

**EUROPEAN UNIVERSITY INSTITUTE**  
**DEPARTMENT OF ECONOMICS**

EUI Working Paper **ECO** No. 2004/1

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Producing Twin Cars**

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©2004 Nora Lado, Omar Licandro and Francisco Pérez  
Published in Italy in January 2004  
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# How Brand Names Affect the Price Setting of Carmakers Producing Twin Cars?\*

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December 2003

## Abstract

In the automobile sector, it is a usual practice that independent carmakers engage in the development and production of a common car model, the so-called twin cars. From the point of view of the marketing literature, we claim that carmakers should not charge different brand premia on separate models of a twin car. We use hedonic regressions and panel data estimators to value brand premia, by controlling for quality diversity. We find that there are no significant differences between brand premia of separate models of a twin car, even if brand premia may differ across different carmakers.

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\*We would like to thank Miguel Aguilar from providing us the data. We have profited from very useful comments and suggestions by Andrea Ichino and Olmo Silva. The usual disclaimer applies. Omar Licandro acknowledges the financial support of the Spanish Ministry of Sciences and Technology (Grant SEC2000-0260). Nora Lado: Universidad Carlos III de Madrid, c/Madrid 126, 28903 Getafe, Spain; tel: 0034 91 624 9640; fax: 0034 91 624 9607; email: nora@eco.uc3m.es. Omar Licandro: European University Institute, Villa San Paolo, Via della Piazzuola 43, 50133 Florence, Italy; tel: 0039 055 4685 953; fax: 0039 055 4685 902; email: omar.licandro@iue.it. Francisco Pérez: FEDEA, c/Jorge Juan 46, 28001 Madrid, Spain; tel: 0034 91 435 0401; fax: 0034 91 577 9575; email: fperez@fedea.es.

# 1 Introduction

In the automobile sector, it is a usual practice that different carmakers engage in the development and production of a common car model, which they sell as separate models of different brands. These are the so-called twin cars. Sullivan (1998), for example, reports for the US in the period 1985-1993 ten pairs of twin cars. In Europe, the production of twin cars was developing during the nineties, as a strategy for many car producers to enter the *MPV* (multi-purposes vehicle) segment. A fundamental question arises from this practice: Do different carmakers selling the same twin car charge different brand premia? Do they profit from differences in brand reputation to differentiate in some other dimension? Very little evidence is available, in particular for the European automobile market.

The main hypothesis we test in this paper is whether carmakers jointly producing a twin car charge different price premia to their list prices. In order to estimate brand premia, we use hedonic regressions, which allow us to control for the value of observed attributes and time dummies. We use monthly data, from January 1997 to June 2000, on list prices and 17 relevant characteristics for cars belonging to the MPV segment of the Spanish automobile market. Information is available on 156 versions of 12 car models, all of them produced abroad and sold in Spain by different brands. Estimations are computed using panel data estimators.

This methodology is consistent with the statement in Swait et al (1993) that the total value of a product can be decomposed into a value due to product attributes and a value due to the brand name. In the same direction, Yoo et al (2000) write: “Brand equity is the incremental utility or value added to a product by its brand name. Research has suggested that brand equity (value) can be estimated by subtracting the partial utility of the physical attributes of the product from the total utility of a brand.” Hedonic regressions separate the value of physical attributes from the incremental utility of a brand. Erdem et al. (1999) defines brand value as the “incremental effect of the brand on all aspects of the consumer’s evaluation and choice process.” In the case of a twin car, the utility of physical attributes may be estimated by a regression of car prices on a set of characteristics. By including brand dummies in these estimations, it may be possible to estimate brand premia.

There are two central findings in this paper. Firstly, brand premia are not significantly different for brands belonging to the same twin car. Secondly, brand premia may be different for brands producing different cars. Sullivan (1998) uses twin automobiles as a natural experiment to examine how price differences among second-hand twin cars are related to different brand names. She finds for the US automobile market that the relative price

of second-hand twin car pairs is significantly different from unity, concluding that consumers do not perceive twin models as being perfect substitutes. Our results contradict her claim that this conclusion should apply to the primary automobile market.

Section 2 provides the conceptual background supporting our main research hypothesis, by reviewing the relevant literature. In section 3, we present the empirical model and discuss the different estimation strategies and tests. Section 4 describes the data. The main results are outlined in section 5 and section 6 concludes.

