The Welfare Effects of Trade Liberalization in Colombia: Evidence from the Car Industry

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ABSTRACT

Trade liberalization as part of the globalization process was encouraged in many Latin American countries during the eighties and nineties. Colombia joined this process in 1991. Using product level data, I examine the effect of trade liberalization in the Colombian automobile industry. The discrete choice methodology that I use allows me to estimate consumer welfare and evaluate firms' performance. Car prices declined on average 7.6% per year after the economic reforms were implemented. Imported cars had prohibitively high prices and were essentially unavailable before the tariff reduction (200% on average before, 35% after the reforms). I find the gains in consumers' welfare to be, as a consequence of declining prices and increased variety, around three thousand dollars per purchaser. On the supply side I find that as the industry reorganized in the second half of the eighties, price costs margins dropped from 33% to 24% even before the reforms took place. After the reforms, margins increased because of the associated lower costs, but then again started to fall, reaching a low 23% for domestic cars. Domestic competition prior to the reforms, the associated decrease in costs and the relatively unchanged market structure seem to explain the price cost margins behavior.

Introduction

There has been considerable debate about the effects of trade policy on welfare. Since the introduction of theories of trade under imperfect competition, empirical estimations have gained importance in determining the possible gains of trade policy (Feenstra, 1995). In this paper, I estimate and measure the economic effects of implementing trade reforms in the context of an oligopolistic market with differentiated products. Specifically, I study the automobile market in Colombia prior and after the reforms of the 1990s. I focus on the impact of such reforms on prices, firms' markups and consumers' welfare.

The trade reform in Colombia was initially planned in the last quarter of 1990 and scheduled to be gradually implemented over a four-year period. However, by the second half of 1991, policy makers did not observe the projected effects of the reforms and decided to immediately reduce tariffs to the levels expected in 1994. This unique feature, and the changes observed in the automobile market since then, allow me to examine the effects of such liberalization process both before and after the reforms took place.

Previous evaluations of trade policy have focused primarily on cross-country and cross-industry regressions. Specifically, the effects of trade policy over the manufacturing industry structure have been widely studied. In a recent survey, Tybout (2001) concludes that domestic market performance seems to be affected by changes in market structure due to trade. But, as Tybout (2001) argues, the causality is still unclear, and moreover, it is uncertain how trade reforms have effectively influenced firms. Using plant level data, cross-industry studies concentrate on the effects of changes in industry structure over firms' performance. Theory suggests, however, that changes in trade policy will have effects on both producers and consumers behavior. Effects over the latter are, at most, indirectly analyzed with this type of data.

Product level data has also been used to evaluate the effects of trade policy[1]. The framework used in these papers is useful to analyze both the demand and the supply side. The advantage of this approach is the ability to determine a product-by-product behavior and to examine changes in consumer welfare via the calculation of consumer surplus.

[1] Examples are Feenstra (1988), Goldberg (1995) and Berry, Levinsohn and Pakes (1999), which study the effect of VER on the 1980's U.S. – Japan relations. Berry, Grilli and López (1992) study the effects of the NAFTA formation on the Mexican car industry.

I follow this literature to study the effects of trade liberalization on the Colombian auto industry. The hypothesis is that intensified international trade will force domestic firms to become more competitive. But, as Brown and Stern (1989) state, the question of whether there are gains from liberalization is distinct form the question of whether there are gains from trade. In fact, my results show that gains from trade are limited while gains from liberalization are significant.

Using prices, characteristics, and sales for cars sold in Colombia between 1986 and 1998, I adopt a discrete choice random utility model to econometrically estimate demand based on the Bresnahan, Stern and Trajtenberg (1997) principles of differentiation general extreme value model. A GMM framework allow me to deal with the (potential) correlation between prices and unobserved car characteristics and thus to obtain consistent demand estimates. The instruments I use exploit increasing competition, the fact that many cars are imported and that, even if domestically produced, up to 70% of their components are imported. In order to find a valid set of instruments I need variables that are correlated with the price of each car, but uncorrelated with the unobservable (to the researcher) car characteristics. My first set of instruments is based on the idea that for a specific car the observed characteristics of competing models are correlated with the cars price, but uncorrelated with the unobserved characteristics. As a second set of instruments I use the real exchange rate, the import tariffs and the sales tax. These variables are correlated with the price, but not with the unobserved characteristics. Finally, based on the idea that as competition increases, prices fall; I use the number of competing models available in the market as an instrument.

