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Competitiveness and export market shares in high tech industries in the US and the EMU: A comparative study

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Abstract

This paper aims to analyse the nature of the gap in high tech industries between the United States and the EMU countries, and to investigate the link between cost competitiveness and market share in these industries. We examine the empirical evidence to ascertain whether some tentative conclusions can be drawn regarding the impact of the appreciation of the euro against the dollar on the growth of these industries.

We show that there has been a growing gap between the US and the EMU countries in terms of production in the high tech industries since the beginning of 1990s, but that rather surprisingly, this gap is not reflected in the evolution of exports and market share. On the contrary, EMU country high tech exports caught up to US exports and the world market share of the EMU countries has increased. These results are supported by the average rise in the cost-competitiveness of the EMU countries over the period 1988-2002, which is higher than that of the US.

In order to appreciate the evolution of cost-competitiveness and its effect on industry growth, we investigate whether export market share is sensitive to cost-competitiveness. Our results show both a contemporaneously positive relationship between relative unit labour cost (RULC) and export market share, supporting the Kaldor paradox; and a negative relationship between RULC and export market share two years later.

We conclude first then, that cost-competitiveness, brought about by the exchange rate and labour productivity, affects changes in the market shares of high tech industries; and second, that non-cost competitiveness is also having an effect. The latter is the result of the higher labour costs associated with high skills and better qualifications.

JEL Codes : C23, F14, F31, L63, L11

Keywords: Competitiveness, high tech industries, relative unit labour cost.

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Compétitivité et parts de marché à l'exportation des industries "high tech": une comparaison des États-Unis et de l'Union Economique et Monétaire

Résumé

Cette étude s'intéresse aux industries de haute technologie de la zone euro et des Etats-Unis alors que ces industries apparaissent de première importance pour la croissance économique et alors que l'on recherche les causes du différentiel de croissance persistant entre la zone euro et les Etats-Unis.

L'observation de l'évolution des productions respectives dans ces industries montre un écart croissant à partir de la seconde moitié des années 1990 entre la zone euro et les Etats-Unis principalement dans les industries de haute technologie au sens strict (HT). Du côté des exportations, l'écart entre la zone euro et les Etats-Unis ne se reproduit pas. Le niveau des exportations de la zone euro et des Etats-Unis est quasiment identique aujourd'hui signifiant donc une plus forte exposition des industries de la zone euro. Le dynamisme des exportations de la zone euro est conforté par l'augmentation des parts de marché dans ces industries bien que les Etats-Unis, dont les parts de marché déclinent, conservent des niveaux de part de marché supérieur dans les industries HT.

Ceci est cohérent avec deux autres faits stylisés issus de la comparaison de la compétitivité-coût de la zone euro et des Etats-Unis. D'une part, le niveau moyen du coût unitaire relatif est plus élevé dans la zone euro qu'aux Etats-Unis alors qu'il est plus faible dans les industries M-HT; d'autre part le coût du travail unitaire augmente moins ou diminue plus en moyenne dans les industries HT et M-HT dans la zone euro qu'aux Etats-Unis. La zone euro améliore donc sa compétitivité-coût par rapport aux Etats-Unis sur la période.

Notre dernière section permet de vérifier si cette amélioration explique la dynamique des parts de marché. Nos résultats montrent que pour 7 des 9 industries de haute technologie, un avantage de coût se traduit par un gain de part de marché.

La régression réalisée en ne distinguant que les trois zones monétaires montre une relation contemporaine entre le coût du travail unitaire par zone et les parts de marché positive mais négative avec le coût du travail unitaire retardé. La relation positive signifie que les zones dont le coût unitaire du travail relatif augmente ont également vu leurs parts de marché augmenter. La spécification décomposée révèle que le coût salarial est à l'origine de cette hausse et donc que les gains de parts de marché ont été réalisés dans des industries « hautement haute technologie » où les compétences sont associées à un coût salarial élevé. Parallèlement, la relation négative entre le coût du travail unitaire retardé et les parts de marché montre que l'évolution de la compétitivité-coût est pertinente pour comprendre l'évolution des parts de marché des industries de haute technologie, au moins dans un certain nombre d'industries. La spécification décomposée montre que la sensibilité négative des parts de marché à la compétitivité-coût est causée par le taux de change et la productivité.

1. Introduction

The importance of the high tech industries for European growth was expressed in political terms at the Lisbon Summit in March 2000. The statements made were based on the broad consensus that there is a positive relationship between level of R&D and economic growth rate. High tech industries are viewed as strategic industries since they are the main source of R&D spending. Theses industries also figure largely in the improvement of living standards in general as a result of the major positive spillovers they generate (Griliches (1998)) which produce high social returns. Biotechnology and ICT (information and communication technologies) production are notable means of improving labour productivity in the medium-long term, and the quality of life in general.

European leaders and analysts have increasingly focused on these industries adding that the growth gap between Europe and the US is attributable to the dynamics of these industries and more specifically the large productivity growth in the ICT industries. There are several studies that have established the importance of ICT productivity (O'Mahony and Ark, 2003) for the economic growth.

Other arguments have been advanced that focus on macroeconomic policies or institutional constraints. The former set of arguments emphasizes that European monetary, budgetary and exchange rate policies are not designed to foster growth. For instance, in exchange rate policy, the creation of the euro undoubtedly produced a favourable context for intra-European trade given the disappearance of exchange rate variability (Frankel and Rose, 2002). But EMU countries have since abandoned exchange rate policy as a means of encouraging growth. One may wonder whether the lack of this political instrument has any consequence for the changes in the competitiveness of EMU countries' high tech industries[1]. The latter set of arguments claims that European economies are characterized by certain institutional constraints, specifically related to the labour market, that hamper economic growth. Lack of flexibility, which has a particularly negative effect, leads to higher relative labour costs. Thus, this characteristic of European Economies might explain the decrease in competitiveness together with the relocation of production. Neither argument is peculiar to the high tech industries, but these industries are particularly exposed to international competition and are likely to be extremely sensitive to the determinants of competitiveness.

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1. The observation of a fictive euro since 1980 shows that, since the last 1990s, its evolution is "contra-cyclic".This evolution then is quite unable to temper the negative shocks that have affected European economic growth (see Fitoussi, J.-P. (2004). "La question du taux de change de l'euro." Lettre de l'OFCE, Observations et Diagnostics économiques(247).).

This study focuses on cost-competitiveness as we assume a positive relationship between cost-competitiveness and industry growth. International competitiveness is frequently associated with the ability of a country to achieve economic policy goals, particularly growth in income and employment. But there are no theoretical models that establish a clear relationship between growth and cost-competitiveness. However, theoretical studies agree that there is a positive relationship between growth and trade (Lopez, 2005). Provided that the growth of exports is related to greater competitiveness, then the correlation between growth and competitiveness should be positive. Some studies have challenged this view since Kaldor (1978) showed that some countries can experience a simultaneous decrease in cost-competitiveness and increase in market shares. This result, known as the Kaldor paradox, led to the conclusion that major industrialised countries do not base their export performance on cost-competitiveness. Recent changes in international competition have somewhat modified the claims inherent in this paradox. The high tech industries are very exposed to international price competition because of large rate of exports due mainly to high increasing returns to scale (Hatzichronoglou, 1997), but at the same time are also strongly influenced by qualitative product differentiation given the importance of innovation. These characteristics do not lead to a clear assumption about the role of cost-competitiveness on the market shares of these industries.

This study investigates the nature of the relationship between cost-competitiveness and export performance in the high tech industries at a disaggregated level, by identifying nine high tech industries from the ISIC rev.3.

The focus on cost-competitiveness is justifiable because it is possible to decompose the measure into productivity, labour cost and exchange rate. This allows us to seek for evidence about whether the growth of high tech industries is determined by productivity issues or/and by the macroeconomic and institutional environment. The institutional environment is represented here by the labour cost level. The macroeconomic environment is the exchange rate level.

The impact of the exchange rate on industry performance has been much debated in the literature. The theoretical literature generally shows a lack of sensitivity of economic activity to changes in the exchange rate, at least in the short term. Trade is relatively rigid to exchange rate variation as the adjustment can be very long run (Baldwin and Krugman, 1989). In terms of firm behaviour, the uncertainty about exchange rate changes leads to a 'wait-and-see' attitude that creates major hysteresis (Dixit, 1989; Krugman, 1988). At industry level, there are numerous studies that have shown an inverse relationship between industry growth and the country's exchange rate. Thus industry performance is affected by the exchange rate through changes in competitiveness (Branson and Love, 1988); Krugman, 1988)). Empirical studies have supported the claim that industry characteristics determine the sensitivity of industry to exchange rates (Fouquin, Sekkat et al., 2001)). The degree of competition, the degree of differentiation but also the organizational characteristics (whether the production is internationalized, relocated or not for instance), influence the level of competitiveness and its sensitivity to exchange rate variation.

This leads to a controversial conclusion about the consequences of the adoption of the Euro. Some analysts have argued that the absence of exchange rate policy has no effect given the small sensitivity of exports to exchange rates (Buiter, 1995)); others claim that its absence is detrimental to EMU economies (Eichengreen and Ghironi, 1995)). New empirical studies are required, and at a disaggregated level.

Obviously, the growth of the high tech industries can be explained only partly by changes in competitiveness. Many other factors are involved, mostly technological variables (see Fagerberg, 1994); Carlin, Glyn et al., 2001); Landesmann and Pfaffermayr, 1997)), but the focus of this study is the preliminary question of cost, which is so important in price competition. Through this investigation we hope to contribute to the ongoing debate regarding the source of the growth gap between the EMU economies and the US.

