive hourly labour productivity gains in favour of France has indeed benefited French unit labour costs as the evolution of the relative hourly labour costs have remained stable.

In Germany, the absorption of unification is likely to last longer than expected. At the end of the 1990s, the east German manufacturing productivity is 40% below the west German level. The rapid catch-up in the first years of unification came to a halt around 1995 that puzzled most experts. A lot of changes have intervened in a short period of time: the German industrial restructuring has involved a shedding of the east German employees. The German industrial policy was favourable on the contrary to the input in capital in the east. The relative level of the east German capitalistic intensity that is twice as high as in 1991 comes now quite closer to the level of the western Länder. According to some German economists, the fact that subsidies were directed towards very capital-oriented industries in the east that have entailed a shift in the output composition in favour of smoke-stake industries could be blamed for the slowdown of the catch-up process. Our results show that in 1991, the relative labour productivity of east Germany was the largest in the capital intensive industries but in 1999 the labour intensive industries took the lead. With respect to annual average growth rates, some industries belonging to the skilled labour intensive industries have raised their labour productivity dramatically: “computers”, “road vehicles”, “precision instruments” and “media technology”. This helps water down somewhat the least sanguine statements about east Germany’s ability to commit into more valuable production.

The comparison of the 1984-1990 period with the last decade shows that the pace of growth has been quite stronger in the first period for both countries. Between 1984 and 1990, the German value added growth has been sustained through the stability of employment along with a cut in the working time and a better technological efficiency in the function of production. The role of the technological efficiency was also important in France but the cutback in labour was accompanied by a lower growth than in Germany. After the unification, things have changed. The French output has kept on growing whereas the German one has decreased. The cut in the German manufacturing employees has impeded growth. But in the last decade, France was characterised by a strong contribution of the technological efficiency to the value added and hourly labour productivity growth while Germany was not, the contribution of the multifactor productivity being of a small magnitude.

On the whole, results show that at the end of the decade, the impact of the German unification on relative price and productivity levels between France and Germany has been significantly subdued. The French and German economies undergo the same economic fluctuations. The comparison of the United-States -France-Germany productivity levels that the CEPII is carrying out at present with the University of Groningen will allow to put in perspective the European productive performance in an international framework.

ABSTRACT

This study compares manufacturing output and productivity levels between France and Germany since the German unification. Taking as a benchmark the year 1997, the relative price level is calculated with the industry-of-origin method. The French level of productivity in terms of labour, capital and their combination is below the German one in 1997. However, with respect to cost competitiveness, France takes advantage of lower unit labour costs than Germany. Over the 90s, the factor productivity catch-up France achieved is significant. Disparities between the eastern and the western Länder that resulted in a lesser productivity growth remain large. But the commitment of the east into more high-tech production processes using skilled labour could turn in the future into competitiveness gains for all Germany.

Keywords: relative price level, sectoral productivity, unit labour costs, growth accounting, German unification, *désinflation compétitive* policy.

JEL: E31, J24, J30, L60, O47.

THE FRENCH-GERMAN PRODUCTIVITY COMPARISON REVISITED : TEN YEARS AFTER THE GERMAN UNIFICATION

RESUME LONG

L'objet de cette étude est de comparer les niveaux de production et de productivité dans l'industrie entre la France et l'Allemagne depuis la réunification allemande. La principale difficulté dans les comparaisons internationales consiste à trouver une unité de conversion adéquate pour exprimer les différentes productions nationales dans une monnaie commune. Les comparaisons du CEPII utilisent la méthode dite *industry-of-origin* du projet ICOP (International Comparisons of Output and Productivity). Il s'agit de construire un panier de produits communs aux différents pays et de le valoriser dans la monnaie nationale de chacun des pays. La comparaison des prix du même panier en différentes monnaies donne les taux de conversion pour l'industrie.

Le panier des produits manufacturés commun à la France et à l'Allemagne a été construit en appariant les biens fabriqués dans les deux pays au niveau le plus fin de la nomenclature PRODCOM (8 chiffres). Dans les enquêtes de branche 2 045 produits français et 3 586 produits allemands ont été recensés pour lesquels à la fois les quantités et les valeurs des ventes étaient disponibles pour l'année de référence 1997. Avec ces deux bases, 1 151 produits ont pu être appariés et constituent le panier des parités de production. En 1997, la valeur de ce panier représente 35% des ventes manufacturières en France et 32% en Allemagne.

Le taux de conversion pour l'ensemble du secteur manufacturier, qui peut être considéré comme un taux de parité de prix de production entre la France et l'Allemagne, est 3.41 FF/DM en 1997. L'utilisation des prix hédoniques pour les véhicules particuliers a eu pour conséquence d'élever le niveau moyen des prix dans l'industrie en France par rapport à l'Allemagne. Le taux de conversion manufacturier franco-allemand est toutefois très proche du taux de change nominal à cette date (3.37).

En 1997, la valeur ajoutée réelle française est deux fois moins importante que la valeur ajoutée allemande dans le secteur manufacturier (47%). Les niveaux relatifs français pour les facteurs de production (volume d'heures travaillées et le stock de capital) sont supérieurs au ratio de production (respectivement 51 et 58%). Ce qui implique *de facto* que les niveaux français de productivité sont en deçà des niveaux allemands : 92% pour la productivité horaire, 81% pour celle du capital et 88% pour la productivité globale. La France bénéficie toutefois d'une meilleure compétitivité par rapport à son voisin outre-Rhin lorsque l'on considère les coûts salariaux unitaires. Les rémunérations des employés français sont en effet nettement inférieures aux rémunérations allemandes. De ce fait, le coût nominal qu'un investisseur doit supporter pour produire une unité physique de valeur ajoutée comparable dans les deux pays est

en moyenne 20% moins important en France qu'en Allemagne dans le secteur manufacturier.

Les résultats de la comparaison France-Allemagne pour l'année de base 1997 contrastent avec ceux précédemment obtenus par le CEPII pour l'année de base 1987. En effet, dix ans auparavant, le niveau relatif des prix français était nettement plus bas par rapport à l'Allemagne de l'Ouest (92%). Le taux de change nominal n'ayant pratiquement pas bougé entre les deux dates, ceci s'explique par le renchérissement de la valeur du panier commun estimé en francs français. Le renchérissement provient, à notre avis, d'un effet de composition du panier, puisque le différentiel d'inflation France-Allemagne a été négatif dans le secteur manufacturier durant la décennie. L'accrochage du franc au deutschmark, dans le cadre de la politique de désinflation compétitive menée en France, s'est notamment traduit par une montée en gamme des produits français. Les statistiques du commerce extérieur montrent ainsi que la part des produits de haut de gamme a augmenté de 20% entre 1998 et 1999 dans les ventes françaises contre 9% dans les ventes allemandes.

La politique de désinflation compétitive a sensiblement marqué la spécialisation de la France dans le secteur manufacturier. Ne pouvant plus utiliser le taux de change nominal comme un outil de compétitivité-prix, les entreprises françaises ont dû rationaliser leurs processus productifs. Les effets négatifs de cette politique sur la croissance et l'emploi ont été contrebalancés, dans les années 1990, par l'instauration d'une compétitivité basée sur une meilleure productivité. Les gains de productivité horaire enregistrés en France sont supérieurs à ceux enregistrés en Allemagne durant la décennie.

Dix ans après, l'impact de la réunification continue de marquer aussi bien le secteur manufacturier que l'ensemble de l'économie allemande. A la fin des années 1990, la productivité manufacturière est-allemande est 40% en dessous du niveau de l'Ouest. Les taux de croissance élevés enregistrés à l'Est dans les premières années après la réunification se sont estompés à partir de 1995. Plusieurs éléments peuvent être avancés pour expliquer les raisons de ce ralentissement. La restructuration industrielle allemande s'est traduite simultanément par des licenciements massifs et par une accumulation non moins massive du stock du capital dans les entreprises des Länder de l'Est. Le niveau relatif de l'intensité capitalistique y a plus que doublé depuis 1991 (il atteint plus de 80% du niveau de l'Ouest en 1999). Selon certains économistes allemands, en privilégiant les industries fortement capitalistiques, la politique de subventions vers les entreprises de l'Est a fortement affecté la structure de la valeur ajoutée est-allemande en faveur des industries lourdes. Ce qui expliquerait, selon eux, l'arrêt du rattrapage est-allemand. Nos résultats montrent une divergence des performances relatives Est-Ouest dans les branches industrielles intensives en main d'œuvre et celles en capital : alors que ces dernières enregistraient les plus hauts niveaux de productivité relative en 1991, les branches intensives en main d'œuvre sont au premier rang en 1999. La croissance de la valeur ajoutée a été considérable dans certaines branches intensives en travail qualifié telles que « équipement informatique », « véhicules à moteurs », « instruments de précision » et « matériel de télécommunication ». Ces considérations nuancent quelque

peu les jugements sévères sur la capacité de l'adaptation du secteur manufacturier est-allemand.

L'étude de l'évolution de la valeur ajoutée et de la productivité en France et en Allemagne est complétée par une analyse de la comptabilité de la croissance. Afin de pouvoir constater les effets de la politique de désinflation compétitive en France et de la réunification en Allemagne, l'analyse compare les résultats de deux périodes consécutives : la période 1984-1990 et la décennie 1990. Dans les deux pays, le rythme de la croissance de la valeur ajoutée manufacturière a été nettement plus fort dans la première période que dans la seconde. Entre 1984 et 1990, la croissance de la valeur ajoutée allemande (supérieure à celle de la France), a été soutenue par un maintien du niveau des employés grâce à une diminution de la durée du travail et une importante contribution de l'efficacité technologique dans la fonction de production. Le rôle de l'efficacité technologique fut également importante en France pendant cette même période. Toutefois, la diminution de l'emploi français s'est traduite par une moindre croissance de la valeur ajoutée par rapport à l'Allemagne. La réunification allemande a logiquement changé la donne. La valeur ajoutée a continué à croître en France alors qu'elle a diminué en Allemagne. La restructuration de l'industrie allemande, notamment par la suppression radicale des emplois à l'Est a entravé la croissance outre-Rhin. Cette contribution fortement négative de l'emploi allemend après la réunification était toutefois un résultat attendu. Ce qui paraît plus surprenant, c'est la faiblesse de la contribution de l'efficacité technologique à la croissance en Allemagne. La France, au contraire, a bénéficié d'une contribution importante du progrès technique.

Dans l'ensemble, les résultats montrent qu'à la fin de la décennie, le fort impact de la réunification allemande sur les niveaux relatifs de prix et de productivité entre la France et l'Allemagne se trouve sensiblement atténué. Toutefois, en ce qui concerne la comparaison des performances économiques, il ne faut pas oublier que les économies française et allemande sont soumises aux mêmes cycles économiques. L'étude en cours de comparaison de productivité entre les Etats-Unis, la France et l'Allemagne permettra de mieux cerner la performance productive européenne sur la scène internationale.

RESUME COURT

Cette étude compare les niveaux de production et de productivité dans le secteur manufacturier entre la France et l'Allemagne depuis la réunification allemande. Le niveau de prix relatif est calculé avec la méthode *industry-of-origin* pour 1997. Le niveau français de productivité est inférieur au niveau allemand pour cette année. Cependant, du fait de rémunérations nettement plus faibles, la France bénéficie des coûts salariaux unitaires inférieurs à ceux de l'Allemagne. La décennie 1990 est caractérisée par un rattrapage de la France en termes de productivité totale des facteurs. Les disparités entre les Länder Est et Ouest qui sont à l'origine de la moindre performance productive allemande durant les années 1990 demeurent importantes. Mais l'engagement des firmes est-allemandes dans des productions davantage intensives en main-d'œuvre qualifiée pourrait se traduire à terme par des gains de compétitivité pour toute l'Allemagne.

Mots Clés : Niveau de prix relatif, productivité sectorielle, coûts salariaux unitaires, comptabilité de la croissance, unification allemande, politique de *désinflation compétitive*.

JEL: E31, J24, J30, L60, O47.

The French-German productivity comparison revisited: ten years after the German unification

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INTRODUCTION

This paper investigates the gap in price and productivity levels that still exists in the manufacturing sector between two leading partners of the European construction. This issue is of particular importance in the context of the euro. The abolition of exchange rates within the euro zone should entail quickly a price convergence across the same branches in both countries. Nonetheless, the convergence of levels of productivity, of a more structural nature, will be more time-consuming. The difficulty to reduce in the short term the productivity differentials by a nominal exchange rate adjustment is likely to increase unemployment in the lagging branches of the tradable goods sector, to urge the labour force to migrate, or at least give way to financial transfers.

The CEPII had already carried out a comparison of price and productivity levels between France and Germany based on the benchmark year 1987 showing the evolution in the 1970s and 1980s. Results evidenced that France had benefited relative to Germany by an advantage of price competitiveness in 1987 on the one hand and by a stronger multifactor productivity on the other hand. The French manufacturing sector had recorded productivity gains thanks to massive layoffs during the 1980s but the gap in the level of production relative to Germany whose manufacturing sector was twice as large had not been filled in accordingly. Nevertheless, the national industrial structures of both countries had converged in terms of prices as well as in terms of labour productivity. The CEPII had then concluded that the manufacturing sectors of both countries were ready to take up one money.

The present study takes the year 1997 as a benchmark. This paper ushers in methodological changes relative to the previous study. The major one in terms of impact on the price level is the use of hedonic prices for cars. The 1997 price and productivity levels were extrapolated back and forward in order to extricate tendencies. The 1990s are typified above all by the German unification and by the French *désinflation compétitive* policy. Ten years after the unification, results show that the price convergence is completed. Factors and multifactor productivity levels are higher in Germany than in France. In the wake of the *désinflation compétitive* policy, the level of the manufacturing prices in France is slightly above the German one but the actual weakness of labour costs relative to Germany provides France basically with an advantage in terms of cost competitiveness.

In the first section of the paper, we will develop the ICOP methodology used to assess the levels of prices in international comparisons, and then focus on the relative levels of manufacturing prices as well as their evolution in the last decade. The second section is dedicated to the analysis of levels of output, inputs and productivity and is closed by a scrutiny of the cost competitiveness and the comparative advantages. The third section

gets started by the analysis of the German industrial restructuring following the unification and goes further with the relative France-Germany evolution of the output and productivity levels. The last section analyses the contributions to growth in the periods 1984-1990 and 1991-1998.

1. FRENCH-GERMAN RELATIVE PRICES IN MANUFACTURING

1.1. Estimating value added at international prices: a choice between two methods

The major difficulty in international comparisons of production or productivity levels lies in finding out the appropriate conversion rate, allowing national productions to be compared. Each country owns, indeed, its specific system of relative prices.

As nominal exchange rates reflect mainly traded goods prices and changes due to factors such as capital movements, they do not represent a stable and consistent indicator, likely to gather the most consistent information upon national relative prices.

The economic literature backdating to the 50s puts forward two methods in order to compute more relevant conversion rates. Both of them lean on the same idea. A basket of goods, common to different countries is defined and valued at national prices for each country. The conversion rate results from the confrontation of the national prices of the basket[1].

The method developed by Kravis, Heston and Summers (1982) in the framework of the International Comparisons Programme (ICP), is based on a basket of goods reflecting final demand. The value of this basket is computed from price surveys launched in each of the countries belonging to the project. Prices from the census are related to goods and services consumed at home, i.e. the goods produced in the country and the goods imported from abroad. Comparing the value of the basket quoted in different currencies results in the internal Purchasing Power Parity (PPP) of these currencies. Thus, the ICP which is led by the main international institutes (World Bank, OECD, Eurostat) and entails 150 countries, aims mainly at comparing the levels of income per head across countries as well as the structure of the internal demand.

The use of PPP in international comparisons of productivity is not appropriate. Indeed, PPP can be very different of producers relative prices for several reasons: they do not take into account neither the goods produced for export nor the intermediate goods to be used in the production area. On the contrary, they include the imported goods. Furthermore, the related prices entail transport and trading costs along with taxes and subsidies.

[1] See van Ark, R. Inklaar and M. Timmer (2001) for a methodological discussion on "expenditure *versus* industry of origin approach" in the international productivity comparisons.

The second method called *industry-of-origin* is more relevant to compare production levels. It can be identified to a supply approach as the value of the common basket is computed from data on production. In this method, the conversion rates are calculated from unit values of the products available in the industry branch surveys. Unit values are retrieved by dividing the value of the product by the corresponding quantity.

Although the *industry-of-origin* method is as old as the PPP method, it is less known. There exists neither standardised international surveys for producers prices nor a detailed international classification. The lack of both of them could be the cause of a least spreading of this method. Nevertheless, it has experienced important developments thanks to the International Comparisons of Output and Productivity Project (ICOP) at the University of Groningen (Netherlands). At present, more than thirty bilateral comparisons (mainly referring to the United States) were carried out in the framework of this project. They involve most countries of the OECD, as well as some emerging countries of Asia, Central Europe and Latin America[2].

In this study, we chose to apply the *industry-of-origin* method in order to get the most relevant conversion rate to compare productivity across countries. The want of comparable statistical surveys in the fields of agriculture and services led us to restrict the comparison between France and Germany to the manufacturing sector alone. Like other old industrialised countries, the share of the manufacturing industry is relatively small in the French and German economies (respectively 19% and 24% of GDP in 1997, see appendix 4) whereas the weight of services is overwhelming (respectively 71.5% and 67.3% of value added). The weak share of the manufacturing industry in national productions can raise doubts as to the relevancy of a comparison that does not entail services.

Let us recall, nevertheless, that services are relatively few traded internationally. Today, about 70% of international trade involve manufacturing products against only 20% for services (see appendix 4). In developed countries, such as Germany, the weight of industrial products in international trade overshoots the world average (75%). Moreover, the importance of the industry sector has been increasing even more since the mid-80s thanks to the third industrial revolution hubbed on the electronic products. As there is more and more theoretical and empirical evidence on the links between openness, growth and international trade through the channel of technology transfer, comparisons of productivity in the industry are wholly allowed for.

[2] CEPII takes part actively in this project. A former industrial comparison between France and Germany bore on the year 1987 and three sets of studies are leading at present; a Europe-United States comparison in co-operation with the University of Groningen, Euro-Mediterranean comparisons in the framework of research programmes launched by the FEMISE (Forum for Euro-Mediterranean studies), a Latin America- United States comparison involving Mexico and Brazil in cooperation with CEPAL. CEPII has also developed new methods in the field of production and productivity comparisons in services.

1.2. The common basket of manufacturing products to France and Germany in 1997

The manufacturing conversion rates are calculated by comparing the prices in national currencies of a representative basket of products common to the two countries. As it was previously underlined, there does not exist any standardised international surveys on manufactured product prices. Therefore, we compute statistics on values and sold quantities provided by production surveys to obtain products unit values which are assimilated to prices.

The common basket of manufactured products is built by matching the goods produced in both countries at the finest level of the PRODCOM classification[3] (8 digits). In the production surveys, we have counted 2 045 French products and 3 586 German ones for which both quantities and sales value were available in 1997. This year is the last benchmark year of the ICOP productivity comparisons. From these two databases, the 1 151 products which could be matched between the two countries, constitute the basket of common products to France and Germany (table 1, first column).

An important part of the national production is not matched on several accounts: the quantity and/or the value of the sold production are not always available in the statistics (partly for confidentiality reasons); the units used for quantities can diverge across countries; some products are not produced in both countries,…Moreover, products for which the unit values show a wide gap between both countries have been removed from the matching. In this case, it was assumed that this gap may be due to quality differences between products, such that they could not be considered as equivalent.

In order to assess the representativeness of the matched products within the branches, the second and third columns of table 1 show the value of the sales of these products compared to the total value of the branch turnover. In 1997, the share of matched output amounts to 35% of the whole manufacturing sales in France and 32% in Germany. Within branches, these rates can drift a long way from this average. Rubber and plastic products as well as food and wood products have very high rates of representativeness (between 60 and 70%). As French surveys do not detail quantities and/or values in machinery and equipment and electric and electronic products, rates of representativeness are very low (from 0 to 11 %)[4].

For each of the 1 151 products included in the common basket, the unit value in French francs is divided by the unit value in deutschemarks. The product unit value ratios (UVR) are then aggregated by a stepwise procedure for 226 industries (4 digits), 21 branches (2 digits), 7 major branches and for the whole manufacturing sector (see

[3] For more detail on the classifications used, see appendix 2.1.

[4] The magnitude of the non matched part of the production relative to the matched one (34%) in studies using the *industry-of-origin* method has raised some criticisms. As an alternative, Pilat (1996) has suggested to use the PPP based on the final expenditures to complete the missing relative prices. This method combining the UVR and the PPP used as *proxies* does not seem to be suitable for branches as furniture or investment goods (B. Van Ark, R. Inklaar et M. Timmer, 2000).

appendix 1 for the detailed methodology). The central columns of table 1 show the branches and whole manufacturing sector UVR. As the relative weight of products in French and German production is not the same, the UVR assessed with French quantities is different from the one assessed with German quantities. In 1997, the manufacturing UVR at French and German weights amounted to 3,58 and 3,24 FF/DM respectively, what corresponds to a geometric average of 3,41 FF/DM.

Table 1.
Unit value ratios and reliability indicators by manufacturing branch, France-Germany, 1997

NACE		Number of product matches	Matched output as % of total		Unit value ratio (FF/DM)			Coefficient of variation		Is the branch UVR reliable?
			France	Germany	French quantity weights	German quantity weights	Geometric average	French quantity weights	German quantity weights	
	Total manufacturing	**1 151**	**35**	**32**	**3.58**	**3.24**	**3.41**	**0.0255**	**0.0186**	
	Food and tobacco				**3.60**	**3.44**	**3.52**			
15	Food products	193	65	75				0.0104	0.0091	Yes
16	Tobacco	3	25	27				0.1154	0.0969	No
	Textiles									
17	Spinning and weaving	40	13	19	2.27	2.58	2.42	0.1338	0.0976	No
18	Wearing apparel	109	34	34	3.47	4.13	3.78	0.0355	0.0393	Yes
19	Leather products	19	58	34	2.66	2.96	2.81	0.1527	0.1133	No
	Wood, paper, publish.									
20	Wood & wood products	45	77	61	2.36	2.76	2.55	0.0750	0.0620	Yes
21	Paper & paperboard	47	43	48	3.61	3.70	3.65	0.0339	0.0241	Yes
22	Publishing	10	47	46	3.40	3.37	3.39	0.0243	0.0142	Yes
	Chemicals									
24	Chemical prod.	174	23	27	3.51	3.86	3.68	0.0402	0.0398	Yes
25	Rubber & plastic prod.	99	72	67	3.09	3.38	3.23	0.0233	0.0239	Yes
26	Non met. mineral prod.	65	60	56	3.11	3.48	3.29	0.0561	0.0446	Yes
	Metal pr. & Machinery									
27	Basic metals	92	39	47	3.55	3.94	3.74	0.0293	0.0339	Yes
28	Metal products	106	21	29	3.16	3.46	3.31	0.0427	0.0484	Yes
29	Machinery & equipment	70	10	7	3.16	3.67	3.40	0.0551	0.0714	Yes
	Electric. pr., electronics									
30	Office mach., computers	0	0	0	-	-	-	-	-	No
31	Electrical machinery	25	11	8	2.94	3.36	3.14	0.0466	0.0622	Yes
32	Radio, TV & com. Equip.	3	1	3	2.63	3.67	3.11	0.5141	0.3047	No
33	Med., precision & optical	23	8	8	2.38	3.34	2.82	0.1338	0.2502	No
36	Manufacturing n.e.c.	9	6	5	3.31	4.08	3.67	0.0000	0.0000	Yes
	Transport equipment									
34	Motor vehicles	12	29	36	3.48	3.50	3.49	0.0483	0.0587	Yes
35	Other transport equipment	7	5	8	3.89	4.14	4.01	0.1086	0.1030	No

Notes: On account of confidential data for tobacco in France, the UVR for food and tobacco industries are presented in the major branch level (NACE 15 + NACE 16).

