

Price Convergence in the European Union

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Abstract

This paper assesses the progress in EU product market integration by analyzing price differentials in a multivariate framework for 22 industrialised economies and almost 200 product categories. Using the so-called Grubel-Lloyd index, we model changes in bilateral price similarities as a function of initial bilateral similarity levels, bilateral trade intensities, the bilateral correlation between expenditure shares and various variables reflecting EU membership, product category, the tradability of the product and the presence of non-tariff barriers throughout 1985-1999. The results suggest that price structures within the EU are more similar than among other OECD countries, especially for energy products and consumer goods. After correcting for factors such as catching-up and trade intensities, prices in the EU have almost consistently converged faster than in the rest of the OECD. Finally, we find that the countries in the so-called D-Mark area have witnessed a significantly stronger tendency for prices to converge than countries which have had relatively higher exchange rate fluctuations. This gives some foundation to hopes that monetary union will promote price convergence, especially because private agents probably have not attributed as much credibility to the EMS arrangement (even in the countries with relatively stable bilateral exchange rates) as a full monetary union such as EMU might have.

JEL Codes: L16; E31. Keywords: Price convergence, market integration.

1. Introduction

The move to economic and monetary union and the introduction of the euro form the crown on two decades of structural policies in the European Union (EU) aimed at promoting market integration and increasing competition. These policy initiatives include the establishment of the Single European Market, changes in (national and European) competition policies and EU-directives liberalising domestic markets in areas such as telecommunications, postal services, air and railroad transport, electricity and gas. Technological change was a strong driving force of these changes in policies as new technologies made new, innovative forms of competition possible (e.g. competition on fixed telephony networks), thereby raising the costs of policy inaction. It is widely believed that, once completed, this process of product market integration will lead to significant benefits for European consumers, in terms of the quality, the variety and the price of goods and services sold in the EU, improving overall living standards.²

Although competition has increased in many sectors, domestic regulatory barriers still seem significant in many countries, especially in some service industries and public procurement, lessening the impact of trade integration and liberalisation on product market competition (Haffner and van Bergeijk, 1997). The still large scope for improvement in these areas has also been recognised by the heads of state and government of the European Union. At their 2000 ("dotcom") summit in Lissabon, they noted that Europe was lagging behind in many areas, most notably in information and communication technologies. At Lissabon, they formulated the objective to make the European economy "the most competitive economy in the world by 2010".

This paper reviews the progress which has been achieved in increasing EU product market integration. To this end, we analyze price differentials as an indicator of product market integration. This is based on the theoretical notion of the "law of one price". This law states that in a perfectly integrated market with no transport costs, competition between suppliers and arbitrage by consumers should eliminate price divergences. Therefore, prices for identical goods should not differ geographically. Although for a number of macro- and microeconomic reasons³, price differences are not expected to be eliminated completely, a reduction in price differences (or more similar price structures) among EU-countries can, in part, be attributed to increased competition and market integration. The elimination of barriers to trade by the single market programme and other regulatory reforms should erode market power, raise the possibilities for arbitrage

² See Van Bergeijk and Haffner (1996). OECD (1997) estimates of the expected impact of regulatory reform in five sectors of the European economy (telecommunications, electricity, airlines, road transport and distribution) point to expected gains ranging from 3% of GDP in Sweden to 6% of GDP in Spain.

³ See Rogoff (1996) for a survey. Among them are the presence of transport and distribution costs, arbitrage and search costs, differences in regulatory and fiscal systems between countries, state aid, collusive behaviour of firms and movements in exchange rates.

and reduce the potential for price discrimination across EU-markets. In the absence of new collusive behaviour, increased integration should result in more active price competition, leading to more similar price structures.

In the following, we focus on the similarity between price structures and their convergence over time, comparing developments in both EU and other OECD countries. The paper builds on earlier work on price convergence⁴ and incorporates newly available data on prices in the OECD area.⁵ One of the results of the earlier study was that price convergence in the EU had slowed down in 1993-1996, after having controlled for differences in initial conditions and some OECD-wide trends in price convergence. In this paper, we assess the development in the speed of price convergence in the EU over a longer timeframe, adding an extra three-year period (1996-1999) to the investigation. Secondly, the question can be asked which types of products (e.g. tradeable-nontradeable) have achieved the highest degree of price convergence, and whether trade barriers have had an impact on convergence. Finally, we look at the importance of the exchange rate regime for the degree of price convergence. Specifically, it is useful to see whether those EU-countries where (in the past) exchange rates have been relatively stable witnessed a stronger tendency for prices to converge (e.g. due to greater transparency of prices quoted in national currencies) than countries which have had relatively wide exchange rate fluctuation bands or frequently adjusted central rates. This question is especially relevant as it may provide information on the degree of price convergence which may be brought about by EMU.

Paragraph 2 below provides a cursory review of the evidence on price convergence in the EU. We look at aggregate price levels and variations in prices among major product categories. In paragraph 3, the patterns of price similarity are analysed by looking at the determinants of convergence in a multivariate framework. Paragraph 4 compares the differences in price convergence between EU-countries with a relatively high degree of exchange rate stability, with the performance of countries which have not enjoyed this benefit. Paragraph 5 discusses the conclusions of the paper.

2. Evidence on EU price convergence

Aggregate indicators of the level of product prices suggest that price disparities are significant in the EU (Table 1).⁶ Since 1985, there has been some convergence in aggregate price levels, as implied by the decline in the standard deviation. However, the ranking of member states' price levels has remained relatively stable since 1985. The rank correlation is high (0,93); only four member states have moved more than two places up or down the ranking.

⁴ Nicoletti et al (2001).

⁵ See OECD (2002).

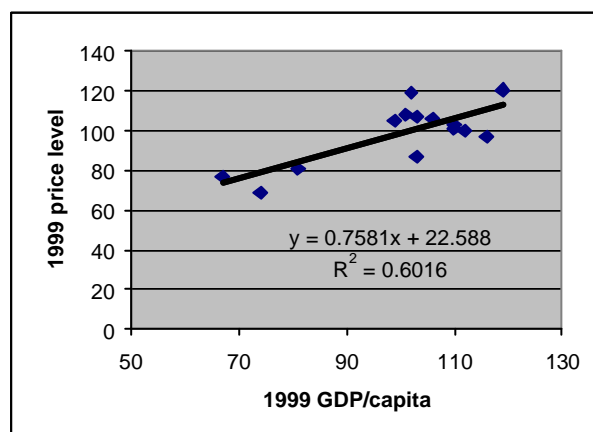
⁶ EC (1999b) report that price disparities (as measured by the coefficient of variation) are about 40% higher in the EU than in the United States.