The next section analyses the production and export gap between the EMU and the United States. Section 3 examines the measure of cost-competitiveness and Section 4 investigates the relationship between market shares and cost-competitiveness. Section 5 concludes.

2. High tech industries in the United States and in the EMU : production gap but export level convergence [2]

We adopt the OECD classifications of high tech (hereafter HT) and middle-high tech (M-HT) industries. Further details about data and classifications are given in appendix 1.

2. In any comparison of EMU and US it is necessary to keep in mind that the real GDP of EMU is 62% (70%) of US real GDP in 2002 (1990) respectively. The EMU’s labour force was 95% of the US 2002. The EMU produces less than the US, but with nearly as much labour. And the EMU is much more opened than the US. In 2003, the export rate (exports on GDP) of the EMU countries was 36.5% against 9.7% for the US. The EMU is thus more internationally exposed than the US.

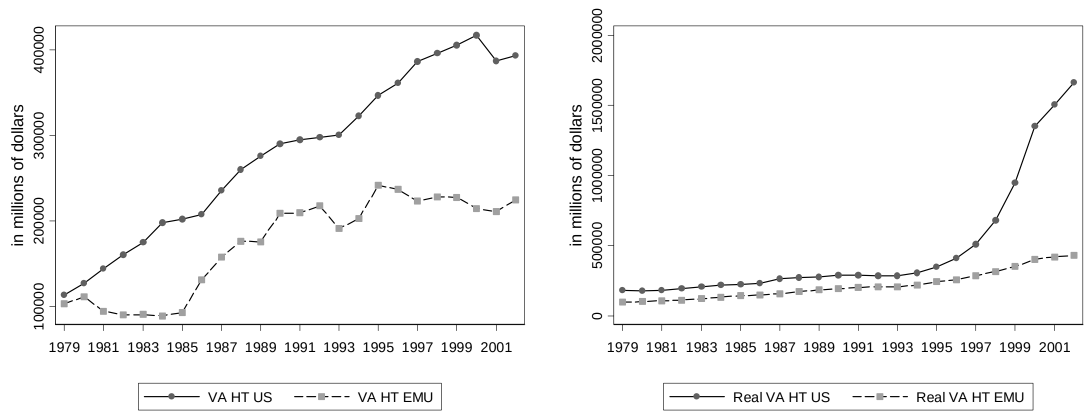
2.2. High tech industries' production: EMU and United States

The following compares value added for the EMU and the US from 1979 to 2002.

2.2.1. Growing gap in HT production between EMU and United States

A comparison of the HT industries' production shows that there is a difference between the two regions, and that this difference has been increasing since the beginning of the 1990s (see Graph 1).

Graph 1 : Nominal and real (1995 price) Value Added in millions of dollars of HT industries of the EMU and the United States



Sources : Calculated from "Groningen Growth and Development Centre, 60-Industry Database, February 2005".

To compare levels of production, we would generally use purchasing power parity (PPP) for the US and the euro area. However, previous to 1999 (the period covered in our study) this exchange rate is not available and second, PPP when studying industries whose prices are far removed from the general level of prices, is not appropriate[3]. In graph 1, value added for the US and the EMU is expressed in dollars. Thus, the evolution of the EMU ' value added reflects the dollar variation (appreciation in the beginning of the '80s, strong depreciation in the second half of the '80s appreciation against the euro from 1995 to 2001[4]). Despite this exchange rate limit, it is interesting to note that levels of production at the beginning

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3. The calculation of value added here takes account of the huge decline of prices in the ICT industry. This industry is not only part of the HT industry but also constitutes a major input (see Inklaar, R., et al. (2003). Data sources and methodology. EU Productivity and competitiveness: an industry perspective. M. O'Mahony and B. v. Ark. Luxembourg, European Commission. **chapter VII:** 227-273.
4. For the fictive euro/dollar parity in question, see appendix 3.

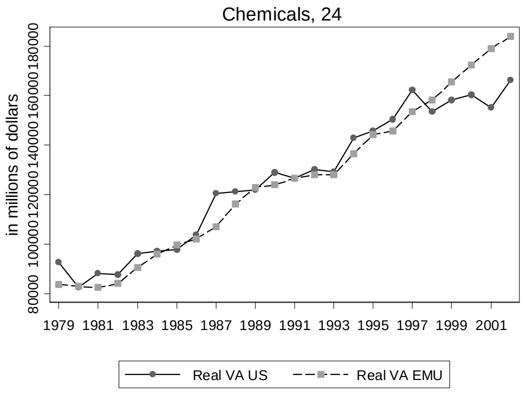
of the 1980s were identical, while by the beginning of 2000 they were very different. The EMU HT value added was equivalent to 90% of the HT US value added in 1979, but only 55% in 2002.

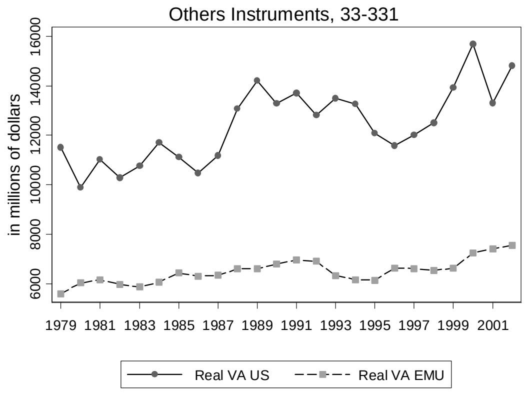
The real value added (at 1995 constant prices) reinforces the nominal production gap. In 1979, EMU real value added was 78% of US values, but only 55% in 2002.

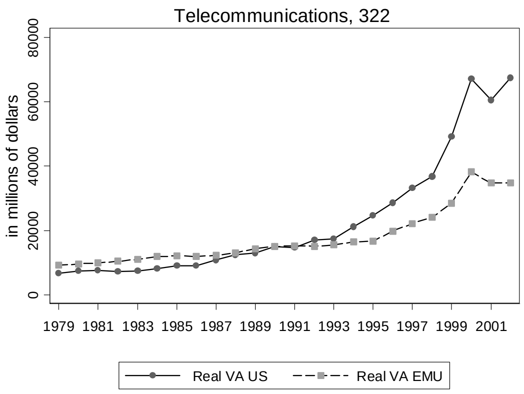
A look at the evolution of the industry in each zones from 1979 to 2002 indicates that the industrial dynamics, at the observed desegregation level, are the same for both. The industries showing the strongest growth are the same in both zones. Moreover, except for the aircraft and spacecraft industry[5] (which is fundamentally linked to defence policy), all industries show a same evolution. Thus, there is no suggestion from these graphs that it is some difference in industry structure that is the cause of the production gap. Rather, the production gap that exists between the US and the EMU is attributable to different growth rates, and this is particularly obvious in the ICT industries ("30" and "321"). The gap in HT production growth since the 1990s has to be related mainly to the ICT industries.

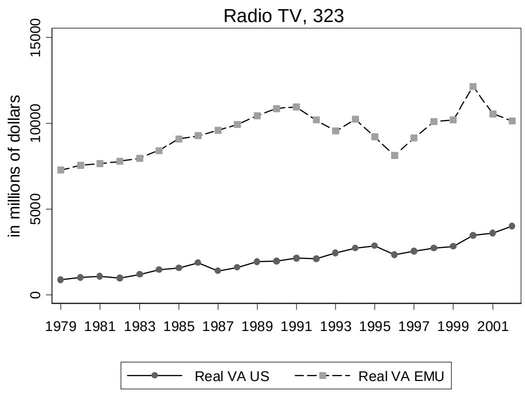
5. It is possible to distinguish the pre and post cold war periods quite clearly.

Graphs 2 to 9 : Real values added of HT industries in the United States and the EMU









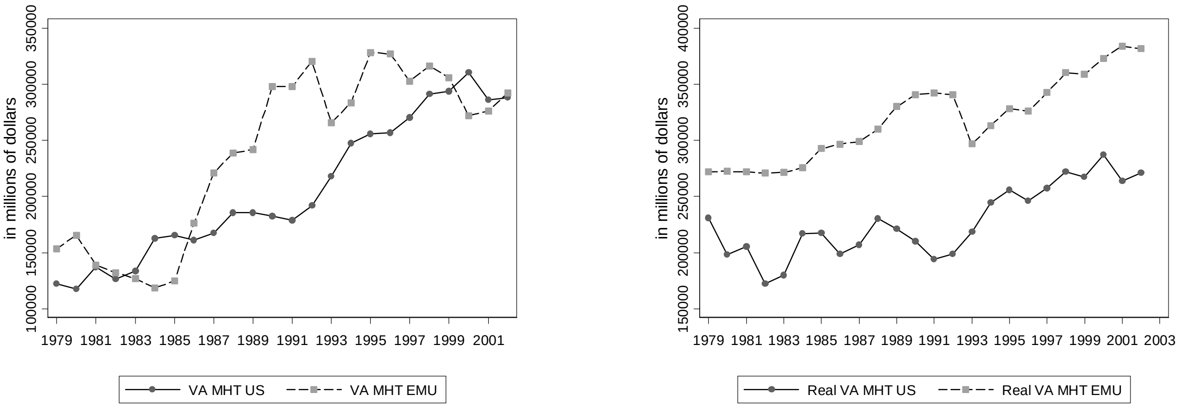
There are some differences within the euro zone that should be noted. First the contribution of each country to the total HT production of the EMU depends on the production capacity of each country. The biggest HT industry producers are Germany, France and Italy (see table A2.1 appendix 2). Second, HT intensity that is, the percentage of HT production relative to GDP is not homogeneous in the EMU. Some countries including Greece, Portugal and Luxembourg are far below the average, while Finland and Ireland are far above the EMU average(see table A2.2 appendix 2).