Sources: See appendix 2.

The coefficients of variation in table 1 indicate for each branch the variation of the industry UVR around the mean. A high level of variation points to a low reliability of the corresponding UVR[5]. It appears that the UVR for tobacco (Nace 16), spinning and weaving (Nace 17), leather products (Nace 19), office machinery and computers (Nace 30), radio, TV. and telecommunication equipment (Nace 32), medical, precision instruments and optical products (Nace 33) and other transport equipment (Nace 35) are

[5] When the geometric average of the industry coefficients of variation for France and Germany exceed 0.1, the branch UVR is considered as unreliable.

relatively unreliable. For these branches we prefer to use the whole manufacturing sector UVR when calculating the real value added levels (i.e. value added at international prices).

The basket of matched manufactured products allows to calculate UVR that are likely to translate the parity of producer prices. But as these exchange rates are based upon unit values and not price surveys like purchasing power parities, they can be significantly affected by product quality problems.

The "quality" problem arises because of differences in unit values which are due to factors not directly observed in the price differentials. This is particularly important in the case of personal cars as a specific product category and for Germany as a famous high quality goods producer country. With respect to the relative weight of personal cars in the output of both countries, we decided to adjust prices for quality differences in this specific industry through hedonic method (box 1). This methodology assumes that the production of heterogeneous goods can be analysed by disaggregating them into more elementary units which represent the characteristics of these goods. A regression analysis is usually made with the characteristics of the product as the independent variables and the price of the product as the dependant variable. The price gap due to the characteristics discrepancies are then eliminated leaving only the price differences related to disparities in production costs.

Box 1. The use of hedonic prices for personal cars

The case of "personal cars" is typical of the product quality problem that can be inherent to the ICOP methodology. This quality issue arises because of factors not directly observed in the price differentials. As a matter of fact, cars are highly differentiated products and German cars may be viewed by consumers as better quality goods.

Griliches (1961) was the first one to use hedonic prices to produce a quality adjusted automobile index[6]. Instead of deducing the unit values of products from values and quantities, the hedonic method regresses the price of the product on several characteristics[7].

In this study, we use hedonic UVR provided by P.H. van Mulligen (2001). The characteristics considered are length in meters and engine power (in horsepower). Data on prices, quantities and characteristics were retrieved from different sources for five countries: the USA, France, Germany, the UK and Italy. Hedonic prices are computed with a dummy variable on the country of origin. Coefficients of these dummies for France and Germany give the relative quality-adjusted price of French and German cars.

[6] For a more recent study using hedonic prices in the automobiles sector, see Gaulier and Haller (2000).

[7] For a detailed survey on hedonic prices, see OECD (2000).

The use of hedonic UVR for personal cars within the motor vehicles branch have radically changed our results. The average UVR for the motor vehicles that is not adjusted for quality amounts to 2,46 FF/DM, which impacts on the total manufacturing sector UVR at 3,25 FF/DM in 1997. The motor vehicles UVR is thus the lowest of all branch UVR. As shown in table 1, the motor vehicles branch UVR adjusted for quality amounts to 3,49 instead of 2,46. The total manufacturing UVR is also affected by this change: 3,41 instead of 3,25. Using the hedonic method we assume that the "average car" —which has the same characteristics, therefore the same quality, in the two countries— is cheaper in Germany than in France.

1.3. French and German manufacturing UVR differ roughly between benchmarks 1987 and 1997

The average unit value ratio for the manufacturing sector, which could be considered as a manufacturing output price parity between France and Germany, is 3,41 FF to 1 DM in 1997. This figure is very close to the value of the nominal exchange rate (3,37). Then, the French level of industrial prices, which compares the UVR to the nominal exchange rate, is slightly above the German one (101%).

The relative product prices are somewhat contrasted within the NACE branches (table 2). Basically, the French price levels are higher than the German ones in next to all branches with reliable UVR. They are notably higher in wearing apparel (112%), basic metals (111%), chemical products (109%), paper and paperboard products (109%) as well as in the furniture and miscellaneous products (109%).

These results stand out against the levels displayed in the former comparison achieved at the CEPII[8]. In the reference year 1987, the average price of the basket common to France and Germany stood at 3.06 francs per mark. The level of manufacturing prices then was by far lower in France than in Germany (92%). The sources of this discrepancy can be manifold: it may stem from the inflation differential; it may be ascribed to the impact of the German unification on industrial performances of both countries; it may also come from a shift in the composition of the basket between 1987 and 1997 or further from a change in the method used.

[8] See M. Freudenberg and D. Ünal-Kesenci (1994).

Table 2.
France-Germany unit value ratios
and relative price levels in manufacturing, 1997

NACE		Unit value ratios FF/DM	Relative French price level (Germany=100)
	Total manufacturing	**3.41**	**101**
15+16	**Food products**	**3.52**	**105**
	Textiles		
17	Spinning and weaving	*2.42	*72
18	Wearing apparel	3.78	112
19	Leather products	*2.81	*83
	Wood, paper, publish.		
20	Wood & wood products	2.55	76
21	Paper & paperboard	3.65	109
22	Publishing	3.39	101
	Chemicals		
24	Chemicals	3.68	109
25	Rubber & plastic prod.	3.23	96
26	Non met. mineral prod.	3.29	98
	Metal pr. & Machinery		
27	Basic metals	3.74	111
28	Metal products	3.31	98
29	Machinery & equipment	3.40	101
	Electric. pr., electronics		
30	Office mach., computers	*-	*-
31	Electrical machinery	3.14	93
32	Radio, TV & com. Equip.	*3.11	*92
33	Med., precision & optical	*2.82	*84
36	Manufacturing n.e.c.	3.67	109
	Transport equipment		
34	Motor vehicles	3.49	104
35	Other transport equipment	*4.01	*119
	Nominal exchange rate	3.37	
	PPP exchange rate	3.26	

Notes: On account of confidential data for tobacco in France, the food and tobacco industries are aggregated (NACE 15 + NACE 16). figures marked with asterisks correspond to branches, the UVR of which are not reliable. The relative price level is computed by dividing the UVR by the nominal exchange rate.
Sources: See appendix 2.

To compare the evolution of the two benchmark years, we first tried to remove the effect of the change in the method. The difference in the methods lies in the way UVR are aggregated on the one hand and in the use of hedonic prices for cars on the other hand.

When proceeding along the same aggregation steps for benchmark 1997 as for benchmark 1987 without hedonic prices for cars (see appendix 3), the UVR for the whole manufacturing sector amounts to 3,24 FF/DM in 1997 (table 3, column 2). Thus, the change in the aggregation method has no impact on the level of the manufacturing UVR (3,24 FF/DM against 3,25 FF/DM in the new method). On the contrary, the use of hedonic prices for cars brings about a considerable change (see previous section).

Column (3) of table 3 provides an alternative estimate for 1997, obtained by extrapolating forward the 1987 figure of column (2) using the implicit price indices of output from the national account statistics. The extrapolated UVR is very different from the last benchmark UVR: 2.91 FF/DM.

The growth rate between the 1987 and 1997 benchmark UVR estimates reaches 6% (column 4) whereas the growth rate between the 1987 benchmark estimate and the extrapolated UVR to 1997 displays a decrease by 5% (column 5). The difference between the two estimated UVR growth rates for 1997 appears in column (6). The positive difference of 12% for total manufacturing means that the 1997 benchmark value is higher than what would be expected from the 1987 reading, given the national account price indices between 1987 and 1997. For most major branches, the difference is significant.

To our opinion, the German unification plays a role to explain the gap between the two rounds of benchmarking, albeit less important than other factors we will discuss further. In table 3, extrapolated 1997 values for Germany have been calculated with a series of indices related to west Germany from 1987 to 1990 and to Germany as of 1991. When only focussing on west Germany, the total manufacturing extrapolated UVR amounts to 2.96 FF/DM in 1997 (see appendix 3).

Table 3.
FF/DM unit value ratios:
A comparison of benchmark and national account estimates

Major branches	FF/DM UVR (geometric average)			Growth rates (percent)		
	ICOP Benchmarks		Extrap.	97/87	97*/87	Difference
	1987	1997	1997*	[(2)/(1)-1]	[(3)/(1)-1]	[(2)/(3)-1]
	(1)	(2)	(3)	(4)	(5)	(6)
Total manufacturing	**3.06**	**3.24**	**2.91**	**6**	**-5**	**12**
Food products	3.04	3.49	3.15	15	4	11
Textiles	3.18	3.09	3.26	-3	2	-5
Wood, paper, publishing	3.11	3.43	2.88	11	-7	19
Chemicals	3.18	3.43	2.84	8	-11	21
Metal pr. & machinery	3.07	3.38	3.12	10	1	8
Electric. pr., electronics	3.05	3.26	2.42	7	-21	34
Transport equipment	2.84	2.57	2.80	-10	-1	-8
PPP (GDP)*	**3.20**	**3.24**	**3.09**	**1**	**-3**	**5**

Notes: The figures in the last line correspond to PPP FF/DM exchange rates calculated by the OECD, their benchmarks years being different from our UVR: 1985 (column 1) and 1996 (column 2 and 3). The benchmark PPP are extrapolated by the relevant growth rates.
Sources: See appendices 2 and 3.

These contradictory results between extrapolated and benchmark figures may as well come from mistakes in national accounts statistics as ones in the calculation of the benchmark UVR. In the latter case, the use of a detailed European classification in 1997 has definitely enabled us to increase the number of products making up the basket of industrial goods and thus improve its representativeness. Indeed, the common basket for the benchmark 1987 included only 237 matches which amounted to 18% of the manufacturing sector in both countries. For 1997, the 1 151 product matches which could be performed amounted to 33% of the total manufacturing average for France and Germany (see appendix 2.1).

With regard to mistakes in national accounts, the major problem between France and Germany lies in the method for measuring quality change in electronic products price indices[9]. Indeed, French national accounts use hedonic price indices for microcomputers while the German ones do not. In table 3, the largest gap between benchmark and extrapolated figures concerns precisely the major branch of electrical products and electronics. This methodological difference could however explain a relatively small fraction of the whole manufacturing gap. Actually, the branch of office machinery which contains microcomputers (NACE 30) amounts only to 2.1% of total manufacturing real value added in France and 1.2% in Germany in 1997 (see appendix 5).

The difference in results between the benchmark years and the extrapolated figures using national account growth rates has been observed many times in the International Comparisons Programme (ICP) studies since 1970. For instance, the benchmark PPP calculated for 1985 by the OECD amounts to 3.20 FF/DM and the one for 1996 reaches 3.24, i.e. an increase by 1.29% (the last line of table 3). The 1985 benchmark PPP extrapolated forward to 1996 gives 3.09 FF/DM, what corresponds to a decrease relative to the 1985 estimate by 3.44%. So for GDP, the OECD estimates extrapolated from the national accounts show the same discrepancies as the calculated manufacturing UVR.

In their article of 1993 on the successive ICP benchmark estimates, A. Heston and R. Summers wondered about the relationship between the country's exchange rate and its PPP over time. They observe that "when the U.S. dollar appreciates relative to the SDR as in 1985, then the effective exchange rate of dollar declines because costs or prices in the U.S. have not changed relative to those in other countries by as much as have exchange rates. While this may represent a situation that is not viable in the long

[9] In international comparisons, other methodological differences could come from the differences in national accounts systems or from the calculations of price-weighting. National accounts in France and Germany are established according to the same system, the 1995 European System of National Accounts (ESA95). However, French national accounts use chain-weighted price indices while the German ones use fixed-weight price indices. The France-Germany comparison currently uses the latter indices for both countries.

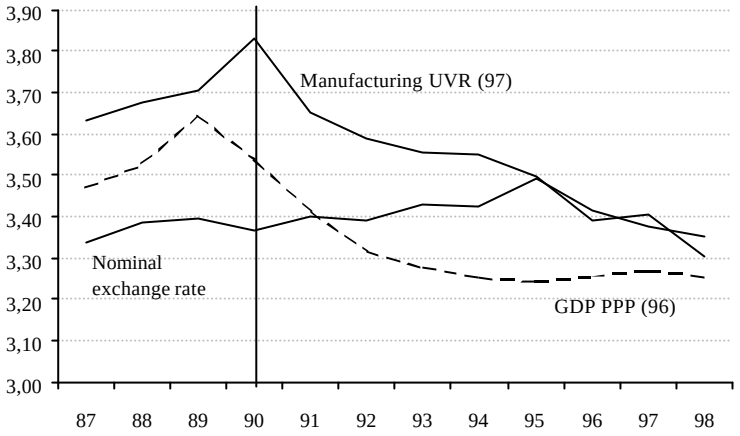
run, in the short run of a benchmark comparison, it will make the U.S. look affluent relative to production. The more favourable dollar will allow a number of prices in the U.S. to decline relative to previous levels and permit an increase in income." They believe those differences between successive benchmark estimates and national growth rates are partially explained by this terms of trade effect. According to them, the extrapolated value of the price level from 1990 back to 1985 is higher than the 1985 benchmark because the latter incorporated a terms of trade effect and a lower set of prices.

The logic of Heston and Summers can be applied to the ICOP France-Germany comparison to explain the gap between the benchmark and the extrapolated figures (table 3). As a matter of fact, the politics of *competitive disinflation* launched in France in the first part of the eighties to stabilise the exchange rate and improve the supply side could have given birth to this discrepancy.

1.4. The economic policy of *désinflation compétitive* and France-Germany relative price levels

In 1983, after a period of Keynesian expansionary policies, France has adopted an economic policy labelled *désinflation compétitive* (competitiveness through disinflation) which is maintained until today over several changes of governments. As noted by F. Lordon (1998), this policy, which is not based on any clear economic doctrine, could be presented as a pragmatic way imposed by the acceptance of the rules of the game of an opened up and internationalised economy. Nominal exchange stability, wage restraint and public finance discipline are its three mainstays. Congratulated for wiping out inflation, the *désinflation compétitive* has been on the other hand criticised because of its negative effects on growth and employment. The *désinflation compétitive* and its positive or negative aspects is not a shut case yet. Nevertheless, it is now admitted that the nominal exchange rate stability, strengthened by the mechanisms of wage restraint and public finance discipline, has notably affected the evolution of prices in the French economy. This argument can shed light on the France-Germany relative prices.

Figure 1.
France-Germany conversion rates, 1DM=xFF



Notes: The 1997 benchmark UVR value is extrapolated back and forward by the output price indices of the two countries.
Sources: See appendix 2.

The nominal exchange rate stability, namely the pegging of the franc to the deutschmark was conceived as the main instrument of disinflation. Except for the monetary turmoil episode of 1992, the pegging of the franc to the deutschmark has been rather inflexible since 1987 fluctuating within a 5% bracket in the context of a common decision within the exchange rate mechanism of the European monetary system. This stability was one of the mechanisms which prepared the set-up of the actual European monetary union.

Figure 1 presents the evolution of the nominal exchange rate and the manufacturing unit value ratio for France and Germany between 1987 and 1998. The exchange rate of the purchasing power parity for the GDP (measured by the expenditure approach) is also presented as a reference mark[10]. The results concern west Germany for the period 1987-1990 and reunified Germany as of 1991. The nominal exchange rate has remained roughly steady during the period. The FF/DM exchange rates for the manufacturing UVR and the PPP for the whole economy have moved similarly: both of them indicate a deteriorated price competitiveness for France until the German unification and a reversion of this tendency since 1991.

This break in the tendency since the German unification was rather important and led to a real depreciation of the FF/DM exchange rates. Figure 2 shows the real exchange rates for FF/DM in the manufacturing sector and the total economy. This indicator expresses

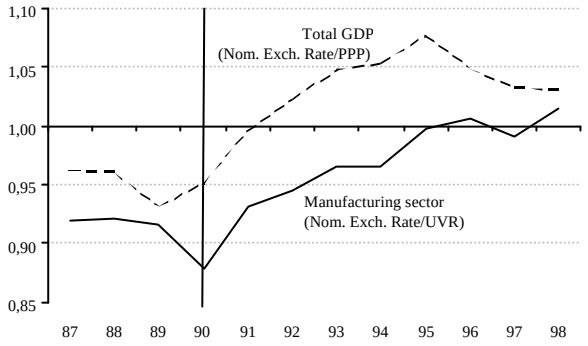
[10] Manufacturing UVR presented in figure 1, as well as relative prices, real output and productivity benchmark levels presented in this section are measured by using the hedonic prices for the motor vehicles branch.

the prices of foreign countries (P^*) converted in the national currency relative to national prices (P):

$$e_r = e \times \frac{P^*}{P} = \frac{e}{P/P^*}$$

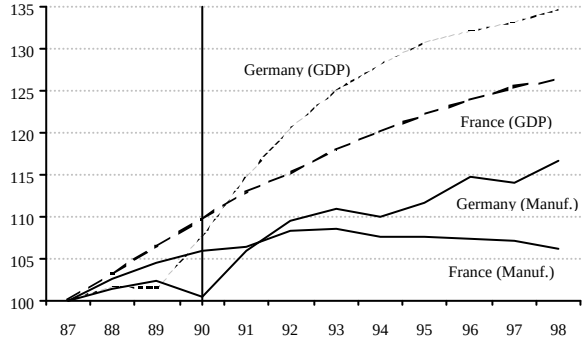
with P^* being the German price and P the French price.

Figure 2.
Real exchange rates in the manufacturing sector and the total economy



Note: Exchange rates are quoted 1 DM=xFF. An upwards curve indicates a real depreciation of the FF and vice versa.
Sources: See appendix 2.

Figure 3.
Implicit price index of manufacturing output and GDP (1987=100)



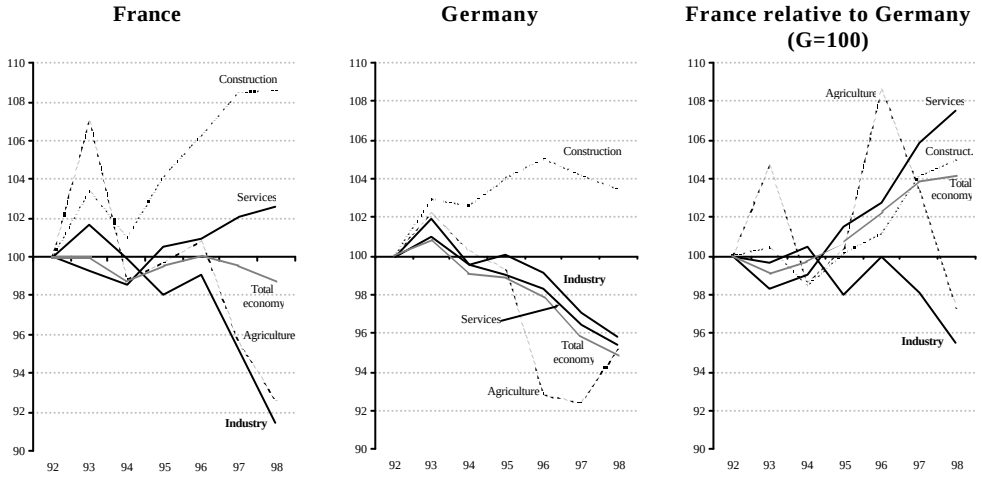
Sources: See appendix 2.

In figure 2**,** the real exchange rates are calculated by the "$e/UVR_{FF/DM}$" and "$e/PPP_{FF/DM}$" ratios. France clearly records competitive gains relative to Germany in both the manufacturing sector and the total economy as shown by the two curves going upwards. This real depreciation of the FF/DM can be explained both by the stability of

the nominal exchange rate (figure 1) and by a weaker growth of French prices relative to German ones (figure 3). The latter increased dramatically in Germany due to the rise in wages in the wake of the German unification boom. The real depreciation was more important in the manufacturing sector than in the whole economy. In 1990, the French relative price levels amounted to 114% of the German level for the manufacturing sector and to 105% for the total GDP, whereas they stand at 99% and 97% respectively in 1998.

As the pegging of the French franc to the deutschmark has involved to give up the use of the exchange rate as an adjustment instrument, the French firms have been compelled to cash in on competitiveness gains through the control over costs as well as the cut-down on their mark-ups. Figure 4 shows the evolution of the labour compensation share in value added in France and Germany for major economic sectors between 1992 and 1998. After the fast convergence of east German wages towards western German levels in the first years following German unification, Germany has led a moderate wage rate policy. The labour compensation share has then decreased in value added in all economic sectors (except construction)[11]. The evolution of the wage share was relatively stable in France at the aggregate level of total economy. But it has dramatically decreased in industry and agriculture, i.e. the sectors of tradable goods for which the nominal exchange rate plays a significant role.

Figure 4.
Evolution of the labour compensation share in value added for major economic sectors (at current prices, indices: 1992=100)



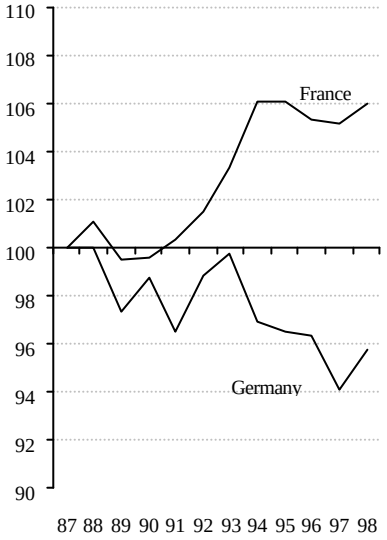
Sources: See appendix 2.

The politics of *désinflation compétitive* has entailed significant consequences on the French external trade. The pegging of the franc to the deutschmark has been in fact

[11] See Deutsche Bundesbank (2001a and 2001b), and P. Artus and D. Cohen (1998) for the evolution of factor compensation rates in value added since 1970 in Germany and France.

used as a macro incentive aiming at modifying the French specialisation (M. Aglietta and C. Baulant, 1993). French firms have been urged to commit into the production of goods in which the non price competitiveness prevails in order to overcome the drawback of a strong currency. The relative price indices of exports and imports, i.e. the terms of trade, for France and Germany are shown in figure 5. When the value of this indicator increases, the country's exports become more valuable or its imports are cheaper. It is exactly what is going on for France since the middle of the eighties. As to Germany, export prices have tended to decrease relative to import prices since the recession in Germany in 1993.

