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The Convergence of Automobile Prices in the European Union:
an Empirical Analysis for the Period 1993-1999

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RÉSUMÉ

La progression du processus d'intégration des marchés, d'abord avec l'accomplissement de l'Acte unique européen en 1993 puis la signature du Traité de Maastricht, mais aussi les débats actuels sur la remise en cause du système de distribution automobile dans l'Union imposent un réexamen de l'évolution des différences de prix sur ce marché.

L'étude la plus complète, de Goldberg et Verboven (1998), met en évidence une convergence des prix entre 1980 et 1993. Ce processus s'est-il poursuivi voire accentué avec la mise en place progressive de l'Union économique et monétaire ?

Nous analysons la dynamique des écarts de prix entre pays de l'Union européenne sur le marché automobile entre 1993 et 1999. Depuis 1993, dans un souci de transparence, la Commission européenne impose aux constructeurs la publication semestrielle des prix de leurs principaux modèles dans tous les pays de l'Union. Nous utilisons ces données pour construire des séries de prix par pays à l'aide d'un modèle économétrique quasi-hédonique. Les propriétés de *beta* et *sigma* convergence de ces séries sont étudiées. On montre que, depuis la mise en œuvre du Marché unique, il n'y a pas eu de convergence (*sigma*-convergence, c'est-à-dire réduction de la dispersion) des prix hors taxes pratiqués dans les différents pays de l'Union. Un mécanisme de convergence (*beta*-convergence, i.e. une corrélation négative entre l'accroissement des prix et leurs niveaux relatifs initiaux) est pourtant bien à l'œuvre, mais ne se traduit pas par la réduction des écarts de prix principalement à cause des fluctuations monétaires. Par ailleurs la fiscalité, très variable d'un pays à l'autre, exerce un impact considérable sur les prix hors-taxes et leur dispersion.

La disparition des fluctuations monétaires entre les pays de la zone Euro devrait permettre aux mécanismes d'arbitrage de jouer pleinement leur rôle et conduire à une réelle réduction des écarts de prix. L'éventuelle non-reconduction du règlement d'exemption autorisant la distribution exclusive pourrait limiter les pratiques anticoncurrentielles de segmentation des marchés.

SUMMARY

Over the last decade, the EC automobile market has been the scene of significant price differentials for the same vehicle across the member states. The move towards a more integrated internal market, since January 1993, obviously calls for more up-to-date empirical information. We provide an analysis of price convergence over the period 1993-1999 for EU countries. Car characteristics were collected to build aggregate prices for countries thanks to a quasi-hedonic econometric model. Price dynamic is analysed through *Sigma* and *Beta* convergence. We found that *Sigma* convergence is impeded by exchange rates fluctuations, while there is a strong force driving *Beta* convergence. The Euro should then favour convergence.

Jel Codes: C23, F02, L62.

Keywords: Automobile European Integration, Panel Data, Price Convergence.

THE CONVERGENCE OF AUTOMOBILE PRICES IN THE EUROPEAN UNION: AN EMPIRICAL ANALYSIS FOR THE PERIOD 1993-1999

Guillaume GAULIER & Séverine HALLER[1]

INTRODUCTION: MEASURING AUTOMOBILE PRICE CONVERGENCE

Over the last decade, the European automobile market has been shown to be the scene of significant price differentials for the same vehicles across the member states. For example, in May 1999, buying a Volkswagen Golf would have cost, pretax, about EURO 8.600 in Finland, and about EURO 13.250 in the United Kingdom: a 53% gap exists between the lowest and the highest pretax price for that car in the European Union. The move towards a more integrated internal market, in particular with the 1993 implementation of the Internal Market Programme and the talks about a new institutional setting for competition in automobile distribution, calls for more up-to-date evidences on the evolution of price disparities.

The political will to see car prices harmonised in the European Community goes back to the beginning of the 1980s, with the 1983 draft regulation of the European Commission. The idea was to introduce bounds on price differentials between member states. More precisely, price differentials exceeding 12% for more than 6 months would lead to producers being denied the right to sign exclusive dealership agreements with their retailers. In the end, the text was never implemented; yet the Commission retained the possibility of intervening in cases of "excessive discrimination".

A decade later, the European Commission, following the objective of the single market, commissioned the half-yearly survey of car prices in member countries and undertook a number of investigations of individual manufacturers to assess the legality of certain restrictive practices. These have resulted in substantial fines for producers such as Volkswagen (see below).

Is Economic and Monetary Union reducing price discrepancies across member states? Empirical studies fail to bring conclusive up-to-date evidence on price discrimination in the European car market, as they refer to periods prior to the implementation of the Internal Market (January 1993). Goldberg and Verboven (1998) is the only study confirming price convergence over the period 1980-1993.

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Was this process completed by 1993? If this was not the case, did the speed of convergence increase over the period 1993-1999, with the implementation of the Monetary Union and the acceleration of market integration?

The aim of this paper is to study price convergence across European Union member States for the period 1993-1999. Since many car models were not present during the entire period, we analyse the convergence of estimated aggregate prices constructed as averages of car prices, computed at every date and for each country, using the quasi-hedonic method[2]. The aggregate car price of country *j* at time *t* is an estimated average of prices for all models available in this market and at that date, weighted by the corresponding market shares.

We then turn to the β-convergence (i.e. a negative correlation between the increase of prices and their initial relative levels) of national aggregate prices and then to the σ-convergence, the decrease over time of the cross-country price dispersion.

Our results point to a lack of σ-convergence despite β-convergence over the period. However, this is not confirmed when controlling for exchange rate fluctuations, which are the main impediment to σ-convergence. Monetary Union should therefore lead to less price disparities.