The M-HT industries production in the EMU countries is also accounted for by Germany, France and Italy and the outlier countries are also the same.. However, comparison between the US and the EMU M-HT industries does not lead to the same conclusion as for the HT industries.

2.2.2. Convergence of the EMU and the US in M-HT industries

The EMU production in M-HT is larger than the US. Graph 10 shows that the EMU has maintained its superiority since 1979, but its lead has decreased.

Graph 10 : Nominal and real value added in millions of dollars of M-HT industries of the EMU and the United States

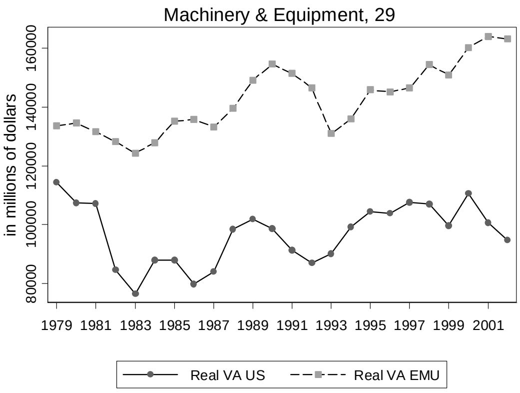


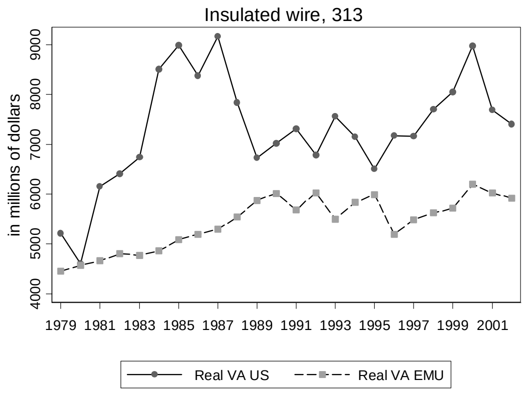
Sources : Calculations based on “Groningen Growth and Development Centre, 60-Industry Database, February 2005”.

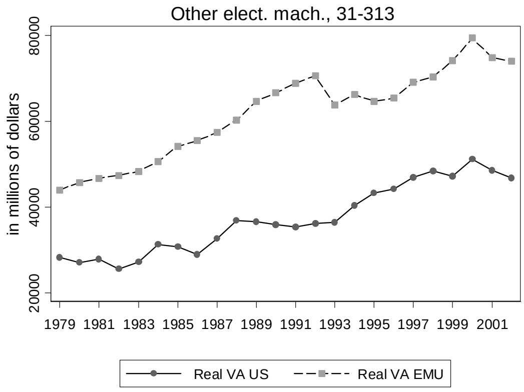
The nominal US value added was 71% of the EMU value added in 1980, but amounted to 98% in 2002. The real value added shows that the difference was maintained; US M-HT real value added was 72% in 1980 and 70% in 2002.

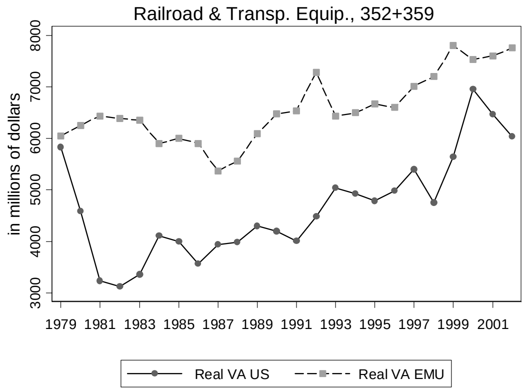
Thus the production gap that exists between the EMU and the US in the HT industries is not mirrored by the M-HT industry.

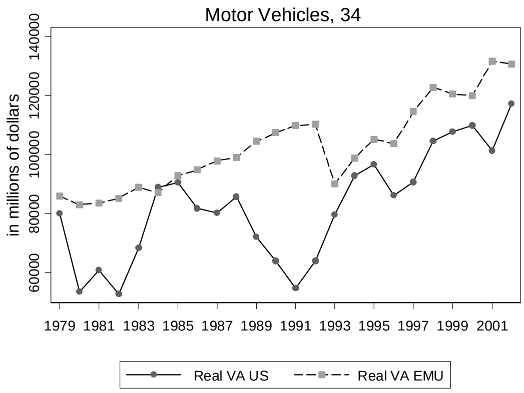
Graphs 11 to 15 : Nominal and real added values of M-HT industries in the United States and the EMU






Other elect. mach., 31-313
in millions of dollars
20000
40000
60000
80000
1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001
Real VA US
Real VA EMU


Railroad & Transp. Equip., 352+359
in millions of dollars
3000
4000
5000
6000
7000
8000
1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001
Real VA US
Real VA EMU


Motor Vehicles, 34
in millions of dollars
60000
80000
100000
120000
140000
1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001
Real VA US
Real VA EMU

The EMU HT production is smaller than that of the US. At the beginning of 1980, when Europe had successfully achieved technological catch up, levels of production were very similar and can be attributed totally to the difference in capacity of the two zones. The production gap at this time was nascent. By the beginning of the 1990s the gap has increased and is clearly evident. Thus, the production gap cannot be attributed to technological lags in some of the EMU economies (such as Ireland, Greece, or Portugal for instance). Rather the gap seems to be due to some ICT sectors that grew faster in the US than in the EMU group of countries.

In the M-HT industries, the constant difference over the period between the US and the EMU has to be related to consistence in the industrial structure. The industrial dynamics were the same in both zones leading to a rather constant share of the industry over the period.

This production gap in the HT industries, caused mostly by ICTs, suggests productivity growth differences. However, in the context of the strong international exposure of these industries and the high growth of demand, an examination of export performance might uncover alternative explanations for this growing production gap.

Export and market share levels are indicative of the distance between the US and the EMU economies in the HT industry.

3. Competitiveness of United States and EMU in HT industry

This section looks at euro-dollar parity which assumes that this mainly affects the EMU group of countries. With the exception of non-EMU European countries and the African countries, the currency of EMU trading partners is generally linked to the dollar. Asian and South America currencies belong to the dollar zone. Thus, euro-dollar parity is more important than might first be expected when examining trade between the EMU and the US. The competition in euros is less worrying for US exporters, but as the EMU can be extended to non-EMU European countries, then these countries also have to be concerned about euro-dollar parity. In consequence, euro-dollar parity is much more important than might be expected and its main drawback is that prior to 1999 it is fictive.

3.1. Specialization and exports in HT industry

3.1.1. The United States is more specialized in HT than the EMU

Table 1 : Distribution of US and EMU exports by level of technology

	1989		2002	
	EMU	US	EMU	US
HT	16%	32%	22%	36%
MHT	40%	40%	42%	39%
MLT	19%	11%	15%	11%
LT	25%	17%	20%	15%
ICT	8%	18%	9%	21%

Source: calculated from BTD STAN OECD

In 2002, the US was more specialized in HT than the EMU. More than one third of US exports (36%) was accounted for by the HT industries whereas just over one fifth (22%) of EMU exports was from the HT industries. However, the EMU is more specialized in M-HT industries and has increased its relative specialization in HT industries whereas the US has not increased its share of the M-HT industries. Table 1 shows that the EMU zone had a higher specialization in HT and M-HT industry in 2002 relative to 1989 (+8%) whereas the share of the HT and M-HT industry in the US increased by only 3%. Table 1 also shows the stronger growth of the US ICT industries during the last decade compared to the EMU.

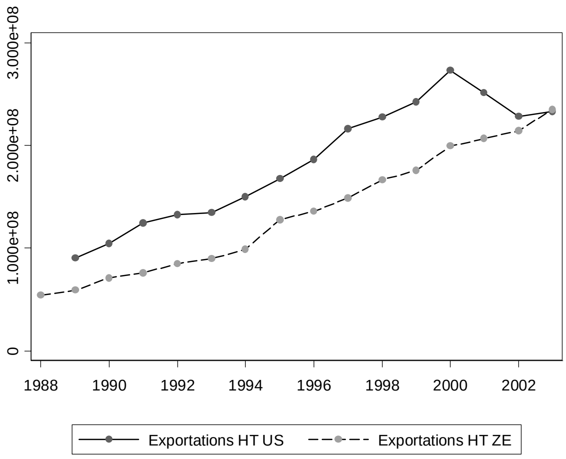
3.1.2. High tech US and EMU exports and market shares converge

The comparison of US and EMU HT exports shows that here there is no gap. The increase in EMU HT exports led to an almost identical level of exports in both zones in 2003. Whereas in 1989, HT EMU exports were equal to 65% of US exports, they amounted to 102% in 2003. But this convergence is recent. The level of EMU exports for the years 1999 and 2000 was equivalent to 70% of US exports. It is only since 2000 that the decrease in US HT exports has allowed a levelling up with the EMU[6].

From 1995 to 2002, the dollar appreciated leading to a decrease in the value in dollars of trade invoicing in other currencies. EMU exports in dollars since 1995 might therefore be under-estimated if we take account of this dollar appreciation against the various European currencies that existed prior to 1999 and against the euro from 1999 to 2002. The increase in EMU exports might be higher if the appreciation were lower.