## 2 Conceptual Background

In the marketing literature, there are two different but complementary views on brand equity: One is based on the economics of information and the other is rooted on cognitive psychology, see Erdem et al (1999). From the economics of information perspective, a brand helps consumers to improve the perceived quality of a product by reducing risk and the cost of search for information. In this framework, quality is considered as a product characteristic about which potential buyers are imperfectly informed. As stated by Erdem and Swait (1998), under imperfect and asymmetric information, brand reputation is a credible signal to the market on the quality of a product, which allows producers to charge brand premia to their prices. The reputation literature, see Swait et al (1993, p. 24), has focused on *experience goods*, for which quality cannot be learned by consumers without using them. In this case, brands can build a reputation on the quality of the unobserved attributes of the product.

In the framework of cognitive psychology, brand equity comes from two elements: awareness of brand features and associations driving attribute perceptions. As claimed by Keller (1993), brand value is the result of a strong, favorable and unique association in consumers' mind between brand name and product quality. Recent research provides theoretical support and empirical evidence on the relevance of uniqueness in brand premium valuation (see Elrond and Keane (1995), Krishnan (1996) and Erdem et al. (1999)). Uniqueness is a property of brand that makes products with identical observable attributes different in consumer's mind. Nenemeyer et al (2003) find that brand uniqueness, brand quality and perceived brand value are predictive variables of the willingness to pay a prime premium.

Twin cars share common unobserved attributes, since they have an almost identical design and the same workers with the same equipment and using the same inputs produce them jointly in the same plant. Of course, dif-

ferent versions of different brands of the same twin car may have distinctive observed characteristics, which can be used to differentiate products. Moreover, automobile expenditures represent a large fraction of family budgets. It implies that the perceived risk is significant, and the buyer is highly involved in the purchase decision. As a consequence, car buyers are interested in collecting information before buying, which makes them relatively well informed about observed attributes of cars. In particular, they should know that twin cars are jointly produced, an information largely disseminated by specialized journals. For these reasons, carmakers jointly producing a twin car have little margin to price differentiation among them apart from offering car versions with different observed attributes.

From the point of view of the economics of information, consumers face small informational problems when comparing different brands of the same twin car. In such cases, there are no objective reasons to believe that the unobservable quality is different, making brand reputation loses its differentiation power and leading carmakers to charge very close brand premia. This is essentially due to the nature of twin cars. A car is an experience good. However, when consumers compare car models of the same twin car with each other, cars become in relative terms *search goods*, since the potential buyer can determine differences in quality by inspection of observable characteristics prior to the purchase act. In this case, brands producing a twin car share a common reputation, since any information acquired by experience in the use of a particular model of the twin car should be attributed to the twin car not to the brand itself.

Cognitive psychology also helps us to understand the value of brands sharing the production of a twin car. Prior to the introduction of a twin car, consumers may associate different brand values to the brands selling it. However, when they observe that all these cars are produced jointly, they should realize that they share common unobserved attributes. It should induce potential buyers to break the unique association they had between brand name and brand attributes. In the case of twin cars, uniqueness is not a property of the brand but a property of the twin car itself, implying that consumers should have a single willingness to pay a prime premium for models of different brands sharing the production of a twin car.

According to Erdem et al (1999), attribute perceptions and the formation of brand value is a dynamic process guided by consumer's learning. In this process, a brand plays the role of an organizer of product information, in which news is assessed in terms of existing beliefs, biasing the exposure, encoding and integration of this new information. Under the *hypothesis testing* theory, consumers do not favor generating new hypotheses, unless there is unambiguous evidence that the existing hypothesis is false. In this frame-

work, when some brands decide to develop and produce a new twin car, even if consumers perceive the value of these brands as being a priori different, the development of the twin car is unambiguous evidence that the existing hypothesis is false. Consequently, consumers should revise it and hypothesize that there is no significant difference among models of the same twin car even if they are offered by different brands.

Finally, there is a gap in the literature on how firms estimate their own brand equity and the consequences for their marketing-mix decisions, in particular, price decisions. Ailawadi et al (2003) say that efforts to measure brand equity have focused on their sources, located in customers mind, and outcomes, including product-market and financial-market outcomes. They claim that product-market measures, including price setting rules, are the result of various mechanisms by which the brand name adds value, and they “offer an attractive middle ground between customer mind-set measures and financial market measures in terms of objectivity and relevance to marketing” (Ailawadi et al, 2003, p.3). In this paper, we adopt a similar approach by measuring brand premia as a result of firms’ price strategies.