The remainder of the paper is organised as follows. Section I identifies the mechanisms behind the lack of convergence of automobile prices in the European Union. Section II begins with the description of the dataset. We then explain the methodology used to construct the "aggregated" prices. In section III we show the results of our estimations of β and σ-convergence. Section IV concludes.

I. THE MECHANISMS HINDERING PRICE CONVERGENCE IN THE EUROPEAN CAR MARKET

The issue of price disparities in the European car market has given rise to a fair amount of empirical and theoretical research. These studies point to three types of mechanisms hindering price convergence towards competitive levels.

The first is *market structure*. On the supply side, firms operating in several markets determine their optimal price on the basis of the nature and intensity of competition in each market. On the demand side, asymmetrical consumer preferences, which give rise to differing price elasticities of demand across countries and across brands, also imply differentiated pricing policies. Bresson and Mathieu (1992) show this pattern to be empirically relevant for the French car market. Anderson and Ginsburgh (1999) showed that, even if arbitrage takes place, it is in the interest of a monopoly to segment markets by

[2] This method has been used by Danzon and Chao (2000).

applying a differentiated pricing policy. As a consequence, price convergence will be slowed down.

Secondly, price convergence is impeded by "*behavioural*"[3] factors. A large part of the price gaps observed between European markets appear to be linked to market segmentation practices of firms. Ginsburgh and Mertens (1985) examine the determinants of prices of European and Japanese automobiles in five EC countries. They argue that in an oligopolistic market, prices should reflect the production costs and technical characteristics of products. However, when prices are regressed on the two groups of variables, a sizeable part of variance remains unexplained. The authors show that this residual price variation is due to unmeasurable vehicle characteristics (degree of comfort of the car, etc.), and anti-competitive behaviour (price discrimination).

Thirdly, *institutional and macroeconomic* factors hinder price convergence. One of them is non-tariff barriers, which include different national industrial norms, as well as import quotas temporarily imposed on Japanese vehicles by countries such as France, and different tax regimes and exchange rate fluctuations between European currencies.

Kirman and Schueller (1990) show the influence of heterogeneity in taxation systems on the pricing strategies of firms, when domestic producers play as Stackelberg leaders in their home market. Under these circumstances, and assuming symmetrical preferences across countries, pre-tax prices are higher in markets where indirect taxes are low. Moreover, since the automobile sector benefits from an exemption regime for VAT, consumers cannot arbitrate in favour of low tax countries: VAT is paid in the purchaser's home country. This specific regime rules out tax competition between countries. It can explain the persistence of a huge heterogeneity of taxation systems.

With regards to exchange rates, Ginsburgh and Vanhamme (1989) show for the period 1984-1987, that firms stick to an export price close to these of local producers. This strategy is referred to as "Pricing to Market", which means that exchange rate variations are not transmitted to export prices. For example, Volkswagen Audi Group (VAG) maintained its Lira prices after the depreciation from 1992 to 1994, in order not to loose market shares. This Pricing to Market strategy implies mark-up cuts for makers and lower prices (in their national currency) for European consumers in the Italian market. This led to arbitrage (parallel trade) especially by German and Austrian consumers. In turn, VAG then managed to prevent its dealers from selling cars to non-Italian consumers. VAG was convicted of refusal to sell by the Commission, and had to pay high fines (euro 102 millions, reduced to 90 in July 2000). This case demonstrates how exchange rate fluctuations can be associated with strategic behaviour to generate price heterogeneity.

[3] In this case, pricing policies leading to price discrepancies across markets are viewed as discriminatory, rather than resulting from a "fair" behaviour within the bounds of the market.

Verboven (1996) evaluates three sources of international price discrimination in the European car market[4] related to the previous classification: Heterogeneity of price elasticities across countries (market structure), imports quotas (institutions) and collusion (behaviour). Very low price elasticities and high domestic market power are observed in France, Germany, the United Kingdom, and Italy. Quotas are imposed on the imports of Japanese cars by France and Italy. The hypothesis of collusion seems to be realistic in Germany and the United Kingdom.

This study sheds light on factors hindering the convergence of prices. In particular, it points out the role played by exchange rate fluctuations during the last decade. However many features of the automobile market are difficult to quantify, and therefore, their impact on price convergence is difficult to assess. Firstly, the distribution systems in the automobile sector is characterised by exclusive territories, exclusive and selective dealerships. Producers and retailers benefit from the exemption regulation 1475/95 which will fall due in September 2002. One possible new option could be to end this regulation. This regulation may be abolished, despite protests from the car manufacturers, because of the numerous examples of geographical market segmentation by firms (refusals to sell avoiding parallel trade). The distribution system plays an important role in maintaining price differentials in the EU. Another element also related to the distribution of products, is the role of the internet in bringing information to the consumer and in reducing the distribution costs.

II. EVALUATING AGGREGATE PRICES

2.1. The data

In order to increase market transparency, the European Commission requests car producers to communicate the list prices of their best selling models in EU countries. Pre-tax prices are available for about 75 automobile models in 10 countries from the beginning of the period (first semester of 1993) onwards, 12 countries from the first semester of 1995 onwards, and finally 15 in the last semester (first semester of 1999). The observation period contains 13 semestrial dates in all.

Purchasing tax[5] rates as well as Value Added Tax rates are available from ACEA (Association des Constructeurs Européens de l'Automobile). Prices including taxes are computed from pre-tax prices and tax rates.

[4] The author used price measures for a hundred of car models across five of the EC founding member states in 1990.

[5] See appendix for the various definitions across countries.

Exchange rates against the ECU are averages of monthly rates computed over each semester.

The technical characteristics of the models (see the appendix for details) as well as the brand[6] and market segment, from lower economy to luxury, are also available. However, characteristics are assumed to be identical for a given model across countries at every date. Technical characteristics of vehicles (horsepower, type and engine capacity, dimensions, fuel consumption and acceleration capacity) are taken from *La Revue Automobile*.