The estimated parameters allow me to calculate consumer surplus over the thirteen-year period. Once I have estimated the demand model, I am also able to recover own and cross-price elasticities for each car in my sample.

On the supply side, I characterize the behavior of firms as an oligopolistic competition. I derive the first order condition under the assumption of existence of Nash-Bertrand equilibrium. With these conditions and the demand parameters estimated following the above procedure, I can recover the (unobserved) marginal cost of production for different car models. These estimates allow me to calculate price cost margins and thus, check changes in firms' performance.

My data shows that a 10% decrease in tariffs meant approximately a 2% decrease in prices. Similarly, as the number of models sold in Colombia increased by 10%, prices dropped by roughly 1.5%. Given the liberalization process and the increased variety of cars sold, it is not surprising that, according to my estimates, consumer welfare improved by approximately three thousand dollars per purchaser when comparing the pre- and post-reform periods.

The own and cross price elasticities derived from the demand estimates allow me to calculate price cost margins. As mentioned earlier, theory predicts that lower tariffs and increased competition should reduce these price cost margins. Indeed I find evidence of this, but I detect that existing domestic competition before the reforms also had an effect on margins. My estimates show that price costs margins declined from an average of 33% in 1986 to 24% in 1991. Despite the fact that only three firms existed in Colombia prior to the reforms, anecdotal evidence suggest that in this period domestic firms began to compete intensively. Changes in the ownership of such firms and in the contractual relationship with the government seems to explain such behavior. The trade reform set the tariffs for the main inputs to be on average 3% and for imported cars 38%, considerably lower than the existing 20% and 200% respectively. Under such conditions, price cost margins increased in 1992, starting a new descent that took margins to slightly lower levels than those observed before the reforms.

With prices going down, to keep margins stable, costs must have fallen. These lower costs are a direct result of the lower tariffs and the real appreciation process observed in the years that followed the reforms. In 1992, the first year after the reforms were implemented, I find the (estimated) marginal costs for domestic vehicles to be 22% lower than the previous year. Further, the supply model derived allows me to calculate the exchange rate pass through which I find to be incomplete, 0.28 on average. Notably, however, exchange rate pass through is higher for foreign cars, 0.33, than for domestic cars 0.24.

This paper finds that the liberalization process improved consumer welfare as the variety of models offered increased. Also, the reforms pushed both prices and cost downwards. As competition increased, domestic firms were forced to modernize the production process, but they also retained significant levels of protection relative to imported cars. Specifically, tariffs for imported cars remained high, 35%, while tariffs for the inputs used in assembling a domestic car were set to be only 3%. Moreover, in 1996 the sales tax for small cars (under 1.4 liters) was set to be 20%, while for an imported car the tax was 35%. Such improvements and protection allowed domestic firms to maintain price cost margins at similar levels to those observed before the reforms.

Therefore, this *incomplete* liberalization process shows that domestic firms took advantage of these reductions in costs while improving efficiency in order to maintain their price cost margins and to compete against imports. Nevertheless, and despite the extra protection, they lost around 50% of the market in the years following the reforms. The last year of my sample, 1998 is a turning point. Devaluation surged and recession began in Colombia. The higher exchange pass through and the inability of imported cars to maintain low prices seem to explain the market share recovery of the three domestic firms.

The rest of the papers is organized as follows. (TO BE WRITTEN).

I. Empirical Literature on Trade Reforms

Theory tends to predict that trade liberalization leads to efficiency gains. However, an overview of the existing empirical literature suggests that although such gains may actually exist, it is not clear that trade reforms are the cause. The literature on the effects of trade on growth, productivity and welfare can be divided into three general categories: Cross country regressions, cross industry regressions and product level analysis.

A thorough survey of cross-country regressions is out of the scope of this paper. However, it is worth noting that a major issue in this literature is how to measure openness. Once the decision is made on whether trade volumes, quotas (or tariffs), price differentials or artificially constructed indices (such as the Sachs-Warner index) are to be used, the main result in most papers is that trade reforms seem to have an effect on growth (and productivity), but results are not robust, and no strong policy conclusions can be extracted from such literature[2].

Cross industry regressions use primarily manufacturing industry data, whenever possible disaggregated at the plant level. Tybout and Westbrook (1996) claim that industry or plant level data is preferred because country level data cannot be used to distinguish scale economies from changes in market share allocation across heterogeneous plants, or from technological progress.