6. From 2000 to 2002, total US exports fell. This decreasing trend, then, is not confined to the HT industry. The rate of growth of US total exports was negative: -5.2% in 2001 and -2.4% in 2002 (source World Bank). Growth was positive in 2003: +4.2% (source US Trade Department).

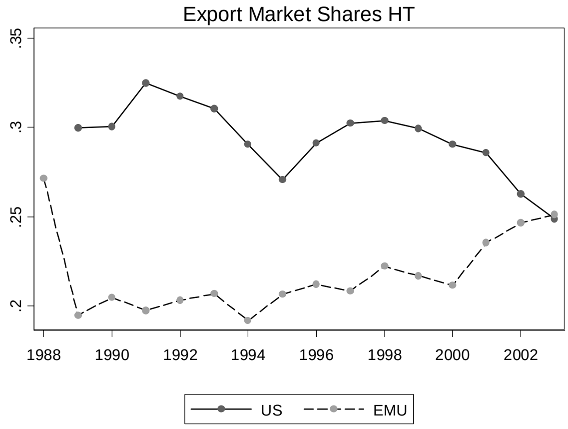
Graph 16. High tech industries exports from 1988 to 2003 (in millions of dollars)



Bearing in mind the differences in production, this export level convergence means that the export rate of the EMU zone is higher than the US rate. The high and sustained US domestic demand explains why these results for exports are compatible with the previous results for production. Graph 16 does not suggest any major sensitivity of exports to the exchange rate, whatever the depreciation of the euro from 1999 to the end of 2001, or its appreciation in 2002 and 2003.

Graph 17 shows the world market shares of the HT industry for the US and the EMU.

Graph 17. EMU and US world market shares in HT industries



These world market shares are relative to OECD exports in HT (exports from non-OECD countries are not available at an industry-disaggregated level). Thus, these are over-estimated compared to "real" world market shares. The major HT exporters belong to the OECD group of countries, but some non-OECD Asian countries have in recent years, been increasingly present in parts of the HT industry. With this caveat, we can say that there has been a net decline in the US world market shares since 1997 while the EMU share of the world market has increased since 1994.

If we compute market shares by industry (table 2), we find, (i) that the EMU increased or maintained its market share from 1989 to 2002 in all HT and M-HT industries except one, where it shows a decline (electrical machinery, « 31 ») ; (ii) that the US market share sharply decreased in Aircraft (353), Office (30) and chemicals (24) industries; (iii) that in 2002, the EMU had a higher market share in Chemicals (24), Machinery and equipment (29); Electrical machinery (31); motor vehicles (34) and railroad and transport equipment (352+359), that is in five out of nine of the HT and M-HT; (iv) that the strongest EMU market share increases occurred in the Aircraft (353) and in Transport equipment(352+359), and also in Computer and office machinery (30); and (v) that the strongest decline in US market share was in Aircraft (353) and Office (30) industries.

Table 2 : Market shares in 1989 and in 2002 of the EMU and the United States in HT and M-HT industries

	1989		2002	
	EMU	US	EMU	US
Chemicals (24)	36%	24%	37%	20%
Office (30)	17%	31%	22%	25%
Radio & TV (32)	14%	21%	18%	23%
Scient. Instr. (33)	23%	26%	26%	29%
Aircraft (353)	19%	52%	25%	41%
Mach. & equip. (29)	36%	19%	35%	20%
Elec. Mach. (31)	30%	21%	26%	19%
Motor Vehicles (34)	27%	15%	27%	15%
Trans. Equipment (352+359)	27%	11%	34%	13%
HT	19%	30%	27%	26%

Sources : STAN BTD database.

The decrease in US market share could be partly explained by massive relocation in some HT industries. However, relocation usually first affects production where we saw no similar decreases.

Thus, although the EMU has a lower level of HT production, this is not correlated with a decline in market shares. The production gap cannot be explained by a competitiveness gap. Rather, the level of HT market shares suggests that the US has lost some of its competitiveness. However, the US maintains some advantage in the HT industry; the US market share level is higher than the EMU's in all industries except for chemicals. The EMU shows real export dynamism, which implies greater foreign exposure and dependence than is the case for the US.

The next section analyses the competitiveness of both zones in these industries.

3.2. Competitiveness of the EMU and of the United States in the HT and M-HT industries

The most commonly used measure of cost-competitiveness is relative unit labour cost (RULC) (Fagerberg, 1988)). This measure has been mostly used at aggregate level in studies comparing national levels of competitiveness. Recent empirical work has shown that some differences in unit labour costs only show up at industry level (van Ark, Stuivenwold et al., 2005)). Here we conduct a disaggregated analysis, again using the International Standard Industrial Classification (ISIC) (rev.3).

Unit labour cost takes account of labour cost, productivity and exchange rate. The unit labour cost for industry i of country j is defined as the cost of labour required to produce one unit of output in a particular industry.

$$ULC_{ij} = \left(W_{ij} / E_j \times Empe_{ij}\right) \Big/ \left(Q_{ij} / N_{ij}\right)$$

For each industry i and country j, W measures the wage compensation in domestic currency; Empe accounts for the total number of employees; Q is the real value added; and N is total employment. We use the nominal dollar exchange rate (that is the amount of national currency of country j against one dollar unit), Ej, in order to express all ULC in dollars[7]. Thus, the ULC measure allows us to compare labour costs between countries at identical levels of productivity. The real value added is measured at 1995 constant prices. We use the 1995 exchange rate PPP to express it in dollars.

In order to take into account the exchange rate characteristics of the EMU, we include the UK, which has a distinct monetary and exchange rate rationale.

Table 3 indicates the ULC mean, by country and by industry, over the period 1988-2002. The ULC mean is relatively high for Office and computing machinery (30) and Electronic valves and tubes (321) as a result of their high value at the beginning of the period. The huge growth in productivity has led to a major decline in the ULC in these industries. The EMU has average levels of ULC over the period which are higher than those for the US in eight of the 13 industries concerned. Overall industry level differences are more important than country-level differences.

7. The wage compensation is expressed in dollars. If the euro depreciated against the dollar, then the EMU labour cost decreases, the ULC decreases.

Table 3. Mean of ULC by country and by industry 1988-2002

	Chemicals (24)	Aircraft & Space (353)	Office & Comput. (30)	Elec. Comp. (321)	Telecomm. Equip. (322)	Receivers. (323)	Scient. Inst. (331)	Others instr.(33-331)	Insulated wire (313)	Elec. Mat.(31-313)	Motor vehicles (34)	Transp. Equip. (352+359)	Mach. & Equip. (29)
AUSTRIA	0.49	0.60	0.85	0.85	0.68	0.64	0.56	0.57	0.54	0.57	0.56	0.56	0.58
BELGIUM	0.47	0.62	1.56	1.55	0.66	0.50	0.72	0.60	0.62	0.63	0.55	0.86	0.55
FINLAND	0.40	0.97	1.28	1.77	0.48	0.52	0.49	0.58	0.54	0.48	0.61	0.84	0.67
FRANCE	0.45	0.97	0.97	1.25	0.69	0.83	0.58	0.60	0.53	0.60	0.49	0.56	0.64
GREECE	0.62	0.90	1.72	0.64	0.30	0.74	0.79	0.73	0.49	0.70	0.79	0.83	0.88
IRELAND	0.15		0.55	1.38	0.44	0.68	0.37	0.44	0.73	0.53	0.99	1.03	0.61
ITALY	0.53	0.86	1.64	1.57	0.75	0.79	0.73	0.60	0.66	0.73	0.71	0.94	0.71
LUXEMBOURG	0.33	0.54	0.86	0.22	0.56	0.56	0.53	0.53	0.53	0.53	0.54	0.54	0.63
NETHERLANDS	0.34	1.14	1.33	1.17	0.56	0.56	0.60	0.40	0.48	0.61	0.64	0.56	0.60
PORTUGAL	0.43	0.85	0.79	1.48	0.59	0.57	0.60	0.60	0.48	0.59	0.55	0.60	0.61
SPAIN	0.57	0.62	1.27	1.13	0.67	0.67	0.66	0.71	0.58	0.62	0.59	0.80	0.65
GERMANY	0.59	0.74	1.26	1.71	0.76	0.76	0.68	0.58	0.58	0.62	0.67	0.73	0.66
UK	0.59	0.82	1.13	1.23	0.70	0.63	0.80	0.69	0.67	0.71	0.79	1.08	0.70
US	0.46	0.87	1.15	1.23	0.63	0.75	0.82	0.44	0.77	0.78	0.65	0.82	0.87
EMU	**0.59**	**0.92**	**1.28**	**1.50**	**0.72**	**0.79**	0.75	**0.65**	0.64	0.72	**0.72**	0.82	0.75

To specify the determinants of ULC changes, we decompose the ULC change into its three components: growth in wages, exchange rate growth and growth in productivity.

$$ULC_{ij} = \left(W_{ij} / E_j \times Empe_{ij}\right) \Big/ \left(Q_{ij} / N_{ij}\right)$$
$$\log ULC_{ij} = \log(W_{ij} \big/ Empe_{ij}) - \log(E_j) - \log(Q_{ij} \big/ N_{ij})$$
$$\Delta ulc_{ij} = \Delta w_{ij} - \Delta e_j - \Delta prod_{ij}$$

Table 4 illustrates the strong growth in productivity in industries belonging to ICT, supporting the two-digit growth rate found by empirical studies.