2.2. Construction of aggregate prices

We aim at using representative prices for each country over the entire period. Prices of a given vehicle are rarely available for the entire period (models disappear from producer's best sales list). This leads us to aggregate the available information. The quasi-hedonic method allows us to make use of the entire dataset. This method considers all car characteristics. Heterogeneity between countries, related to market shares of makers[7], is dealt with by weighting the hedonic regressions by the market share of the model in each market.

The quasi hedonic method consists of linear regression of prices over a set of characteristics and dummies capturing non-observable determinants. Hedonic prices are part of the theory of characteristics (New Theory of Consumer, Lancaster (1966)), which assumes that consumers maximise their utility with respect to the amounts of *characteristics* of each good. Hence, from this point of view, a "product" is to be considered as a basket of characteristics (see the appendix for the theoretical foundations of hedonic prices). Here, we estimate quasi-hedonic prices regressing the market price of a product over a set of its characteristics. The regressions are "quasi-hedonic" because apart from technical characteristics, other variables are included in the regression, such as market segment or brand.

Following Couton, Gardes and Thépaut (1996) we neglect the interaction between supply and demand. For a given automobile vehicle *i*, in a market *j*, at date *t*, we regress the logarithm of its ECU pre-tax price over a linear combination of the logarithm of its characteristics, and a set of dummies which capture fixed effects.

$$\ln(p^{ecu}_{i,j,t}) = \alpha \ln z_{i,t} + D_s + D_{j,t} + D_{b,t} + \varepsilon_{i,j,t} \qquad (1)$$

We focus on pre-tax prices because they are the relevant prices for arbitrage between markets. Purchases of any car may be made in any country, where the price is lower than

[6] The dataset includes US and Japanese brands selling cars on the European market.

[7] In particular, it is a well-known fact that consumption patterns in countries such as France, Italy or Germany exhibit a significant bias towards domestic brands.

the one paid for the same item in the home country. However, taxes are to be paid in the home country. Hence, what matters to the consumer is the pre-tax price[8].

$Z_{(i,t)}$ is the matrix containing the characteristics of model *i* at date *t* (we take the logarithm of the continuous characteristics), D_s is a market segment dummy standing for the belonging of the model to the segment *s*, $D_{j,t}$ is a cross fixed effect "market/time", finally, $D_{b,t}$ stands for a fixed effect "brand/time". The estimated coefficient for $D_{Fiat,98.1}$, for instance, indicates how much the price of Fiat cars departed from the average in the first semester of 1998.

Table 1: Results of the estimation of quality adjusted prices

Variables	(1a)	(1b)	(1c)
INT	-5.57 *(-12.56)*	-6.35 *(-13.83)*	-5.45 *(-12.27)*
LCAP	0.56 *(39.87)*	0.55 *(40.90)*	0.56 *(39.95)*
LHPWR	0.04 *(1.55)*	0.02 *(0.61)*	0.04 *(1.56)*
DOORS	0.002 *(5.74)*	0.03 *(9.81)*	-0.02 *(5.76)*
LSIZE	0.16 *(6.18)*	0.20 *(7.77)*	0.16 *(6.98)*
LWEIGHT	0.51 *(17.88)*	0.32 *(10.95)*	0.51 *(17.90)*
LSPEED	0.85 *(18.05)*	1.11 *(23.65)*	0.85 *(18.07)*
LACCEL	0.19 *(8.42)*	0.24 *(10.96)*	0.19 *(8.42)*
LCONS	0.03 *(2.28)*	-	0.03 *(2.24)*
LCONS1	-	-0.21 *(-6.62)*	-
LCONS2	-	-0.23 *(-9.72)*	-
LCONS3	-	-0.13 *(-6.01)*	-
LCONS4	-	0.36 *(18.94)*	-
LCONS5	-	0.18 *(3.68)*	-
LTAXR	-	-	-0.04 *(3.43)*

$R^2_{(1a)} = R^2_{(1b)} = R^2_{(1c)} = 0.97$.

In parenthesis: t-statistics.

Equation (1b): Equation (1a) with LCONS differentiated by market segment.

Sources: Authors' calculations.

Regressions should be weighted by $w_{i,j,t}$, i.e. the market share of model *i*, in market *j* at date *t*. However, the only available data was the brand's market share in each country, and

[8] The relevant decision variable for firms is also the price net of taxes.

at each date[9]. This allows some amount of observable market structure heterogeneity between countries to be taken into account. However, our main results are robust to the use of any weighting scheme.

Our main focus is the construction of aggregate prices. This is done by simulating the estimated equation fixing all variables to their mean values except for the $D_{j,t}$, as they are intended to capture country/time specific effects. We refer to $h_{j,t}$ as the aggregate price for country *j* at time *t*.

Table 1 summarises the results for 3 specifications of the base equation (1): equation (1a), equation (1b) when each car's fuel consumption is differentiated by market segment (variable LCONS) and equation (1c) with tax rate. The three estimated equations[10] have a large explanatory power, and all the variables used in the regression have a significant impact on the price, except for horsepower. Because of multicolinearity between characteristics, the interpretation of the coefficients on these variables may be dubious. However, it is still of interest that one additional percent of engine capacity results in a 0.56% price increase of the car. Concerning fuel consumption, the equations 1a and 1c exhibit an unexpected, positive coefficient for this variable. This is a consequence of the multicolinearity problems mentioned above. Differentiating fuel consumption with respect to the market segment (Equation 1b in table 1) shows that this characteristic is valued in a negative way for the first three segments (the cheapest) – one extra litre of fuel consumption reduces the price of the cheapest cars – while in the market segments 4 and 5, this feature will be valued in a positive way. However, using the quasi-hedonic method does not aim at estimating how observable characteristics are valued by consumers. Our goal was to compute aggregate prices adjusted for quality. Consequently, it is legitimate to abstract from the multicolinearity problem and focus on the fixed effects $D_{j,t}$.