Despite the volume of empirical work that addresses the correlation between trade and firms performance, efforts to measure gains from trade at the micro level have been inconclusive. For example, Harrison's (1994) results suggests, analyzing the 1985 trade reforms in Cote d'Ivoire, that price-cost margins fell only in few sectors. However, the period of analyses for her paper is 1979-1987 not enough to actually test for long term effects of the reforms. Harrison has access to tariffs data and finds that productivity increased after liberalization took place, but sector-by-sector, the net results are inconclusive.

Haddad, de Melo and Horton's (1996) and Tybout's (1996) results for Morocco and Chile respectively raise doubts on whether exposure to international trade affects market power when using import penetration as trade proxy[3]. Haddad et al. (1996) show that entering firms consistently locate in exporting sectors but find no clear pattern of correlation between trade flows and price cost margins.

Roberts (1996) studies the Colombian manufacturing industry over the period 1977-85, during which no major trade reform took place. He finds no statistical significant effect between import penetration and price costs margins in Colombia. However, he does find some effect over relatively more concentrated industries. For the late 1980s Mexican reforms, Grether (1996) results suggest that foreign competition reduced price cost margins. Having access only to industry level data Foroutan (1996) analyzes the early 1980's Turkish trade reforms. He finds that, depending on the

[2] See for example Renelt and Levine (1992), Harrison (1996), Frankel and Romer (1999) or Rodriguez and Rodrik (2000).

[3] Haddad, de Melo and Horton (1996) study the 1983-84 trade reforms in Morocco. Tybout (1996) studies the 1979 trade reforms in Chile with 1979-1985 plant level data. As Grether (1996), Haddad, de Melo and Horton (1996) and Roberts (1996) do for several other countries, Tybout analysis is performed using industry and plant level data. In general, results are very week when using industry level data.

specification used, import penetration varies from little impact to none. He argues that the little impact of reforms may be due to the fact that export oriented industries were already the most competitive and efficient firms.

Recent work by Pavcnik (2002) and Muendler (2002) based on the Olley and Pakes (1996) methodology, use Chilean and Brazilian plant level data respectively to analyze the evolution of productivity in those countries manufacturing sectors[4]. Pavcnik finds no evidence that firms in export competing sectors increase performance, but her results suggest that, for import competing sectors, liberalized trade did in fact enhanced plant productivity. Muendler concludes that foreign competition improved productivity while eliminating inefficient firms.

The above review, though far from exhaustive, suggests that the effect of trade liberalization still remains an empirical question. As argued by Tybout (2001), it seems that there is a tendency for mark-ups to fall with import competition, but the link between trade reforms and the observed performance is not yet clear.

The third category of trade liberalization related literature; product level analysis is also the most recent. This approach has been widely used in the industrial organization literature in the past[5]. The use of such models for trade related questions is much more scarce. Among the latter, Berry, Grilli and López (1992) forecast the expected growth of the Mexican car industry in an attempt to anticipate the effects of NAFTA. They conclude that economic growth together with declines in price to world levels would expand the Mexican auto market.

The imposition of voluntary export restraints (VER) from Japan to the U.S. was the focus of Goldberg (1995) and Berry, Levinsohn, and Pakes (1999). The former finds that the VER were binding in the first years after they were imposed, while the latter finds the opposite. Brambilla (2003) measures the effect of adopting a customs union in the automobile market in Argentina and Brazil. She finds that under a customs union, prices in Argentina were lower, while consumers were better off. The opposite is true for Brazil.

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[4] Pavcnik focuses her research on the period 1976-86. Muendler uses Brazilian plant level data for the period 1986-98.

[5] See Feenstra (1988), Berry, Levinsohn and Pakes (1995), Goldberg (1995), Nevo (2001a) or Petrin (2001)

The advantage of this approach is twofold. First, it is flexible enough to allow the researcher to actually measure (in monetary terms) the effects of such trade policy, and second, it is possible to directly calculate the effects on consumers' welfare, via the estimation of consumer surplus.

II. Trade Reforms in Colombia

Following international trends, many Latin American countries undertook international policy changes in the early 1980s. However, not until the early 1990s did Colombia decide to engage in such changes. For years, Colombia was an inward-looking economy, and remained such even until the late 1980s. Though some very timid liberalization measures where taken in the early 1980s, it was not until 1991when deep structural fiscal, labor, monetary and trade reforms were actually implemented[6].