Figure 5.
Terms of trade

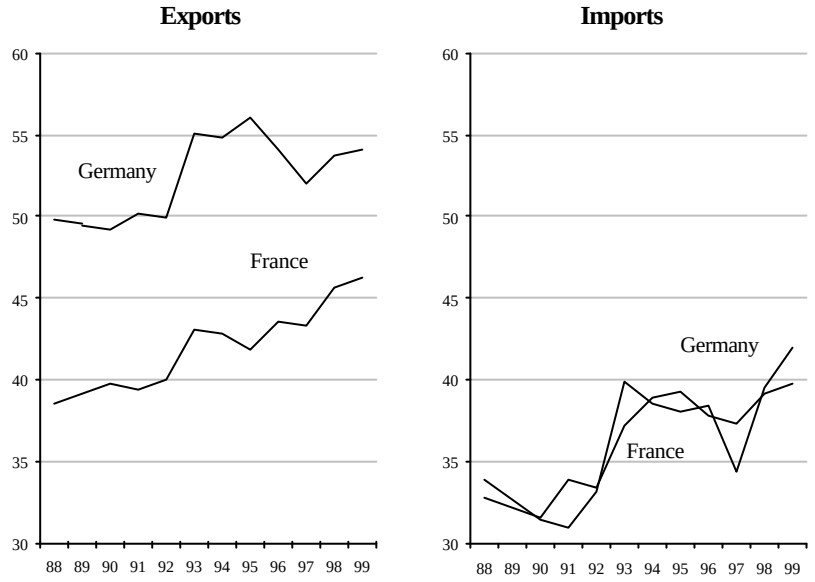


Note: The terms of trade are defined as the unit value of exports divided by the unit value of imports. The original figures were based on year 1995.
Source: IMF, IFS, yearbook 2000.

Figure 6 shows the share of high quality/price products in total manufacturing exports and imports for France and Germany between 1988 and 1999. The range of quality/price is calculated by comparing the unit values of French and German flows to a European norm (see box 2 for the methodology). The upper range points to more expenditures in R&D, a better labour qualification and thus higher production costs. The shares of upmarket products in the manufacturing imports of both countries are relatively close (about 40% in 1999) and have increased in the same proportions during the period. On the export side, Germany has been famous for the high quality of its products in international trade for ever. At the end of the 1980s, half of German exports ranked in high quality products against 38% for France. The last decade was a time of catch-up for France. Indeed, the share of the upper range flows has increased by 20% between 1988 and 1999 in the French sales whereas the increase in Germany was bounded to 9%.

As a conclusion, on one side the politics of *désinflation competitive* has deeply altered the supply conditions in France over the 1990s. On the other side, Germany has experienced a historical and economic break with unification[12]. These dramatic changes have indeed affected the composition of the French-German common basket of goods used to compute the manufacturing output production prices (UVR). The gap between the extrapolated and benchmark estimates (see previous section), that could be puzzling at first sight, points out very likely the upgrading of the French products.

Figure 6.
Share of high quality/price products in total manufacturing trade



Source: M. Freudenberg calculations from Eurostat, Comext data base.

[12] We will expand thoroughly on German unification in section 3.1.

Box 2.
The assessment of price-quality ranges

In the analysis of market segments in terms of price/quality in trade flows, it is assumed that the differences in unit values reflect difference in quality. In order to define price-quality ranges, the unit value of each flow at the most detailed level (product, reporting country, partner, export and import flow) is compared to an EC "norm": if the unit value of the most detailed flow exceeds 15% of the European average value, it is filed into the upper quality range, if it undershoots this threshold, it is put into the lower-quality range and otherwise, this flow is categorised in the middle-quality range (for a detailed methodology, see Freudenberg, 1998).

In order to keep geographical and sectoral biases as low as possible, calculations are carried out at an eight-digit level (about 10 000 products) of the European "Harmonised System" classification, for the bilateral trade of EU member-countries vis-à-vis some hundred partners.

The difficulty to take into account the quality differences is one of the sharpest critic uttered towards the ICOP methodology. The quality problem is generally not considered in the calculation of the conversion rates of a benchmark year. Nonetheless, as it could be emphasised, the evolution of the supply quality can be traced in the results of the different benchmark years.

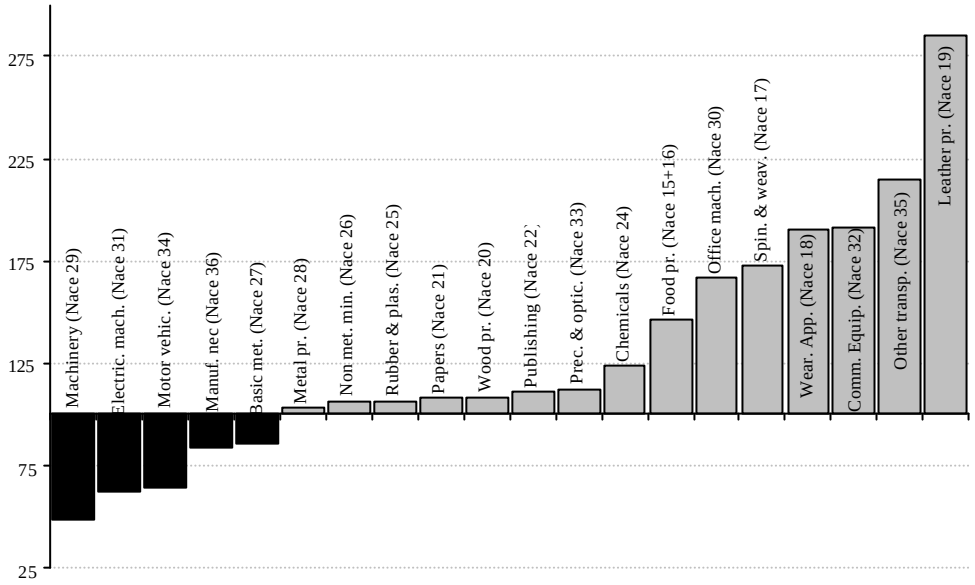
Endearing of the common basket of products between the two benchmark years in disfavour of France impacts significantly on the assessment of its real production in the manufacturing sector (see appendix 3). Consequences on this quality/price effect on productivity and subsequently on the unit labour costs must be assessed in order to pinpoint the position of both countries with respect to their cost competitiveness. In next section the French-German relative levels of output and productivity will be then analysed for the benchmark year 1997.

2. RELATIVE OUTPUT AND PRODUCTIVITY LEVELS IN 1997

2.1. Value added

Unit value ratios presented previously are used here to assess the relative levels of the real production of France relative to Germany. In other words, the French production is valued with a relative price system common to both countries. In order to avoid double accounting due to intermediate inputs, the concept considered here is value added at factor costs instead of gross value of production.

Figure 7.
Specialisation of the French manufacturing production relative to Germany, 1997
(Germany=100, manufacturing sector =100)



Note : The indicator of production specialisation compares the relative level of value added by branch between France and Germany to the relative level for the whole manufacturing sector (47% in 1997).
Sources : See table 4**.**

Gross "real" value added can be computed according to two methods. The first one consists in deflating separately the final production and the inputs by their corresponding UVR. The difference between both ratios yields the real value added. Even if the method seems more relevant, it is not easily put into practice as UVR for intermediate inputs are not reliable. For the time being, the lack of reliable information about input prices precludes this possibility. Applying this method in the manufacturing sector has failed as separate estimated UVR have sometimes led to negative value added. Therefore in this paper, the method of the "single indicator" will be used. The UVR calculated from product unit values are directly applied to the gross value added. Implicitly, this means that relative input prices and product prices are assumed to be identical[13].

In 1997, French real value added in manufacturing is twice as small as the one of Germany (47%, table 4). There are strong disparities across branches relative to the average. In order to assess the specialisation in production of both countries, the relative levels for each branch were compared to the manufacturing average (figure 7). Thus, Germany is more specialised in machinery and equipment, electrical machinery

[13] See B. van Ark and M. Timmer (2001) for a detailed discussion on this subject.

products and motor vehicles. To a lesser extent, German specialisation is also more pronounced in metal products and other manufacturing. As the French value added composition appears to be less concentrated than the German one[14], France seems to be more specialised in all the other branches. France is relatively more committed in the chemical and food products, two heavy weight branches. Textiles (spinning and weaving, wearing apparel, leather articles), other transport equipment, office machines and communication equipment record by far the biggest differences but the size of these branches is quite limited.

2.2. Labour input and capital stock

The relative level of employees in manufacturing between France and Germany is slightly higher than the one of the relative output in 1997 (50%, table 4). The annual average actual working time is quite different between France and Germany: 1 604 hours against 1 566 respectively on average in the manufacturing sector (table 5). In most branches, people work longer hours in France. For instance, the level of hours worked per employee relative to Germany stands at 116% in the wearing apparel branch (table 4).

[14] See structures of output and inputs of both countries in appendix 5.

Table 4. :Relative French levels of output, inputs, capital intensity and productivity in 1997 (Germany=100)

		Value Added	Labour input			Capital Stock	Capital intensity		Partial productivity			Total factor productivity	
			Employees	Annual Hours	Total Hours				Labour		Capital		
									per employ.	per hour			
		(VA)	(L)	(H)	(LH)	(K)	(K/L)	(K/LH)	(VA/L)	(VA/LH)	(VA/K)	(TFP[L])	(TFP[LH])
	Total Manufacturing	**47**	**50**	**102**	**51**	**58**	**116**	**113**	**94**	**92**	**81**	**90**	**88**
15+16	**Food products**	**69**	**65**	**92**	**59**	**81**	**125**	**136**	**106**	**115**	**85**	**99**	**106**
	Textiles	**89**	**106**	**107**	**114**	**66**	**62**	**58**	**84**	**78**	**135**	**96**	**92**
17	Spinning and weaving	81	90	103	92	59	66	64	90	88	137	102	100
18+19	*Wearing apparel & leather*	*100*	*126*	*113*	*142*	*88*	*70*	*62*	*80*	*71*	*115*	*89*	*81*
18	Wearing apparel	89	118	116	136				76	66			
19	Leather products	134	150	104	155				89	86			
	Wood, paper, publishing	**52**	**46**	**102**	**47**	**47**	**104**	**101**	**113**	**111**	**109**	**112**	**110**
20+21	*Wood & paper*	*51*	*55*	*100*	*55*	*60*	*110*	*111*	*93*	*94*	*85*	*90*	*91*
20	Wood & wood products	51	48	97	46				107	110			
21	Paper & paperboard	51	60	102	61				84	83			
22	Publishing	52	39	104	41	35	88	85	133	127	151	138	134
	Chemicals	**54**	**55**	**99**	**54**	**59**	**108**	**109**	**99**	**100**	**91**	**97**	**97**
24+25	*Chemicals, plast. & rubber*	*55*	*56*	*100*	*56*	*62*	*110*	*110*	*99*	*99*	*90*	*96*	*96*
24	Chemicals	58	56	101	56				104	104			
25	Rubber & plastic prod.	50	56	99	56				89	90			
26	Non met. Mineral prod.	50	51	97	50	52	101	104	98	101	97	98	100
	Metal pr. & Machinery	**33**	**40**	**104**	**41**	**51**	**128**	**123**	**82**	**79**	**64**	**77**	**74**
27	Basic metals	40	48	106	50				85	80			
28	Metal products	48	57	102	58				85	83			
29	Machinery & equipment	23	27	105	28				84	80			
	Electric. pr., electronics	**47**	**49**	**106**	**52**	**57**	**118**	**111**	**96**	**90**	**81**	**91**	**88**
30	Office mach., computers	78	70	104	72				112	108			
31	Electrical machinery	29	32	107	35				91	85			
32	Radio, TV & com. Equip.	90	96	109	105				94	86			
33	Med., precision & optical	53	51	104	53				104	100			
36	Manufacturing n.e.c.	39	48	106	51				82	77			
	Transport equipment	**39**	**45**	**107**	**49**	**55**	**121**	**113**	**86**	**80**	**71**	**81**	**77**
34	Motor vehicles	30	37	107	40	54	145	135	81	76	56	73	70
35	Other transport equipment	101	96	107	103	63	65	61	105	98	161	119	113

Sources: See appendix 2.

Table 5
Employees and annual average working time
France-Germany, 1997

		Employees (1000 persons)		Annual average working time per employee (hours)		Total hours worked (millions of hours)	
		France	Germany	France	Germany	France	Germany
	Total Manufacturing	**3 249**	**6 495**	**1 604**	**1 566**	**5 211**	**10 171**
15+16	**Food products**	**388**	**600**	**1 571**	**1 710**	**609**	**1 026**
	Textiles	**260**	**245**	**1 582**	**1 480**	**411**	**362**
17	Spinning and weaving	119	132	1 591	1 550	189	205
18+19	*Wearing apparel & leather*	*141*	*112*	*1 574*	*1 399*	*222*	*157*
18	Wearing apparel	98	84	1 574	1 358	155	114
19	Leather products	43	29	1 574	1 518	67	43
	Wood, paper, publishing	**295**	**648**	**1 609**	**1 573**	**475**	**1 020**
20+21	*Wood & paper*	*147*	*269*	*1 635*	*1 635*	*240*	*441*
20	Wood & wood products	56	117	1 635	1 678	91	196
21	Paper & paperboard	91	153	1 635	1 603	150	245
22	Publishing	148	379	1 596	1 528	236	579
	Chemicals	**614**	**1 121**	**1 599**	**1 611**	**981**	**1 806**
24+25	*Chemicals, plast. & rubber*	*483*	*865*	*1 592*	*1 593*	*770*	*1 378*
24	Chemicals	283	510	1 592	1 581	451	807
25	Rubber & plastic prod.	200	355	1 592	1 611	319	572
26	Non met. mineral prod.	130	256	1 627	1 670	212	427
	Metal pr. & Machinery	**726**	**1 836**	**1 628**	**1 566**	**1 183**	**2 875**
27	Basic metals	130	273	1 628	1 539	212	420
28	Metal products	330	578	1 628	1 602	537	926
29	Machinery & equipment	267	985	1 628	1 552	434	1 528
	Electric. pr., electronics	**559**	**1 148**	**1 605**	**1 512**	**898**	**1 736**
30	Office mach., computers	41	59	1 605	1 547	66	91
31	Electrical machinery	160	496	1 605	1 499	257	743
32	Radio, TV & com. Equip.	134	139	1 605	1 475	214	205
33	Med., precision & optical	111	218	1 605	1 547	177	338
36	Manufacturing n.e.c.	114	237	1 605	1 519	183	359
	Transport equipment	**407**	**897**	**1 606**	**1 503**	**654**	**1 348**
34	Motor vehicles	286	771	1 615	1 506	462	1 161
35	Other transport equipment	121	126	1 587	1 480	192	187

Sources: See appendix 2.

Total hours worked are obtained by multiplying the annual average working time by the employees. With a French level of employees at 50% of the German one but a relative level of 102% for hours worked per person, total hours worked in France amount to about 51% of the German level in 1997. Relative levels by branch for total hours can drift apart from those for value added, involving a quite important relative productivity gap as it will be seen further below. Thus, in the food branch (NACE 15), the value added level in France makes up 69% of the one of Germany whereas the relative level of hours worked amounts to only 59%.

In 1997, the French stock of capital in the manufacturing sector amounts to 58% of the German stock (table 4). In the sectoral breakdown, the relative level of French capital is weaker in the major branch "metal products and machinery" (51%) while it is higher in the food industries (81%).

The capital intensity is higher in France than in Germany: 116% per employee and 113% per hour for the manufacturing average in 1997 (table 4). Several major branches are far apart from this average. In the major branch of textiles, the French capital intensity per hour amounts to only 58% of the German level. Indeed, the relative level of hours worked amounts to 114% while the one of the stock of capital makes up only 66% of the German stock. As a matter of fact, the textiles industries are significantly more capital-intensive in Germany than in France which rests mainly on labour. On the contrary, the French capital intensity levels outreach the German ones in the major branches "food" (136%) and "metal products & machinery" (123%). In the "transport equipment" major branch, which is broken down in motor vehicles and other transport equipment, differences are puzzling. French capital intensity per hour in motor vehicles is greatly above the German level (135%). On the contrary, in the branch "other transport equipment", the relative level of capital intensity is somewhat weak (61% per hour). This is mainly due to a higher relative level of hours worked in France (103%).

2.3. Labour, capital and total factor productivity

The last columns of table 4 show the relative levels of productivity. Those are computed from the relative levels of output and input of the preceding columns. On account of a not detailed enough classification for capital, results for capital productivity and total factor productivity are presented at a more aggregated level of the classification.

Producing about 47% of the German value added with 50% of German employees, France performs poorer in terms of labour productivity in the manufacturing sector (94%) than Germany in 1997. As the annual working time in France is longer, the relative level of the hourly labour productivity is even lower (92%). Germany performs better in the electric and mechanical branches which are located in the second half of table 4. Hourly labour productivity in the major branch "metal products and machinery" as well as in the branches "motor vehicles", "electrical machinery", "telecommunication equipment" and "other manufacturing" is about 20% above the French level. Among the electric and mechanical branches, French productivity outperforms nonetheless the German one in "office machinery and computers" (108%), and draws level with Germany in the "medical, precision and optical instruments" and "other transport equipment" branches.

French best record in terms of hourly labour productivity is rather located in branches of the upper part of table 4 publishing and printing products (127%), food (115%), wood (110%) and chemical products (104%). The major branch textiles looks a bit strange. Basically, France is less productive than Germany in textiles (78%) and namely in the "wearing apparel" branch (66%). As underlined above, the textiles industries are significantly more capital-intensive in Germany than in France which rests mainly on labour. "Wearing

apparel" and "leather products" are the two sole branches where French employees are many relative to German ones.

Table 4 shows further that sectoral performances with respect to capital productivity are quite uneven. As the French stock of capital represents 58% of the German level, the French capital productivity is then rather weak (81%). Results regarding major branches such as "food products" and "electrical products and electronics" lie in the manufacturing average. France displays better performances than Germany in the textile and wood products (135 and 109%), whereas the German productivity is 36% above in "metals products and machinery" and 29% in "other transport equipment".

The total factor productivity is here computed with a Cobb-Douglas function of production (see appendix 6). Because the share of wages in production (α) reaches for both countries on average 71% of the manufacturing sector GDP, the total factor productivity is then closer to the labour productivity than to the capital one. In 1997, in terms of hours, the French total factor productivity amounts to 88% of the German one in the manufacturing sector. Sectorwise, "wood, paper and publishing" and "food" major branches rank first in France relative to Germany (110% and 106% respectively) whereas Germany takes the lead in "metal products and machinery" with 126% and in "electrical products" with 112%.

2.4. Unit labour costs

The investigation of the productive performance is closely intertwined with the analysis on the costs of factors. By producing a specific good, the manager-investor compares the cost to be borne to the return to be expected from the investment. Usually in international comparisons, the indicator of unit labour costs is used to enhance this process. Unit labour costs are defined as total labour compensation per hour, divided by real output per hour.

The main difficulty in comparing unit labour costs across countries lies in the translation of the denominator into common currency units. The originality of this study rests, in the one hand, on the assessment of output by industrial branch converted by production price parity rates (UVR) and in the other hand, on the use of compensation data coming from the same surveys as value added and employees. Statistics from firm annual surveys allow thus to compare the unit labour costs of France and Germany at a four digit level of the NACE Rev.1 for the year 1997.

In contrast with international comparisons of productivity, compensation of employees are quoted in current prices and then are not controlled for differences in relative prices between countries.

Therefore, the numerator of the indicator of unit labour costs (compensation of employees) is assessed in nominal terms whereas the denominator (the output) is quoted in real terms:

$$\textbf{(1)} \qquad \frac{ULC^{F}_{DM}}{ULC^{D}_{DM}} = \frac{\left(\frac{(W/LH)^{F}_{FF}}{NER_{FF/DM}} \right)}{(W/LH)^{D}_{DM}} \Bigg/ \frac{\left(\frac{(VA/LH)^{F}_{FF}}{UVR_{FF/DM}} \right)}{(VA/LH)^{D}_{DM}}$$

with ULC unit labour costs, W/LH compensation per hour, VA/LH gross value added at factor cost per hour, UVR unit value ratio, NER nominal exchange rate, F France, D Germany.

This difference in the assessment of the input cost and of the output price points to a definition of the cost-competitiveness **as the nominal cost that must be supported by an investor in order to produce one unit of value added that can be compared in both countries**.

The first two columns of table 6 show hourly labour compensation in France and Germany. Employees compensation data refer to gross earnings paid in each fiscal year to employees. It entails all forms of compensation including commissions, dismissal pay, bonuses, vacation and sick leave pay, compensation in kind and excludes employers' social security contributions. In 1997, an hour's work costs about a quarter less in France than in Germany in the manufacturing sector in nominal terms, respectively 30 DM vs. 41 DM[15]. If employers' contributions were included in the calculation just as the Bureau of Labour Statistics of the US does, then compensation costs converted from US dollars into DM would reach 31 DM for France vs. 46 DM for Germany, what results in an even lower ratio in favour of France (about by a third), a token that employers contributions in Germany are higher than in France (BLS, 2000).

Hourly compensation costs vary a lot. For both countries, in the three branches of "textiles" where the intensity of low-skilled labour is high, compensation per employee is one of the lowest in the manufacturing sector. In the electric and electronic industries where labour is high-skilled, hourly costs are among the highest of the manufacturing sector.

[15] A study from INSEE (2000) on labour costs shows the same gap between both countries. The latter is related to 1996 and bears only on the western part of Germany. Nonetheless, as pointed out by the Financial Agency of the French Embassy (2000), as Germany resorts less to outsourcing than France, a lot of high-wages services (law, consulting, computing) are included in the manufacturing sector in Germany. This contributes to inflating labour costs in the manufacturing sector on the one hand and to downplay the role of services in the economy on the other hand.