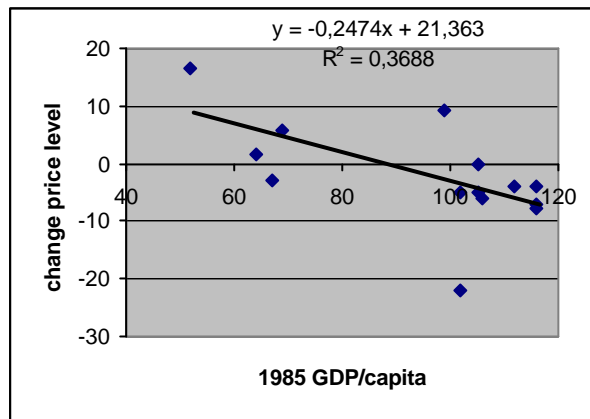
Table 1: Price levels in the EU

Country	1985		1999	
	(EU12=100)	rank	(EU15=100)	rank
Austria	108	6	103	8
Belgium	101	9	101	9
Denmark	124	3	120	1
Finland	130	1	108	3
France	109	5	105	7
Germany	113	4	106	6
Greece	75	13	77	14
Ireland	103	7	100	10
Italy	92	12	87	12
Luxembourg	98	10	107	4
Netherlands	103	7	97	11
Portugal	52	15	69	15
Spain	75	13	81	13
Sweden	127	2	119	2
UK	98	10	107	4
<i>Memorandum:</i>				
<i>Standard deviation</i>	21,0		14,8	
<i>Rank correlation (85-99)</i>		0,93		

Sources: EC (2001) and OECD (2002).

Some of the cross-country price differences may be explained by differences in living standards. Indeed, preliminary regressions show that up to 60% of the variation in aggregate price levels (including taxes) in the EU can be explained by differences in GDP per capita (Figure 1, upper panel). Probably due to lagging productivity in services, countries with a relatively higher living standard (and a higher share of

Figure 1: Price levels, price convergence and GDP/capita in the EU



the service sector) tend to have a relatively higher price level. This is confirmed in the lower panel of Figure 1, which shows the change in the aggregate price level over the period 1985-1999 in relation to living standards in 1985. Countries with the lowest living standard in 1985 had the highest increase in prices, which is an illustration of the catch-up effect. Differences in indirect taxation may also explain some of the differences in price levels. However, as EC (2001) notes, the ranking of countries' aggregate price levels is not much affected by the use of pre- or post-tax data. Based on the aggregate price data presented in Table 1 and Figure 1, some price convergence has taken place. The question remains, however, whether the aggregate convergence also implies that price structures have become more similar. Only if price structures also become more similar can aggregate price convergence be interpreted as a sign of product market integration. Moreover, it is not clear against which benchmark the price convergence in the EU can be assessed.

For this reason, we below use much more detailed price data which we use to assess convergence in the EU with convergence among other OECD-economies. The analysis is made using the data on *Purchasing Power Parities and Real Expenditures* produced by Eurostat and the OECD in the context of the United Nations International Comparisons Project, which provides the prices of about 200 categories of goods and services observed in 1985, 1990, 1993, 1996 and 1999. These data are in turn based on extensive price surveys for product categories of equal characteristics and quality, collected by the various national statistical services. The "benchmark years" for which data are available, are the years for which all the basic heading purchasing power parities have been recalculated with new survey data since the previous benchmark. Purchasing power parities data in between benchmark years are based on extrapolation of previous benchmark data and are therefore less reliable.

It should be noted that the comparability of price data over time forms a serious caveat to the type of analysis presented in this paper. Firstly, product categories across countries may not be completely identical. Differences in preferences, for example, may

be a reason why some product varieties are widely available in one country, but not in another. Secondly, improvements in data collection methods and changes in the composition of product categories make intertemporal comparisons more difficult. Although Eurostat and the OECD have tried to ensure a maximum of comparability, it could not be avoided that national accounts methods, expenditure classifications, data collection and pricing procedures have evolved, mostly as a result of improved methods and data sources. The composition of the product categories under consideration have also changed somewhat, either because new products have appeared, others have disappeared, and many other products have undergone improvements in quality. Finally, it should be noted that although the empirical analysis makes use of price data for almost 200 product categories, the level of aggregation may still be too high to fully capture the process of price convergence. Ideally, the analysis of price convergence should be made for relevant antitrust market, which would ensure that all relevant substitutes are included in a particular product category (Haffner and van Bergeijk, 1998). Such an analysis might well reveal a considerable degree of heterogeneity at the level of individual products. However, the data used in this paper are the best ones available. They were composed by the national statistical agencies, Eurostat and the OECD with great care and are widely used to make price comparisons and to investigate broad price trends. We therefore look at our results with some confidence. However, the data used in this paper are the best ones available, and are widely used in making price comparisons and to investigate broad trends as done in this paper.

To analyse the degree of price convergence, we borrow a similarity measure familiar from the trade literature. We use the so-called Grubel-Lloyd index, which is originally a measure of the degree of intra-industry trade, to look at bilateral price similarities across countries and country groups.⁷ This approach has several advantages over earlier ones focusing on the degree of overall price dispersion, as measured for instance by the coefficient of variation (see EC, 2001). Firstly, it allows a direct comparison of price similarity between (groups of) countries, which is not possible with the more commonly used coefficient of variation. Whereas the coefficient of variation has no clear upper bound, the similarity index ranges between 0 (completely different price structures) and 100 (identical prices for all products). It takes both differences in price levels and in the composition of prices into account. Secondly, the similarity index has the additional advantage that it can be easily used in a multivariate framework. This makes it possible

⁷ The similarity index between countries j and k is:

$$\text{Similarity index}_{jk} = 100 - \sum_{i=1}^n w_i \frac{|p_{ji} - p_{ki}|}{p_{ji} + p_{ki}} * 100$$

where p_{ji} and p_{ki} are the average prices of product category i in countries j and k respectively and w_i is the weight assigned to product i in the calculations. The index varies between zero and 100. The similarity index between m countries is:

$$\text{Similarity index}_m = \frac{1}{2(m^2 - m)} \sum_{j=1}^m \sum_{k \neq j}^m \text{similarity}_{jk}$$

to check whether convergence (or the lack of it) may be explained by economic factors, such as initial conditions, trade intensity or barriers to trade.

Table 2 summarises some of the characteristics of our dataset. We use three different classifications of price data. Firstly, we distinguish between goods and services as classified at the basic expenditure heading, consisting of consumer goods, equipment goods, construction, services and energy. Services on balance have the highest average share in OECD nominal expenditure, closely followed by consumer goods. Secondly, we look at price similarity based on the tradability of the product categories involved. Roughly half of the average OECD-wide expenditures are on tradables. Finally, we classify products according to the degree of regulatory barriers to trade. These can potentially be powerful obstacles to cross-border competition and may therefore contribute to explain price disparities within the OECD and maybe even within the Single Market. We distinguish between products for which at the beginning of the nineties, the degree of non-tariff barriers (NTB) was “high”, “medium” and “low”, respectively, based on information of the European Commission (see EC (1997a)).⁸ Products in the category with low NTB’s have the highest average share in expenditure.