### 3 Method and Empirical Model

Hedonic regressions has become a common practice for the measurement of product quality, in particular, for the estimation of quality bias in price indexes for the automobile sector.<sup>1</sup> The main assumption is that the price of a product can be decomposed in the value of a set of observed characteristics and a residual, which measures changes in prices corrected by quality improvements. Panel data estimations control for unobserved characteristics common to the basic unit of observation (car versions in our data). Brand dummies are usually added to capture the value of unobserved characteristics that are common to a brand. In this paper, we also include twin car dummies, and we test if brand dummies associated to the same twin car are significantly different. In order to do so, we also consider MPV models that do not belong to any twin car, which helps to estimate the value of observed attributes.

A brand is supposed to sell in the automobile market a variety of *versions* of a single model. Version  $i$  in period  $t$  is defined by a set of observable characteristics, described by a vector of attributes  $X_{it}$ . The logarithm of the list price of version  $i$ , denoted by  $p_{it}$ , is modeled as

$$p_{it} = \alpha + d_t + d_b + \beta' X_{it} + c_i + \varepsilon_{it}, \quad (1)$$

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<sup>1</sup>The seminal contribution is Court (1939). See also Griliches (1971) and Gordon (1990).

where  $d_t$  is a time dummy controlling for changes in nominal prices,  $d_b$  is a brand dummy capturing the brand value, the vector  $\beta$  represents the value of observed attributes  $X$ ,  $c_i$  is a real number measuring the value of the unobserved characteristics of version  $i$  and  $\varepsilon_{it}$  is a random shock.

Model (1) can be estimated by several techniques, pooled ordinary least squared (OLS), Fixed Effects (FE), and Random Effects (RE). See Wooldridge (2002). Since our interest is on testing for differences in the brand dummies for firms producing the same twin car, consistency and efficiency become fundamental in selecting the method of estimation.

The key question that determines the appropriateness of each method is the assumption made about the relation between the individual effect  $c_i$  and the vector of explanatory variables  $Z_{it} = \{X_{it}, d_t, d_b\}$ . Under the assumption of no correlation between the  $c_i$ 's and the observed attributes, i.e.,  $E(c_i | Z) = 0$ , we may treat the  $c_i$ 's as realizations of a (latent) random variable that can be included into the error term. Consistent estimates of the true parameters can be obtained by performing either a pooled OLS regression or a RE estimation of

$$p_{it} = \alpha + d_t + d_b + \beta' X_{it} + \vartheta_{it}, \quad \text{where} \quad \vartheta_{it} = c_i + \varepsilon_{it}. \quad (2)$$

However, the composite error term in (2) includes two types of uncertainty, general ignorance,  $\varepsilon_{it}$ , and individual-specific heterogeneity,  $c_i$ . As long as the latter is ignored by the pooled OLS method, this would cause the standard errors to be downward biased, making it inadequate when testing for differences in brand dummies. Then, if the no correlation assumption holds and there is individual-specific heterogeneity, only performing an RE estimation, that explicitly considers the two types of uncertainty, will produce both consistent and efficient results. Furthermore, it must be pointed out that if the non correlation assumption is valid, estimating (1) by FE will produce consistent, though inefficient, estimates.

On the contrary, if we allow for arbitrary correlation between the individual effects and the observed attributes (i.e.  $E(c_i | Z) \neq 0$ ), we should move towards a FE strategy, as long as both the pooled OLS and the RE methods will become inconsistent. If this is the case treating the  $c_i$ 's as additional parameters and estimating (1) by the FE procedure will yield consistent and efficient estimates.<sup>2</sup> Since the RE estimator is superior when the no correlation assumption holds, a previous step in choosing the more

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<sup>2</sup>The usual methods in implementing a FE strategy are the Least Squares Dummy Variables (LSDV) approach, in which we would estimate model (1) by OLS but including one specific dummy for each version in the sample, or the (panel) within estimator, in which we transform the original model, by eliminating all the time-invariant factors. The second method does not allow for the estimation of brand dummies.



efficient procedure should involve a test for the validity of such assumption. Hausman (1978)'s specification test provides the adequate framework; the null hypothesis to be tested is:

$$H_0 : E(c_i | Z) = 0.$$

If  $H_0$  is not rejected, the RE estimation would be adequate in achieving both consistency and efficiency. However, if the no correlation hypothesis is rejected the FE method should be preferred.