Table 6.
French relative levels of unit labour costs, 1997

NACE		Compensation per hour			Labour Productivity per hour	Unit labour costs
		France DM (1)	Germany DM (2)	Germ=100 (3)=(1)/(2)	Germ=100 (4)	Germ=100 (5)=(3)/(4)
	Total Manufacturing	**30**	**41**	**73**	**92**	**80**
15+16	**Food**	**28**	**27**	**103**	**115**	**89**
	Textiles	**22**	**31**	**73**	**78**	**93**
17	Spinning and weaving	23	31	75	88	85
18	Wearing apparel	21	31	69	66	105
19	Leather products	22	28	78	86	91
	Wood, paper, publishing	**31**	**34**	**91**	**111**	**82**
20	Wood & wood products	22	32	68	110	62
21	Paper & paperboard	29	38	77	83	93
22	Publishing	35	33	107	127	84
	Chemicals	**33**	**42**	**78**	**100**	**79**
24	Chemicals	39	50	78	104	75
25	Rubber & plastic products	26	35	75	90	84
26	Non met. mineral products	29	35	82	101	82
	Metal products, machinery	**28**	**41**	**67**	**79**	**84**
27	Basic metals	31	43	72	80	90
28	Metal products	25	37	69	83	83
29	Machinery & equipment	29	44	66	80	82
	Electrical pr., electronics	**32**	**44**	**73**	**90**	**81**
30	Office mach., computers	46	60	77	108	71
31	Electrical machinery	30	47	63	85	75
32	Radio, TV & com. Equip.	34	49	70	86	81
33	Med., precision & optical	35	40	87	100	87
36	Manufacturing n.e.c.	24	34	71	77	91
	Transport equipment	**31**	**51**	**61**	**80**	**77**
34	Motor vehicles	29	51	56	76	74
35	Other transport equipment	38	52	73	98	74

Sources: See appendix 2.

The position of some branches relative to the manufacturing average can be quite different in both countries. For instance in the "motor vehicles" branch, with 56% the relative French gross compensation per hour is the lowest of the whole manufacturing sector (column 3, table 6). Actually, compensation per hour in the French automobile sector is close to the manufacturing average. On the contrary, "motor vehicles" belongs to branches fraught with high unit labour costs in Germany.

Column (5) of table 6 displays relative French levels of unit labour costs. They result from the comparison of column (3) "relative hourly labour compensation" and of column (4) "relative hourly labour productivity". In 1997, unit labour costs are 20% lower than German ones for the manufacturing sector average. Because of the relative weakness of hourly compensation, it is more attractive for an investor to produce in France than in Germany, and this in spite of a least hourly labour productivity. With the exception of "wearing apparel", unit labour costs are weaker in France relative to Germany in all manufacturing branches, but with a very high dispersion relative to the manufacturing average. The scale goes from 71% (office machinery and computers) to 105% (wearing apparel). In other words, in next to all branches, France has got an absolute advantage relative to Germany. This cost-competitiveness in favour of France in 1997, so before the coming into effect of the cutback in the working time from 39 to 35 hours without wage reduction, may have somewhat eroded since.

2.5. Comparative advantages

The confrontation of unit labour costs for each branch between France and Germany made in the previous section has allowed to assess the absolute costs advantages in terms of hourly labour costs in both countries. This measure is of particular interest when the attraction of the national territory is considered in the optic of potential investors. However, policy-makers can be more concerned with another view, the country specialisation along its comparative advantages, in order to retrieve gains in international trade and improve welfare. The principle of Ricardo's comparative advantage can be defined as follows: to the necessary and sufficient condition there exists a difference between the observed comparative costs in autarky across several countries, each country should specialise to its benefit in and export goods for which it has got the largest comparative advantage or the least comparative disadvantage, and imports in exchange the other goods from its partners[16].

The Ricardian formulation refers basically to autarkic domestic relative costs of products in each country, and then to an international comparison of these relative prices. If the production costs of goods are assumed to depend, roughly, on the quantity of labour used to produce them and if each country specialises and export goods for which its costs are the lowest, the exchange of these goods at a rate included in the comparative costs bracket, provides countries with a gain and even a country that is not favoured in absolute terms for all goods will gain in international trade relative to the autarkic situation.

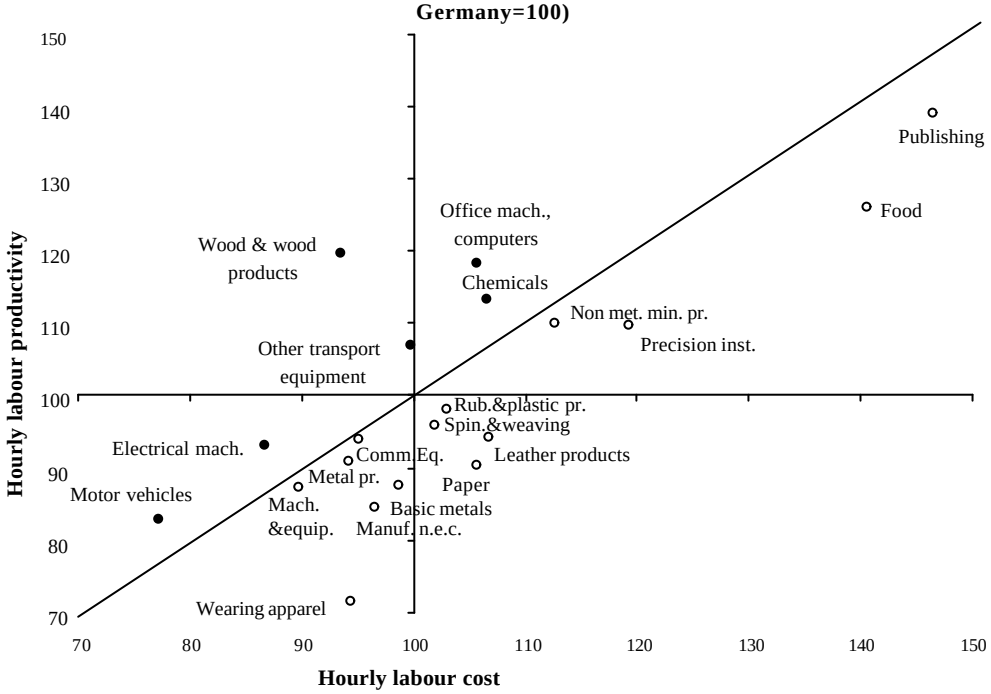
The Ricardian logic on comparative advantages was called upon in order to interpret our results. We then divided French unit labour costs by branch relative to Germany (column 5 of table 6) by the manufacturing average (80%). The results are displayed in the first column of table 7. A value above 100 means a comparative disadvantage relative to Germany and a value below 100 points out a comparative advantage. As the base of comparative advantage is to be found in a difference in the autarkic costs, theoretical comparative

[16] See B. Lassudrie-Duchêne & D. Ünal-Kesenci (2001) for an survey on the principle of comparative advantage.

advantages cannot be assessed. The first measure put forward in table 7 is one of comparative advantages revealed by the unit labour costs observed in two open economies.

Figure 8 synthesises the information on hourly labour costs and labour productivity, two components of the unit labour costs, in the framework of comparative advantages. It plots the relative hourly labour costs on the horizontal axis and the relative hourly labour productivity on the vertical one. The value by branch of the two indicators are here divided by the total manufacturing figures. The diagonal means that the relative hourly labour costs are equal to the relative hourly labour productivity and keeps branches with a comparative advantage apart from the ones with a disadvantage.

Figure 8.
France revealed comparative advantages by unit labour costs relative to Germany
Branch positions relative to the manufacturing average (total manufacturing=100 and Germany=100)



Source: table 6.

The area above the diagonal corresponds to France's comparative advantages relative to Germany in 1997. The latter can be filed into three groups according to the relative compensation and productivity levels. In these branches, the relative weakness of French unit labour costs stems from:

– *A least compensation of labour costs and a better productivity*: "wood and wood products" (NACE 20) and "other transport equipment" (NACE 35).

– *A higher level of productivity that outbalances higher costs*: "chemical products" (NACE 24) and "office machinery and computers" (NACE 30).

– *Weaker costs outbalancing a weaker productivity*: "electrical machinery" (NACE 31) and "motor vehicles" (NACE 34).

Table 7.
France-Germany revealed comparative advantages, 1997
(Germany=100 and manufacturing sector=100)

NACE		By unit labour costs	By Balassa's index
	Total Manufacturing	**100**	**100**
15+16	**Food**	**112**	**270**
	Textiles	**116**	**123**
17	Spinning and weaving	106	100
18	Wearing apparel	132	156
19	Leather products	114	146
	Wood, paper, publishing	**103**	**104**
20	Wood & wood products	78	124
21	Paper & paperboard	117	103
22	Publishing	105	94
	Chemicals	**99**	**108**
24	Chemicals	94	116
25	Rubber & plastic products	105	88
26	Non met. mineral products	102	131
	Metal products, machinery	**105**	**73**
27	Basic metals	113	106
28	Metal products	104	76
29	Machinery & equipment	103	62
	Electrical pr., electronics	**101**	**91**
30	Office mach., computers	89	159
31	Electrical machinery	93	84
32	Radio, TV & com. Equip.	101	136
33	Med., precision & optical	109	73
36	Manufacturing n.e.c.	114	62
	Transport equipment	**96**	**100**
34	Motor vehicles	93	71
35	Other transport equipment	93	406

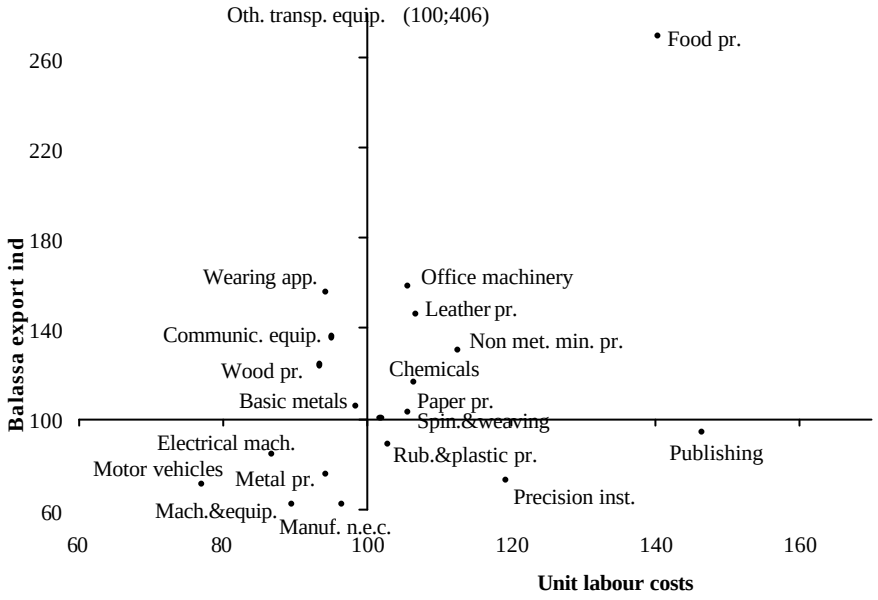
Notes: In the first column, a value above 100 means a comparative disadvantage revealed by ULC relative to Germany and to the manufacturing average. In the second column, on the contrary, a value above 100 means a comparative advantage revealed by international trade relative to Germany and to the manufacturing average.
Sources: Table 6 and authors' calculations from CHELEM data base of CEPII.

The area below the diagonal corresponds to France's comparative disadvantages relative to Germany in 1997. French relative unit labour costs are here above the manufacturing average. Branches are again broken down into three groups:

- *branches where costs are high and productivity is lower than the manufacturing average:* "spinning and weaving" (NACE 17), "leather products" (NACE 19), "paper and paperboard" (NACE 21) and "rubber and plastic products" (NACE 25). This is the least favourable case.
- *branches where costs and productivity are high*: "food products" (NACE 15 and 16), "printing and publishing" (NACE 22), "non metallic mineral products" (NACE 26) and "medical, precision and optical instruments" (NACE 33).
- *branches where costs and productivity are weak*: "wearing apparel" (NACE 18), "basic metals" (NACE 27), "metal products" (NACE 28), "machinery and equipment" (NACE 29), "telecommunication equipment" (NACE 32) and "other manufacturing products" (NACE 36).

For some branches, results can be striking. Contrary to expectations, the food industries point to a comparative advantage for Germany relative to France and the reverse is true for motor vehicles. Given the information pieces provided by both axes, the hourly labour productivity in the food products is above the French manufacturing average as well as above the German level. This relative productive "superiority" is, however, outbalanced by a relative higher wage compensation. The same explanation can work for the relative disadvantage of Germany in the motor vehicles industry.

Figure 9.
Two indicators of comparative advantage in 1997
France relative to Germany (total manufacturing=100 and Germany=100)



Source: Table 7.

Conceptually, the comparative advantage can be measured as well by indicators that reveal the factors of relative superiority or of least inferiority within a domestic economy (unit labour costs) as by indicators that reveal it in international trade. The insertion of an economy in international trade involves a specialisation according to its comparative advantages.

In that respect, it seems interesting to compare the results of both types of indicators. The second column of table 7 shows the values for the Balassa's revealed export comparative advantage index. The latter divides the relative share of French exports by branch in the manufacturing exports by the German relative share in the same branch. A value above 100 means a comparative advantage relative to Germany and a value below 100 points out a comparative disadvantage.

Results of both indicators in table 7 must be read with caution. As an example, in the "rubber and plastic products" (NACE 25) branch, the result in the first column (unit labour costs), 105%, shows a comparative disadvantage for France relative to Germany and to the manufacturing average. The result of the second column (Balassa export index), 88%, also indicates a comparative disadvantage for France.

Figure 9 shows clearly that both indicators do not fluctuate in the same direction for all branches. If both indicators pointed to comparative advantages (disadvantages), then branches should be concentrated in the upper left part (lower right-hand part). But they are

spread all over the graph. In other words, the trade specialisation of a country can drift apart the pattern of its unit labour costs. Comparative advantages are then not necessarily based on differences of relative production costs.

In the right-wing upper part, France benefits by comparative advantages in international trade whereas its unit labour costs are relatively high (food products, office machinery, leather products, non metallic mineral products, chemicals and paper products). Symmetrically, in the left-wing lower part, Germany records comparative advantages with high unit labours costs (electrical machinery, motor vehicles, metal products, machinery and equipment). These two parts display branches where relative quality or technology differences prevail upon the comparative costs gap of both countries as a determinant of international specialisation. Nonetheless, the too aggregated level of classifications do not allow us to draw strong conclusions but further research could give new evidence on the links between the specialisation of a country in international trade and the hierarchy of its comparative costs.

3. EVOLUTION SINCE THE GERMAN UNIFICATION

3.1. Restructuring of the German manufacturing sector

In 1991, several months after unification, east German Länder made up only 4% of the manufacturing value added and 6% of the stock of capital relative to its west German counterpart (table 9). Further, employees represented a fifth of those of west Germany (22%). But the east German average working time was about a quarter shorter than the one of the western part: 1 181 hours per employee in the east against 1 573 in the west. In terms of total hours worked, east Germany reached a level of 16% of the west German one in 1991 (appendix 8).

The German industrial restructuring exacted a real toll on the east German employees. Their number has decreased by 64% between 1991 and 1999 and the average working time has gone up by 43% (figure 10). The German industrial policy was favourable on the contrary to the capital input in the east. The east German capital stock has increased by 49% against only 3% in the west. The drop in employment and the increase in the working time have been clear-cut in the two years following the unification. Levels have stabilised since. On the contrary, capital accumulation after a slowdown in the middle of the decade, has kept going at a rather steady pace. The capitalistic intensity has been thrice as high entailing a growth of the value added of 75% in the decade.

Figure 11 shows the evolution of east German relative levels in the manufacturing sector over the period 1991-1999. The eastern Länder have made a breakthrough in terms of catch-up with west Germany. Hourly labour productivity in the manufacturing sector except energy there that hardly reached 23% of the west German level stands now at 60%. Due allowance being made to the huge capital accumulation in east Germany, the east German catch-up is lower for this input (73% in 1999 against 62% in 1991). The relative level of the east German capitalistic intensity that is now twice as high as in 1991 comes now quite closer to the level of the western Länder.

The east German catch-up was quite significant but came to a stop since the middle of the 90s (table 8). The relative level of the hourly labour productivity that had increased by 17% per year on average in the first half of the decade has been rolling at a pace of 3% only in the second half. The same goes for the capital productivity. The catch-up of value added has then slowed down over time (6.3% in 91-95 against 4.7% in 95-99).

Table 8.
Relative East-West German manufacturing growth

	Average annual growth rate		
	91-99	91-95	95-99
Value added	6.1	6.3	4.7
Total hours worked	-4.3	-8.9	1.3
Capital stock	4.2	3.2	4.3
Capital intensity	8.9	13.2	3.0
Hourly labour productivity	10.9	16.6	3.4
Capital productivity	1.9	3.0	0.4

Source: Figure 11.

According to Klodt (1999), if the productivity growth rate experienced in east Germany in the two or three years following unification have been maintained, then convergence with west Germany would have been completed in 1998. The puzzle hinted by the stopping of the convergence in east Germany is worth some explanations.

The capital intensity is considered as rather high in east Germany. This view is conveyed by the very large subsidies earmarked there to the industry. Indeed, in 1998, DM 140 billions in subsidies were transferred in net to east Germany, 60 billions of which to firms. Subsidies were especially dedicated to capital intensive industries, which require less new technologies than skilled labour industries and which have a lower labour productivity (Klodt, 1999). It was widely believed by policy-makers that increasing the capitalistic intensity would foster a quicker convergence. According to Gerling (2000), technical progress would become quite smaller when capital-intensive industries are heavily subsidised.

Table 9.

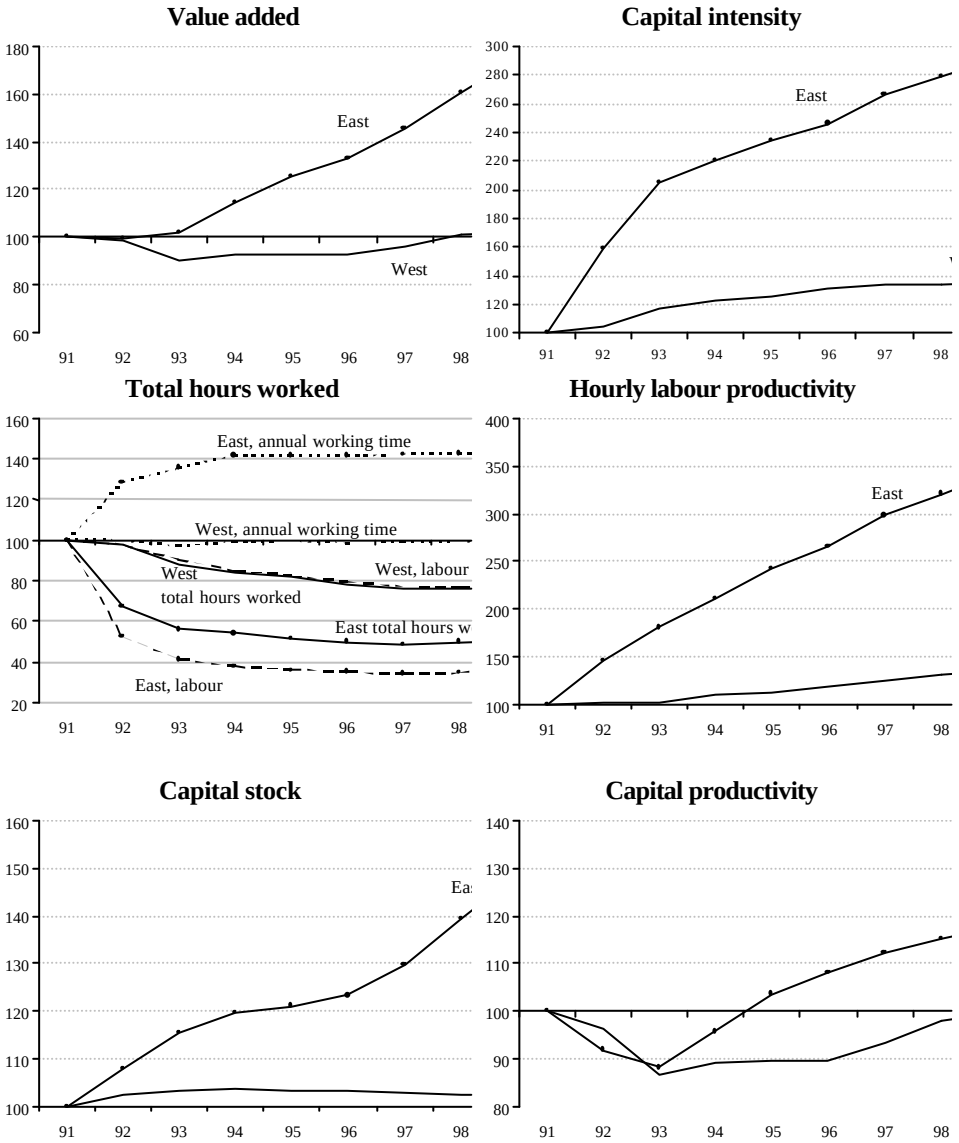
Relative East Germany manufacturing output and inputs levels in 1991 and 1999 (West Germany=100)

NACE		Value added (in 95 prices)		Capital stock		Total Hours worked		Employees		Annual working time	
		91	99	91	99	91	99	91	99	91	99
	Total Manufacturing	**4**	**7**	**6**	**9**	**16**	**11**	**22**	**10**	**75**	**108**
	Food	**6**	**12**	**5**	**13**	**22**	**19**	**26**	**18**	**86**	**104**
15	Food and beverages	6	13	6	13	22	19	26	18	86	104
16	Tobacco	2	4	3	5	18	9	18	10	97	92
	Textiles	**5**	**8**	**6**	**8**	**26**	**14**	**40**	**12**	**65**	**111**
17	Spinning and weaving	4	11	7	10	26	18	42	17	62	109
18	Wearing apparel	3	3	1	2	23	8	32	7	73	113
19	Leather products	10	6	9	9	37	9	61	9	60	107
	Wood, paper, publishing	**2**	**8**	**5**	**9**	**12**	**10**	**14**	**9**	**87**	**107**
20	Wood & wood products	4	16	10	17	16	16	19	15	84	106
21	Paper & paperboard	2	6	5	8	10	8	13	8	80	106
22	Publishing	2	6	3	5	11	7	12	6	94	105
	Chemicals	**5**	**8**	**8**	**11**	**15**	**11**	**19**	**11**	**79**	**107**
24	Chemicals	7	6	7	9	17	7	21	7	80	108
25	Rubber & plastic products	2	6	4	7	6	10	8	9	73	107
26	Non met. Mineral products	6	16	14	24	25	22	32	22	78	104
	Metal products, machinery	**4**	**6**	**7**	**8**	**17**	**10**	**23**	**9**	**75**	**108**
27	Basic metals	3	5	10	10	20	10	25	9	78	107
28	Metal products	3	9	4	8	12	13	16	12	77	108
29	Machinery & equipment	5	4	6	6	19	8	26	8	74	109
	Electrical pr., electronics	**3**	**6**	**3**	**6**	**15**	**10**	**23**	**9**	**66**	**111**
30	Office mach., computers	1	7	4	4	17	8	32	8	55	111
31	Electrical machinery	2	3	3	3	14	10	21	9	67	114
32	Radio, TV & com. Equip.	3	6	2	10	16	12	26	11	62	107
33	Med., precision & optical	4	10	2	4	14	9	23	8	62	107
36	Manufacturing n.e.c.	3	7	4	8	17	13	21	11	78	113

	Transport equipment	**2**	**3**	**6**	**7**	**12**	**8**	**14**	**7**	**80**	**106**
34	Motor vehicles	1	3	2	4	4	5	6	4	66	115
35	Other transport equipment	14	11	29	32	45	24	51	25	89	96

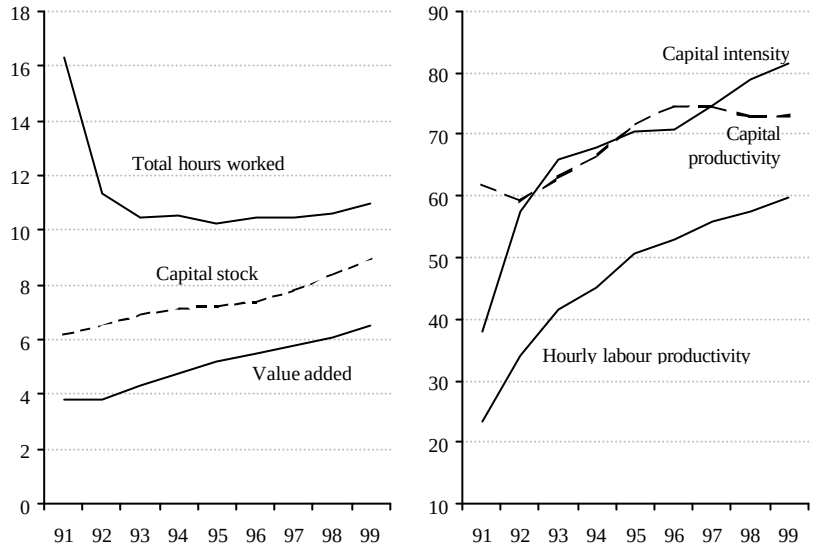
Sources: B. Görzig, & G. Noack 2000 (see in statistical references).