The exchange rate variation does not depend on the industry. For instance, in 1988-2002, the drachma suffered an average depreciation of 6.5% whereas the French Franc depreciated only slightly by 0.8%. In chemicals, the strong depreciation of the drachma was over-compensated for by the increase in the labour cost, leading to an increase in ULC. In France, wage moderation and the increase in labour productivity led to an average decrease in ULC.

In the EMU, the average depreciation in the exchange rate against the dollar has more often than not been compensated for by a rise in labour costs. In industries that show a decrease in ULC, this is due to greatly increased productivity.

Table 4 : Mean of ULC growth rate and of its components in HT industries in percentage

		Chemicals (24)			Office & computing mach.(30)			Aircraft & Spacecraft (353)			Elect. Compon. 321			Instr. Scient. (331)		
	De	dUlc	dw	dprod	dUlc	dw	dprod	dUlc	dw	dprod	dUlc	dw	dprod	dUlc	dw	dprod
AUSTRIA	0.7	-0.8	3.8	3.9	-34.7	4.1	38.0	-2.2	5.2	6.8	-31.8	4.1	35.2	-2.8	2.2	4.3
BELGIUM	0.7	-2.4	3.2	4.4	-33.4	1.6	32.9	-3.0	3.0	5.0	-37.3	3.1	37.8	-2.0	2.4	4.1
FINLAND	2.3	-1.5	5.6	3.9	-38.6	3.0	37.9	3.3	4.3	-1.5	-39.0	4.7	39.9	1.0	5.2	2.2
FRANCE	0.8	-2.5	4.0	5.7	-28.2	-1.4	26.1	1.0	4.9	3.1	-33.7	3.6	36.5	0.3	2.0	0.9
GREECE	6.5	0.5	11.9	4.2	-22.5	6.1	22.3	6.7	17	5.6	-31.0	16.2	37.1	4.5	13.6	1.5
IRELAND	1.2	-9.6	3.9	12.3	-26.2	1.8	26.7	-	-	-	-41.4	2.8	42.9	-0.5	4.4	3.7
ITALY	3.0	0.6	5.7	2.1	-26.3	3.8	27.1	3.3	5.8	-0.5	-38.3	6.0	41.3	1.9	5.5	0.7
LUXEMBOURG	0.7	-3.3	3.6	6.7	-27.4	4.9	28.4	2.6	2.5	-1.5	-58.1	6.1	45.8	3.5	4.9	-0.8
NETHERLANDS	0.7	-0.8	4.2	4.2	-30.6	3.0	32.9	-1.7	2.8	3.8	-34.1	1.7	35.1	0.5	6.9	5.7
PORTUGAL	2.6	3.0	9.4	2.9	-9.5	27.6	32.8	-1.7	6.9	5.9	-38.9	8.3	42.0	-3.0	10.7	9.8
SPAIN	2.2	0.6	6.2	3.4	-28.7	3.3	29.7	0.8	6.5	3.5	-33.0	6.7	37.4	0.4	4.5	1.9
GERMANY	0.7	-1.4	4.6	5.3	-28.5	4.0	31.8	-0.2	6.0	5.5	-33.7	4.0	37.0	0.7	4.2	2.8

To obtain a clearer picture of the difference between the EMU zone and the US, we reproduce this decomposition for EMU, US and UK for all industries. To compute the EMU variable, we use the fictive dollar against euro parity that we constructed for the period from 1979.

$$ULC_{ij} = \left(W_{ij} / E_j \times Empe_{ij}\right) \Big/ \left(Q_{ij} / N_{ij}\right)$$
$$\log ULC_{ij} = \log(W_{ij} / Empe_{ij}) - \log(E_j) - \log(Q_{ij} / N_{ij})$$
$$\Delta ulc_{ij} = \Delta w_{ij} - \Delta e_j - \Delta prod_{ij}$$

The index j varies here depending on the geographic zone: EMU, US or UK. The UK is used in order to include a third zone which has specificities in terms of exchange rate variation.

Table 5: Decomposition of ULC growth rate by industry and by zone (1988-2002)

	EMU				UK				US			
INDUSTRIE	dulc	dw	de	dprod	dulc	dw	de	dprod	dulc	dw	de	dprod
24	-2,6	4,6	-2,2	5,0	0,6	6,7	-1,0	5,1	2,0	4,4	0	2,4
29	0,3	4,5	-2,2	2,0	3,3	5,7	-1,0	1,4	2,5	3,7	0	1,2
30	-31,0	2,7	-2,2	31,4	-26,8	6,6	-1,0	32,4	-30,3	3,6	0	33,9
31	0,0	4,6	-2,2	2,3	-0,4	2,8	-1,0	2,2	0,8	4,0	0	3,1
31-313	0,0	4,6	-2,2	2,4	-0,7	3,0	-1,0	2,7	0,0	3,9	0	3,9
313	-0,1	3,6	-2,2	1,5	2,3	1,1	-1,0	-2,1	4,8	4,1	0	-0,6
32	-20,0	4,2	-2,2	22,0	-18,3	6,2	-1,0	23,5	-24,6	5,0	0	29,7
321	-37,6	4,4	-2,2	39,7	-34,0	7,2	-1,0	40,2	-36,6	4,8	0	41,4
322	-6,7	4,8	-2,2	9,3	-1,8	5,7	-1,0	6,6	-7,7	5,4	0	13,2
323	-3,5	2,9	-2,2	4,1	-4,5	4,2	-1,0	7,7	-3,0	4,4	0	7,4
33	-0,1	4,6	-2,2	2,4	-0,4	6,8	-1,0	6,3	1,3	4,3	0	3,0
33-331	-0,6	4,6	-2,2	3,0	3,5	7,0	-1,0	2,5	-0,9	4,1	0	5,0
331	0,0	4,5	-2,2	2,3	-0,9	6,8	-1,0	6,7	1,7	4,3	0	2,6
34	0,6	4,8	-2,2	2,0	1,8	6,6	-1,0	3,8	1,2	3,3	0	2,2
352+359	-0,9	5,3	-2,2	3,9	0,7	5,2	-1,0	3,5	2,1	3,0	0	1,0
353	-0,7	5,6	-2,2	4,1	-1,5	4,7	-1,0	5,2	2,7	3,9	0	1,2

The average growth of ULC is always lower in the EMU compared to the US (except in 322 and 33-331) but more often has the same sign. This means that when the average growth rate of ULC is increasing over the period, the increase is greater for the US than for EMU; and when it decreases, the decrease is greater for the EMU than for the US. The average growth rate of labour productivity is higher in five EMU industries: Chemicals (24), Aircraft (353), Machines and equipment (29), Insulated wire (313) and Transport equipment (352+359). Labour productivity increases less in the EMU zone than in the US when other industries are concerned.

Table 5 shows that strong changes in ULC are due to high increases in labour productivity. When changes in productivity are small, exchange rate variation (depreciation) compensates for the increase in EMU labour costs. There are thus some wide differences depending on the industry.

4. Relative unit labour cost and market shares in high tech industries

Our objective is to verify whether cost-competitiveness has an impact on market shares in HT and M-HT industries among the 12 EMU countries, the US and the UK; and if so to try to identify the influence of the exchange rate. The focus on labour cost in our measure of competitiveness excludes capital cost. This constitutes a limit in terms of the sensitivity of these industries to financial issues. However, the relative immobility of labour compared to the mobility of capital implies that differences between countries lie in labour cost differences.

The RULC is computed by dividing the ULC by a weighted ULC for the 21 OECD countries. These 21 countries are the major exporters of HT and M-HT products. The weights are the export shares in industry i in 1995. The variable RULC is our measure of competitiveness in dollars, which is used in the regression.

An increase in RULC implies a fall in competitiveness and then a decline in export performance and should lead to a decrease in export market share. However, some empirical studies have shown that there can be a positive relationship between cost-competitiveness and market share. This result, known as the Kaldor paradox (Kaldor, 1978), is found at an aggregated level and enables countries at different technological levels to be differentiated. Our regression is based on disaggregated data and technologically similar countries. We next describe the textbook derivation of the level of market shares in Cournot competition.

4.1. Relationship between competitiveness and market shares

The relationship between RULC and market share can be modelled in an imperfect competition Cournot model. This model leads to a mark-up on marginal cost that depends on the number of competitors. Market share is then a function of relative cost.

Under mark-up pricing behaviour, an increase in marginal cost is translated directly into an increase in prices. But in a situation of an imperfect competition market, such as the Cournot competition model, an increase in relative marginal cost (relative to foreign marginal cost) implies a decrease in market share and also a decrease in profits. The cost increase is not completely transmitted to prices. In the absence of export prices, it is impossible to say how much has been passed on to prices (and negatively to margins).

The Cournot model suggests that the fall in export market shares will depend on the structural characteristics of the markets, notably the degree of competition.

Suppose a linear inverse demand function of country j in market i :

$$p_{ij} = a - b_{ij} Q_{ij}$$
$$b_{ij} = 1/m_{ij}$$

Demand is negatively dependent on the size of the market. The size of the market depends on the country and on the industry. If we consider two countries, j=1,2; and n_j is the number of firms producing the good i, each firm produces at constant unit operating costs, c_i.