Table 2: Data statistics

Category	OECD Expenditure share	Number of product categories	Examples
Consumer goods	36%	96	Rice, pasta products, beer, refrigerators
Equipment goods	11%	21	Tools for metal working, boilermaking
Construction	14%	11	Single family dwellings, industrial buildings
Services	37%	51	Insurance, repair, postal services
Energy	2,5%	5	Electricity, gas, solid fuels
Tradables	49%	122	Consumer goods, equipment and energy
Nontradeables	51%	62	Services and construction
High NTB’s	8,3%	20	Locomotives, boats, pharmaceuticals
Medium NTB’s	11,9%	55	Agricultural machinery, mining equipment
Low NTB’s	21,4%	31	Bicycles; motorcycles, cigarettes

Note: total number of observations and expenditure shares are lower for NTB-categories, because information on type of trade-barrier was not always available.

⁸ Information on NTB's in the late 1980s and early 1990s was gathered by EC (1997a) drawing on a questionnaire among 11,000 European enterprises and a horizontal study of technical barriers in six industries. The information was used to classify industrial sectors into three groups according to the overall impact of NTB's.

Table 3 summarises unweighted (gross of tax) price similarities and their development over the 1985-1999 period for both EU and non-EU. The degree of price similarity is substantially higher among EU countries than among non-EU countries, confirming that the EU is a relatively highly integrated area. Prices in the EU have also converged more throughout the period, although only slightly. About half of the price convergence in the EU has taken place in the most recent period, 1996-1999, and even more than half in the rest of the OECD. The table also shows large differences in similarity and convergence between different product categories. Within the EU, prices structures for consumer goods are the most similar, while prices for services are least similar. In the non-EU-area, price similarity is relatively low in the energy and services sectors. For both EU and non-EU-countries, the equipment goods sector has a relatively high degree of price similarity, and the levels of price similarity are quite similar (88 for the EU versus 87,3 for non-EU). This indicates that it the equipment goods sector may have become an international or even global market. The overall degree of price similarity is significantly lower for non-tradable goods (80,6 for non-tradables versus 86,3 for tradables within the EU), demonstrating the considerable scope for price convergence in the non-tradable sector. For the non-EU countries, a similar picture emerges.

Table 3: Price similarity for some categories of products, 1985-1999 (unweighted)

	1985	1990	1993	1996	1999	Change	
						1996-1999	1985-1999
EU							
All products	81,9	81,5	84,5	84,6	87,0	2,4	5,1
Consumer goods	82,9	82,2	86,0	85,9	89,3	3,4	6,4
Equipment goods	88,5	88,1	88,6	89,8	88,0	—1,8	—0,5
Construction	85,3	85,0	85,9	84,8	84,5	—0,3	—0,8
Services	75,2	76,1	79,4	79,5	82,4	2,9	7,2
Energy	84,1	78,3	77,2	79,1	84,6	5,5	0,5
Tradables	83,9	83,1	86,1	86,3	88,8	2,5	4,9
Non-tradables	76,7	77,2	80,3	80,6	82,8	2,2	6,1
Other OECD							
All products	75,3	78,2	75,7	76,4	80,3	3,9	5,0
Consumer goods	77,1	79,9	76,9	76,7	81,5	4,8	4,4
Equipment goods	80,0	80,7	82,0	85,7	87,3	1,6	7,3
Construction	70,9	81,4	75,8	79,3	80,5	1,2	9,6
Services	69,2	72,7	70,2	71,0	75,6	4,6	6,4
Energy	76,1	73,4	71,0	72,3	75,3	3,0	—0,8
Tradables	77,4	79,8	77,5	78,0	82,0	4,0	4,6
Non-tradables	69,8	74,3	71,0	72,6	76,5	3,9	6,7

Other OECD = Australia, Canada, Japan, Norway, New Zealand, Turkey and United States.

Table 4 shows our price similarity indices according to the presence of non-tariff barriers. Significant progress towards price similarity has been achieved in the EU for both high and low-NTB sectors, while the other OECD countries mainly achieved progress in the high and medium NTB sectors.⁹ These results suggest that the Single Market programme successfully increased EU market integration and succeeded in reducing price disparities in those markets which were more regulated at the start of the programme. A counter-intuitive result is that, especially in the EU, price similarity is higher for the medium NTB-category than for the low NTB-category. This may be due to the fact that markets characterised by medium NTB's are mainly equipment goods markets which show a higher similarity of prices due to their highly traded nature (see also Tables 2 and 3).

Table 4: Price similarity according to NTB categories, 1985-1999 (unweighted)

	1985	1990	1993	1996	1999	Change	
						1996-1999	1985-1999
EU							
High NTB	82,0	81,3	85,1	85,5	88,1	2,6	6,1
Medium NTB	88,0	86,8	88,1	88,5	89,9	1,4	1,9
Low NTB	82,2	81,9	85,9	85,8	88,7	2,9	6,5
Other							
OECD							
High NTB	76,7	80,4	78,9	81,3	83,1	1,8	6,4
Medium NTB	76,7	77,2	80,3	80,6	83,9	3,3	7,2
Low NTB	76,4	79,1	76,7	76,2	80,7	4,5	4,3

Other OECD = Australia, Canada, Japan, Norway, New Zealand, Turkey and United States.

Table 5 shows some examples of the country pairs with relatively similar and relatively dissimilar prices. As to be expected, the country pairs with the highest price similarities are the neighbouring European countries with (generally) close trade relations. Among the least similar price structures, the inclusion of Japan and Turkey seems to lower the average price similarity. Of the 12 country pairs with dissimilar prices, nine of them include Japan and three of them include Turkey.

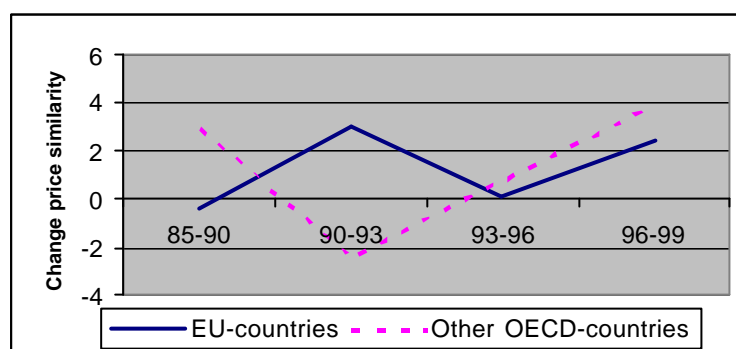
Looking at the overall results, price convergence in the EU has mainly taken place in 1990-1993 and 1996-1999 (see Figure 2). During other periods, price convergence almost stopped or even reversed. For the other OECD-countries, prices continuously converged with the notable exception of the 1990-1993 period, which provided a substantial setback. Only after more than six years does price similarity for non-EU countries return to its 1990 level. In the next section, we try to explain developments in price convergence by looking at some of their determinants.