Figure 10.
East and West Germany
Evolution indices in total manufacturing



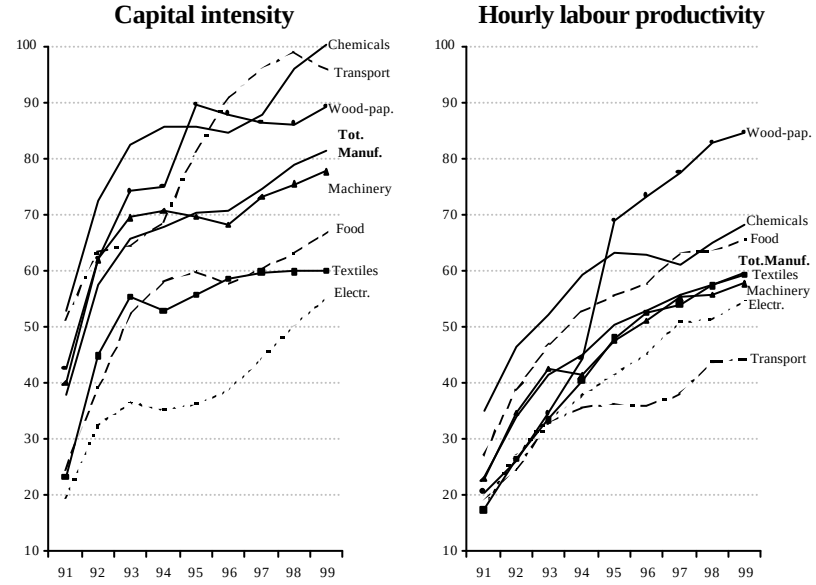
Sources: B. Görzig, & G. Noack 2000 (see in statistical references).

Figure 11.
Relative East-West Germany levels of inputs, output and productivity in manufacturing sector (West-Germany=100)



Sources: B. Görzig, & G. Noack 2000 (see in statistical references).

Figure 12.
Evolution of East-Germany relative capital intensity and labour productivity levels major branches (West-Germany=100)



Sources: B. Görzig, & G. Noack 2000 (see in statistical references).

At an aggregate level, figure 12 shows the evolution of the east German relative levels of the capitalistic intensity and the hourly labour productivity. Three major branches whose capitalistic intensity was above the west German manufacturing average in 1991 ("chemicals", "transport equipment", "wood, paper and publishing"), still are. Among them, only "wood, paper and publishing" has recorded a growth of the hourly labour productivity above the manufacturing growth.

Table 10 compares the growth rate of the relative east German value added and capital intensity levels in NACE branches to the growth rate of the relative total manufacturing level. Branches for which east Germany has caught up in terms of the output level are located in the left side of the table. In most of these branches, namely the first five ones, the growth of the relative capitalistic intensity has been lower than the average. On the contrary, in branches where the gap in the level of output has become larger between east and west (on the right side of the table), growth of the capitalistic intensity has often outreached the average.

Table 10.
Growth rate of relative East German branch value added and capital intensity levels
(West Germany=100 and total manufacturing=100)

NACE		Capital intensity	Value Added	NACE		Capital intensity	Value added
30	Office mach., computers	92	370	19	Leather products	177	40
34	Motor vehicles	68	297	35	Other transport equipment	95	46
20	Wood & wood products	86	224	29	Machinery & equipment	114	48
28	Metal products	76	212	24	Chemicals	124	49
25	Rubber & plastic products	49	203	18	Wearing apparel	235	54
22	Publishing	143	194	27	Basic metals	93	90
26	Non met. mineral products	90	162	31	Electrical machinery	81	92
21	Paper & paperboard	92	150	16	Tobacco	156	94
17	Spinning and weaving	95	150				
33	Med., precision & optical	165	135				
36	Manufacturing n.e.c.	114	129				
15	Food and beverages	126	120				
32	Radio, TV & com. Equip.	287	120				

Sources: Table 9.

Appendix 7 shows further that in 1991, the relative labour productivity of east Germany was the largest in the capital intensive industries but in 1999 the labour intensive industries took the lead. With respect to annual average growth rates, some industries belonging to the skilled labour intensive industries have raised their labour productivity dramatically: "computers", "road vehicles", "precision instruments" and "media technology". This helps water down somewhat the least sanguine statements about east Germany's ability to commit into more valuable production.

Anyway, and in concordance with the authors view about the inefficiency of subsidies in the east, the convergence does not seem to be driven by the capitalistic intensity in east

Germany. Some authors like Klodt (1999) or Ragnitz (2000) point to the role of prices between east and west and of other factors like infrastructures, poor efficiency in companies and administration in explaining the productivity gap. The sales price of the east German firms makes up some 88% of the one in the west while the input price 91%. The labour-intensive industries whose production in the manufacturing total has leapt from 13% in 1991 to 24% in 1999 and employment from 16% to 24% are those which broadly direct their sales towards the local market. Moreover, a lot of small firms with a low capital intensity toil to get access to the financial market.

The restructuring of the German manufacturing sector will still spark off a debate among the economists about the best way to lead an industrial policy after such a shock as the German unification. Nonetheless, the huge catch-up achieved by the eastern Länder within only a decade must not be downplayed. Over 1991-1999, the annual weighted average growth of east Germany amounts to 7.8% while the west German one reaches hardly 0.5%. Allowing for a low east German share in aggregate value added, unified Germany has only gained 0.3 points of percentage thanks to east Germany.

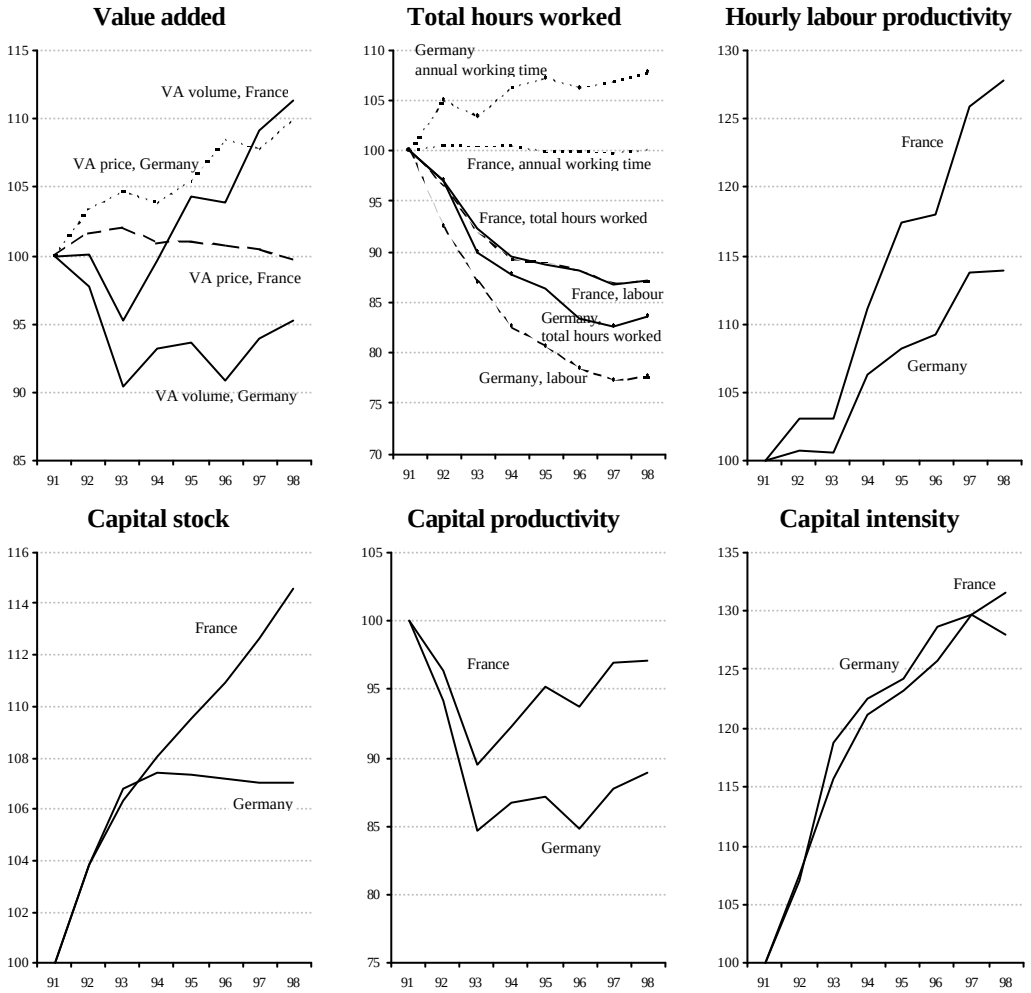
3.2. France-Germany relative evolution in total manufacturing

The survey on the integration of the eastern Länder is useful to shed light on the evolution of the industry in France and in Germany. figure 13 displays the national accounts indices applied to the relative levels of the output and the inputs of the benchmark year 1997. It can be seen that during the 90s, industrial prices have fallen in France while at the same time the volume of production has increased. In Germany, on the contrary, industrial products prices have risen after the setting of the parity at "one-east-mark-equals-one west mark" in 1990 and the faster catch-up of compensation in east Germany compared to its productivity gains, while the volume of production has decreased. This can be contrasted with the rise in the volume of GDP by some 10 % owing to the catch-up of Germany in the field of services and to the industrial reorganisation in the manufacturing sector in the wake of unification.

Employment has dropped a lot in both countries (by 13% in France and by 22% in Germany). But as stated before, the significant lengthening of the average annual working time in the east (which ended up by topping the west one) has resulted into a clear-cut lengthening for the whole country. In France, the working time has so to say not budged over the 90s. A large gap in the hourly labour productivity gains (14%) between both countries has followed over the period.

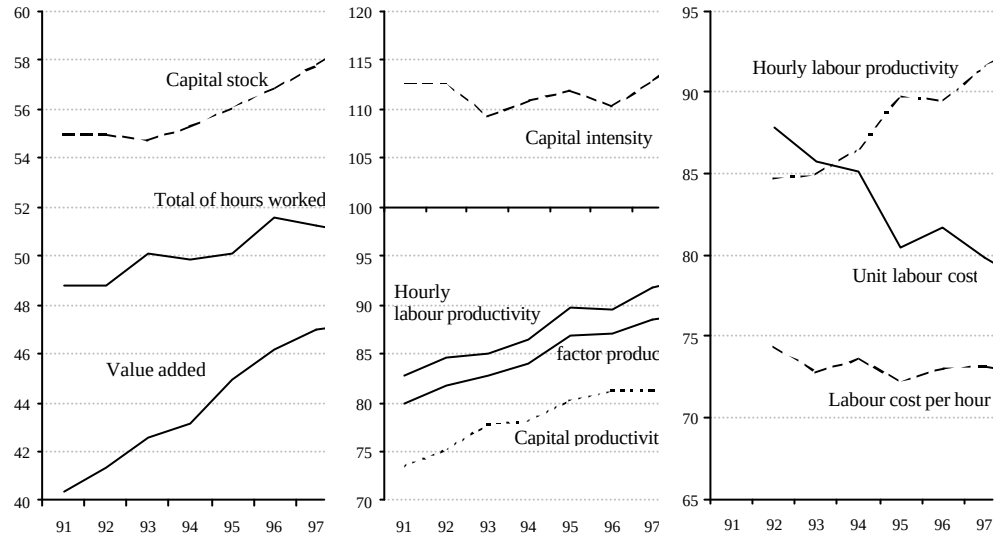
The accumulation of the capital stock has kept the same pace in both countries in the first two years of the decade. Nonetheless, from 1993 on, at the time of the European monetary turmoil, growth of the German capital stock has come to a stop and then has slightly decreased. In France, the accumulation of the capital stock has retracted a little bit during the 1993 recession, but it has got started again thereafter.

Figure 13.
Indices on data from national accounts for total manufacturing, France and Germany (1991=100)



Notes: Because of differences in data sources, indices for Germany in this graph could slightly differ from the average of East and West Länder indices shown in the previous section. We could not use there national accounts statistics which only refer to Germany as a whole at the sector detailed level.
Sources: See appendix 2.

Figure 14.
Relative French levels of inputs, output, productivity and unit labour cost in manufacturing sector (Germany=100)



Sources: See appendix 2.

Figure 14 shows the changes in the relative levels of output and inputs that result from this contrasted evolution. The 1990 decade is typified for France by a global catch-up of German levels. As the French relative value added has more increased than the inputs, productivity gains have been higher in France than in Germany, as well in terms of labour as in terms of capital. France's productivity gains have been passed on favourably to the evolution of its unit labour costs. The labour cost per hour at the nominal exchange rate having fluctuated in a similar way in France and Germany, the relative French productivity gains alone explain actually the cut-down on French unit labour costs.

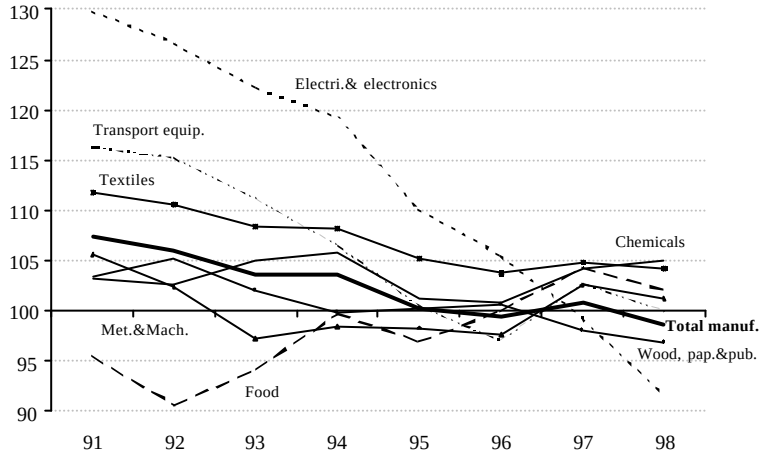
3.3. France-Germany relative evolution by manufacturing branches

The previous France-Germany comparison of the CEPII results pointed to a strong decrease in the price and productivity gaps by branch between the two countries over the period 1970-1990. This significant convergence of the manufacturing structures was considered as a token for a strong economic integration between both countries and CEPII concluded that the manufacturing sectors in both countries were ready to take up a single currency.

In the following decade results of this study show that the structural divergences brought about by the German unification between both countries are dwindling. figure 15 shows the relative French-German price level in major branches, i.e. UVR divided by the exchange rate. The German price level equals 100 for each major branch. Values above the one hundred line indicate relatively high French prices and values below suggest a better French price-competitiveness. Over the 90s, the French price level is basically above the German one.

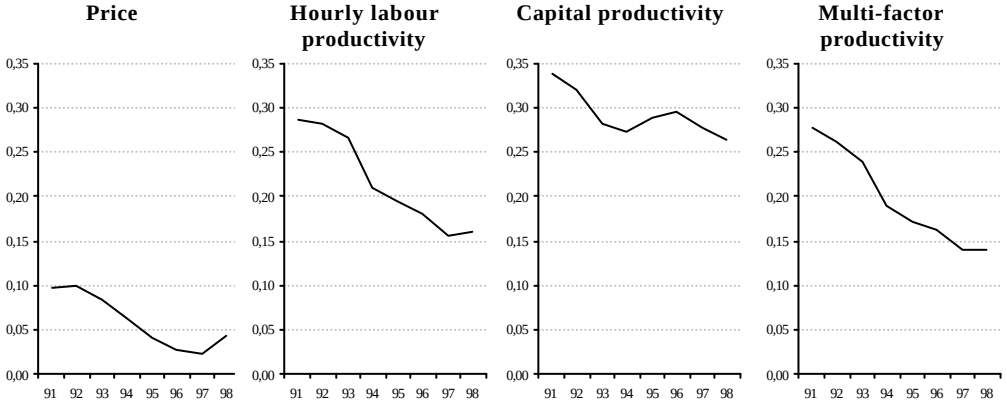
But the trend is downwards. As already stated in section 2.4, the manufacturing average goes under the 100 line in 1998. In spite of the high dispersion in 1991, a year after the German unification, the relative French-German producer price levels have clearly converged among major branches.

Figure 15.
Relative French price level by manufacturing major branch
(Germany=100)



Sources: See appendix 2.

Figure 16.
Dispersion of relative French price and productivity levels across 7 major branches
(coefficient of variation, Germany=100)

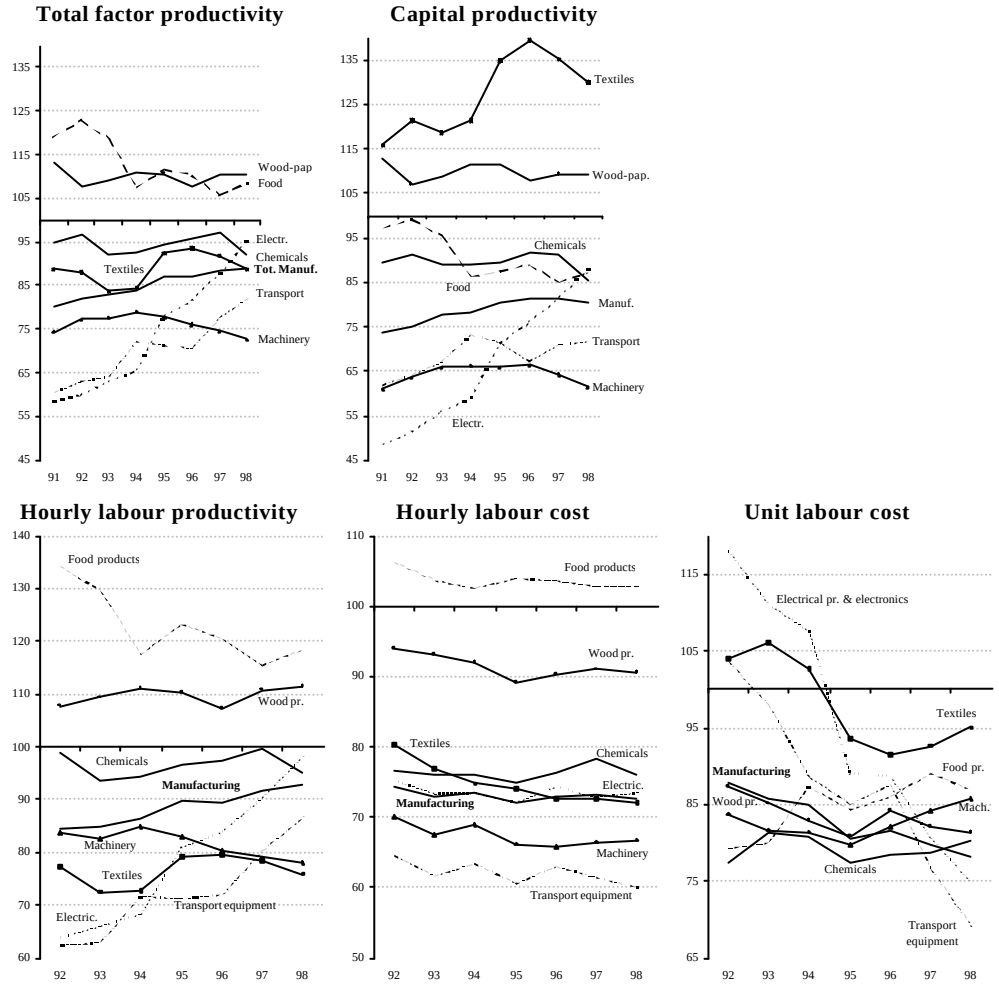


Sources: see appendix 2.

The coefficient of variation (figure 16) dropped substantially, especially at the beginning of the period, mostly on account of the evolution of the relative prices in the "electrical equipment and electronics" major branch. The sharp downwards trend it shows is mostly

due to the evolution of the French index that has dropped by 25% in ten years. The fact that French national accounts use hedonic price indices for computers contrary to Germany explain partly relationship.

Figure 17.
Relative French productivity and unit labour cost levels (Germany=100)



Sources: See appendix 2.

The convergence in relative levels of partial and total factor productivity across the seven branches is not so obvious that the one observed for relative price levels (figure 16 and figure 17). The relative levels of the capital productivity remain greatly scattered over the period across the major branches while on the other hand, a certain convergence for labour productivity and total factor productivity is under way. Nevertheless, the latter is not as important as the one observed for relative prices. After the German unification, the price

convergence is faster across branches of the manufacturing sectors than across factors of production. Between France and Germany, that are very close trade partners, trade allows a quicker integration of the goods market. The integration of the factors market is actually a slower process.

As far as the evolution of manufacturing unit labour costs levels is concerned, as stated before in the previous section, France has increased its cost competitiveness advantage relative to Germany rather through productivity gains than through a diminishing of labour costs per hour. Sector-wise, evolutions are somewhat contrasted (figure 17). Transport equipment is a special case. Indeed, French unit labour costs have decreased through both stronger productivity gains and lower hourly labour costs. The latter for Germany in transport equipment have increased by 24% vs. 15% only in France between 1992 and 1998.

3.4 Contributions to the manufacturing growth in the 80s and 90s

In the previous section, we have investigated the evolution of the French-German relative levels of the manufacturing output and inputs in the last decade. Here will be analysed the contribution of factors of production to the growth of value added in each country in the periods 1984-1990 and 1991-1998. The main feature of the first period is the cancellation of a growth economic policy to the benefit of a pledge in the policy of *désinflation competitive* for France, whereas the second period is marked by the German unification.