Note that the coefficient for LTAXR, the tax rate by country, is significant and negative. Nevertheless, the coefficient is very weak, which allows us to infer that the influence of tax is relatively weak across the time dimension of the panel. For this reason, we also estimate the influence of tax on price in a cross section. It turns out that for the last semester of our sample, the tax effect is significant and equal to -0.09[11]. One should bear in mind, however, that this date corresponds to the entry of Denmark and Finland in the dataset. As taxes are very high in these countries, this increase substantially the variability of LTAXR.

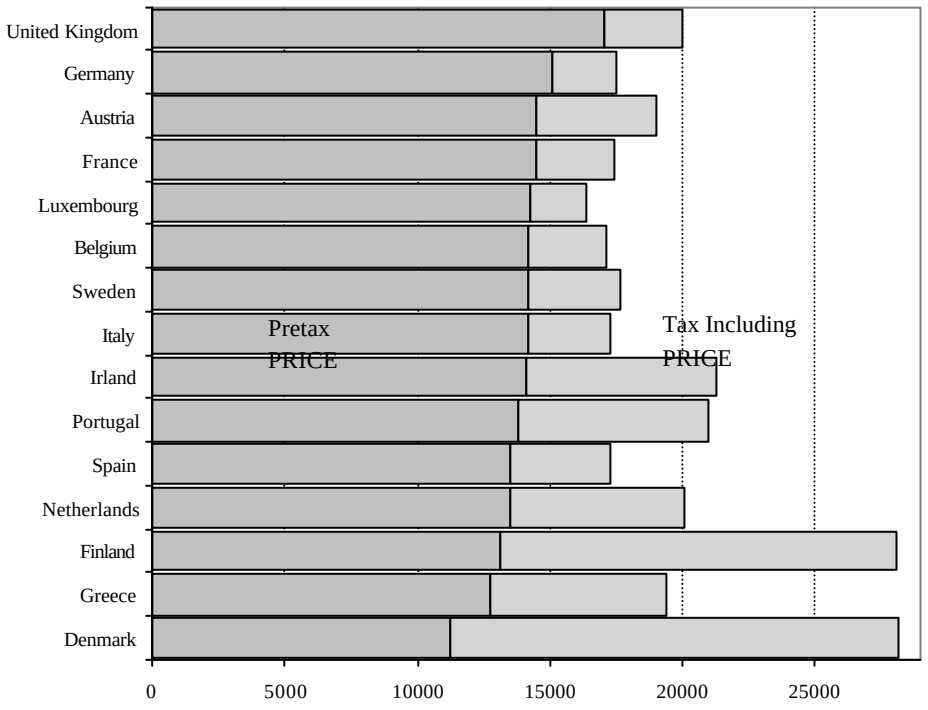
[9] So as to obtain weights for the models, we divided brand market share by the number of models.

[10] We used OLS estimator.

[11] We regress the logarithm of countries pre-tax price on the logarithm of tax rate in 1999. The R^2 is about 0.6. Given the variability of taxes (see appendix) this coefficient implies for instance almost 20% price difference between the German and the Danish prices only because of taxes.

Figure 1 shows the estimated pre-tax aggregate prices for all countries in the first semester of 1999, as well as the including taxes prices (the latter are obtained by applying tax rates to aggregate pre-tax prices). Pre-tax prices appear to be lower on average in countries where taxes are higher. This observation, made for the first semester of 1999, is consistent with the coefficient of the tax variable obtained in the second version of the hedonic regression (table 1). High rates of taxation induce firms to set low pre-tax prices, in order to be able to continue to sell cars in those countries (for instance Denmark). Such producer behaviour has been studied by Kirman and Schueller (1990). The smoothing effect of makers' pricing behaviour in high tax markets implies that local consumers have no interest in buying cars abroad (since taxes paid on such purchases are local taxes, and foreign pretax prices are higher), and that for the same reason rational foreign consumers should buy their cars in markets exhibiting low pre-tax prices.

Figure 1: Automobile prices, first semester of 1999



Sources: Authors' calculations.

However, this impact of taxes on pre-tax prices does not compensate for the huge variability observed on tax rates (see appendix 3): the dispersion of prices including taxes is higher than that of pre-tax prices.

Figure 1 is based on average prices and does not provide any information as to the impact of market segment on the dispersion of both pre-tax and tax-including prices. In order to shed light on this relationship, we compute average model prices across countries for each date. We also evaluate the dispersion of model prices across countries at the same dates. Our aim is to establish a link between both variables, i.e. to find out whether price dispersion across countries for a given model is correlated with the average price of this model in Europe. We show the corresponding correlations in table 2 for both pre-tax (P) and tax including prices (TI).

Table 2 shows, for each date, the correlation between the mean price[12] and the coefficient of variation. A negative correlation exists between pre-tax prices and their dispersion, while the reverse holds between tax included prices and their coefficients of variation. The latter means that pre-tax price gaps between markets for a single automobile model are lower for the most expensive market segments (segments 4 and 5 in our sample). This suggests that consumers for those segments do arbitrate more across markets. This is possibly due to better access to information and lower search and transportation costs relative to the value of the purchase. Comparing the results obtained for pre-tax and tax-including prices shows that the dispersion in tax rates increases with the segment: this effect is sufficiently significant to transform the negative pre-tax correlation into a positive tax including correlation.