⁹ The results for non-EU countries should be interpreted with caution as the NTB-classification was derived for EU sectors only.

Table 5: Country pairs of most and least similar price structures, all goods, 1999

Twelve most similar price structures (Similarity index >90,3)		
Austria-Belgium	Germany-Netherlands	Ireland-UK
Austria-Germany	Belgium-Netherlands	Denmark-Finland
Belgium-Germany	France-Germany	Portugal-Spain
Italy-Spain	Belgium-France	Austria-France
Twelve least similar price structures (Similarity index <70,9)		
Japan-Turkey	Japan-New Zealand	Greece-Japan
Norway-Turkey	Denmark-Turkey	Japan-USA
Japan-Portugal	Japan-Spain	Australia-Japan
Sweden-Turkey	Canada-Japan	Italy-Japan

Figure 2: Change in (unweighted) price similarity of all products (1985-1999)



3. Price convergence in a multivariate framework

The respective roles of initial conditions and EC integration and liberalisation programmes can be elucidated by looking at the determinants of price convergence in a multivariate framework. To this end, for each couple of EU and other OECD countries, we model changes in bilateral price similarity as a function of initial bilateral similarity levels, bilateral trade intensity, the bilateral correlation between expenditure shares, a dummy for EU membership and a series of other dummies identifying basic product

headings, tradeability and the NTB classification.¹⁰ The equations were estimated using the aggregate similarity measures (including all products) as well as panels of similarity measures relative to goods included in specific product categories (i.e. consumer goods, construction, equipment goods, energy, services; or high NTB, medium NTB, low NTB; or tradables and non tradables). The sample size changes accordingly.

The degree of price similarity at the start of the period is included to measure a “catch-up” effect. The assumption is that the prices of country pairs showing a larger initial gap will converge faster than those of country pairs in which prices were already quite similar at the beginning of the period. This may occur when the gap is due to a difference in initial development levels. Since price levels in more highly developed countries tend to be relatively high (as confirmed in Figure 1), faster convergence in income levels would also imply faster convergence in prices.¹¹ Alternatively, it may reflect the fact that relatively more far-reaching and difficult reforms have to be implemented to achieve further progress in countries which already have similar prices, thereby slowing down the rate of convergence. We therefore expect the coefficient of this variable to have a negative sign.

Other factors potentially affecting the speed of convergence can be motivated as follows. The bilateral trade intensity variable (the sum of the bilateral imports, scaled with the sum of the bilateral GDPs) should catch the effect of bilateral trade relations on price convergence. Countries having intense trade relations are expected to be able to reach a higher degree of price similarity (e.g. due to price arbitrage) than countries which do not have such relations. The trade variable can also be seen as a proxy for

¹⁰ The general form of the estimated equation is:

$$\text{sim}_t - \text{sim}_{t-k} = a_1 \text{sim}_{t-k} + a_2 \text{trade} + a_3 \text{share} + a_4 \text{eu} + a_5 \text{dummy} + \text{const}$$
where the dependent variable is the change in the (weighted or unweighted) price similarity of the price structures of two countries ($3 \leq k \leq 14$), “similarity t-k” is the degree of price similarity between the two countries at the start of the period, “trade” is a measure of the bilateral trade intensity, “share” is a measure of the bilateral correlation between expenditure shares, “EU” is a dummy-variable which has the value one if both countries are part of the EU and zero otherwise, “dummy” is a dummy variable measuring the effect of the kind of product (consumer goods, energy, services, construction, and equipment goods), the level of NTB’s (high, medium or low) and the tradability of the product (tradable versus non-tradables) and “c” is a constant.

¹¹ This can be attributed to the Balassa-Samuelson effect of lagging productivity growth in services: countries with a higher living standard (which generally coincides with a higher share of the service sector) tend to have a relatively high aggregate price level.

relative distance, transport costs and even cultural differences which may also act as trade barriers.¹²

The bilateral correlation between expenditure shares is used to control for the effect of differences in consumer preferences. For example, prices in one country may be higher simply because consumers have a relatively high demand for particular product varieties which are relatively expensive. Demand may be relatively inelastic, allowing producers to earn a relatively high profit margin. Including the correlation between the expenditure shares should (at least in part) correct for these effects. However, it should be noted that a low correlation in expenditure shares between countries may also be the result of a lack of competition in one of the two countries and/or regulatory or other barriers preventing price arbitrage. In any case, we expect a positive sign for this variable.

Dummy variables for the different product categories are included to control for the types of products (consumer goods, energy, services, construction, and equipment goods), the level of NTB's (high, medium or low) and the tradability features (tradable versus non-tradables). A dummy variable is also included to test whether, once controlling for initial conditions and other factors affecting the speed of convergence, prices have converged at a significantly higher rate among EU-countries than among non-EU countries.

The results of cross-section OLS estimates of this equation using as the dependent variable the average change in (both unweighted and weighted) similarity over the 1985-1999 period are shown in Table 6.¹³ Each column shows a different specification of the equation: columns 1 and 2 present the basic equation with unweighted and weighted similarity indices, respectively; columns 3 through 6 check the contribution of each basic heading for EU-countries and non-EU countries, respectively, column 7 checks for convergence according to tradability; column 8 according to the presence of non-trade barriers and column 9 shows results for the most recent period only.

The following conclusions can be drawn from the analysis. As expected, the level of price similarity in 1985 has a significant negative effect on the increase in similarity. This effect proves to be particularly robust across all types of specifications and provides evidence for the catch-up hypothesis.¹⁴ Countries with relatively dissimilar price structures have therefore tended to achieve much more progress in price convergence than countries which already had a high level of similarity.

¹² We use the logarithm of this variable since it displays a considerable variance, ranging from almost zero (e.g. between Australia and Greece) to 7,1% for the trade between Belgium and the Netherlands. Data on aggregate bilateral trade flows refers to 1990 and 1994.

¹³ Luxembourg is excluded in the regressions due to a lack of trade data.

¹⁴ Using the logarithm of the initial similarity level produces the same qualitative results.