Once the validity of the no correlation assumption is tested, an additional test that supports the use of the RE estimator against that of pooled OLS is the Breusch and Pagan (1980) Lagrange multiplier test. In this case, the null hypothesis to be tested is:

$$H_0 : \sigma_c^2 = 0.$$

If this hypothesis were rejected, the appropriate covariance structure of the error term, as explained above, should take into account individual-specific heterogeneity, ruling out the pooled OLS estimation.

## 4 Data

The original database was provided by the Spanish *Instituto de Estudios de Automoción* (IEA). The IEA collects data for 48 brands, 300 models and more than 5,000 versions, representing almost the whole population of automobiles sold in the Spanish market. Since the focus of our analysis is on the MPV segment, we restrict the original data set to this particular segment of the automobile market. Therefore, our sample contains monthly data, from January 1997 to June 2000, on 156 versions of 12 models, being 2,762 the total number of observations included. Among these models, there are two twin cars. The first includes Citroen Evasion, Fiat Ulysses, Lancia Zeta, and Peugeot 806, and the second Ford Galaxy, Seat Alhambra and Volkswagen Sharan.<sup>3</sup>

The database contains, at the version level, information on list prices and 17 characteristics, which can be sorted into two different types: engine power (h.p.), top speed (km/h), acceleration (sec. in 0-100 km/h), volume (m<sup>3</sup>), fuel consumption (liters/100 km), cylinder capacity (c.c.) are *continuous* variables, while air-conditioning, automatic climate, front power windows, rear power windows, driver airbag, passenger airbag, ABS brakes, remote

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<sup>3</sup>Other models included in the database are the following: Mazda MPV, Mitsubishi Space-wagon, Nissan Serena, Opel Sintra and Renault Espace.

lock, on-board computer, alloy wheels and turbo are *discrete* variables taking values one – whenever this attribute is included in the standard equipment – or zero.

We claim that the group of variables included in our final sample provides information on the main technical features and standard equipment of MPV cars and, hence, it may be considered as an adequate measure of observed quality. Some statistics on these attributes are in Table 1. Moreover, as the descriptive statistics for the diesel and gasoline automobiles are quite different, we include a dummy for diesel engines that aim to capture such a difference. Finally, given that our sample period coincides in time with the diffusion of the *Direct Injection* technology — the so-called TDIs — among the turbo-diesel models, we also introduce a dummy that accounts for this fact.

Table 1: Descriptive statistics for the whole sample

Variables	No. Observations	Mean	Std. Deviation	Min.	Max.
Power	2762	120.5	28.1	75	201
Top Speed	2715	174.37	16.32	135	206
Acceleration	2692	14.75	4	10.1	27.8
Volume	2762	14.42	0.69	12.3	15.68
F. Consumption	2746	8.82	1.45	6.2	13.5
C. Capacity	2762	2094.48	290.24	1596	2963
Air-Condit.	2762	0.84	0.36	0	1
A. Climate	2762	0.37	0.48	0	1
Front P. Wind.	2762	0.95	0.22	0	1
Rear P. Wind.	2762	0.43	0.5	0	1
Driver Airbag	2762	0.88	0.33	0	1
Passenger Airbag	2762	0.5	0.5	0	1
ABS Brakes	2762	0.41	0.49	0	1
Remote Lock	2762	0.75	0.43	0	1
On-board Comput.	2762	0.29	0.45	0	1
Alloy wheels	2762	0.3	0.46	0	1
Turbo	2762	0.56	0.5	0	1

### Some preliminary observations

Let us, as a first approximation, define a *simple quality indicator* as the simple mean of the 17 attributes. Continuous variables are in logarithm, and the logarithm of those affecting quality negatively, as acceleration, are multiplied by minus one. At this stage, we would like to stress some pattern of the data. Firstly, the evolution of the simple quality indicator is shown in Figure 1. It can be observed that average quality was relatively stable until the middle of 1998 and increasing after. This results from the fact that almost all attributes are improving over the sample period, an expected property of a good measure of quality.

Secondly, Figure 2 plots all observations for December 1997. As it can be seen, there is a linear positive relation between the quality indicator and the logarithm of prices. The dashed line is the cross-section estimation. A similar picture is observed for the full sample, but it is slightly distorted by inflation. This is a simple evidence in favor of using hedonic regressions to control for observed quality.