The outgoing government took initial steps around 1989, but different internal and external events prevented any serious reform from being implemented. Therefore, it was not until 1990, when the recently elected Gaviria Administration designed a four-year program to gradually lower tariffs. However, in October 1991 the gradual program was terminated and Colombian policy makers decided to abruptly lower tariffs, breaking the program designed months earlier[7]. Tariffs were set, at the end of 1991 at the 1994 expected levels. Among other reasons, the stagnation of both imports and exports induced government analysts to believe that economic agents where postponing any investment decision until the moment when tariffs were at their lowest levels.

III. The Colombian Car Market

Over the period 1986-1998, three companies were the sole assemblers (not producers) of cars in Colombia. The three companies are *Compañía Colombiana Automotriz* (CCA), assembler of Mazda; *Sociedad de Fabricación de Automotores S.A.*

[6] See Garay et. al 1998.
[7] The program aimed to lower tariffs from an aggregate average level of around 25% in 1990, to a level of 11% in 1994.

(Sofasa), assembler of Renault and General Motors Colmotores S.A. (GM Colmotores)[8], assembler of General Motor vehicles[9].

The oldest firm is Colmotores, which was founded in 1956. Chrysler owned the company until 1979, when General Motors bought the production plant. In 1991 the name was changed to its current name. As part of GM, the company assembles and sells in Colombia Chevrolet's, Opel's and Suzuki's models under the Chevrolet make. Historically, Colmotores has been the largest of all three firms.

CCA, the second oldest firm, was founded in 1960. In 1973, Fiat and the government Industrial Investment Institute (IFI) bought the company. Fiat models were produced until 1983 when the company was authorized to switch and produce Mazda's instead. In 1988 IFI sold its share to Colombian private investors who in turn sold its part to Japanese investors. By 1993, the entire company was owned by Mazda.

Sofasa was established in the late 1960's by the creation of a joint society between IFI and Renault. In 1989 Renault bought IFI's share and offered 24% to Toyota Motor Corporation. Colombian private investors bought 52% of the company in 1994, remaining the rest at equal shares in the hands of Renault and Toyota. Finally, last year Colombians sold its share of the company to Renault, Toyota and Mitsui[10].

Given that domestic firms assemble, but not produce cars in Colombia most of its inputs are imported. The imported materials known as CKD, which stands for Completely Knocked Down, represent around 70% of a fully assembled car.

Throughout the period of analysis (1986-1998), the main regulation changes were related to the 1991 structural reforms. Prior to the reforms, the government intervention in the car market began to be relaxed, particularly in the second half of the 1980's. In 1988 a new contract unifying the operational conditions of all three firms in the market was signed. Each firm was authorized to assemble no less than three models per year. They had to produce each model for at least 5 years and provide spare parts for at least 10 years. A 3% tax on the value of CKD imports in order to support the auto-parts sector was also established. Before this new contract took place competition was distorted as each firm had a different contract with the government given artificial advantage to the

[8] Originally and up to 1991 it was known as *Fabrica Colombiana de Automotores S.A.*
[9] Which include Chevrolet, Suzuki and Opel among others.
[10] Today Renault owes 60% of the company.

firms depending on the contract conditions. Up to 1985 prices of taxis, commercial vehicles and small cars were regulated. This type of regulation was terminated early 1986.

In 1991the government authorized the entry of new firms willing to assemble, it eliminated the import license requirements for CKD units and reduced the tariffs for both CKD and completely built up (CBU) cars. Firms were allowed to freely assemble as many models and versions as they wanted, as long as they guaranteed the supply of auto parts and service for each model for a period of at least 10 years. Other legal changes had to do with the domestic components requirements for Colombian produced or assembled cars. Despite these changes, no new company has yet established a plant in Colombia.

IV. The Model

IV.i. Demand Model

I will use a discrete choice random utility model to estimate the demand parameters. The demand model described below is derived from McFadden's (1978) generalized extreme value model as developed by Bresnahan, Stern and Trajtenberg (1997).

The product differentiation general extreme value (PD GEV) model allocates each alternative to one nest along each of pre-selected dimensions, which characterize attributes of the product. It is based on the notion that markets for differentiated products exhibit increase cross elasticity due to nesting relative to dimensions. In this paper I differentiate cars along two dimensions: origin (domestic vs. foreign) and size as perceived by engine volume (small, medium, large).