Table 6: Bilateral convergence equations

Dependent variable	Change in price similarity (average 1985-1999)								
	1	2	3	4	5	6	7	8	9
Specification/ Independent variables	Uw		W	Uw	W	W	W	W	W
	all	all	all	EU	EU	non-EU	EU	EU	EU
<i>Similarity 1985</i>	-0,4 (-7,5)	-0,5 (-10,5)	-0,5 (-22,4)	-0,5 (-14,2)	-0,6 (-17,5)	-0,5 (-15,9)	-0,5 (-19,1)	-0,7 (-19,3)	-0,3 (-8,8)
<i>Trade intensity</i>	-0,3 (-1,3)	-0,5 (-1,8)							
<i>Expenditure share</i>	2,0 (1,6)	4,4 (3,2)	2,7 (3,3)	1,6 (1,9)	2,0 (2,1)	2,8 (2,4)	4,5 (2,4)	3,0 (2,8)	2,5 (3,2)
<i>EU-variable</i>	3,7 (6,3)	4,7 (7,1)	3,6 (8,3)						
<i>Construction</i>			-3,1 (-4,3)	-5,3 (-6,6)	-6,5 (-7,3)	-0,6 (-0,6)			-2,3 (-3,0)
<i>Equipment goods</i>			2,0 (3,0)	-3,1 (-4,1)	-2,4 (-2,9)	5,3 (5,5)			-1,4 (-2,1)
<i>Energy</i>			-6,5 (-10,9)	-5,0 (-7,2)	-5,9 (-7,5)	-7,0 (-7,5)			-2,4 (-3,5)
<i>Services</i>			0,4 (0,6)	-2,5 (-3,3)	-1,3 (-1,5)	1,6 (1,6)			-0,2 (-0,3)
<i>High NTB</i>								-1,4 (-3,4)	
<i>Medium NTB</i>								-0,5 (-1,1)	
<i>Tradable</i>							0,6 (0,8)		
<i>constant</i>	28,2 (7,6)	35,8 (10,0)	41,9 (20,9)	46,2 (15,1)	51,7 (17,8)	38,0 (14,2)	45,1 (19,3)	60,4 (21,1)	26,0 (8,3)
<i>Observations</i>	210	210	1050	455	455	595	182	273	455
<i>R² (adjusted)</i>	28,4	43,5	45,0	50,4	59,3	42,4	70,0	63,5	23,0

Notes: T-statistics in parentheses.

The intensity of bilateral trade relations has a negative sign in the estimations: countries with intensive bilateral trade relations tend to show relatively little price convergence. The reason may be that their (initial) level of similarity is generally high and, possibly, regulatory barriers impede further convergence. This coefficient is not always significant, which may be explained by the fact that it plays a similar role as the initial

similarity variable.¹⁵ The bilateral correlation between the expenditure shares (an indicator of closeness of preferences) is also significant and correctly signed in most specifications.

Comparing the weighted and unweighted specifications, no obvious differences in overall explanatory power seem to be present. However, the weighted specifications seem to be the more relevant ones, as they put more weight on those product categories which on average have a higher share of expenditures. Note however that the weights themselves may be influenced by factors not included on the right hand side (such as collusive behaviour or regulatory barriers).

Taking a closer look at the results at the basic heading level (see equation 3), these show that the EU-variable is significant and the coefficient is of the same order of magnitude as in specifications 1 and 2. However, a problem with equation 3 may be that it implicitly restricts the development in price similarity among the basic heading categories to be the same in EU- and non-EU countries. This assumption may not be valid. To test whether the sub-samples of EU and non-EU countries can be combined, separate regressions were performed for EU and non-EU countries. The error sum of squares of the separate regressions were compared with the error sum of squares of a regression for the whole sample where the coefficients were restricted to be equal.¹⁶ The test statistic (Pindyk and Rubinfeld, 1991) which has an F-distribution shows that equality of coefficients at the basic heading level can clearly be rejected. The same holds for the regression with proxies for the presence of non-tariff barriers. Only in the regressions with the tradability-variable it was not possible to reject the hypothesis of equality of coefficients. In order to look at patterns of price convergence for specific product categories, it is therefore on balance more appropriate to estimate separate regressions for EU and non-EU-countries.

Separate equations for EU- and non-EU-countries are presented in Table 6, columns 4 through 8. The results indicate that:

- Within the EU, price convergence was highest for consumer goods, followed by services, equipment goods, energy and construction (see specifications 4 and 5). The differences between the weighted and unweighted specifications are not large. The fact that price convergence for consumer goods has been higher than for services is

¹⁵ This is confirmed by leaving out the initial similarity variable and including only the trade variable. The trade variable becomes highly significant, but the overall explanatory power of this specification is much lower. This does not affect the coefficient of the EU-variable, however.

¹⁶ As our goal is to test whether price convergence at the basic heading level displays a significantly different pattern among EU-countries and non-EU-countries, we correct for the higher average *rate* of price convergence among EU-countries (compared to non-EU-countries). This was done by subtracting the estimated coefficient for the EU-variable from the EU-observations of the dependant variable and then re-estimating the three equations with the new dependant variable.

remarkable as table 3 presented an opposite result. This indicates that price convergence in the services sector can to a significant extent be attributed to catching up;

- Comparing the development between EU and non-EU countries (specifications 5 and 6), significant differences are evident, as expected. Prices for equipment goods and services in non-EU countries have converged more relative to consumer goods. In both country groupings, prices in the energy-sector have converged less than for consumer goods;
- Tradables in the EU have not performed significantly better than non-tradables. This result seems to be due to the fact that very different product categories have been lumped together in this composite category (see Table 2);
- Neither high- nor medium-NTB sectors have been able to achieve a more significant increase in price similarity compared to the low NTB sectors; the performance of medium-NTB sectors is not significantly different from low-NTB-sectors.

The disadvantage of estimating separate equations for EU and non-EU countries is that it does not allow one to directly compare progress in EU-countries with those in other OECD-countries. Using the methodology illustrated above, we below investigate some of the properties of the sample along various dimensions (country grouping, product category and time). We illustrate the results graphically.

Figure 3 shows the results of estimations replicating equations 1 and 2 for different time periods. The figure shows that in all periods some progress was made, but price convergence was especially high in the period 1990-1993 and (somewhat less) in 1996-1999. The difference between the weighted and unweighted specifications is again not high, with the exception of 1996-1999.