If we consider as usual that the marginal contribution of each factor of production is proportional to the share of total production that it receives as compensation, total input growth can be calculated as a weighted average of labour and capital growth, with the marginal contributions of each of these factors to output being used as the weights. Multifactor productivity (MFP*)* growth is the residual of the estimation (see appendix 6). Increases in multifactor productivity reflect the combined contributions made to growth by advances in knowledge of how to produce at low cost (technology or efficiency) and of miscellaneous output determinants for which separate estimates have not been made.

Table 11 shows the contributions of inputs to the growth of the French and German value added. In the whole manufacturing sector, for both countries, the growth rate of output was stronger in the period 1984-1990 than in the last decade. In the first period, the German growth rate was above the French one for total manufacturing (+20% vs. +17%). Nevertheless, if value added kept increasing at a rate of 11%, in the meanwhile the German output has receded (-5%).

Table 11.
France and Germany: Contributions to the manufacturing value added growth (%)

Major branch		84-90		91-98	
		France	Germany	France	Germany
Total Manufacturing	**Value added growth**	**117**	**120**	**111**	**95**
	Contribution of				
	Employees	95	105	91	84
	Average hours	100	96	100	105
	Capital stock	104	103	104	102
	Multifactor productivity	118	115	118	106
Food	**Value added growth**	**93**	**102**	**96**	**101**
	Contribution of				
	Employees	99	99	97	94
	Average hours	99	96	99	100
	Capital stock	104	100	104	102
	Multifactor productivity	91	106	96	105
Textiles	**Value added growth**	**99**	**101**	**81**	**64**
	Contribution of				
	Employees	84	88	78	59
	Average hours	100	95	100	108
	Capital stock	101	99	101	98
	Multifactor productivity	117	122	103	103
Wood, paper, publishing	**Value added growth**	**109**	**111**	**100**	**102**
	Contribution of				
	Employees	100	104	92	91
	Average hours	100	95	100	101
	Capital stock	108	104	106	106
	Multifactor productivity	101	109	102	104
Chemicals	**Value added growth**	**115**	**119**	**117**	**111**
	Contribution of				
	Employees	99	106	93	85
	Average hours	100	96	100	103
	Capital stock	104	102	105	102
	Multifactor productivity	112	114	120	123
Metal products, machinery	**Value added growth**	**117**	**122**	**101**	**93**
	Contribution of				
	Employees	95	108	91	81
	Average hours	101	95	100	104
	Capital stock	102	102	103	101
	Multifactor productivity	120	118	108	110
Electrical pr., electronics	**Value added growth**	**139**	**137**	**148**	**84**
	Contribution of				
	Employees	99	114	89	78
	Average hours	100	94	100	104
	Capital stock	110	109	102	103
	Multifactor productivity	128	118	163	100
Transport equipment	**Value added growth**	**120**	**124**	**131**	**95**
	Contribution of				
	Employees	88	106	90	93
	Average hours	100	98	100	101

	Capital stock	105	107	107	102
	Multifactor productivity	130	112	135	99

Notes: Results for the period 1984-90 are for west Germany in the 1991 national accounts scheme and results for the period 1991-98 are for all Germany in the 1995 national accounts scheme.
Sources: See appendix 2.

In France, labour contribution to growth was negative, above all in the second period, contrary to the contribution of the capital stock. The average annual working time being about the same, its contribution has been neutral. The streamlining of the production facilities helped by the *désinflation compétitive* policy has entailed a positive and large contribution of the multifactor productivity to the French manufacturing output growth (+18% for both periods).

In Germany, contributions of factors of production were uneven from one period to another. In the second half of the 80s, as west Germany had opted for a decrease of the working time in order to shield the level of employment, the latter has contributed positively to the German growth (+5%) contrary to what has happened in France. The contribution of capital was also positive but its magnitude lesser (+3%) while the multifactor productivity was significant (+15%). After the unification, the blunt drop in employment in the east, but also in the west, has radically changed the contribution of this factor (-16%). Otherwise, the lengthening in the east of the working time whose levels in 1991 were extremely low has allowed a relatively high contribution of hours worked per employee (+5%). In the 1990 decade, multifactor productivity growth has got a smaller impact on the evolution of value added (+6%) than at the end of the 1980s.

Except for massive layoffs in east Germany after the unification, the sharp decrease in the industrial employment in France and in Germany can be ascribed to a process of enlargement of the services sector in these two developed economies. The sector bias in the employment structure to the benefit of services was strong in the 1990s (CDC IXIS, 2001 and IAB, 2000).

In both countries, the capital stock contribution to value added growth was positive contrary to the labor contribution in the eighties. The manufacturing sector growth was then accompanied by a higher capital intensity. Nevertheless, as seen before (figure 13, section 3.2), the increase in the German capital stock has come nearly to a stop since the mid-1990s and its contribution to growth has been of a least magnitude relative to the French one (respectively 2% vs. 4% in the 1990s).

As far as major branches are concerned, the output growth in France has been above average in “electrical products and electronics”, “transport equipment” and “chemicals” (the second period for the latter). For each of these branches, the impact of the multifactor productivity increase on growth was by far above the average. Let us mention that the capital accumulation has contributed very positively to the growth of “electrical products and electronics” at the end of the 1980s.

The “food” and “wood, paper and publishing” major branches show specific profiles in France. Contrary to the rest of the manufacturing sector, the contribution to growth of the

multifactor productivity is negative for the former and neutral for the latter over the two periods. In "Wood, paper and publishing", the contribution of the capital stock is rather high.

The redundancies in "textiles" have been massive in the 1990s and explain most of the fall in the German output in this major branch. Nonetheless, in the period preceding unification, the contribution of employment in "textiles" was quite negative contrary to what had happened in the other major branches. The withdrawal from this sector has started earlier in Germany than in France.

Table 12.
France and Germany
Contributions to the growth of the manufacturing hourly labour productivity, (%)

Major branch		84-90		91-98	
		France	Germany	France	Germany
Total Manufacturing	**Hourly labour productivity growth**	**125**	**118**	**128**	**114**
	Contribution of				
	Capital deepening	106	103	108	107
	Multifactor productivity	118	115	118	106
Food	**Hourly labour productivity growth**	**96**	**109**	**101**	**110**
	Contribution of				
	Capital deepening	105	102	106	105
	Multifactor productivity	91	106	96	105
Textiles	**Hourly labour productivity growth**	**127**	**130**	**115**	**121**
	Contribution of				
	Capital deepening	108	106	112	117
	Multifactor productivity	117	122	103	103
Wood, paper, publishing	**Hourly labour productivity growth**	**109**	**113**	**112**	**114**
	Contribution of				
	Capital deepening	108	104	110	109
	Multifactor productivity	101	109	102	104
Chemicals	**Hourly labour productivity growth**	**117**	**116**	**130**	**133**
	Contribution of				
	Capital deepening	104	102	109	108
	Multifactor productivity	112	114	120	123
Metal products, machinery	**Hourly labour productivity growth**	**124**	**118**	**115**	**119**
	Contribution of				
	Capital deepening	103	101	106	108
	Multifactor productivity	120	118	108	110
Electrical pr., electronics	**Hourly labour productivity growth**	**141**	**125**	**174**	**111**
	Contribution of				
	Capital deepening	110	106	107	112
	Multifactor productivity	128	118	163	100
Transport equipment	**Hourly labour productivity growth**	**143**	**118**	**150**	**104**
	Contribution of				
	Capital deepening	110	106	112	105
	Multifactor productivity	130	112	135	99

Notes: Results for the first comparison France/ West Germany 1987 for the period 1984-90 and results of the second comparison France/ Germany 1997 for the period 1991-97.
Sources: See appendix 2.

With the same method, the contributions to the labour productivity growth can be assessed (see appendix 6). Results are shown in table 12. In the manufacturing sector, the growth of the hourly labour productivity was stronger in France than in Germany in both periods, but thanks to a greater capital deepening rate in the period preceding the unification and to a multifactor productivity growth in the 1990s.

At the major branch level, in Germany, growth of the hourly labour productivity is more sustained than in France in "food", "wood, paper, publishing" and "textiles". The relative gap between both countries increases chiefly in "electrical products and electronics" as well as in "transport equipment" to the benefit of France. In these major branches in Germany, the multifactor productivity contribution was next to zero contrary to France which reaches its highest rates in these branches[17].

CONCLUSION

The UVR we calculated for the benchmark year 1997 with the method of the industry-of-origin method results into a higher price level and then lower productivity levels in France relative to Germany. In Germany, the challenge consists in maintaining higher productivity levels in terms of labour, capital and multifactor in order to match higher levels of labour compensation. But with respect to evolution, Germany toils to keep productivity gains high; in France their increase steadies the competitiveness as evidenced by the fall in unit labour costs since 1991. Moreover, our results compared with those of the study for the benchmark year 1987 show that French products gain in quality. In that respect, further research on the comparison of real comparative advantages with those revealed by international trade could be of interest.

In France the *désinflation compétitive* policy has provided an enticement to enhance productivity. In Germany, the unification has not led to a full convergence of both German regions yet but the orientation of east Germany towards more skilled labour intensive industries gives hope that east Germany will get out of its productivity trap. Investigating the impact of skills on productivity could be another axis of further research.

Basically, with respect to the assessment of economic performances, the French and German economies undergo the same economic fluctuations. The comparison of the United-States - France-Germany productivity levels that the CEPII is carrying out at present with the University of Groningen will allow to put in perspective the European productive performance in an international framework.

[17] Let us remind that the national accounts series in France use hedonic price indices to deflate computer values while they are not applied by the German national accounts yet (see section 1.3). This can explain partly the growth differential between both countries in this major branch.

LIST OF ACRONYMS

DIW: Deutsches Institut für Wirtschaftsforschung

GGDC: Groningen growth and Development Centre

INSEE: Institut National de la Statistique et des Etudes Economiques

SCEES: Service Central des Enquêtes et des Etudes Statistiques

SESSI: Service des Statistiques Industrielles (Ministère de l'Industrie)

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APPENDICES

1. Formalisation of the ICOP methodology for binary manufacturing comparisons

by M. Timmer (GGDC) in cooperation with
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1.1. Basic structure

A major task in the ICOP approach to manufacturing is to derive industry-specific conversion factors on the basis of relative product prices. As a first step, unit values (uv) are derived by dividing ex-factory output values (o) by produced quantities (q) for each product i in each country

$$(2) \qquad uv_i = \frac{o_i}{q_i}$$

The unit value can be considered as an average price, averaged throughout the year for all producers and across a group of nearly similar products. Subsequently, in a bilateral comparison, broadly defined products with similar characteristics are matched, for example ladies' shoes, cigarettes, cheese and car tyres. For each matched product, the ratio of the unit values in both countries is taken. This unit value ratio (UVR) is given by

$$(3) \qquad UVR_i^{xu} = \frac{uv_i^x}{uv_i^u}$$

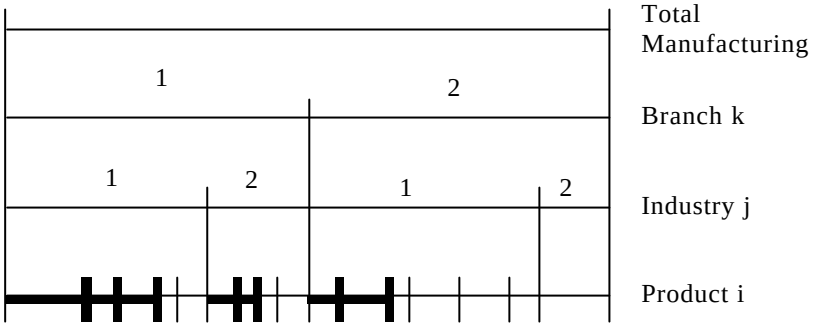
with x and u the countries being compared, u being the base country. The product UVR indicates the relative producer price of the matched product in the two countries.

Product UVRs are used to derive an aggregate UVR for manufacturing branches and total manufacturing in a stepwise weighting procedure. Next figure shows the four levels which are being distinguished: products, industries, branches and total manufacturing. These levels correspond with the levels distinguished in the International Standard Industrial Classification (ISIC rev 3). ICOP industries consist four-digit ISIC industries, and ICOP branches consist of two-digit divisions. The four horizontal level lines in the figure can be thought of as representing manufacturing output value. The total manufacturing output is the sum of branch output, which is the sum of industries' output value. The output value of an industry is the sum of the value of output of its products. In a binary comparison some of these products can be matched, but not all. This is because of lack of value or quantity data, difficulties in finding corresponding products, the existence of country-unique products, etc. Bold lines at the product level in the figure indicate the total output value of the matched products in the different industries.

Two UVR are derived at each level. A Laspeyres UVR is calculated by using base country weights and a Paasche by using weights for the other country. The Laspeyres and Paasche

indices are combined into a Fisher index when a single currency conversion factor is required. It is defined as the geometric average of the Laspeyres and the Paasche.

Simplified representation of the four levels of aggregation within ICOP



1.2. Aggregation Step One Industry Level UVR

The industry UVR (UVR_j) is given by the mean of the UVR of the sampled products. Product UVR are weighted by their output value as more important products should have a bigger weight in the industry UVR:

$$(4) \qquad UVR_j = \sum_{i=1}^{I_j} w_{ij} UVR_{ij}$$

with i=1,.., I_j the matched products in industry j; $w_{ij} = o_{ij} / o_j^M$ the output share of the i^{th} commodity in industry j in total matched output; and $o_j^M = \sum_{i=1}^{I_j} o_{ij}$ the total matched value of output in industry j. In bilateral comparisons the weights of the base country (u) or the other country (x) can be used. The use of base country value weights leads to the Laspeyres index. Substituting base country weights in (3) gives:

$$(5) \qquad UVR_j^{xu(u)} = \sum_{i=1}^{I_j} w_{ij}^{u(u)} UVR_{ij}$$

with $w_{ij}^{u(u)} = o_{ij}^{u(u)} / o_j^{M\,u(u)}$; $o_j^{M\,u(u)} = \sum_{i=1}^{I_j} o_{ij}^{u(u)}$; and $o_{ij}^{u(u)} = uv_{ij}^u q_{ij}^u$, the output value of matched product i in country u at own prices. Using (1), (4) can be rewritten as

$$(6) \qquad UVR_j^{xu(u)} = \frac{\sum_{i=1}^{I_j} uv_{ij}^x q_{ij}^u}{\sum_{i=1}^{I_j} uv_{ij}^u q_{ij}^u}$$

with $UVR_j^{xu(u)}$ indicating the Laspeyres index which is the unit value ratio between country u and x weighted at base-country quantities indicated by the u between brackets. For the Paasche index, weights of the other country quantities valued at base country prices are used in formula (3). This gives

$$(7) \qquad UVR_j^{xu(x)} = \sum_{i=1}^{I_j} w_{ij}^{u(x)} UVR_{ij}$$

with $w_{ij}^{u(x)} = o_{ij}^{u(x)} / o_j^{Mu(x)}$; $o_j^{Mu(x)} = \sum_{i=1}^{I_j} o_{ij}^{u(x)}$; and $o_{ij}^{u(x)} = uv_{ij}^u q_{ij}^x$, the output value of matched product i in country x at u prices.. Using (1), (6) can be rewritten as

$$(8) \qquad UVR_j^{xu(x)} = \frac{\sum_{i=1}^{I_j} uv_{ij}^x q_{ij}^x}{\sum_{i=1}^{I_j} uv_{ij}^u q_{ij}^x}$$

with $UVR_j^{xu(x)}$ indicating the Paasche index which is the unit value ratio between country u and x weighted at the quantities of the other country (x).

1.3. Aggregation Step Two Branch Level UVR

Branch UVRs (UVR_k) are calculated as a weighted average of industry UVR. Use of weights from the base country and the industry UVR at base country weights, gives the Laspeyres index for branch k.

$$(9) \qquad UVR_k^{xu(u)} = \sum_{j=1}^{J_k} w_{jk}^{u(u)} UVR_{jk}^{xu(u)}$$

with j=1,.., J_k the number of industries in branch k in which a product match has been made and $w_{jk}^{u(u)}$ the industry weight. UVR of industries with bigger output should have a higher weight to reflect the structure of the economy. However, this weight should also depend on the reliability of the industry UVR, being lower the lower the reliability, as unreliable UVR should have a limited influence on the higher level result. Therefore the set of industries J_k is split into two, $J_k(a)$ and $J_k(b)$ depending on their reliability. UVR of industries belonging to the first set ($J_k(a)$) are weighted with the total industry output at own prices: $o_{jk}^{Tu(u)}$. The UVR from the other industries (belonging to $J_k(b)$) are weighted only by the output value of the matched products in the industry: $o_{jk}^{Mu(u)} = \sum_{i=1}^{I_j} uv_{ij}^u q_{ij}^u$. Hence the weights are given by

$$w_{jk}^{u(u)} = o_{jk}^{T\,u(u)} / o_k^{M\,u(u)} \qquad \forall j \in J_k(a)$$

$$w_{jk}^{u(u)} = o_{jk}^{M\,u(u)} / o_k^{M\,u(u)} = \sum_{i=1}^{I_j} uv_{ij}^{u}\, q_{ij}^{u} / o_k^{M\,u(u)} \qquad \forall j \in J_k(b)$$

$$\text{with} \quad o_k^{M\,u(u)} = \sum_{J_k(a)} o_{jk}^{T\,u(u)} + \sum_{J_k(b)} o_{jk}^{M\,u(u)}$$

To arrive at the Paasche index, the output weights of country x valued at base prices is substituted. This gives

$$(\mathbf{10}) \qquad UVR_k^{xu(x)} = \sum_{j=1}^{J_k} w_{jk}^{u(x)}\, UVR_{jk}^{xu(x)}$$

with

$$w_{jk}^{u(x)} = o_{jk}^{T\,u(x)} / o_k^{M\,u(x)} \qquad \forall j \in J_k(a)$$

$$w_{jk}^{u(x)} = o_{jk}^{M\,u(x)} / o_k^{M\,u(x)} \sum_{i=1}^{I_j} uv_{ij}^{u} q_{ij}^{x} / o_k^{M\,u(x)} \qquad \forall j \in J_k(b)$$

$$\text{with} \quad o_k^{M\,u(x)} = \sum_{J_k(a)} o_{jk}^{T\,u(x)} + \sum_{J_k(a)} o_{jk}^{M\,u(x)}$$

The split in the industry set is based on an assessment of the reliability of the industry UVR. Given the homogeneous character of the products belonging to an industry, it is expected that product UVR in an industry do not differ much. Hence, if the variation of the product UVR is high, this is deemed an indication of unreliability. Also, reliability increases the higher the percentage of industry output covered by matched products. Therefore the coverage ratio is also taken into account when assessing the industry UVR reliability by using the so-called finite population correction in calculating the variance. The following decision rule is used: when the coefficient of variation is less than 0.1, the industry is assigned to $J_k(a)$, other wise to $J_k(b)$:[18]

$$\begin{aligned} &\textit{if} \quad cv\left\lfloor UVR_{\ j}\right\rfloor < 0.1 \quad \textit{then} \quad j \in J_k(a) \\ &\textit{otherwise} \qquad\qquad\qquad\quad j \in J_k(b) \end{aligned}$$

The coefficient of variation of industry j (cv_j) is measured as follows:

[18] This just replaces the original 25%-rule.

$$cv[\text{UVR}_j] = \frac{\sqrt{\text{var}[\text{UVR}_j]}}{\text{UVR}_j}$$

The variance of the industry UVR is given by the mean of the weighted deviations of the product UVRs around the industry UVR (see also Selvanathan 1991):

$$(\mathbf{11}) \qquad \text{var}[\text{UVR}_j] = (1 - f_j)\frac{1}{I_j - 1}\sum_{i=1}^{I_j} w_{ij}(\text{UVR}_{ij} - \text{UVR}_j)^2$$

with I_j the number of products matched in industry j and with f_j the share of industry output which is covered by the matched products within an industry (O^M_j / O^T_j). ($1 - f_j$) is the finite population correction (fpc).[19] The fpc ensures that with an increasing coverage of products, the variance goes down. This formulae can be applied to either the Laspeyres or Paasche UVR using output value weights of the base country for the variance of the Laspeyres, and quantity weights of the other country valued at base prices for the variance of the Paasche. To allocate an industry to one of the two sets, a decision is made on the basis of the (geometric) average variance for the Paasche and Laspeyres.

1.4. Aggregation Step Three Total Manufacturing UVR

The total manufacturing UVR is a weighted average of the branch UVR. Use of weights from the base country and the branch UVR at base country weights, gives the Laspeyres index for total manufacturing ($\text{UVR}^{xu(u)}$)

$$(\mathbf{12}) \qquad \text{UVR}^{xu(u)} = \sum_{k=1}^{K} w_k^{u(u)} \text{UVR}_k^{xu(u)}$$

with k=1,.., K the number of branches and $w_k^{u(u)}$ the branch weight. For branch weights the total branch output $o_k^{u(u)}$ is used irrespective their reliability, so $w_k^{u(u)} = o_k^{u(u)} / o^{u(u)}$ with $o^{u(u)} = \sum_{k=1}^{K} o_k^{u(u)}$.

To arrive to the Paasche index, the output weights of country x valued at base prices is substituted. This gives

$$(\mathbf{13}) \qquad \text{UVR}^{xu(x)} = \sum_{k=1}^{K} w_k^{u(x)} \text{UVR}_k^{xu(x)}$$

[19] The fpc is normally stated as one minus the number of products sampled divided by the total number of products in the population. Here I use the output share of sampled products rather than the number of products to account for the difference in importance of products.

with $w_k^{u(x)} = o_k^{u(x)} / o^{u(x)}$ with $o^{u(x)} = \sum_{k=1}^{K} o_k^{u(x)}$.

To have an indication of the reliability of the branch and total manufacturing UVR the coefficient of variation for these UVRs can be calculated as follows. The sample variance of the UVR for total manufacturing is given by the quadratic output weighted average of corresponding branch UVR variances.

$$\text{(14)} \qquad \text{var}[\text{UVR}] = \sum_{k=1}^{K} w_k^2 \, \text{var}[UVR_k]$$

In a similar vein, the estimated variance of the UVR in branch k is given by

$$\text{(15)} \qquad \text{var}[\text{UVR}_k] = (1 - f_k) \sum_{j=1}^{J_k} w_{jk}^2 \, \text{var}[UVR_{jk}]$$

with f_k the share of branch output which is covered by the matched products within a branch. Branch variance is thus defined as a weighted average of the estimated variances of the industry UVR, $\text{var}[\text{UVR}_{jk}]$, corrected by the finite population correction (fpc).[20]

2. The database used for the France-Germany comparison

In the nineties, big changes have prevailed in the working out of European statistics. In several fields, EU countries have adopted the same classifications and harmonised the various national definitions of economic aggregates. In spite of the recorded strides in this area, economists have still work to do in order to make industrial statistics even more comparable. In this section, we tried to synthesise the various definitions and classifications related to French and German data, as well as the statistical work performed.