The Nash equilibrium price is then :

$$p_{1i} = p_{2i} = \frac{a_i + n_{1i}c_{1i} + n_{2i}c_{2i}}{n_{1i} + n_{2i} + 1}$$

Total exports from country 1 to country 2 (X_1) and from country 2 to country 1 (X_2) are :

$$X_1 = m_2 \left[n_1 \left(a - c_1 \right) + n_1 n_2 \left(c_2 - c_1 \right) \right]$$
$$X_2 = m_1 \left[n_2 \left(a - c_2 \right) + n_1 n_2 \left(c_1 - c_2 \right) \right]$$

If *MS* is the export market share,

$$MS_{ij} = X_{ij} / X_i \qquad \text{j=1,2}$$
$$\frac{\partial \mathrm{MS}_{\mathrm{i1}}}{\partial \mathrm{c}_{\mathrm{i1}}} = -\frac{n_{1i}}{X_i} \left[\left(1 - MS_{i1} \right) m_{i2} (1 + n_{i2}) + MS_{i1} m_{i1} n_{i2} \right]$$

The previous expression is negative. An increase in c_1, c_2 remaining constant, will decrease the market share of country 1.

4.2. Specification

The empirical specification that results from the imperfect competition model leads to the following equation.

$$\log\left(MS_{ijt}\right)=\sum_{k=0}^{L}\alpha_k \log\left(RULC\right)_{ijt-k}+\upsilon_{ijt} \qquad (1)$$

where υ_{ijt} captures the influences of other variables, and L indicates the level of the maximum lag. The adjustment time between cost changes, prices changes and adjustment in consumer behaviour that leads to changes in market shares could be quite long. Based on some earlier studies (Carlin, Glyn et al., 2001), we chose a maximum lag of 4 years.

We estimate equation (1) in first differences. This allows us first, to make all variables stationary and second, to suppress the specific effect of the industry-country pair that is independent on time. The fixed effect industry-country is excluded. The market size and competition parameters that appear in the model are captured by the fixed-effect. We add a complete set of time dummies in order to take account of the macroeconomic shocks that would have applied to all countries (for instance the evolution in world demand).

$$\Delta\log\left(MS_{ijt}\right)=\sum_{k=0}^{L}\alpha_k\Delta\log\left(RULC\right)_{ijt-k}+\sum\beta_t ann\acute{e}e_t+\upsilon_{ijt} \qquad (2)$$

To appreciate the contribution of each component of ULC, we next regress market share on the exchange rate, labour cost and productivity.

$$\Delta\log\left(MS_{ijt}\right)=\sum_{k=0}^{L}\alpha_k\Delta\log\left(e\right)_{ijt-k}+\sum_{k=0}^{L}\alpha_k\Delta\log\left(w\right)_{ijt-k}+\sum_{k=0}^{L}\alpha_k\Delta\log\left(prod\right)_{ijt-k}+\sum\beta_t ann\acute{e}e_t+\upsilon_{ijt}$$

(3)

4.3. Results

We estimate equations 2 (regression 1) and 3 (regression 2) on all HT and M-HT industries; first, on all countries (the 12 EMU countries, the US and the UK) and second, on the three monetary zones (EMU, US and UK).

We apply Ordinary Least Squares (OLS). We assume that RULC is exogenous, meaning that changes in market shares should not have reciprocally any effect on RULC. As the regression is in first differences, this hypothesis is respected in relation to the random shocks that affect market shares.

4.3.1. Estimation on all countries

a) Regression 1 : MS and RULC, all industries, all countries

Table 6 : Results of Regression 1

	All ind.	Chemicals (24)	Office (30)	Aircraft (353)	TV-Comm. (32)	Elec. Mach. (31)	Med. & Opt. instr. (33)	Vehicles (34)	Transp Equip. (352+359)	Mach. & Equip. (29)
dRULC	-0.053	-0.005	0.033	**-0.321**	**-0.197**	0.023	0.032	-0.09	0.053	0.326
	[0.032]*	[0.105]	[0.062]	**[0.179]***	**[0.098]****	[0.079]	[0.064]	[0.081]	[0.129]	[0.088]***
dRULC (-1)	-0.06	**-0.469**	-0.057	-0.088	-0.138	**-0.164**	-0.034	0.042	-0.046	-0.097
	[0.031]*	**[0.075]*****	[0.062]	[0.179]	[0.099]	**[0.070]****	[0.055]	[0.079]	[0.139]	[0.085]
dRULC (-2)	-0.035	0.043	0.044	0.021	**-0.215**	-0.079	**-0.148**	0.048	**-0.324**	**-0.221**
	[0.031]	[0.077]	[0.064]	[0.172]	**[0.105]****	[0.070]	**[0.053]*****	[0.082]	**[0.143]****	**[0.086]****
dRULC (-3)	-0.035	-0.006	-0.002	**-0.3**	0.233	**-0.168**	**-0.154**	0.217	0.091	-0.036
	[0.032]	[0.104]	[0.061]	**[0.174]***	[0.105]**	**[0.069]****	**[0.055]*****	[0.077]***	[0.144]	[0.087]
dRULC (-4)	0.007	-0.073	0	0.075	0.123	0.02	0.08	0.08	-0.232	-0.117
	[0.031]	[0.102]	[0.055]	[0.169]	[0.119]	[0.069]	[0.077]	[0.077]	[0.133]*	[0.088]
Obs	1115	125	125	115	125	125	125	125	125	125
R2adj	0.013	0.206	0.015	0.042	0.09	0.185	0.202	0.048	0.178	0.09
F	2.055	3.296	1.13	1.358	1.874	3.01	3.239	1.443	2.914	1.874

Standard deviation in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

The results of this first regression allow us to:

(i) demonstrate the existence of a negative (but slightly significant) relationship between current and past years' RULC and market shares ;

(ii) confirm that most industries show a negative relationship, except Office and computer machinery industry(30), which shows no relationship, and Motor vehicles industry (34) and Machines and equipment (29), which show a positive relationship illustrating the Kaldor paradox;

(iii) conclude that the sensitivity of market share and the adjustment delays depend on the industry.

Thus, price competitiveness explains the changes in market shares for six of the nine HT industries in the EMU countries, the US and the UK over the period 1988-2002.

b) Regression 2: MS and decomposed RULC, all countries, all industries

When we decompose RULC, we could expect that a labour cost increase should have a negative impact on market share. Then, the coefficient for *w* would be negative. As the exchange rate used is the amount of domestic currency per dollar, an increase in the exchange rate (appreciation of the dollar against the domestic currency) will produce a decrease in the RULC. Thus, the exchange rate coefficient should be positive. A depreciation in the domestic currency should increase market share. An increase in labour productivity will diminish RULC and should lead to an increase in market shares.

Table 7 : Results of regression 2

	All industries	Chemicals (24)	Office (30)	Aircraft (353)	TV-Comm. (32)	Elec. Mach. (31)	Med. & Opt. instr. (33)	Vehicles (34)	Transp. Equip. (352+359)	Mach. & Mat. (29)
		24	30	353	32	31	33	34	352	29
w	0.01	0.359	0.039	-0.284	-0.016	-0.226	0.062	0.153	0.356	0.865
	[0.049]	[0.230]	[0.154]	[0.334]	[0.227]	[0.162]	[0.087]	[0.164]	[0.189]*	[0.189]***
w (-1)	-0.046	-0.949	0.006	0.147	-0.28	0.177	-0.012	0.004	-0.308	0.002
	[0.047]	[0.226]***	[0.075]	[0.251]	[0.224]	[0.083]**	[0.115]	[0.084]	[0.028]	[0.167]
w (-2)	0.095	0.223	0.053	0.114	-0.324	-0.01	-0.126	0.05	-0.012	0.077
	[0.047]**	[0.205]	[0.022]	[0.049]*	[0.152]	[0.149]	[0.011]	[0.087]	[0.200]	[0.146]
w (-3)	-0.072	-0.285	0.004	0.305	-0.372	-0.103	-0.153	0.379	-0.255	-0.233
	[0.044]*	[0.202]	[0.076]	[0.338]	[0.138]***	[0.085]**	[0.013]	[0.015]	[0.171]	[0.010]
w (-4)	0.038	0.382	-0.059	-0.21	0.05	0.096	-0.069	-0.199	0.44	0.077
	[0.045]	[0.204]*	[0.334]	[0.728]	[0.273]	[0.135]	[0.094]	[0.210]	[0.156]***	[0.154]
e	0.002	-0.021	-0.022	-0.018	0.004	0	0.01	0.014	0.03	-0.01
	[0.007]	[0.015]*	[0.022]	[0.049]	[0.019]	[0.009]	[0.012]	[0.014]	[0.028]	[0.008]
e (-1)	0.003	-0.007	0.113	0.242	0.201	-0.494	0.013	0.122	-0.169	-0.058
	[0.007]	[0.010]	[0.022]	[0.049]	[0.019]	[0.148]***	[0.075]	[0.013]	[0.169]	[0.156]
e (-2)	0.004	-0.002	-0.023	0.501	0	0.07	0.095	-0.076	0.274	0.052
	[0.007]	[0.010]	[0.13]*	[0.239]	[0.021]	[0.009]	[0.094]	[0.013]	[0.175]	[0.167]
e (-3)	-0.01	-0.008	-0.093	-0.053	0.186	0.22	-0.004	-0.18	-0.017	0.167
	[0.009]	[0.012]	[0.091]	[0.241]	[0.023]	[0.140]	[0.079]	[0.161]**	[0.034]	[0.163]
e (-4)	0.078	0.204	-0.111	-0.015	0.557	-0.142	-0.022	-0.006	0.083	0.058
	[0.110]	[0.150]	[0.077]	[0.325]	[0.219]**	[0.139]	[0.173]	[0.088]	[0.431]	[0.132]
prod	0.084	0.294	-0.028	0.421	0.316	0.033	0.057	0.234	-0.022	-0.089
	[0.037]**	[0.147]**	[0.073]	[0.243]*	[0.137]**	[0.089]	[0.136]	[0.085]***	[0.149]	[0.142]
prod (-1)	-0.006	0.604	0.113	0.02	0.023	0.008	-0.032	-0.078	-0.001	-0.056
	[0.036]	[0.098]***	[0.126]	[0.340]	[0.138]	[0.009]	[0.011]	[0.173]	[0.197]	[0.008]
prod (-2)	0.016	0.08	0.248	0.096	0.176	-0.02	0.004	-0.004	0.105	-0.002
	[0.036]	[0.099]	[0.080]	[0.348]	[0.221]	[0.082]	[0.072]*	[0.162]	[0.028]	[0.008]
prod (-3)	-0.051	-0.236	-0.072	-0.272	0.027	-0.019	0.164	-0.008	-0.204	-0.007
	[0.036]	[0.167]	[0.026]	[0.056]	[0.219]	[0.011]*	[0.097]*	[0.086]**	[0.190]	[0.171]
prod (-4)	-0.02	0.18	0.063	0.723	-0.06	-0.002	0.057	0.25	-0.241	0.236
	[0.037]	[0.150]	[0.077]	[0.325]	[0.140]	[0.086]	[0.105]	[0.150]*	[0.182]	[0.154]
Obs	1115	125	125	115	125	125	125	125	125	125
R2adj	0.017	0.337	0.047	0.039	0.198	0.154	0.136	0.273	0.119	0.185
F	1.821	3.628	1.254	1.191	2.274	1.939	1.812	2.936	1.7	2.171