The most commonly used version of GEV models is the nested logit. Motivated by different questions, Goldberg (1995) and Goldberg and Verboven (2001) use a multi-level and a two-level nested logit respectively to estimate demand for cars[11]. Similarly, also for cars, BLP (1995), Berry, Levinsohn and Pakes (1999), Petrin (2002) and Brambilla (2003) use a random coefficient logit approach to determine demand estimates.

The main advantage of the PD GEV model over the nested logit model is that while in the latter the order of the nests matters, in the former it does not. The nested logit

[11] Goldberg and Verboven also attempts to estimate their model using a PD GEV, but they report that this model did not find support in the data.

model implies that all alternatives are grouped into pre-determined mutually exclusive nests. This means that given two categories, origin and size, a change in price on say, a small Colombian car, will have the same effect on shares on a medium Colombian car, than over a large Colombian car. The PD GEV overcomes this limitation.

In principle, the random coefficient logit model allows for flexible substitution patterns without *a priori* segmenting the market. As argued by Nevo (2001), this advantage comes at a cost. First, as shown below, the expression for the share function is solved via simulation as opposed to the close form of the PD GEV model. Second, detailed information about consumer heterogeneity is required to compute the market shares. And third Petrin (2002) notes that a very rich dataset set is required in order to obtain precise estimates. Given the limitations of my dataset, only 926 observations and no consumer heterogeneity available beyond income, I choose to use the PD GEV model.

Assume that the conditional indirect utility function for consumer i for product j in market (period) t depends on observed product characteristics (x_{jt}), unobserved (to the researcher) product characteristics (ξ_{jt}), income (y_{it}), price (p_{jt}), and unknown parameters θ_{jt}. Building on a Cobb Douglas utility function, BLP (1995) show that the following functional form may be used to study the consumers' decision problem:

$$\begin{aligned} &U_{ijt} \equiv \alpha \ln(y_{it} - p_{jt}) + x_{jt}\beta + \xi_{jt} + \varepsilon_{ijt} \\ &\delta_{jt} = x_{jt}\beta + \xi_{jt} \\ &i = 1 \ldots I, j = 1 \ldots J, t = 1 \ldots T \end{aligned} \tag{1}$$

where ε_{ijt} is defined below. The δ_{jt} term is common to all consumers and is therefore referred to as the mean utility. α is the marginal utility from income and β represent specific taste characteristics.

Correlation between the price and the unobserved product characteristics is expected because when the price is set, the producer takes into account these (observed by the firm) characteristics. When estimating the model, this endogeneity issue will be taken in consideration.

Consumer i will buy car j if he/she reports a higher utility, i.e.:

$$U(x_{jt}, \xi_{jt}, p_{jt}, \varepsilon_{ijt}; \theta) \geq U(x_{rt}, \xi_{rt}, p_{rt}, \varepsilon_{irt}; \theta), \text{ for } r=1\ldots J$$

The model must take into account the possibility that consumers may not want to buy a new car. Ignoring this possibility would imply that an even change in the price of all cars will have no effect over demand and so, the substitution patterns would be biased. Let A_{jt} be the set of values for ε such that the consumer decides to buy good j.

$$A_{jt} = \{\varepsilon : U(x_{jt}, \xi_{jt}, p_{jt}, \varepsilon_{it}; \theta) \geq U(x_{rt}, \xi_{rt}, p_{rt}, \varepsilon_{it}; \theta), \textit{for } r = 0,1,...J\}$$

The mean utility from the outside option cannot be identified separately from a constant term in equation (1) and therefore is normalized to zero as is common in the literature, i.e.

$$u_{iot} = \alpha \ln(y_{it}) + \xi_{ot} + \varepsilon_{iot} \equiv 0$$

Assuming ties occur with zero probability, and given $P_0(\varepsilon)$, the density of ε in the population, the market share of the j^{th} good as a function of the $J+1$ goods competing in the market is:

(2) $$s_{jt}(x_{.t}, p_{.t}, \xi_{.t}; \theta) = \int_{\varepsilon \in A_{jt}} P_o(\varepsilon)$$

where $x_{.t}=(x_{1t},\ldots,x_{Jt})$. Similarly for p and ξ.

Dropping the t subscript, and defining M to be the size of the market, then the J-vector of demands is $Ms_j(p,x,\xi;\theta)$.