Figure 3: Coefficient of EU-variable in various sub-periods

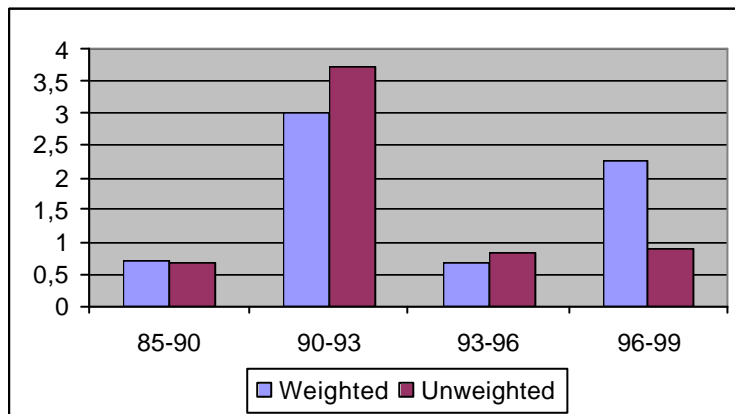


Figure 4 compares the performance of EU- and non-EU countries for different types of products and during different sub-periods. For most products, EU-countries have consistently outperformed non-EU-countries, most notably in consumer goods and in energy. For consumer goods and services (which represent the majority of products and expenditures), progress was highest in 1990-1993. After that, progress slowed down somewhat, only to accelerate again in 1996-1999. Over all periods, performance in construction is least convincing.

Figure 4: Coefficient of EU-variable in various sub-periods for various types of products

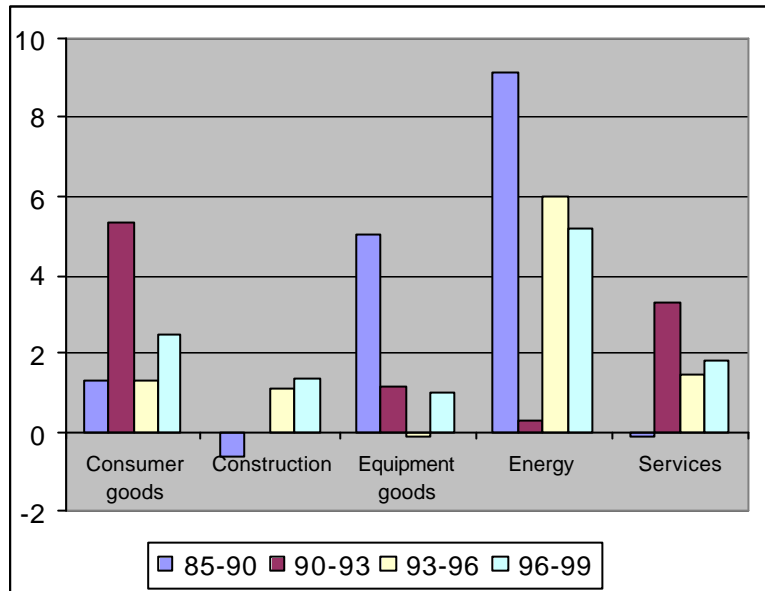
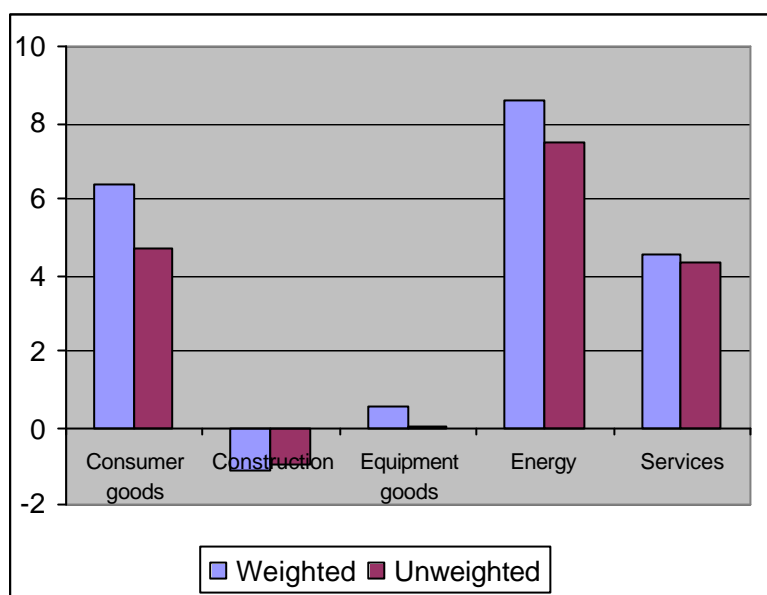


Figure 5 compares the weighted and unweighted development of price convergence between EU- and non-EU countries for various types of products. Again, the differences between the weighted and unweighted estimations are small. For consumer goods and services, expenditure weighted progress has been higher than non-weighted convergence, indicating that progress has occurred in relatively important sectors.

Overall, the evidence on price convergence within the EU is quite positive. Once one corrects for differences in initial similarity and various other variables, prices in the EU have converged significantly faster than in other OECD-countries. This result holds almost across all product categories and time periods. Within the EU, price convergence was highest for consumer goods, followed by services and equipment goods. Convergence in the energy- and construction-sectors is lagging behind.

Figure 5: Coefficient of EU-variable for various types of products (weighted and unweighted estimations)



4. The Implications of EMU for price convergence

It is important to ask whether the creation of the European Monetary Union will provide additional incentives to agents and governments to adjust behaviours and policies in a direction which favours a more competitive environment in the labour and product markets, with possible beneficial effects on employment. Monetary integration is likely to affect the level of competition, e.g. by facilitating price comparisons across countries. In principle, increased transparency raises opportunities for arbitrage by consumers and competitive pressures for producers. As a result, the convergence of prices across countries should be accelerated, even though differences will remain due to factors related to location, tastes, etc. Monetary integration may also bring about changes in behaviour of private agents conducive to increased (nominal) wage and price flexibility and changes in institutions and structural policies which lead to a reduction of real rigidities.

The objective of this section is to discuss whether the experience of a subset of EU countries that participated in an exchange rate stability zone, has been significantly different from the EU-countries which did not participate in such an area. This comparison may be considered as a crude proxy for the possible effects Economic and Monetary Union might have on convergence of price structures. The presence of such changes could be interpreted as evidence that monetary integration encourages

fundamental reforms in the labour and product markets, making the abandonment of independent monetary policy beneficial also on this ground.

It is important to keep in mind, however, that price convergence may be influenced by many factors, of which monetary integration is only one. Secondly, the experience of the so-called D-Mark area may be a rather specific historical episode, characterised by specific institutional and regulatory developments, which may hamper its usefulness as a benchmark for what might happen in EMU.