Finally, if we compare prices and quality for brands belonging to the same twin car, as in Figures 3 and 4 for the full sample period, we observe an interesting pattern: most brands offer versions on the full range of quality and they set similar list prices for cars with similar quality. A most careful look shows that Fiat and Lancia, different brands belonging to the same industrial group, offer the complete range of quality jointly, but Fiat is specialized in low quality segments and Lancia in high quality segments. However, Citroen and Peugeot, as well as Seat and Volkswagen, do not follow the same strategy, even if VW is not offering cars on the low quality segments. There is then no clear evidence that brands in the same twin group are using quality segments to differentiate, apart from Lancia and Fiat. For this reason, we concentrate on price premia.

## 5 Results

In Table 2, we present the estimation results of model (1) by the three different methods discussed in section 2; in the first two columns we report the point estimates and standard errors obtained by applying the pooled OLS method, the third and fourth columns present the results for the FE estimation and the last two columns show the outcomes when the RE estimator is used. The estimated coefficients associated to attributes and time dummies are omitted. It is well-known in the hedonic regressions literature, that attributes are highly collinear. It implies that the point estimate of the coefficient associated to each attribute is not a good measure of the attribute value. However, it is generally accepted that the joint estimation provides a good measure of the value of observed quality.

As commented earlier, a previous step in deciding on the most adequate method should be conducting the Hausman test and the Breusch and Pagan Lagrange multiplier test (B-P LM). Results are presented in the final rows of table 2. Firstly, the null hypothesis of no correlation between individual effects and observed attributes is not rejected at the usual levels, supporting our model specification —the unobserved characteristics can be treated as being part of the residual. Finally, the B-P LM test of  $\sigma_c^2 = 0$  clearly suggests the presence of individual heterogeneity into the error term, making the

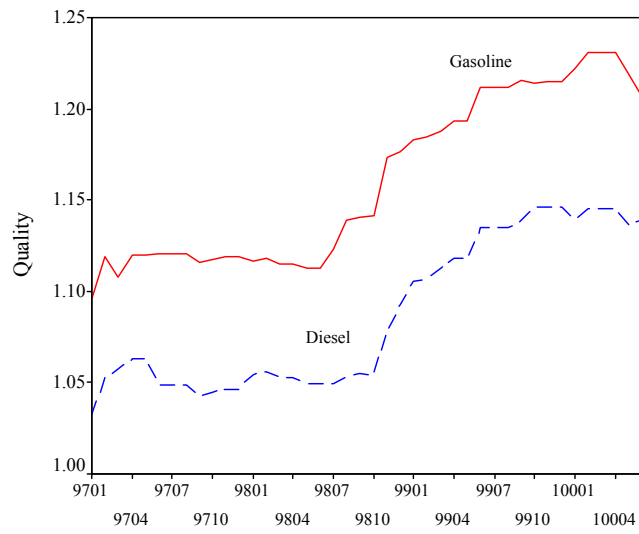


Figure 1: Evolution of the simple quality indicator

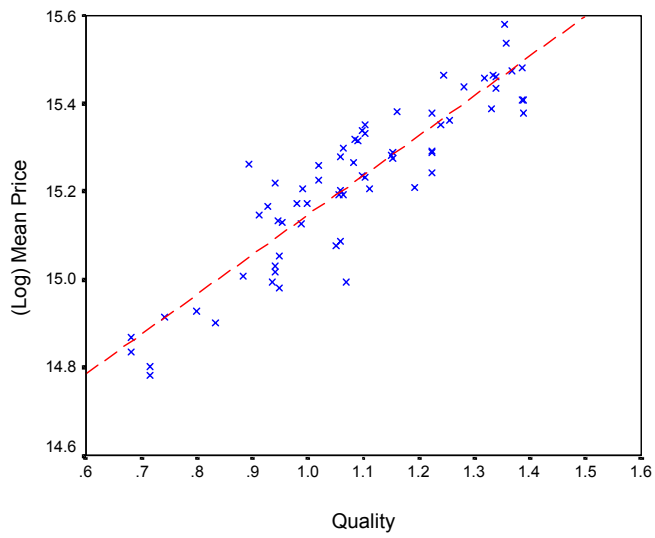


Figure 2: The relation between quality and prices (December 1997)