Table 2: Correlations between dispersion (coefficient of variation) and average price

Semester		N (models)	Correlation (P)		Correlation (TI)	
May	1993	72	0.157	*(0.20)*	0.651	*(0.0001)*
November	1993	72	-0.024	*(0.84)*	0.642	*(0.0001)*
May	1994	74	-0.416	*(0.0002)*	0.439	*(0.0001)*
November	1994	76	-0.456	*(0.0001)*	0.493	*(0.0001)*
May	1995	75	-0.224	*(0.054)*	0.545	*(0.0001)*
November	1995	77	-0.164	*(0.15)*	0.462	*(0.0001)*
May	1996	77	-0.154	*(0.18)*	0.576	*(0.0001)*
November	1996	75	-0.250	*(0.03)*	0.491	*(0.0001)*
May	1997	75	-0.440	*(0.0001)*	0.279	*(0.015)*
November	1997	72	-0.451	*(0.0001)*	0.374	*(0.001)*
May	1998	74	-0.370	*(0.001)*	0.324	*(0.005)*
November	1998	76	-0.504	*(0.0001)*	0.364	*(0.001)*
May	1999	75	-0.422	*(0.0002)*	0.697	*(0.0001)*

[12] Average prices are simple arithmetic means.

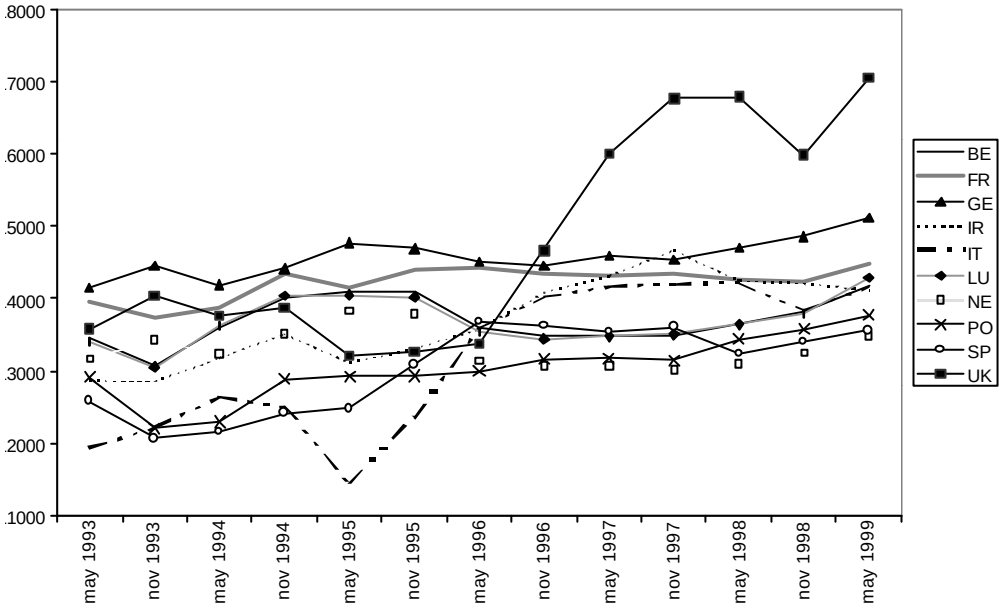
In parenthesis: P-value of the coefficient of correlation.

Sources: Author's calculations.

We will now explain the patterns of the automobile price "dynamics", through the economic and econometric concept of convergence. Figure 2 shows the evolution of the aggregate prices in the ten countries for which data are available for the entire period.

Early 1993, cars were on average most expensive in France and Germany, and cheapest in Italy. Prices in the UK were close to the average of the ten countries until the appreciation of the sterling from November 1995 onwards. In 1999.1, prices in the UK were much higher (more than ECU 16.500) than in the rest of the EU. The commonly held idea that UK higher car prices are due to technical reasons (cost of producing right hand side wheel cars) should be reconsidered in the light of these findings.

Figure 2: Evolution of aggregate (pre-tax) prices for 10 countries



Sources: Authors' calculations.

Figure 2 does not show a clear trend of convergence or divergence. Two types of convergence, stemming from the literature on growth have to be distinguished. ***b***-convergence indicates that price increases are negatively correlated to the initial level, i.e. countries with a relatively low aggregate price level at the beginning of the period will have higher price growth. They "converge" towards the mean price. ***b***-convergence is a

necessary, but not sufficient condition for ***s***-convergence, which is the reduction of price dispersion across markets. If there is no ***b***-convergence the diverging behaviour of price series cannot induce any reduction in the cross-sectional variance of prices. Because of shocks, ***b***-convergence can imply shifts into the ranking of prices, countries with initially high prices may become those with the lowest without any decrease in dispersion.

III. PRICE DYNAMICS

3.1. *b* - Convergence

It is expected that the integration of European markets leads to increased price convergence, in accordance with the law of one price. A growing quantity of information and arbitrage in good markets will accelerate the integration of local markets, prices becoming closer. Our aim is to test the ***b***-convergence, absolute as well as conditional, and to compare our results (patterns and speed of convergence) to those of Goldberg and Verboven (1998).

b-convergence of $h_{j,t}$ is tested by estimating the following base equation:

$$\Delta \ln(h^{ecu}_{j,t}) = \alpha + \beta \ln(h^{ecu}_{j,t-1}) + u_{j,t} \qquad (2)$$