Nevertheless, at the risk of over-simplifying complicated historical developments, in the following we distinguish between the “D-Mark area”, i.e. Germany, the Benelux-countries and Austria, on the one hand, and the rest of the EU on the other hand. The countries in the D-Mark area all succeeded achieving relative monetary stability by pegging their exchange rate to the D-Mark over more than a decade (Austria, Belgium, the Netherlands and Luxembourg). The other EU-countries consist of countries which entered the exchange rate mechanism of the European Monetary System in 1979 but underwent frequent and significant adjustments of their parities (eventually leading to their temporary or permanent exit from the system), countries that entered EMS at a late stage and countries that never participated in the exchange rate arrangement. Changes in exchange rates were particularly important at the beginning of the 1980s, with especially Portugal and Greece experiencing major depreciations of their currencies against the ECU. However, exchange rate fluctuations have remained important also in subsequent years in the majority of EU-countries, culminating in the EMS currency crises of the early 1990s.

As a starting point, it is important to establish whether overall process of convergence documented in section 3 could have resulted merely from changes in exchange rates. While the countries in the D-mark area saw their currencies appreciate relative to the ECU since the mid-1980s, Greece, Portugal, Spain and Italy experienced major depreciations against the ECU. According to the theory of (relative) purchasing power parities, changes in the exchange rate between two currencies should, in the long run, equal the difference in the percentage changes of the national price levels. Given that the countries with relatively low prices were typically the countries which experienced exchange rate depreciations, in the vast majority of cases, changes in exchange rates have favoured an increased divergence in prices. For example, in 1980, the lowest price countries were Portugal, Spain, Greece and Italy, whereas the highest price countries were Denmark, France and Germany. In 1993, the low price countries were Portugal, Greece and the UK, while the high price countries were still Denmark, France and Germany. Therefore, the observed convergence in prices between the low-price and high-price countries cannot be attributed to exchange rate variations (EC, 1997a). On the other hand, convergence could perhaps have been higher had there been more exchange rate stability.

Table 7 presents some indicative results for the development in our price similarity indicator within the D-Mark area and within the rest of the EU. The level of price

similarity is much higher within the D-Mark area. In addition, countries in the D-Mark area already formed a relatively integrated group before the start of the pegged exchange rate regimes. However, price convergence has been substantially higher among the countries outside the Dmark area. This holds for all product categories except for construction (where the change in similarity is equal). Progress has been especially high in the most recent period (1996-1999), as almost half of the development in price similarity occurred during that period. Within the D-Mark area, prices are actually highly similar across all product goods categories, with the possible exception of services.

Table 7: Price similarity indices at the basic goods heading, 1985-1999 (unweighted)

	1985	1990	1993	1996	1999	Change		
							1996-1999	1985-1999
D-Mark area								
All products	90,0	90,7	90,4	90,8	91,3	0,5	1,3	
Consumer goods	91,2	91,7	92,1	92,5	93,1	0,6	1,9	
Equipment goods	91,0	92,0	90,2	90,1	89,0	-1,1	-2,0	
Construction	92,5	90,7	90,4	90,8	91,6	0,8	-0,9	
Services	85,7	87,8	86,9	87,0	88,5	1,5	2,8	
Energy	91,6	88,9	86,4	91,8	91,5	-0,3	-0,1	
Other EU								
All products	81,2	80,7	84,0	84,0	86,5	2,5	5,3	
Consumer goods	82,2	81,3	85,4	85,3	88,9	3,6	6,7	
Equipment goods	88,3	87,8	88,5	89,7	87,9	-1,8	-0,4	
Construction	84,7	84,5	85,5	84,3	83,8	-0,5	-0,9	
Services	74,3	75,0	78,7	78,8	81,8	3,0	7,5	
Energy	83,4	77,3	76,4	77,9	83,9	6,0	0,5	

D-Mark area = Belgium, Germany, Luxembourg, The Netherlands, Austria.

Other EU = ten remaining EU countries.

In Table 8, we check whether there are significant differences in price convergence between these two groups, after controlling for initial conditions and other variables. The first two specifications show the results for all OECD countries. All variables again have the expected sign. Consistent with the results of the previous section, price convergence in both the D-Mark area and the rest of the EU has been higher than in the rest of the OECD. Price convergence in the D-Mark area also seems to be higher than in the rest of the EU. To check whether price convergence in the D-Mark area has been significantly higher than in the rest of the EU, in specification 3 we re-estimate equation 2 while restricting the sample to EU-countries only. The results indicate that price convergence among the D-Mark countries has been significantly higher than among the rest of the EU. This shows that the difference in observed price convergence (see Table

7) can largely be explained by the catching-up of non-D-Mark-area participants. The alternative specifications 4 through 6 in Table 6 yield the same qualitative results.

Table 8: Estimates of bilateral similarity equations including EMS-dummies.
(Dependent variable: change in price similarity over 1985-1999)

Specification	1	2	3	4	5	6
Variables	unweighted all	weighted all	weighted EU	weighted EU	weighted EU	weighted EU
Initial similarity	-0,4 (-7,5)	-0,5 (-10,4)	-0,6 (-13,1)	-0,6 (-18,0)	-0,7 (-19,9)	-0,5 (-19,4)
Expenditure share	1,9 (1,6)	4,4 (3,2)	1,4 (1,2)	1,8 (2,0)	2,7 (2,6)	4,1 (2,2)
Trade intensity	-0,3 (-1,3)	-0,5 (-1,7)	-0,3 (-0,9)			
D-Mark	5,5 (3,2)	6,2 (3,1)	2,5 (2,2)	3,7 (3,4)	2,5 (3,5)	2,3 (2,2)
Other EU	3,6 (6,1)	4,6 (6,9)				
Construction				-6,6 (-7,5)		
Equipment goods				-2,3 (-2,8)		
Energy				-5,9 (-7,6)		
Services				-1,6 (-1,8)		
High NTB					-1,5 (-3,6)	
Medium NTB					-0,3 (-0,7)	
Tradable						0,7 (1,1)
Constant	28,4 (7,6)	36,0 (10,0)	49,3 (13,9)	53,5 (18,4)	63,0 (21,7)	46,2 (19,5)
No. of observations	210	210	91	455	273	182
R ² (adjusted)	28,1	43,1	71,8	60,2	65,0	70,4

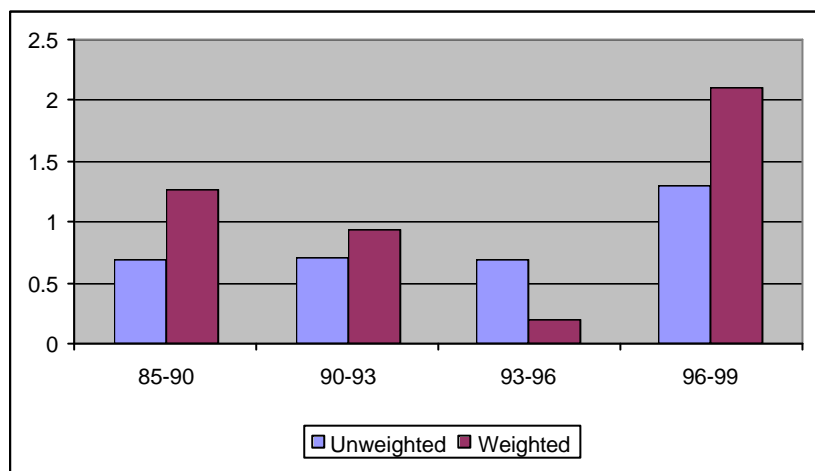
Notes: the D-Mark dummy has the value one if the dependant variable corresponds to two countries from the following group: Austria, Belgium, Germany and the Netherlands. The Other EU dummy has the value one for all pairs of EU countries not belonging to the core EMS-group. The 5% -significance level for the equality of DM and non-DM coefficients is 3,84.