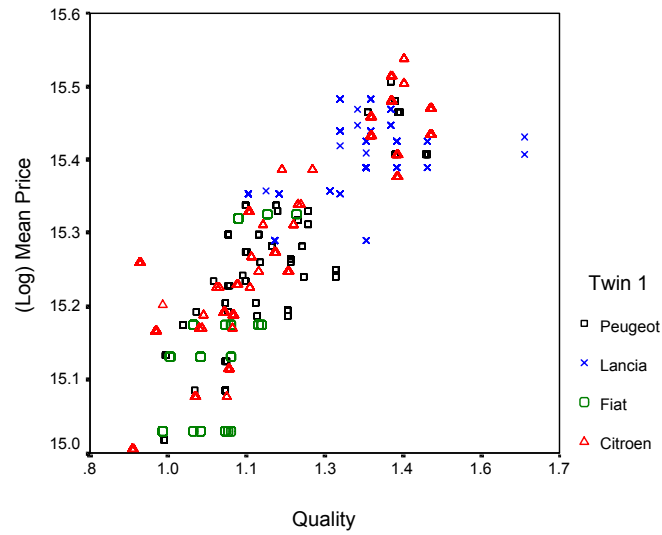


Figure 3: Quality and prices for different brands: Twin group 1

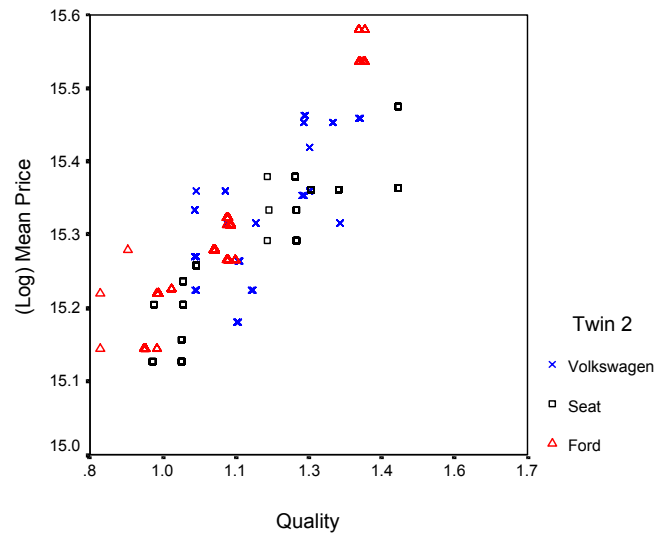


Figure 4: Quality and prices for different brands: Twin group 2

standard errors from the pool estimation inconsistent. As a conclusion, the two tests presented provide clear evidence in favor of the RE method. Then, in analyzing the estimates, we will restrict our attention to the last two columns of Table 2.

The main results of our empirical analysis are related to checking for the existence of differences in brand premia. A first observation is that there are no significant differences across brands producing the same twin car. A second observation is that brand values may be significantly different between pairs of brands producing different models.

The estimated coefficient of a brand dummy measures the effect on prices of unobserved (by the econometrician) attributes that are common to the different versions of a brand, controlling for unobserved attributes common to each version. For obvious reasons, one of the brand dummies must be omitted. We have decided to exclude the brand with the smallest average price in the sample period, which is Nissan. In order to measure the contribution of each brand to a twin car, we have also introduced twin dummies, and we were obliged to exclude one of the brand dummies corresponding to each twin car. We have dropped Citroen and Ford.

Of course, there is a difference between the attributes observed by car buyers and sellers, and the attributes observed by the econometrician, since some attributes are omitted in the sample. It could be the case that a characteristic observed by economic agents, as design for example, is common to all versions of a brand but not observed by the econometrician. In the estimation, the value of this characteristic is implicit in the brand dummy coefficient. What is less clear is whether this is part of the brand premia or it corresponds to the value of an omitted (by the econometrician) attribute. For this reason, it is difficult to compare the estimated coefficients of different brands. However, cars belonging to the same twin share most of the omitted characteristics. Then, differences in the estimated coefficients of brand dummies may be interpreted as differences in brand premia.

In Table 2, we observe that brand dummies corresponding to twin cars are not significantly different from zero. This is a clear evidence that carmakers producing the same twin do not set different brand premia. Notice that point estimates for these brands are close to zero. The largest difference in price premia for brands in the same twin is 3.2% between Lancia and Peugeot. In the case of Twin 2, the largest difference is 0.4%. Of course, none of these difference is significantly different from zero. It can be easily checked that the point estimates for Lancia and Peugeot are contained in the confidence intervals of each other.