Table 3: Results of *beta*-convergence

Variables	(2)	(3)
Constant	1.22 *(2.83)*	1.02 *(5.45)*
$\ln(h_{j,t-1})$	-0.11 *(-2.72)*	-0.11 *(-5.62)*
$\Delta \ln(ECU_{Austria,t})$	-	-1.11 *(-3.10)*
Idem for *Belgium*	-	-0.84 *(-5.28)*
France	-	-0.63 *(-1.95)*
Germany	-	-0.81 *(-3.94)*
Ireland	-	-0.77 *(-4.90)*
Italy	-	-0.75 *(-11.83)*
Luxembourg	-	-0.81 *(-5.13)*
Netherland	-	-0.88 *(-4.30)*
Portugal	-	-0.61 *(-5.07)*
Spain	-	-0.75 *(-6.26)*
Sweden	-	-0.83 *(-11.37)*
United Kingdom	-	-0.9 *(-14.16)*
Country fixed effects	F = 1.32	F = 1.36
P-value	*(0.22)*	*(0.20)*
Durbin-Watson Statistic	1.48	1.99
P-value	*(0.001; 0.001)*	*(0.41; 0.56)*
LM (heteroscedasticity)	7.15	0.23
P-value	*(0.008)*	*(0.64)*

$R^2_{(2)} = 0.05$; $R^2_{(3)} = 0.84$ *(t-statistics of the estimators in parenthesis).*

Equation (2): $\Delta \ln(h^{ecu}_{j,t}) = \alpha + \hat{\alpha} \ln(h^{ecu}_{j,t-1}) + u_{j,t}$

Equation (3): $\Delta \ln(h^{ecu}_{j,t}) = \alpha + \hat{\alpha} \ln(h^{ecu}_{j,t-1}) + \tilde{a}_j \cdot \Delta \ln(ECU_{j,t}) + v_{j,t}$

Sources: Authors' calculations.

Absolute convergence is measured by $\hat{\hat{\alpha}}$, when neither individual fixed effects nor control variables (ECU) are considered. In contrast, conditional convergence will be measured by $\hat{\hat{\alpha}}$ in equation (3), controlling for exchange rates variations:

$$\Delta \ln(h^{ecu}_{j,t}) = \alpha + \hat{\alpha} \ln(h^{ecu}_{j,t-1}) + \tilde{a}_j \cdot \Delta \ln(ECU_{j,t}) + v_{j,t} \qquad (3)$$

Table 3 summarises the results of the convergence estimation. The fixed effect estimation is not reported but the overall significance level of effects is given by the F-statistic. Their non-significance implies that convergence is not conditional on unmeasurable country-specific factors.

We performed Durbin-Watson and Lagrange Multiplier tests which revealed no autocorrelation, nor heteroscedasticity in the estimation of equation (3). The autocorrelation and heteroscedasticity in model (2) are well captured by exchange rate movements.

We find that $\hat{\hat{\alpha}}$ is significant in all specifications. Some absolute *beta*-convergence has therefore been taking place since 1993. However, it remains slow as the implied autoregressive coefficient on aggregate prices lies around 0.9. When controlling for exchange rate fluctuations, $\hat{\hat{\alpha}}$ remains unchanged (around -0.11) but is more precisely estimated. This points to the fact that a large proportion of price variations is due to exchange rate fluctuations: Currency fluctuations, consisting in shocks, prevent ***b***-convergence to be transformed into ***s***-convergence.

Bearing in mind that we observe prices over shorter periods (semesters instead of years), we find a larger coefficient of convergence than the one found by Goldberg and Verboven (-0.06 and -0.07 when controlling for exchange rate fluctuations). We find a convergence half life[13] of equal to approximately 6 semesters, compared to 20 semesters in Goldberg and Verboven(1998)). In other words, if no additional disturbances take place in the meantime, the reduction by 50% of the price gap between two given countries will take no more than 3 years.

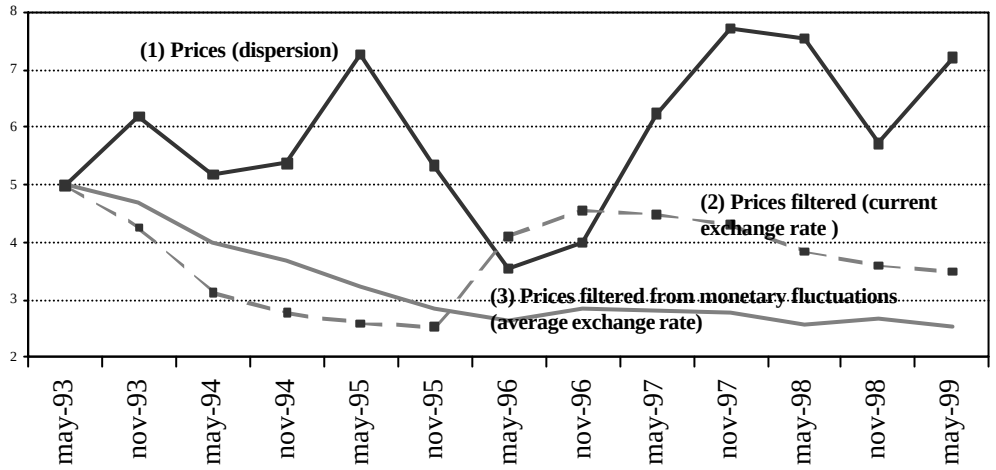
[13] The half life (*hl*) is computed as follows: $(1+\hat{\alpha})^{hl} = 0.5$.

3.2. *s* - Convergence

Evaluating the *s*-convergence of average national prices over time means studying the evolution of price dispersion over successive cross-sections of countries. There is a convergence of the entire sample when the cross-sectional dispersion diminishes in time. We use the coefficient of variation as a measure of dispersion.