Just like in the previous section, we test whether it is appropriate to combine the sub-samples for the EMS-countries and the other EU-countries when looking at specific product categories. F-tests were performed by comparing the error sum of squares for three groups of countries and various product categories, while also taking into account

the higher average rate of price convergence among EMS-countries. Interestingly, the results show that the hypothesis of identical coefficients between EMS and non-EMS countries could not be rejected, while it could be rejected in the previous section (non-identical coefficients for EU and non-EU-countries). This confirms that the EU is a relatively integrated market. While noting that EMS-countries have displayed a higher degree of price convergence compared to other EU-countries, the pattern of price convergence within the EU does not differ significantly among EMS- and non-EMS-countries.

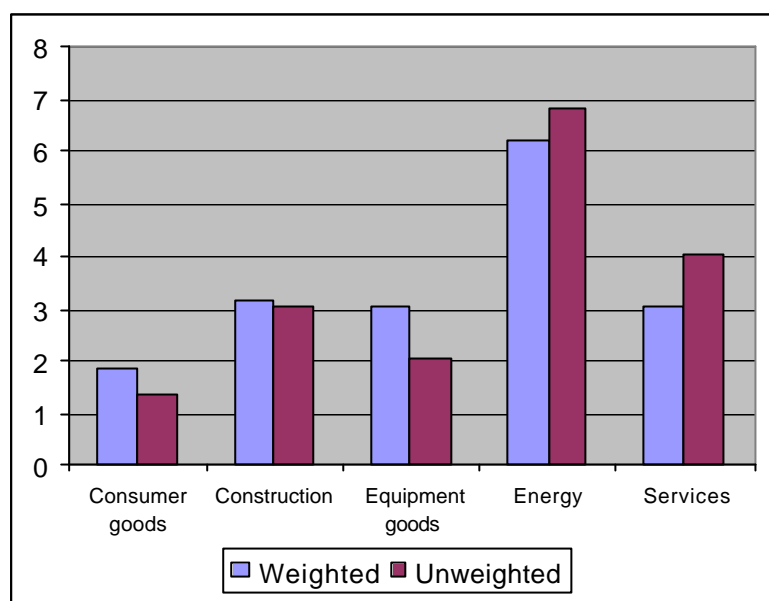
Figures 6 and 7 show the results for various time periods and product categories. Progress in price convergence has been relatively high during 1985-1990 and 1996-1999. Price convergence relative to the rest of the EU was lowest during 1993-1996, confirming previous findings (Nicoletti et al., 2001). Compared to the rest of the EU, convergence in energy and services has been relatively high.

Figure 6: Coefficient of D-Mark variable in various periods, weighted and unweighted



The increase in relative price convergence in the most recent period in the D-Mark countries may be partially explained by the convergence in inflation rates at the start of EMU. Inflation rates indeed displayed a significant convergence as the final stage of EMU came closer and closer. As inflation in the D-Mark area was already relatively low, this implied a relative decline in inflation rates in the rest of the EU, slowing down the pace of relative price convergence between the two groupings. In this way, price convergence in the D-Mark area relative to the rest of the EU could increase.

Figure 7: Coefficient of D-Mark variable for various types of products (weighted and unweighted estimates)



The results of this section give some foundation to hopes that monetary union will promote price convergence, especially because private agents probably have not attributed as much credibility to the EMS arrangement (even in the countries with relatively stable bilateral exchange rates) as a full monetary union such as EMU might have. Exchange rate uncertainty and a lack of price transparency is likely to have persisted to some extent, which may have had a negative effect on price convergence. As EMU is a much more credible and irrevocable form of monetary union, it may have a more substantial impact on price convergence.

5. Conclusion

Before turning to the main conclusions of the paper, it is useful to recall some of the limitations which are inherent to international price comparisons. Firstly, product categories across countries may not be completely identical. Secondly, improvements in data collection methods and changes in product categories (e.g. quality improvements, new products) make intertemporal comparisons more difficult. Finally, it should be noted that although the empirical analysis makes use of price data for almost 200 product categories, the level of aggregation may still be too high to fully capture the process of price convergence. An analysis at an even lower level of aggregation might well reveal a considerable degree of heterogeneity at the level of individual products. However, the data used in this paper are the best ones available. They were composed

by the national statistical agencies, Eurostat and the OECD with great care and are widely used to make price comparisons and to investigate broad price trends. We therefore look at our results with some confidence.

Overall, the evidence on price convergence within the EU is quite positive. Once one corrects for differences in initial similarity and various other variables, prices in the EU have converged significantly faster than in other OECD-countries. This result holds almost across all product categories and time periods. The empirical analysis also confirms that the EU is already a relatively integrated market, as sub-sets of EU-countries tend to display similar patterns of price convergence. The results also show that the progress in price convergence should be evaluated while taking initial conditions into account, as the scope for convergence is higher when initial similarity is lower.

Within the EU, price convergence was highest for consumer goods, followed by services and equipment goods. Convergence in the energy- and construction-sectors is lagging behind. The fact that price convergence in the EU at the aggregate level of almost 200 product categories has progressed, however, does not mean that price differences have disappeared entirely. Price difference can still be substantial for specific product categories, such as fresh products or consumer electronics.

Price convergence within the D-Mark area has been significantly higher than in the rest of the EU. This shows that monetary integration can go hand in hand with price convergence, even when the level of price similarity is already relatively high. However, whether the price convergence in the D-Mark area is representative of the possible effect EMU may have on prices remains an open question. One possible reason is that the experience of the D-Mark-area may be a rather specific historical episode. In addition, price convergence is determined by many factors, of which the monetary regime is only one. For example, structural reforms also play an important role in achieving further progress in this area. Therefore, it is not possible to establish causality between price convergence and changes in other (explanatory) variables, including the exchange rate regime. The results do provide underpinnings to the view that significant progress can still be achieved in the EU, provided that market integration is supported by structural reforms.

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