The statistical work has been organised along three steps:

- the first one has consisted in computing production price parities that allow national production schemes to be compared in a bilateral price system in 1997[21]. Prices have been assessed by unit values in national currency. Their calculation is made from values and quantities available in the *manufacturing product surveys* of France and Germany;
- the second one has been dedicated to the assessment of real levels (in production price parity) of value added, labour, hourly labour and capital productivity for the year 1997. Data for value added and employees come from the *annual firm surveys*; those for hours worked per employee and capital are drawn from the national accounts and DIW

[20] Note that therefore, the industry variance used for calculating the branch variance is given in **(11)** but without the fpc as this cannot be applied twice.

[21] Price, production and productivity levels were computed for the benchmark year 1997 in order to be consistent with other studies of the ICOP project in which the United States is the reference country. For this country, 1997 is the last year with available statistics for production.

for France and Germany respectively. They are then adjusted to be consistent with the other data from the firm surveys.

- the last step has consisted in assessing the evolution of the different variables in the period 1991-1997. The 1997 levels have been extrapolated backwards using the evolution indices stemming from the *national accounts* statistics, or when not available, from series published by some economic institutes as the DIW in Germany.

2.1. Statistics used for initial UVR: production surveys

The first statistical step has consisted in constructing the manufactured products basket common to France and Germany, from which the manufacturing output price parities have been computed. As it was previously underlined, there does not exist any standardised international surveys on manufactured product prices. Therefore, we compute statistics on values and sold quantities provided by production surveys to obtain products unit values. Unit values figures are taken ex-works, i.e. they do not include taxes, transport costs or distribution margins.

For both countries, national data have been used: *Production surveys 1997* published by the SESSI and the SCEES in France and *Produktion im produzierenden Gewerbe des In-und Auslands 1997* published by the statistisches Bundesamt in Germany. In both countries, the production unit covered in national surveys is the establishment of at least 20 employees. In France, the production survey delivers figures on the sold production whereas the German one only documents the production to be sold.

The common basket of manufactured products is built by matching the goods produced in both countries at the finest level of the classification (some 5 475 positions). Since 1991, statistics on values and sold quantities come from production surveys data that are fit in the European classification called PRODCOM, an acronym for industrial product surveys (PROD) defined at the European level (COM). The first four digits of PRODCOM correspond to the most detailed level of the European classification of activities, the NACE (see table below). The first six digits refer to the CPA (*Classification of Products by Activity*), a European products classification and the eight digits to PRODCOM. The last two digits of PRODCOM are designed to be in tune, as far as possible, with the logic of the Combined Classification (CN) used in the European trade statistics. A finest position (a ninth one) can even be defined in some countries pointing to a national level.

Digits	Classification
XXXX	NACE
XXXX.XX.	CPA
XXXX.XX.XX	PRODCOM
XXXX.XX.XX.X	PROD-Country

For instance, German data are collected in the PRODCOM classification with a greater level of detail (nine digits). The German classification, the GP95 (*Güterverzeichnis für Produktionsstatistiken*) entails thus 6 427 positions. French surveys are published in the

PRODCOM classification. Nonetheless, the SESSI owns also data at a nine-digit level (PRODFRA) to specify PRODCOM if need be.

The CEPII has also got the authorisation of the CNIS (*Conseil National du Secret Statistique*) to access the confidential data of product and firm surveys. As far as the firm surveys are concerned, the statistical confidentiality, i.e. data not available for instance on account of the restricted number of establishments or a too bigger share of one firm in the global turnover of the branch, covers about 30 % of the product data.

In the production surveys, we have counted 2 045 French products and 3 586 German ones for which both quantities and sales values were available. From these two data base, the 1 151 matched products are built into the basket of product parities.

The use of a common classification has definitely enabled us to increase the number of products making up the basket of industrial goods and thus improve the representativeness for the whole manufacturing sector in both countries. Table 13 displays the number of matched products and the share of the products in the total turnover for both comparisons performed at the CEPII. In the previous one, Freudenberg and Ünal-Kesenci (1993) had to use national statistics according to national classifications (NAP and GP) more aggregated than PRODCOM and without an official concordance table. Finally, they ended up with 237 matched products, that make up 18% of the manufacturing sector in both countries. In the present comparison, 1 151 PRODCOM products could be matched, which cover 33% of the production of the manufacturing sector in 1997 in both countries. Except for transport equipment, the representativeness rate is significantly more important than for the benchmark year 1987 in all major branches, all the more in "Food and beverages" where no matching was available for the year 1987 while this major branch exhibits the highest representativeness rate of the whole matching for 1997.

Table 13. France-Germany Comparisons of CEPII
Number and Share of Matched Products for the Two Benchmark Years

	France-West Germany Benchmark year : 1987		France-Reunified Germany Benchmark year : 1997	
Major branches	Matched Products Number	Matched/ Sold Production (%)	Matched Products Number	Matched/ Sold Production (%)
Manufacturing	**237**	**18**	**1 151**	**33**
Food & beverages	0	0	196	67
Wear. Ap. text. & leather prod.	30	21	168	27
Wood, paper & other industries	25	26	102	50
Chemicals, rubber & plastic prod.	68	23	338	39
Metallic prod. & machinery	80	17	268	21
Electrical prod. And electronics	26	6	60	6
Transport equipment	8	36	19	28

2.2. Final MOPP, input and output levels in 1997: annual firm surveys and national accounts

In the second statistical step, levels of output, inputs, productivity and unit labour costs for the benchmark year 1997 are assessed. To this purpose, the same sources for production and inputs are used, as far as it is possible. Statistics on value added, employees and labour compensation come from the same firm survey for each country. However, data for the capital stock and the average annual working time are not available in these surveys.

2.3. Value added, employees and labour costs

Statistics on value added, employees and labour costs come from the annual firm surveys: *Enquête annuelle d'entreprise 1997*, published by the SESSI and the SCEES in France; and *Kostenstruktur der Unternehmen 1997*, published by the statistisches Bundesamt in Germany.

Contrary to the production survey where the surveyed unit is the establishment, the firm survey focuses on the firm. A same firm can own several establishments in different industrial activities. The firm will be classified in a position of the nomenclature according to its main activity i.e. secondary products even if different will be attached to the same position.

In both countries, censuses survey firms with more than 20 employees. In 1997, employees of the manufacturing industry recorded in the firm surveys amounted to 82% of employees recorded in the national accounts statistics for Germany and to 86% for France.

The concept of value added used for levels of 1997 is the gross value added at factor costs, that is value added excluding taxes but including operating subsidies less various operating taxes. For labour, data on "employees" were preferred to the ones on "wage-earners" as interim work can increasingly be called on over time. Foreign employees are also taken into consideration in both countries. Employees compensation data refer to gross earnings paid in each fiscal year to employees. It entails all forms of compensation including commissions, dismissal pay, bonuses, vacation and sick leave pay, compensation in kind and excludes employers' social security contributions.

The classification used in firm surveys differs between France and Germany. German statistics are classified in the NACE rev.1 (at the 4 digits level) while French ones are fit in the *Nomenclature d'Activité Française* (NAF 700) with a bridge to NACE.

2.4. Statistics of average hours worked

The average annual working time is not available in the firm surveys. Thus, for France, the data come from the national accounts statistics (*Comptes de la Nation*, INSEE). For Germany, for the time being, only the DIW (Deutsches Institut für Wirtschaftsforschung) gives the annual working hours at a detailed sectoral level (Görzig, B. & G. Noack, 1999), *Vergleichende Branchendaten für das verarbeitende Gewerbe in Ost- und*

Westdeutschland: Berechnungen für 31 Branchen in europäischer Klassifikation, 1991 bis 1998).

As Germany is reunified since 1990, we have chosen to consider Germany on its whole contrary to most of the published work on the topic. Levels for hours worked by sector are often dissimilar between east and west Germany. Thus, in aggregate, the average annual working hours per employee amount to 1 556 hours for the western part and to 1 680 for the eastern one (see appendix 1).

2.5. Estimation of the capital stock

In order to carry out an analysis in terms of productivity, factors of production are assessed in stock. Computation of the stock of capital gives rise to more concern than labour. Estimation methods and assumptions related to the assets life or depreciation can significantly change across countries. In this study, we used national data available on gross capital stocks. Nonetheless, it would be useful to assess consistently the French and German net stocks from cumulated sectoral investment flows on a longer period, by applying the same assumptions upon lifetime and depreciation (according to the permanent inventory method). Furthermore, it would be wise to consider the utilisation rate of production capacities in order to discount the non employed capital in downturn periods.

Annual firm surveys we used for value added and employment do not entail pieces of information on the capital stock. Therefore, we had to turn to series from the national accounts in France (*Comptes de la Nation*, INSEE) and in Germany (Gesamtrechnungen, Fachserie 18, Reihe 1.2).

In order to assess an adjusted stock of capital fit for the firm survey, the capital intensity was assumed to be the same in the national accounts (NA) and in the firm surveys (EAE): the capital stock from the national accounts was multiplied by the ratio "employed EAE/ employed NA".

There are no harmonised surveys at a sectoral level detailed enough to compute manufacturing output price parities for the capital stock. The values of French and German stocks have been converted here with the geometric mean of the purchasing power parities rates for the gross fixed capital formation in producers' durable goods and non-residential buildings of the International Comparisons Project (ICP) (*Purchasing Power Parities and Real Expenditures: Results 1996*, OECD (1999).

The use of PPP seems to be relevant for valuing the capital input at international prices. Indeed, while the establishments of the manufacturing sector *sell* goods that are produced within these units themselves, their capital stock is *purchased* from other producers. Hence, it is more correct to apply a purchasing power parity instead of a manufacturing output price parity.

The GFCF equals 3.28 FF/DM at French quantities and 3.20 FF/DM at German quantities. The geometric mean of the two parities amounts to 3.24 FF/DM for the GFCF of industrial

goods. If the whole GFCF, (including residential buildings, roads,…) were considered, then the parity rate will only reach 2.90 FF/DM.

2.6. Times series statistics (1991-1997): national accounts

Extrapolation backwards and forward of the 1997 MOPP, output, input and productivity levels has been generally performed from the national accounts: *Comptes de la Nation*, INSEE, for France; and Konten und Standardtabellen, statistisches Bundesamt for Germany. National accounts are exhaustive relative to surveys as they cover the whole economy. They are the most reliable statistics on the time series.

In the nineties, countries of the European Union have significantly improved the harmonisation of national accounts classifications and definition of aggregates. Moreover, the same base year has been adopted in the setting of the last accounts (1995).

National accounts data are classified according to the NACE in Germany and to the *Nomenclature Economique de Synthèse* (NES) in France. A concordance in 11 branches common to both countries has been carried out along the line of the NES, as the not enough detailed positions of the NES in terms of data available did not allow an aggregation along the NACE.

The series for the UVR has been obtained by applying the relative price indices of value added to the 1997 level. The GDP purchasing power parity, useful to be analysed with respect to the UVR, has been extrapolated from the OECD figure for the current PPP in 1996 with the evolution of OECD data (OECD-Compendium, 2001). For west Germany, the series were calculated from the IMF-IFS for the period 1987-1990.

For gross value added at market and 1995 constant prices, employees and employees compensation, series come from the national accounts, in a NACE classification (WZ 93). In France, capital and hours worked per employee also come from the national accounts. For capital, the series is made constant with chained prices at the base year 1995. Software has been deducted in order to suit the German definition. In Germany, capital data and hours worked per employee come from the DIW database (see previous section for statistical references).

Statistics for west Germany based on the year 1995 detailed by economic sector of activity will only be available in fall 2002. For the time being, only the figure of value added in base 95 for west Germany is published for the year 1991 for the whole manufacturing sector. In value, the level recorded lies below the one of the previous system of national accounts. This dramatic revision may be due to the externalisation of some services out of the manufacturing sector integrated from now on into the services and construction sector.

3. The implications of the change in the year of reference on levels of productivity

3.1. The gap between 1987 and 1997 benchmark years

Results of the present study differ significantly from those of the previous comparison carried out in 1994 by the CEPII. In the earlier one, the reference year was 1987 and the sole western Germany was compared to France. In 1987, the geometric average UVR for total manufacturing amounted to 3.06 FF/DM and French labour productivity in manufacturing was about 8% above the west German one. In contrast in 1997, with the reunified Germany, the UVR is higher and French labour productivity in manufacturing lies below the German one.

Sections 2.3 et 2.4 of this paper shows that the endearment of the basket in FF/DM between both benchmark years does not come from the evolution of the relative prices in both countries: German manufacturing prices have indeed risen more than French ones between 1987 and 1997.

As the weighting of UVR relies upon the composition of production, we turned then to the common basket of manufacturing products. The products making up the basket are different in 1987 and 1997. In-between, the structure of the basket (relative weights of industries and branches) can fluctuate significantly in the wake of structural changes in both countries. The average quality of manufacturing products can also change affecting then the price of the common basket. At last, the quality of the matching itself varies a lot between both benchmark years, hiking the price of the basket (1 151 matches in 1997 against 237 in 1987, see appendix 2).

In order to assess the sole impact of the common basket on levels of production and productivity, we have estimated the real output and productivity for 1997 with UVR of both benchmark years. To do so, we have then extrapolated the UVR of the benchmark year 1987 up to 1997. We have then calculated the real value added and productivity for Germany and west Germany in order to extricate a unification effect, if any. Statistics and the method we used are detailed in section 3.2. The main results are displayed in table 14.

First of all, it must be made accurate that the levels of UVR and relative productivity for the benchmark year 1997 shown in this appendix are different from the ones in the core of the paper on two accounts:

The method of aggregation of UVR is different for both benchmark years. Here, we have computed the levels of UVR for the benchmark year 1997 in the same way as for the benchmark year 1987 (see section 3.2).

In the new comparison of CEPII, the conversion units we used for personal cars are UVR based on hedonic prices. They are quite different from the ones calculated with the ICOP method. Here we did not adjust prices for quality to be comparable with the year 1997.

Table 14. Main results of the France-Germany productivity comparisons in 1997 -A. France-Unified Germany

A.1. ACCORDING TO THE EXTRAPOLATED 1987 BENCHMARK YEAR UVR RESULTS

	UVR	Relative French		
		Real Value added	Employees	Labour productivity
	FF/DM	Reunified Germany=100		
Total manufacturing	**2.91**	**55**	**50**	**110**
Food products	3.15	76	65	118
Textiles	3.26	97	106	91
Wood, paper, publishing	2.88	59	46	130
Chemicals	2.84	67	55	122
Metal pr. & machinery	3.12	36	40	91
Electric. pr., electronics	2.42	65	49	133
Transport equipment	2.80	48	45	106

A.2. ACCORDING TO THE 1997 BENCHMARK YEAR UVR RESULTS

	UVR	Relative French		
		Real Value added	Employees	Labour productivity
	FF/DM	Reunified Germany=100		
Total manufacturing	**3.24**	**49**	**50**	**98**
Food products	3.49	69	65	107
Textiles	3.09	102	106	96
Wood, paper, publishing	3.43	50	46	109
Chemicals	3.43	55	55	101
Metal pr. & machinery	3.38	33	40	84
Electric. pr., electronics	3.26	48	49	99
Transport equipment	2.57	53	45	116

B. France-West Germany

B.1. ACCORDING TO THE EXTRAPOLATED 1987 BENCHMARK YEAR UVR RESULTS

	UVR	Relative French		
		Real Value added	Employees	Labour productivity
	FF/DM	West Germany=100		
Total manufacturing	**2.96**	**57**	**55**	**104**
Food products	3.19	77	76	102
Textiles	3.36	104	111	94
Wood, paper, publishing	2.91	79	73	108
Chemicals	2.88	67	58	116
Metal pr. & machinery	3.14	36	41	90
Electric. pr., electronics	2.46	66	52	126
Transport equipment	2.94	51	48	106

B.2. ACCORDING TO THE 1997 BENCHMARK YEAR UVR RESULTS

	UVR	Relative French		
		Real Value added	Employees	Labour productivity
	FF/DM	West Germany=100		
Total manufacturing	**3.24**	**52**	**55**	**95**
Food products	3.49	71	76	93
Textiles	3.09	113	111	102
Wood, paper, publishing	3.43	67	73	92
Chemicals	3.43	56	58	97
Metal pr. & machinery	3.38	34	41	83
Electric. pr., electronics	3.26	50	52	95
Transport equipment	2.57	59	48	122

Notes: UVR and real outputs shown in the table are geometric means of aggregates with French and German weights.

The first part of the table (part A) concerns reunified Germany. The UVR 1987 extrapolated from the latest data on value added prices reaches 2,96 FF/DM in 1997 (A.1, first column). It is significantly less than in 1997: 3,24 FF/DM (A.2, first column). The French manufacturing value added converted with the 1987 extrapolated UVR amounts to 54% of the German one. As the input labour in France lies at 50%, productivity per employee is higher in France than in Germany (108%).

In the right part of the table (A.2) the same data on value added in national currencies and employees are used. The sole difference lies in the UVR. The French value added is converted with the UVR of the benchmark year 1997 (3,24 FF/DM). According to this estimation, French value added decreases to 49% of the German one. As the input labour in France lies at 50%, productivity per employee is lesser in France than in Germany.

In part B of table 14 UVR were applied to west Germany using the same logic as for Germany. French output and input relative to west Germany are of course greater than those relative to reunified Germany. So, French employees represent 55% of west German ones in 1997, versus 50% relative to the whole Germany. The real French value added converted with the extrapolated 1987 UVR amounts to 57% of the west German one. France performs then poorer relative to west Germany than to reunified Germany with a relative level of productivity sanding at 104%. Converted with the UVR of the benchmark year 1997, the French relative level against west Germany is then lower by three percentage points (95% against 98%).

As the relative level of productivity varies in the same proportions when France is compared either to Germany or to west Germany, it can be assumed that unification does not seem to have a significant impact on the endearment of the FF/DM basket between the two benchmark years. Results shown in table 14 indicate that the sole shift in the composition of the basket is responsible for the levels of output and productivity.

3.2. UVR Aggregation Method used to compare the results of the two benchmark years

The ICOP methodology developed by the University of Groningen since the end of the eighties has been subject to several changes. The earlier comparison France-Germany of the CEPII had been carried out in 1993 on the basis of the method used in Van Ark (1993). Since then, a new method of aggregation of industry UVRs at the branch and at the manufacturing sector level have taken place. This new methodology which is described in appendix 1 is used for the current 1997 benchmark France-Germany comparison. To compare the results of both benchmark years, the UVR levels in 1997 were computed with the same method as the one used for benchmark 1987.

The products UVR aggregation process at the industry level is identical in both methods. Methods become different at the branch and manufacturing sector level. The 1987 method will be developed shortly below[22:]

[22] See M. Freudenberg et D. Ünal-Kesenci (1994) for a detailed version of the methodology.

The UVR for a given level of aggregation weighted by German values:

$$\textbf{(16)} \qquad UVR_K^D = \sum_k^K \left(\frac{UV_k^{F(FF)}}{UV_k^{D(DM)}} \times \boldsymbol{h}_k^D \right) \quad \text{with}$$

$$\boldsymbol{h}_k^D = \frac{q_k^D UV_k^{D(DM)}}{\sum_k^K q_k^D UV_k^{D(DM)}}$$

Otherwise stated, the MOPP for Germany is the Laspeyres index:

$$\textbf{(17)} \qquad UVR_K^D = \frac{\sum_k^K q_k^D * UV_k^{F(FF)}}{\sum_k^K q_k^D * UV_k^{D(DM)}}$$

With D standing for Germany, F for France; k is the product, K being a product aggregation level, q the produced quantity and UV the unit value of products. The conversion rate to be considered will always be quoted in DEM (1DEM=xFRF).

The UVR for a given level of aggregation weighted by French values is:

$$\textbf{(18)} \qquad UVR_K^F = \frac{1}{\sum_k^K \left(\frac{UV_k^{D(DM)}}{UV_k^{F(FF)}} \times \boldsymbol{h}_k^F \right)} \quad \text{with} \quad \boldsymbol{h}_k^F = \frac{q_k^F UV_k^{F(FF)}}{\sum_k^K q_k^F UV_k^{F(FF)}}$$

Otherwise stated, the MOPP for France is the Paasche index:

$$\textbf{(19)} \qquad UVR_K^F = \frac{\sum_k^K q_k^F * UV_k^{F(FF)}}{\sum_k^K q_k^F * UV_k^{D(DM)}}$$

The computation of UVR is implemented in three steps. Firstly, UVR are computed for comparable products in both countries, by applying the formula above. In a second step, a procedure is ushered in order to determine whether the UVR of the matched products are representative enough to be applied to the whole industry. If the matched part of the industry represents at least 25% of the total sales in this industry for both countries (Fisher geometric average), the UVR is assumed to be representative and will be directly applied to

the non matched part of the industry in step 3. Otherwise, if the value of the matched products lies below 25% of the total sales in the industry, the UVR of the immediate above aggregated level (branch, major branch or manufacturing sector), if representative, will be used for this whole industry in step 3. At the branch and manufacturing aggregated level, the same procedure applies.

In the third and last step, the intermediate UVR given in step 2 are weighted according to the share of branches in **total manufacturing value added**. These final UVR are used to assess the total real value added. In order to avoid double accounting due to intermediate inputs, value added at factor costs has been selected from this step on.