Standard deviation in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

The results of regression 2 on all countries when the RULC is decomposed, introduces new elements concerning the relationship between export market share and RULC.

(i) First, for all industries, when it is significant, productivity has a positive effect on market share; but labour cost can have a negative effect after three years, or a positive effect; and the exchange rate is rarely significant.
(ii) Second, there are industry differences in the number of significant coefficients and delays.
(iii) Third, the exchange rate appears significant only for Communications equipment (32) and after four years and is negatively significant only for Electrical machinery (31) after one year.
(iv) Fourth, labour productivity explains changes in market share in nearly all industries.

4.3.2. Estimation over the three monetary zones : EMU, United States and United Kingdom

Table 8 presents the results of regression 1 and 2. We do not regress by industry because of the too small amount of data available.

a) Regression 1 : PM and RULC, all industries, three zones

The second column in table 8 indicates that the relationship between RULC and export market share is contemporaneously positive. This regression confirms the Kaldor paradox. However, after an interval of two years, there is a negative relationship between RULC and export market share. This means that both the relationship proposed by the literature is exemplified here. A static relationship that shows a positive relation between the contemporaneous growth of RULC and export market share; and a dynamic relationship that shows a negative relationship between lagged growth of RULC and export market share. The first relationship indicates that the monetary zones and industries in which unit labour cost grows, increase market shares. This means that HT industries could be characterized by increased market shares in spite of increased RULCs. One explanation for this might be that the industries-zones that exhibit good export performance are also those involving the most skilled and highly qualified labour and thus higher labour costs. The second relationship supports the positive lagged effect of competitiveness improvement on market shares.
The decomposed specification should provide more information.

b) Regression 2 : MS and decomposed RULC, all HT and M-HT industries, three monetary zones

In the regression that includes the three monetary zones, the exchange rate is the dollar value of a euro or a sterling pound. An increase in e is then an appreciation of the euro or of the pound. It is expected that the coefficient of e will be negative.

The fourth column in table 8 indicates that the exchange rate has the expected negative influence. An appreciation of the zone-currency against the dollar leads to a decrease in export market share after two years. But the results also show a contemporaneous positive relationship that may reveal an increase in the value of exports expressed in dollars when the domestic currency appreciates.

An increase in labour costs appears to have a positive effect on market shares. It is this effect that justifies the positive coefficient for RULC in regression 1. This result again illustrates the Kaldor paradox for the HT and M-HT industries which emerges when we compare all three monetary zones. This supports the hypothesis that the greatest export performance occurs in the high skill industries. The gain in export market share occurs in industry when labour costs increase not because of institutional constraints but because of the higher skills that are demanded. In fact, it is consistent with the view that the gain in world market share for the older industrial countries will occur in the most skilled HT industries where competition from the Asian countries is smaller.

As far as productivity is concerned, table 8 shows a significant and positive effect on market share after two years. Thus this effect along with the exchange rate effect leads to the expected relationship between competitiveness and market share where HT industries are concerned.

Table 8 : Results of regressions 1 and 2 on three monetary zones

	REG. 1		REG. 2
drulc_ze	0.169	dw_zo	0.379
	[0.063]***		[0.136]***
L.	0.013	L.	-0.188
	[0.069]		[0.144]
L2.	-0.149	L2.	0.234
	[0.072]**		[0.147]
L3.	0.023	L3.	-0.214
	[0.065]		[0.151]
L4.	0.068	L4.	-0.129
			[0.180]
		de_euro	0.569
			[0.235]*
		L.	0.103
			[0.182]
		L2.	-0.491
			[0.216]**
		L3.	0.077
			[0.181]
		L4.	0.238
			[0.169]
		dprod_zo	-0.222
			[0.14]*
		L.	-0.124
			[0.111]
		L2.	0.263
			[0.112]**
		L3.	0.043
			[0.107]
		L4.	-0.083
			[0.120]
Obs	270	**Obs**	162
R2adj	0.063	**R2adj**	0.22
F	2.289	**F**	3.228

Standard deviation in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%
L=lagged operator.

5. Conclusion

This study has concentrated on HT industries in the EMU and the US since these industries are considered to be essential for future economic growth. Examination of the levels of real production shows a growing gap in the HT industries to the advantage of the US. A focus on the industry level highlights that the ICT industries are mainly responsible for this gap. These industries are growing more dramatically more than any other in both the EMU countries and in the US, but rates of growth are much higher in US.

Growth of exports, however, does not exhibit a similar gap. On the contrary exports from the EMU and the US have converge in the most recent years and also the export market share of the HT industry in EMU zone has increased while that of the US has partly decreased.

Thus the EMU's lower levels of HT production are not correlated with a decline in market shares. The EMU shows real export dynamism that implies greater foreign exposure and higher international dependence than is found in the US.

These results are supported by two stylised facts given by the analysis of a standard measure of cost-competitiveness, RULC. First, the average level of ULC in the HT industries over 1988-2002 was higher in the EMU than in US. Second, the growth rate of ULC is lower in the HT industries of the EMU than of the US. This means that the EMU's average cost-competitiveness improved over the period.

Nevertheless, there are industry and country differences in the levels and the changes in cost-competitiveness. In order to understand the potential impact of these differences on industry growth, in section 5 we investigated whether export market shares are sensitive to cost-competitiveness.

Our results show that when a country-industry set is considered, first, there is a negative relationship between RULC for the current and past years and market shares, for seven of the nine industries; and second, that there are wide differences in this relationship among industries in terms of sensitivity of market shares and in terms of delay of adjustment. When a zone-industry set is considered, there appears to be both a contemporaneously positive relationship between RULC and export market share, supporting the Kaldor paradox, and a negative relationship between RULC and export market shares after two years.

Regarding the debate about the cause of the gap in high tech industries, our results confirm the prominence of the ICT industry in explaining the production gap. Therefore, an investigation into the determinants of productivity gains in the ICT industry is needed.

However, our results also show that the export performance of these industries is sensitive to changes in cost-competitiveness and to changes in the three components of this competitiveness. Thus, the high technology and innovation content of these industries does not prevent them from being sensitive to cost-competitiveness. Labour cost and exchange rate intervene mostly in industries where productivity growth is relatively stable.

Lastly, the differences in the results of the regression for the set of 14 countries and the three monetary zones, could be explained by the persistent heterogeneity in competitiveness between EMU members, that is, the differences in productivity growth and labour cost growth. When these differences disappear, the exchange rate is significant in explaining the negative relationship between RULC and export market share. The euro depreciation against the dollar increases market shares in the HT industries.

At the same time what differentiates the export performance of the three zones is the specialization in high-level skills and high labour costs to industry. The contemporaneous positive relationship between RULC and export market share indicates that market share gains occur in the most high tech industries where skills are expensive. These industries are also those where competition from the Asian countries is less.

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Appendix 1: DATA

A1.1. The High tech industries

The definition of high tech industries is based on the OECD classification. This classification is mainly used in the literature. In accordance with the Oslo Manual, high tech industries are identified according to the level of R&D spending, but also according to the level of incorporated technology (see, Hatzichronoglou (1997)).
This classification, which is only available for the manufacturing industries, uses the International Standard Industrial Classification revision 3 (ISIC rev.3)
According to Hatzichronoglou (1997)), and annex 1.1 of the "Scoreboard of Science, technology and industry" 2003[8], the high tech (HT) industries are:
- Aircraft and spacecraft (353 ISIC rev.3)
- Pharmaceuticals (2423 ISIC rev.3)
- Office, accounting and computing machinery (30 ISIC rev 3)
- Radio, TV and communications equipment (32 ISIC rev. 3)
- Medical, precision and optical instruments (33 ISIC rev. 3)

The middle-high tech industries (M-HT) are :
- Electrical machinery and apparatus, n.e.c. (31 ISIC rev.3)
- Motor vehicles, trailers and semi-trailers (34 ISIC rev.3)
- Chemicals excluding pharmaceuticals (24 excl 2423)
- Railroad equipment and transport equipment, n.c.a. (352 +359 ISIC rev. 3)
- Machinery and equipment, n.e.c. (29 ISIC rev.3)

When available (only for competitiveness and production variables), a more disaggregated classification is used:
- 321: Electronic valves and tubes (included in 32)
- 322: Telecommunication equipment (included in 32)
- 323: Radio and television receivers (included in 32)
- 331: Scientific instrument (included in 33)
- 33-331: Other instruments (included in 33)
- 313: Insulated wire (included in 31)
- 31-313: Other electrical machinery and apparatus nec (included in 31)

Among these industries, are included the biotechnology industries (within Pharmaceuticals and Chemicals) and the Information and Communication Technology (ICT) industries[9] (items 313, 30, 32, 3312, 3313 of ISIC rev. 3).