Figure 3 shows the comparative evolution of price dispersion between the 10 "base" countries present over the whole period, with and without controlling for currencies fluctuations vis-à-vis the ECU. Curve (1) depicts the evolution of the coefficient of price variation while curves (2) and (3) represents the evolution of the "filtered prices" dispersion. Prices are filtered from exchange rate variations using the following method. First we fix initial values for filtered prices series. We consider two assumption. On the first one prices in the first semester of 1993 are converted into the common currency using the current exchange rate (curve 2). With the second assumption, initial prices are converted using the average of exchange rates over 1993-1999 (curve 3). It is justified by the fact that exchange rates were not at "equilibrium" levels in 1993 (the Sterling was obviously undervalued for instance). The period is sufficiently long to consider the average exchange rate as a proxy of the equilibrium rate. Whatever the assumption for the initial period exchange rates, we then estimate the following regression in order to distinguish in price change what is due to exchange rate changes and what is not: $\Delta \ln(h_{j,t}^{ecu}) = \tilde{a}_j \cdot \Delta \ln(ECU_{j,t}) + \Delta fh_{j,t}$ where the residual $\Delta fh_{j,t}$ is the price variation filtered of exchange rate fluctuations. We finally reconstruct entire price series by summing up the estimated filtered changes: $fh_{j,t} = fh_{j,t-1} + \Delta fh_{j,t}$ with $fh_{j,0}$ depending on the assumption about initial exchange rates.

Figure 3: Sigma-convergence: (1) aggregate prices with current exchange rates in 1993.1, (2) filtered prices with current exchange rates in 1993.1, (3) filtered prices with average exchange rate of the period in 1993.1



Sources: Authors' calculations.

Without controlling for exchange rate fluctuations, large variations are observed in the short run, but there is no general trend of convergence or divergence. Price disparities increased from less than 5% to about 7% from 1993.1 to 1995.1, before they fell to 3.5% in 1996 and rose again to 7% at the end of the period. When controlling for currency fluctuations, price variations are markedly dampened. This calls for two remarks. Firstly, these fluctuations of dispersion are mostly due to exchange rate changes. Secondly, there is an overall trend of convergence, which is still impeded by an episode of divergence between 1995.2 and 1997.2 (curve 2). Divergence during this episode resulted from price decreases in Belgium, the Netherlands and Luxembourg, which already had low relative price levels. When prices are adjusted using average exchange rates (curve 3) we obtain a monotonic decrease in dispersion until May 1996, followed by a flat curve.

Given the sensitivity to the assumption about exchange rates in the first period we focus on two results: the smoothing of price dispersion and the evidence of an overall *Sigma*-convergence when exchange rates are controlled for[14].

[14] Given the large variations of prices in the UK, our results could have been dependant on the sample. We then re-estimated our equations excluding the UK: there is no change for *Beta*-convergence. Average dispersion is reduced and smoothed but the result of *Sigma*-convergence of "filtered" prices is robust.

CONCLUSION

The first aim of this paper was to analyse convergence of automobile prices in the European Union since 1993, so as to shed some light on the debate over price convergence, and, more generally, on the process of market integration in the EU.

Our main finding is that there are indeed forces leading to automobile price convergence (absolute as well as conditional). Convergence has, however, been impeded by exchange rate fluctuations. We confirm the conclusion of Goldberg and Verboven that prices follow exchange rates closely. We find that b-convergence does not induce s-convergence, mainly because of perturbations due to exchange rates fluctuations.

Moreover, we cast doubt on the "British exception": after controlling for the £/ECU exchange rates, prices are not substantially higher in the UK. If prices are adjusted for exchange rate variations, then prices in the UK are close to the EU average price. This invalidates the "technical" hypothesis for the UK. Higher prices in the UK are to a large degree due to Pricing To Market behaviour: Foreign auto makers did not reduce their prices as the British Pound appreciated.

We have shown that exchange rate fluctuations explain a large share of the price dispersion dynamics. Following the implementation of the EMU, one would expect an acceleration of price convergence. The euro will also bring about new transparency. Prices are displayed in euros, as well as in the local currency, making international comparisons easier. It is too early to assess the long-term effects implied by the implementation of the single currency, since parities between euroland countries were fixed in May 1998.

A cross-sectional, negative effect of taxes on pre-tax prices has been highlighted. However, this played no role in the convergence process since taxes were almost constant. In the long run, the EU will probably implement a unique standard rate of VAT. The member states have already agreed to a minimum rate of VAT. (15%), but they rejected the proposal of a 25% maximum rate. Besides, sales taxes vary enormously from zero in France or Germany to over 200% for some models in Denmark. Until today, there is a plan to harmonise sales taxes by moving towards a system based on fuel consumption and the degree of pollution created. Nevertheless, although the European Commission advocates this system, the member states are not quick in applying it.

This study aimed at assessing the role of *institutional and macroeconomic* factors in the convergence process of car prices in the EU. Structural and *behavioural* factors, such as the role of market power and firms' strategies, could be the subject of future research, despite the difficulty of collecting the necessary quantity and cost data.

REFERENCES

Anderson S.P. and V. Ginsburgh (1999), "International Pricing with Costly Consumer Arbitrage". *Review of International Economics*, Vol. 7, No. 1, pp. 126-139.

Bartik T. (1987), "The Estimation of Demand Parameters in Hedonic Price Models". *Journal of Political Economy*, Vol. 95, No. 1, pp. 81-88.

Bresson G. and C. Mathieu (1992), "Différenciation Horizontale et Verticale des Produits: une Application à l'Industrie Automobile". *Annales d'Economie et de Statistique*, No. 27, pp. 116-146.

Couton C., F. Gardes and Y. Thépaut (1996), "Hedonic Prices for Environmental and Safety Characteristics and the Akerlof Effect in the French Car Market". *Applied Economics Letters*, Vol. 3, pp. 435-440.

Danzon P.M. and L-W. Chao (2000), "Cross-National Price Differences for Pharmaceuticals: How Large and Why? ". *Journal of Health Economics*, Vol. 19, pp. 159-195.

European Commission, Directorate-General IV-Competition, *Car Prices Within the European Union*, reports from May 1993 to May 1999.