However, when we compare the value of brands that do not belong to the same twin car, they are in many cases significantly different. This is an

indication that brand premia are not necessarily equal for brands producing different car models.

Table 2: Regression results<sup>a</sup>. Dependent variable: Log(Price)

<i>Variables</i>	Pooled OLS		Fixed Effects		Random Effects	
	<i>Coef.</i>	<i>Std. Err.</i>	<i>Coef.</i>	<i>Std. Err.</i>	<i>Coef.</i>	<i>Std. Err.</i>
Twin 1	0.083**	0.012	0.128	0.217	0.094**	0.032
Fiat	-0.003	0.007	-0.498	0.551	-0.008	0.025
Lancia	0.023**	0.008	0.050	0.146	0.020	0.020
Peugeot	-0.011*	0.006	-0.359	0.522	-0.012	0.015
Twin 2	0.094**	0.016	0.657	0.478	0.121**	0.038
Seat	0.005	0.010	-0.516	0.385	0.004	0.025
Volkswagen	-0.007	0.012	-0.047	0.032	0.001	0.025
Mazda	-0.130**	0.020	-	-	-0.111**	0.051
Mitsubishi	-0.079**	0.015	0.427	0.328	-0.066*	0.040
Opel	0.036**	0.018	0.042	0.429	0.058	0.053
Renault	0.152**	0.016	0.891	0.599	0.171**	0.038
<i>No. Observations</i>	2691		2691		2691	
<i>F<sup>b</sup></i>	251.29		139.4		2212.63	
<i>Adjusted-R<sup>2</sup></i>	0.87		0.91		0.87	
Hausman Test:						
<i>Chi2(69)</i>	-		-		61.98	
<i>Prob&gt;Chi2(69)</i>	-		-		0.30	
B-P LM Test:						
<i>Chi2(51)</i>	-		-		2499.08	
<i>Prob&gt;Chi2(51)</i>	-		-		0.00	

<sup>a</sup> Only brand dummies are shown  
<sup>b</sup> In the RE regression *Chi2* instead of the *F*-statistic is shown  
(\*) significant at the 10%, (\*\*) 5% levels

We have performed RE estimations using regressors in levels and we get very similar results, including for the Hausman and B-P LM test. Finally, we have also found similar results when estimating by RE for every twin separately.

## 6 Conclusions

In this paper, we test the hypothesis that carmakers producing a common twin car do not set different price premia. Our data base contains information on list prices and a set of 17 car attributes for 156 versions of 12 brands of MPV cars sold in the Spanish automobile market from January 1997 to June 2000. After controlling for car attributes, diesel engine, time dummies and random effects at the version level, we find that brand premia are not significantly different for brands belonging to the same twin car, but they may differ for brands producing different cars.

Many questions remain open. Firstly, this result is in contradiction with Sullivan (1998) findings for the US second-hand automobile market. She finds that relative prices of twin car pairs are significantly different, concluding that consumers do not perceive twin models as being perfect substitutes. Our results suggest that this conclusion does not apply to the primary

Spanish automobile market. Additional research is needed to fill this gap. This discrepancy could come from some fundamental differences between the Spanish and the American market, in particular concerning the marketing strategies of carmakers, the behavior of consumers in the primary and the secondary market, the structure of the secondary market.

Secondly, a direct implication of our observations is that carmakers jointly producing a twin car have little margin to price differentiation among them, apart from offering car versions with different observed attributes. But, why would different carmakers, with different perceived brand values, engage in the production of a twin car, which should share a common model value? From our dataset, unfortunately, we cannot separate parent brand premia, referred to brand name, from model brand premia, referred to model name, since every brand offers a unique model on the MPV segment of the automobile market. Future research should explore the difference and interaction between parent brand and model brand values. Our results suggest that brand efforts to build brand awareness, perceived quality and associations (Yoo et al, 2000) are not necessarily reflected in brand premia when carmakers associate with other brands to produce a twin car. This should have strong implications for strategic marketing and marketing management.

Finally, other aspects of the marketing strategies of carmakers engaged in the joint production of twin cars require further attention. In particular, it would be interesting to test the hypothesis that highly valued brands offer versions on the high range of quality, while lowly valued brands do it on the low range of quality.

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