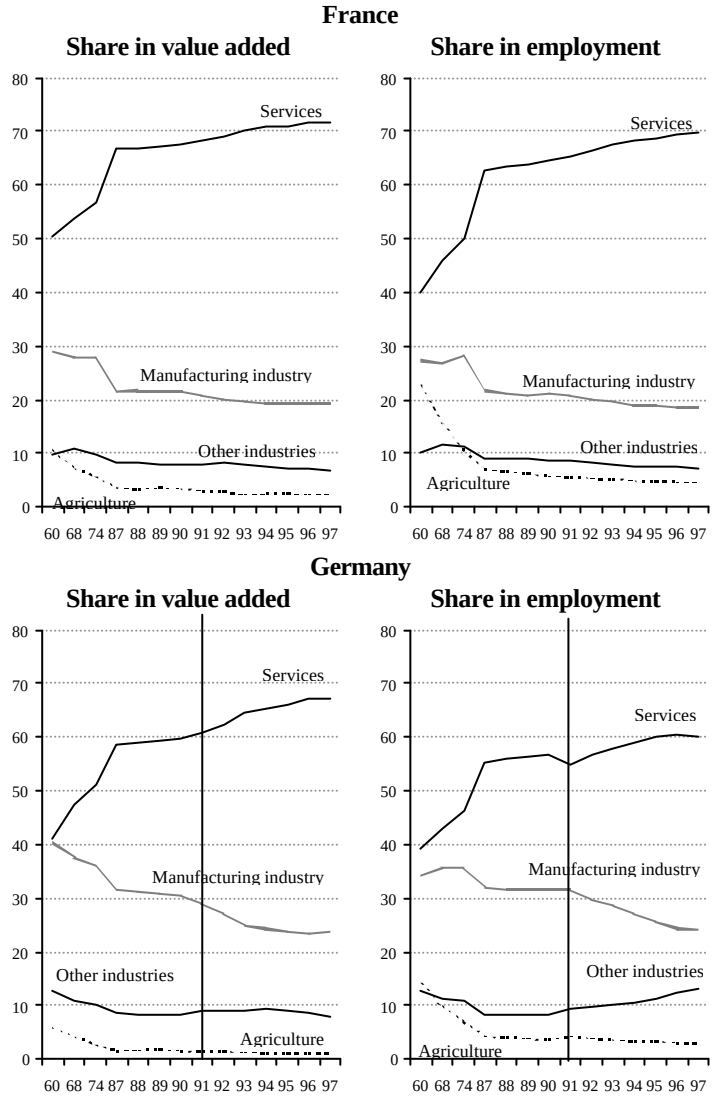
3.3. Data base

The 1987 UVR level was extrapolated up to 1997 by using value added prices quoted in the SNA (System of National Accounts) 95 for France. For Germany, as series had to be extrapolated as of 1987, so before unification, we did not use the SNA 95 series, but the ones of SNA 93 for west Germany (base year 1991).

The extrapolated 1987 benchmark UVR to 1997 and the 1997 benchmark UVR are then used to estimate the relative real French output and the labour productivity. The French data on value added in national currency and employees are the same in parts A and B of table 14: French *Firm survey* statistics in 1997. For unified Germany (part A), we used in the same manner German *Firm survey* statistics in 1997. But we had to change the data source for the west Germany estimations. The German office of statistics does not yet published sectoral figures for west Germany, but for the manufacturing sector on its whole. We have used this source for value added and employees for west Germany for the manufacturing sector. The branch levels have been computed along the sectors composition available in the DIW publications for 1997 (DIW, 2000).

4. The role of the manufacturing sector in the French and German economy

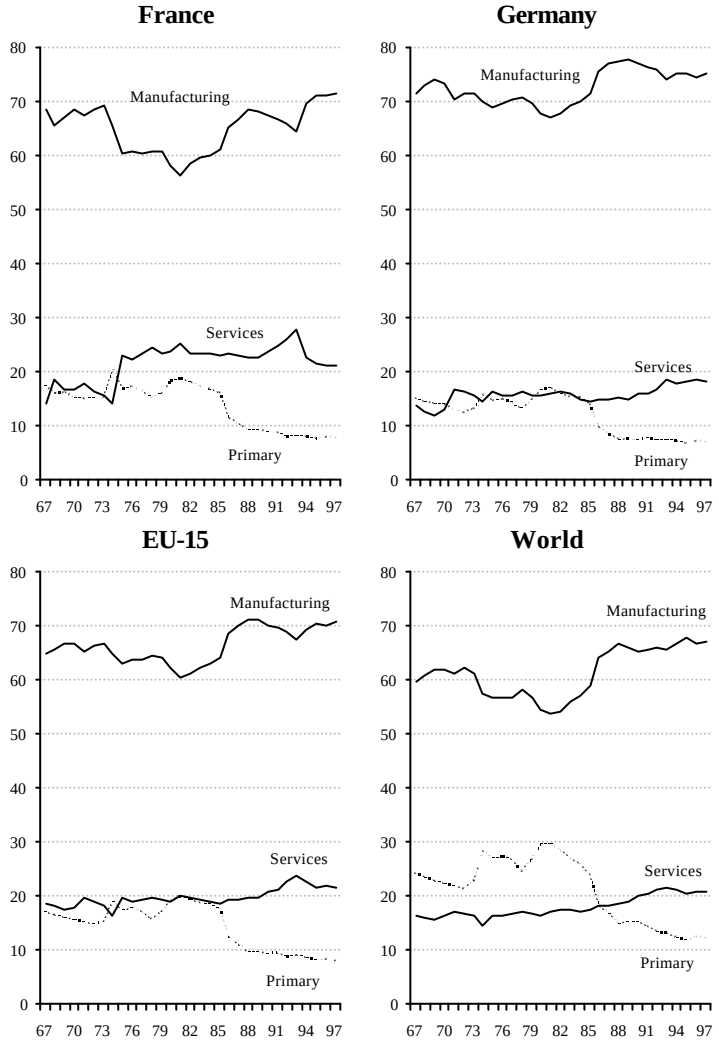
The share of the manufacturing sector in the total economy



Note: Value added are quoted in national currency. Employment corresponds to the occupied labour force. The German series refer to west Germany till 1990 and to Germany since1991.

Source : OECD (1999), Historical Statistics from OECD, 1960-1997.

Sectoral breakdown of trade
(exports plus imports)



Source: CEPII, CHELEM database, authors'calculations.

5. French and German industrial structure by branch

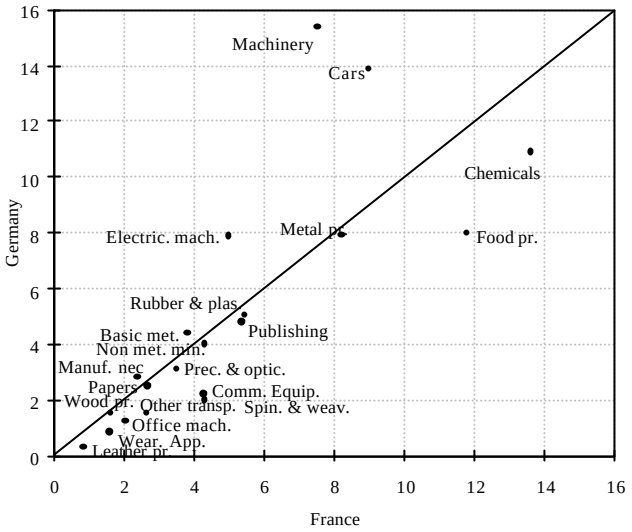
France and Germany have a similar structure of manufacturing output. The first two columns of table 15 and figure 20 display the real value added by branch (i.e. converted by UVR) in 1997. The same five branches have strong shares in the two countries (7% of total manufacturing at least): machinery and equipment (NACE 29), cars (NACE 34), chemicals (NACE 24), food products (NACE 15 & 16) and metal products (NACE 28). The shares of the first two branches are more important in Germany then in France. Otherwise, electrical machinery (NACE 31) has an important share in German manufacturing value added.

Table 15. Breakdown of the manufacturing output and inputs
France-Germany, 1997

NACE		Real value added		Hours worked		Capital stock	
		France	Germany	France	Germany	France	Germany
	Total Manufacturing	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
15+16	**Food products**	**11.8**	**8.0**	**11.7**	**10.1**	**14.1**	**10.1**
	Textiles	**5.1**	**2.6**	**7.9**	**3.6**	**5.1**	**4.5**
17	Spinning and weaving	2.6	1.5	3.6	2.0		
18	Wearing apparel	1.6	0.8	3.0	1.1		
19	Leather products	0.8	0.3	1.3	0.4		
	Wood, paper, publish.	**9.7**	**8.8**	**9.1**	**10.0**	**7.0**	**8.5**
20	Wood & wood products	1.6	1.5	1.7	1.9		
21	Paper & paperboard	2.7	2.5	2.8	2.4		
22	Publishing	5.4	4.8	4.5	5.7		
	Chemicals	**23.4**	**19.9**	**18.8**	**17.8**	**24.4**	**23.7**
24	Chemicals	13.6	10.9	8.7	7.9		
25	Rubber & plastic prod.	5.5	5.1	6.1	5.6		
26	Non met. mineral prod.	4.3	4.0	4.1	4.2		
	Metal pr. & Machinery	**19.6**	**27.7**	**22.7**	**28.3**	**19.6**	**22.4**
27	Basic metals	3.8	4.4	4.1	4.1		
28	Metal products	8.2	7.9	10.3	9.1		
29	Machinery & equipment	7.5	15.4	8.3	15.0		
	Electrical pr., electronics	**17.2**	**17.2**	**17.2**	**17.1**	**14.8**	**14.9**
30	Office mach., computers	2.1	1.2	1.3	0.9		
31	Electrical machinery	5.0	7.9	4.9	7.3		
32	Radio, TV & com. Equip.	4.3	2.2	4.1	2.0		
33	Med., precision & optical	3.5	3.1	3.4	3.3		
36	Manufacturing n.e.c.	2.4	2.8	3.5	3.5		
	Transport equipment	**13.3**	**15.8**	**12.5**	**13.3**	**15.1**	**15.9**
34	Motor vehicles	9.0	13.9	8.9	11.4		
35	Other transport equipment	4.3	2.0	3.7	1.8		

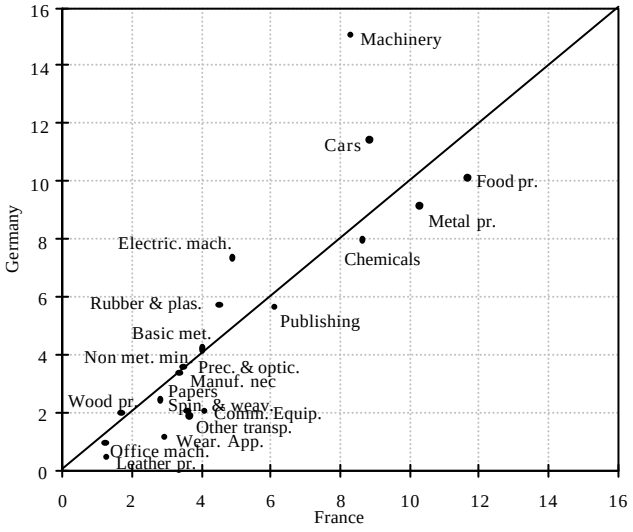
Notes : Values added are in DM. French value added is converted by the UVR. The structure of the capital stock has been assessed by using the PPP rate for industrial investment goods given by the OECD. Hours worked are equal to employees times the average annual working hours per employee.
Sources: See appendix 2.

Figure 20. Composition of real value added, 1997
(in % of the manufacturing sector)



Sources : Table 15.

Figure 21. Composition of hours worked, 1997
(in % of the manufacturing sector)



Sources : Table 15.

The national differences in the manufacturing sector are more obvious with respect to input structures by branch. Table 15 and figure 21 show the breakdown of total hours worked[23] in 1997. The German labour input structure is more concentrated than the French one: more than a quarter of hours worked in the German manufacturing sector are spent in the machinery-equipment (NACE 29) and motor vehicles (NACE 34) branches. In France, food (NACE 15&16) is the first branch where labour input is the most concentrated (12 %) followed by metal products (10 %).

For classification reasons, only the major branches are shown in table 15 for the capital input. The breakdown of the capital stock by major branch is quite identical in both countries. The only exception concerns the food industries (NACE 15&16) where the capital stock makes up 14% of the manufacturing total against 10% in Germany.

6. Total factor productivity and contributions to growth

The total factor productivity is here computed with a Cobb-Douglas function of production where α and $(1-\alpha)$ are equivalent to the partial production elasticity relative to labour and capital:

$$Y = MFP \; L^{\alpha} \; K^{(1-\alpha)} \qquad (20)$$

Alpha is the geometric mean of the share of labour compensation in the manufacturing GDP (minus direct taxes plus subsidies) in Germany and in France. Data extend on the period 1977-1992 for France and 1970-1996 for Germany (OECD, National accounts, 1988, 1993, 1998). Only west Germany was taken into account.

Multifactor productivity *(MFP)* growth is the residual of the estimation. It refers to increases in the productive capacity of the economy that are not attributable to increases in the contributions of labour and capital inputs.

The relative total factor productivity can be written as follows:

$$\ln\left(\frac{MFP^{F}}{MFP^{D}}\right) = \ln\left(\frac{\frac{Y^{F}}{L^{F}}}{\frac{Y^{D}}{L^{D}}}\right) - (1-\alpha)\ln\left(\frac{\frac{K^{F}}{L^{F}}}{\frac{K^{D}}{L^{D}}}\right) \qquad (21)$$

Contributions to growth are computed from the same function of production:

[23] Number of employees multiplied by the average annual working time.

$$(22) \qquad 1+\dot{Y} = (1+\dot{L})^{\alpha}(1+\dot{H})^{\alpha}(1+\dot{K})^{1-\alpha}\,\dot{MFP}$$

where *Y* stands for the value added of the manufacturing sector at prices of 1995 and the dot points to a growth rate.

With the same method, the contributions to the labour productivity growth can be assessed. Removing the growth of labour input [$(1+\dot{L})$ and $(1+\dot{H})$] from both sides of the previous equation, and keeping in mind that the capital compensation equals $(1-\alpha)$, the relationship between output and inputs can be further rearranged to decompose labour productivity growth into two components: (1) the rate of "capital deepening" –the growth of capital intensity- adjusted by the contribution of capital to the production process, and (2) multifactor productivity growth.

$$(23) \qquad \left(\frac{\dot{Y}}{LH}\right) = \left(\frac{\dot{K}}{LH}\right)^{1-\alpha} \dot{MFP}$$

If capital is relatively unimportant ($1-\alpha$ is small), then labour and multifactor productivity growth would be virtually identical. Similarly, if the capital-labour ratio remains essentially fixed, then the growth rates of labour and multifactor productivity would, again be virtually identical.

7. East/West Germany: labour productivity, capital intensity and multifactor productivity

	1991			1999			91-99 annual average growth rate		
	Labour productivity	Capital intensity	Multifactor Productivity	Labour productivity	Capital intensity	Multifactor Productivity	Labour productivity	Capital deepening	Multifactor Productivity
Total Manufacturing	**17**	**71**	**25**	**64**	**98**	**66**	**17,8**	**4,1**	**13,1**
Capital-intensive industries	**20**	**73**	**28**	**68**	**98**	**69**	**16,2**	**3,8**	**12,0**
15 Food &Beverages	24	64	38	69	90	77	14,2	4,4	9,4
16 Tobacco	13	58	23	39	81	49	14,4	4,3	9,7
17 Spinning & weaving	11	60	18	68	87	79	26,2	4,8	20,4
19 Leather products	16	58	27	76	101	75	21,8	7,1	13,7
21 Paper & paperboard	18	76	24	75	100	74	19,5	3,5	15,5
22 Publishing	15	67	23	95	96	99	25,6	4,6	20,1
23 Refinery, coke oven pr.	7	85	8	35	120	29	23,1	4,4	17,9
24 Chemicals	33	74	45	86	107	81	12,6	4,7	7,5
26 Non met. mineral products	18	78	23	74	103	72	19,3	3,5	15,3
27 Basic metals	14	77	18	57	103	55	19,5	3,7	15,2
Skilled labour-intensive ind.	**15**	**65**	**23**	**54**	**94**	**58**	**17,5**	**4,8**	**12,1**
29 Machinery & Equipment	18	65	28	52	94	56	14,0	4,8	8,8
30 Office mach., computers,	4	55	6	94	82	*115*	50,8	5,2	43,4
31 Electrical machinery	10	56	18	39	77	50	18,4	4,0	13,8
32 Radio, TV & com. equip.	12	50	24	58	99	58	21,9	9,0	11,8
33 Med., precision & optical	18	48	38	*113*	81	*139*	25,8	6,8	17,7
34 Motor vehicles	8	74	11	63	98	65	28,9	3,5	24,6
35 Other transport equipment	28	85	33	45	107	42	6,1	2,9	3,0
Labour-intensive industries	**16**	**69**	**23**	**75**	**92**	**81**	**21,5**	**3,7**	**17,2**
18 Wearing apparel	10	40	26	42	72	58	19,1	7,8	10,5
20 Wood & wood products	21	82	26	104	104	100	22,0	3,1	18,3
25 Rubber & plastic products	21	82	26	64	93	69	14,9	1,6	13,1
28 Metal products	17	69	24	75	88	85	20,8	3,1	17,2
36 Manufacturing n.e.c.	15	63	23	61	91	67	19,7	4,7	14,4

Note : Labour productivity equals capital intensity times MFP/100. figures above 100 within the confidence interval of 95% are in italics.

Source: Data in Görzig, B. et G. Noack (2000), classification of industries in Gerling K. (2000), and authors' calculations.

8. The average annual working time in France and in Germany

The average annual working time is not available in the firm surveys. Thus, for France, the data come from the national accounts statistics. For Germany, the federal office of statistics does not publish sectoral data on hours worked per employee. Traditionally, the Institut für Arbeitsmarkt- und Berufsforschung (IAB) affiliated to the federal ministry of labour used to compute hours worked for west Germany. Presently, only the DIW (Deutsches Institut für Wirtschaftsforschung) gives the annual working hours at a detailed sectoral level for Germany.

The concept used here for hours worked refers to the hours actually worked computed from the paid hours less hours accounted for holidays, legal holidays and long week-ends, paid vocational training and leave (sickness, maternity). The annual hours actually worked are computed by INSEE from the ACEMO survey on labour and labour conditions undertaken by the DARES at the French Ministry of labour, and from the labour survey organised by the INSEE itself. For Germany, the DIW relies on the labour survey published by the statistisches Bundesamt. Labour surveys in France and in Germany consider industrial establishments of more than 20 employees in Germany and more than 10 in France.

8.1. The sector gap in hours worked between east and west Germany

The poor performance of Germany against France in terms of hours worked per employee in the food (1 709 and 1 571 hours per employee respectively) or in the other non metallic mineral industry (1 670 hours and 1 627 hours per employee respectively) is partly due to the contribution of east Germany. In 1997, east German employees worked on average 7.4% more than their western counterparts in the manufacturing sector. On average, the gap between both areas is equal to 124 hours in the manufacturing sector.

The gap is significantly wider between west and east Germany in the textiles (NACE-17), wearing apparel (NACE-18), electric products (NACE-31), the automobiles (NACE-34) and the furniture branches (NACE-36) as shown in table 16 below. On the contrary, in the branch other transport than cars, east Germans work shorter hours than west Germans.

The same acknowledgement can be made in terms of total hours worked, i.e. hours worked per employee times total employees in the branch. In the food (NACE-15), metallic (NACE-28) and machinery (NACE-29) industries, the gap between Germany and west Germany is rather wide, as these branches account for a big share of employment in east Germany (39%).

Table 16.
Hours worked per employee, 1997

		East Germany	West Germany	Germany	France
	Total Manufacturing	**1 680**	**1 556**	**1 567**	**1 604**
15+16	**Food products**	**1 763**	**1 700**	**1 709**	**1 571**
	Textiles	**1 659**	**1 461**	**1 480**	**1 582**
17	Spinning and weaving	1 696	1 530	1 550	1 591
18	Wearing apparel	1 571	1 343	1 358	1 574
19	Leather products	1 612	1 511	1 518	1 574
	Wood, paper, publishing	**1 716**	**1 590**	**1 599**	**1 609**
20	Wood & wood products	1 776	1 666	1 678	1 622
21	Paper & paperboard	1 692	1 597	1 603	1 622
22	Publishing	1 636	1 523	1 528	1 596
	Chemicals	**1 729**	**1 599**	**1 611**	**1 599**
24	Chemicals	1 705	1 572	1 581	1 592
25	Rubber & plastic products	1 732	1 601	1 611	1 592
26	Non met. mineral products	1 744	1 654	1 670	1 627
	Metal products & Machinery	**1 666**	**1 557**	**1 566**	**1 628**
27	Basic metals	1 606	1 533	1 539	1 628
28	Metal products	1 693	1 592	1 602	1 628
29	Machinery & equipment	1 661	1 544	1 552	1 628
	Electrical products, electronics	**1 647**	**1 500**	**1 512**	**1 605**
30	Office machinery., computers	1 631	1 542	1 547	1 605
31	Electrical machinery	1 650	1 487	1 499	1 605
32	Radio, TV & comm. equipment	1 586	1 464	1 475	1 605
33	Medical, precision & optical products	1 653	1 538	1 547	1 605
36	Manufacturing n.e.c.	1 675	1 503	1 519	1 605
	Transport equipment	**1 547**	**1 498**	**1 501**	**1 606**
34	Automobiles	1 733	1 498	1 506	1 615
35	Other transport equipment	1 421	1 497	1 480	1 587

Sources: Authors' calculations from INSEE, SESSI, SCEES, Statistisches Bundesamt, DIW and World Bank.

8.2. The gap in hours worked between France and Germany

Even when other sources are considered, the gap between France and Germany keeps wide. For example, in "the cost of labour in France and in west Germany in 1996 by sector of activity", a survey undertaken by both German and French national institutes of statistics, the hours worked per full-time equivalent employee are computed in the industry except the energy sector (table 17). They amount to 1 646 hours in France and 1 589 hours in Germany, equivalent to a gap of 57 hours against 38 hours only in our database (48 hours against the western part and –76 hours against the eastern part). According to this survey, French employees work 90 hours more than west Germans in the electric products and basic metals branches (NACE-31 and NACE-27) and 80 hours more in the radio, TV and communication,

automobiles and machinery equipment branches (NACE-32, NACE-34 and NACE-29) and they work about the same hours in the food, leather and other non metallic mineral branches (NACE-15, NACE-19 and NACE-26).

Differences between the INSEE-STBA survey and the DIW database emerge mainly in the food and in the wearing apparel industries, as the DIW accounts many less hours per employee in the wearing apparel branch and much more in the food one. This can be partly explained by a more or less reliable computation of part-time jobs in these branches and partly by the fact that DIW leans on data of different sources (the IAB, STBA) in order to get a larger account of hours worked per employee.

Table 17.
Average working time in France and west Germany 1996

	West Germany	France	France minus West Germany
Total Manufacturing	**1 589**	**1 646**	**57**
15 Food	1 668	1 667	-1
16 Tobacco	1 594		
17 Spinning and weaving	1 599	1 651	52
18 Wearing apparel	1 582	1 624	42
19 Leather products	1 631	1 628	-3
20 Wood & wood products	1 641	1 660	19
21 Paper & paperboard	1 597	1 646	49
22 Publishing	1 590	1 667	77
24 Chemicals	1 592	1 631	39
25 Rubber & plastic products	1 612	1 651	39
26 Non met. mineral products	1 650	1 659	9
27 Basic metals	1 526	1 616	90
28 Metal products	1 604	1 665	61
29 Machinery & equipment	1 584	1 663	79
30 Office machinery., computers	1 582	1 654	72
31 Electrical machinery	1 557	1 651	94
32 Radio, TV & comm. equipment	1 564	1 650	86
33 Medical, precision & optical products	1 605	1 671	66
34 Automobiles	1 526	1 610	84
35 Other transport equipment	1 581	1 600	19
36 Manufacturing n.e.c.	1 597	1 652	55

Source: Gagnon Christian (2000) "Le coût de la main-d'œuvre en 1996"; INSEE, *Résultats*, Emploi-Revenus, n°159, January.

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