Ginsburgh V. and Y. Mertens (1985), "Product Differentiation and Price Discrimination in the European Community: The Case of Automobiles". *Journal of Industrial Economics*, Vol. 34, pp. 151-165.

Ginsburgh V. and G. Vanhamme (1989), "Price Differences in the EC Car Market. Some Further Results". *Annales d'Economie et de Statistique*, No. 15/16, pp. 138-149.

Goldberg P. and F. Verboven (1998), "The Evolution of Price Discrimination in the European Car Market". *N.B.E.R. Working Paper*, No. 6818.

Kirman A.P. and N. Schueller (1990), "Price Leadership and Discrimination in the European Car Market". *Journal of Industrial Economics*, Vol. 34, pp. 69-91.

Lancaster K. J. (1966), "A New Approach to Consumer Theory". *Journal of Political Economy*, Vol. 74, pp. 132-156.

Rosen S. (1982), "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition". *Journal of Political Economy*, Vol. 82, pp. 34-55.

Verboven F. (1996), "International Price Discrimination in the European Car Market", *Rand Journal of Economics*, Vol. 27, No. 2, pp. 240-268.

APPENDIX 1: DESCRIPTION OF THE DATASET

List of countries

– From 1993.1 to 1999.1 (semestrial data), **EU 10** = Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, the United Kingdom;

– From 1995.1 to 1999.1, **EU 12** = EU 10 + Austria, Sweden;

– In 1999.1, **EU 15** = EU 12 + Denmark, Finland, Greece.

List of characteristics

(L.characteristic=Log(characteristic))

CAP = capacity (cubic centimeters)

DOORS = 0 if 3 doors and 1 if 5 doors

WEIGHT = no-load weight in kg

HPWR = horsepower

LENGHT = length in cm

WIDTH = width in cm

HEIGHT = height in cm

SIZE = LENGHT*WIDTH*HEIGHT (in cm3)

SPEED = theoretical maximal speed in km/h

ACCELER = acceleration from 0 to 100 km/h in s

CONS = average gas consumption (average over urban and extra urban cycles, in l.)

TAXR = tax rate

ECU = exchange rate in the destination of the car country currency/ECU

Brand (producers') market shares:

Are publicly available for the EU 15 from the C.C.F.A. (Comité des Constructeurs Français d'Automobiles) yearly brochures and from MotorSat (http://perso.club-internet.fr/motorsat/Voitures/immeuropmarq.html).

Definition of the market segments:

1: Lower economy segment; 2: Lower medium, segment; 3: Uper medium segment; 4: Uper and luxury segments; 5: 4*4 and miscellaneous.

APPENDIX 2: THEORETICAL FOUNDATIONS OF HEDONIC PRICES

The theory of characteristics assumes that consumers maximise their utility with respect to the amounts of characteristics of each good. Consumer preferences for the characteristics offered may differ. Demand is derived from the maximisation of utility within the space of characteristics. Note *U* the utility function, *Y* the consumer's revenue, x_i the quantity of good *i* (*i*=1...*n*) and z_k the quantity of characteristic *k* (*k*=1...*m*):

$$\text{Max } U(z_1 \ldots z_m)$$

$$z_k = \sum_{i=1}^{n} b_{ik} x_i \quad (4)$$

$$Y = \sum_{i=1}^{n} p_i x_i \quad (5)$$

(4) is the technological constraint and (5) is the budget constraint. The *n* first order conditions are:

$$p_i \geq \sum_{k=1}^{m} \left(\frac{1}{\ddot{e}} \frac{\partial U(z)}{\partial z_k} \right) \cdot b_{ik} \qquad i = 1 \ldots n$$

λ is the Lagrange multiplier of the programme associated with the budget constraint, and can, as always, be interpreted as the marginal utility of revenue. The expression in brackets stands for the implicit price of characteristic *k*. The equality holds when good *i* is actually consumed.

Hedonic prices as defined by Rosen (1974) are equilibrium prices on the market for characteristics. According to Rosen, optimal supply of characteristics should also be considered, which raises the empirical issue of the endogeneity of consumers' and producers' decisions. The estimation bias due to the simultaneity of the decisions can however be circumvented using instrumental variables techniques, as has been suggested by Bartik (1987).

APPENDIX 3: PURCHASE TAXES ON NEW VEHICLES IN THE EUROPEAN UNION IN 1999

Country	*VAT (%)*	*Purchase taxes*	*Registration fees (in ocal currency)*
Austria	20	Based on fuel consumption Maximum=16%	842 to 1269 SCH
Belgium	21	Based on capacity and age	2500 FB
Denmark	25	105% if price < 50800 DKR, 180% if price > 50800 DKR	1070 DKR
Finland	22	100% - 4600 FM (*)	None
France	20.6	None	Local tax 102 to 195 FF (+parafiscal charges)
Germany	16	None	50 DM
Greece	18	16 to 128%	None
Irland	21	22.5 to 30% depending on engine capacity	None
Italy	20	Provincial, based on fiscal power	300000 to 720000 L
Luxembourg	15	None	1128 LFR
Netherlands	17.5	Gasoline: 45.2% - 3394 G (*) Diesel: 45.2% - 1278 G (*)	None
Portugal	17	Based on engine capacity	5000 ESC
Spain	16	7% if engine capacity < 1.6l 12% if engine capacity > 1.6l	10250 PTA
Sweden	25	None	None
United-Kingdom	17.5	None	None

(*) A fixed amount is subtracted from the tax after applying the indicated rate.
1 Euro = 13.76 SCH, 38.38 FB, 7.07 DKR, 5.66 FM, 6.56 FF, 1.86 DM, 1842.22 L, 38.38 LFR, 2.10 G, 200.48 ESC , 158.30 PTA

Source: Association des Constructeurs Européens d'Automobiles.

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