Wyckoff (1995) showed that differences in the methodology used for calculating price indices in the ICT industry led to biased comparisons between countries. Where a hedonistic methodology was used countries showed higher growth rates for the high tech industry. The hedonistic methodology consists of taking into account a product's characteristics (its quality). This methodology implies a huge decline in ICT prices.

8. OECD Science, Technology, and Industry Scoreboard 2003-Towards a knowledge-based economy, available on : http://www1.oecd.org/publications/e-book/92-2003-04-1-7294/
9. See Measuring the Information Economy, OECD, 2002

The GGDC (Groningen Growth and Development Centre) database uses US hedonistic deflators for the ICT industries (30 and 321). These deflators are then corrected by inflation differences between the country and the US (inflation is measured by the variation in the deflator for all industries except the ICT producers) (see Inklaar, Stokes et al. (2003)).

A1.2. The activity variables data

The data exports come from the OECD's STAN Base on Trade (2005 edition) beginning in 1988 up to 2003. The competitiveness variables are calculated using data from the GGDP. These data do not differentiate Pharmaceuticals from Chemicals which is why we retain Chemicals as a high tech industry that includes Pharmaceuticals. But it would not be wrong to consider Chemicals as a M-HT industry.

The aggregates variables (EMU and HT) have been constructed using the chain aggregated index methodology appropriate for Fisher's ideal chain index.

Appendix 2 : Value Added of HT and M-HT industries by country

Tableau A2.1 : HT and M-HT nominal value added of each country relative to the euro zone in 1980 and 2002

	1980	2002	1980	2002
	HT	HT	MHT	MHT
AUSTRIA	2.0%	2.3%	1.8%	3.1%
BELGIUM	4.6%	4.8%	3.2%	2.4%
FINLAND	1.1%	3.3%	1.3%	1.6%
FRANCE	22.4%	17.8%	19.0%	14.3%
GREECE	0.7%	0.6%	0.3%	0.3%
IRELAND	0.8%	9.4%	0.2%	0.7%
ITALY	14.9%	14.3%	18.2%	15.6%
LUXEMBOURG	0.0%	0.1%	0.1%	0.1%
NETHERLANDS	6.8%	5.7%	1.9%	2.4%
PORTUGAL	0.6%	0.7%	0.3%	0.7%
SPAIN	6.1%	5.9%	6.1%	7.2%
GERMANY	40.1%	35.1%	47.6%	51.6%

Table A2.2: HT and M-HT nominal value added relative to the nominal GDP of each country in 1980 and 2002

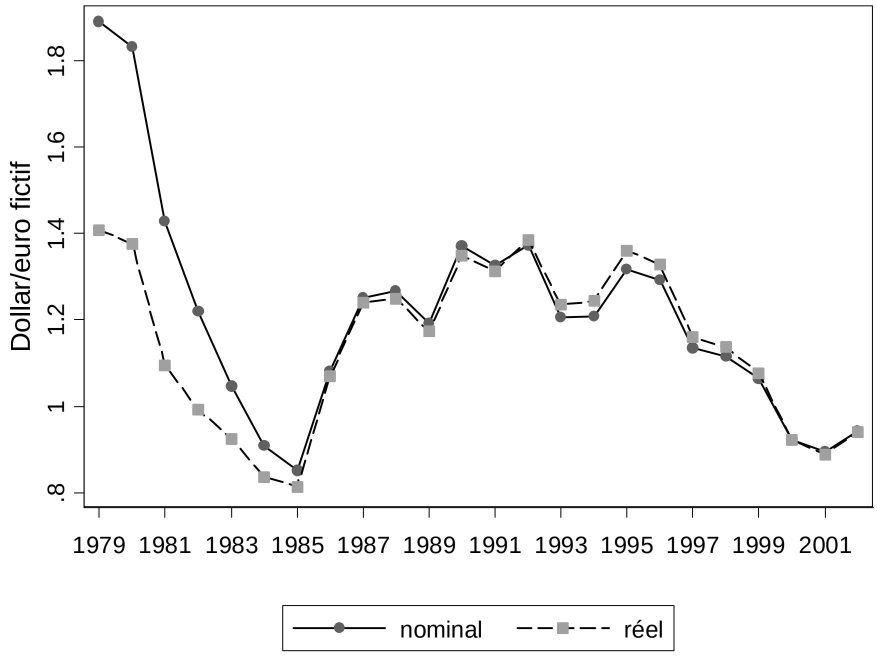
	1980	2002	1980	2002
	HT	HT	MHT	MHT
AUSTRIA	2.9%	2.7%	4.0%	4.9%
BELGIUM	4.2%	4.6%	4.4%	3.1%
FINLAND	2.3%	6.1%	4.3%	3.9%
FRANCE	3.9%	3.0%	5.0%	3.1%
GREECE	1.4%	1.1%	1.1%	0.7%
IRELAND	4.3%	18.6%	1.7%	1.9%
ITALY	3.6%	2.8%	6.7%	4.1%
LUXEMBOURG	1.1%	0.8%	2.2%	0.8%
NETHERLANDS	4.2%	3.2%	1.8%	1.8%
PORTUGAL	2.2%	1.3%	1.8%	2.0%
SPAIN	2.9%	2.1%	4.5%	3.3%
GERMANY	5.1%	4.2%	9.2%	8.1%
UK	4.6%	3.5%	7.1%	2.7%
US	5.0%	4.1%	4.1%	2.7%

Appendix 3: Fictive dollar per euro parity from 1980 to 1999

If we want to analyse EMU variables before 1999 and make international comparisons, we need to construct a fictive euro.

Graph 1 shows the nominal and real change in the dollar against euro parity. The parity before 1999 is calculated by using weighted GDP in PPP for 2000.

Graph A.3.1 : Nominal and real Dollar/Euro parity since 1979



Source : International Financial Statistics, FMI, calculations from the author.

Before 1999, the evolution of EMU members' currencies was rather unstable. A fictive euro in dollars, using EMU currencies (see method below) shows a strong euro at the beginning of 1980s, which depreciates rapidly up to 1985 and then follows an upward trend to the end of 1995 (despite the devaluations of the 1992 crisis). Since 1995, the euro depreciates until the end of 2001. It experiences a strong appreciation from March 2002 to December 2004; then a depreciation from January 2005 to July 2005 and a stabilisation since then around 1.2 dollar.

According to article 1091 (4) of the EMU treaty, the irrevocable conversion rates of the euro were decided the first day of the third phase of the EMU programme, that is, 1st January 1999.
The bilateral exchange rate between currencies was used with the condition that the external value of the ECU is equal to the external value of the euro.

Example of the calculation of the conversion rates with the exchange rate value of 1997, 31 december. (source: European Central Bank, 1998, 2 may)

	Amounts in ECU (a)	Exchange against dollar (b)	Equivalent dollar (a)/(b)	Conversion rate with euro =(USD/ECU)*b
DEM	0,6242	1,7898	0,3487541	1,97632
BEF	3,301	36,92	0,0894095	40,7675
LUF	0,130	36,92	0,0035211	40,7675
NLG	0,2198	2,0175	0,1089629	2,22742
DKK	0,1976	6,8175	0,0289842	7,52797
GRD	1,44	282,59	0,0050957	312,039
ITL	151,8	1758,75	0,0863113	1492,03
ESP	6,885	151,59	0,0454186	167,388
PTE	1,393	183,06	0,0076095	202,137
FRF	1,332	5,9881	0,2224412	6,61214
GBP	0,08784	1,6561	0,1454718 (certain)	0,666755
IEP	0,008552	1,4304	0,0122328 (certain)	0,771961
			USD/ECU=1,1042127	
FIM		5,4222		5,98726
ATS		12,59		8,73234

$$Dollar/ECU = \sum_{EcuCurrencies_i} \left[\frac{Pond_i}{Ecurr_i/Dollar} \right]$$

$$ConverRate_{i,98} = \left(\sum_{Ecu\ currencies_i} \left[\frac{Pond_i}{Ecurr_i/Dollar} \right]_{98} \right) \times Ecurr_i / Dollar_{98}$$

To construct a fictive parity dollar against the euro, we take account of the fact that:

$$Doll/euro_{98} = \frac{1}{12} \sum_{EMUcurrencies_i} \underbrace{\left[\left(\sum_{ECUcurrencies_i} \frac{Pond_i}{Ecurr_i/Dollar_{98}} \right) \times Ecurr_i \big/ Dollar_{98} \right]}_{CR} \times Dollar \big/ Ecurr_{i,98}$$

It is then possible, (i) first to calculate a fictive euro taking the conversion rate (CR) for 1998 divided by 12, as the constant weight of each EMU currency and finding the value of the dollar/euro fictive with the bilateral exchange rate against dollar; (ii) second to replace CR/12 by a variable weight depending on the production weight of each EMU member.

We choose a weighting scheme based on real GDP in PPP for 2000. The bilateral exchange rates against the dollar (annual, end of the period) are from the IMF statistics.