The integral in (2) can be computed either analytically or numerically depending on the distribution assumption made for ε_{ij}. If ε_{ij} is assumed to be independently and identically distributed (i.i.d.) across choices, if its believed multivariate extreme value and if no additional heterogeneity (beyond the ε_{ij} term) is assumed, then one can solve the integral analytically. Specifically, letting $V_{ij}=\alpha ln(y_i-p_j)+\delta_j$ and making use of McFadden's (1978) theorem 1 the share function can be derived. Such theorem specifies that if $F(\varepsilon_{io},\ldots\ \varepsilon_{iJ})$ denotes the $J+1$ dimensional CDF of ε, and $G(y_0,\ldots,\ y_J)$ is a nonnegative, homogeneous of degree one function satisfying certain restrictions[12], then

$$F(\varepsilon_{io}, \ldots, \varepsilon_{iJ}) = \exp(-G(e^{-\varepsilon_{io}}, \ldots, e^{-\varepsilon_{iJ}}))$$

is the multivariate extreme value distribution, and

$$S_{ij} = \frac{e^{V_{ij}} G_j(e^{V_{io}}, \ldots, e^{V_{iJ}})}{G(e^{V_{io}}, \ldots, e^{V_{iJ}})}$$

[12] Specifically $G(.)$ has to be non-negative, homogenous of degree r, (where $r\geq 0$), $lim.\ G(.)\to\infty$ as $e^{V_j}\to\infty$, for $j=0\ldots.J$, and mixed partials of $G(.)$ must alternate in sign with first partial nonnegative.

defines the market share equation of product *j*, where G_j is the partial derivative of *G* with respect to $e^{V_{ij}}$.

I therefore define *G(.)* to be the weighted sum of two one-level nested multinomial logit *G(.)* functions, as follows:

$$(3) \qquad G(e^{V_i}) = a_O\left[\left(\sum_{j\in d} e^{V_{ij}/\rho_O}\right)^{\rho_O} + \left(\sum_{j\in f} e^{V_{ij}/\rho_O}\right)^{\rho_O}\right] + a_S\left[\left(\sum_{j\in s} e^{V_{ij}/\rho_S}\right)^{\rho_S} + \left(\sum_{j\in m} e^{V_{ij}/\rho_S}\right)^{\rho_S} + \left(\sum_{j\in l} e^{V_{ij}/\rho_S}\right)^{\rho_S}\right] + e^{V_{io}}$$

$$a_O = \frac{(1-\rho_O)}{(2-\rho_O-\rho_S)}; a_S = \frac{(1-\rho_S)}{(2-\rho_O-\rho_S)}$$

where *O* denotes origin (domestic *(d)* or foreign *(f)*) and *S* stands for size (small *(s)*, medium *(m)* or large *(l)*). Under the conditions stated above, the model is consistent with random utility maximization for all possible values of the explanatory variables as long as ρ_O and ρ_S lie in the unit interval[13].

Letting *O(j)* and *S(j)* denote the groups to which product *j* belongs, and using *G(.)* from equation (3), McFadden's theorem 1 implies the following share equation

$$(4) \qquad s_{ij} = \frac{a_O e^{V_{ij}/\rho_o}\left(\sum_{k\in O(j)} e^{V_{ik}/\rho_o}\right)^{\rho_o-1} + a_S e^{V_{ij}/\rho_s}\left(\sum_{k\in S(j)} e^{V_{ik}/\rho_s}\right)^{\rho_s-1}}{G\left(e^{V_i}\right)}$$

Equation (4) is the probability that consumer *i* buys car *j* and is composed of two terms, one for origin and one for size. It implies that for any product *j*, a change in the price or characteristics of any other product located in the same cluster will have a stronger impact on product *j* than on any other product located in a different cluster.

The parameter ρ is a measure of the degree of independence in unobserved utility among the products in nest *n*. That is, as ρ tends to zero, the dependence across products that share a particular nest become stronger. Conversely, if $\rho_s=1$, the model reduces to a nested logit by origin status only. Similarly if $\rho_o=1$, the model reduces to a nested logit by size status only.

[13] Train (2002) explains that for $\rho>1$ the model is still consistent with utility maximizing behavior for some range of the explanatory variables but not for all values.

Notice that equation (4) is the close form solution to the integral presented in equation (2) and the corresponding substitution patterns derived from this share function are:

$$(5) \qquad \eta_{jk} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = \begin{cases} -\dfrac{\alpha p_j}{s_j(y_i - p_j)}\displaystyle\sum_n s_n s_{j/n}\left[(1-s_j) + \left(\frac{1}{\rho_n} - 1\right)(1 - s_{j/n})\right] & if \;\; j = k \\ \alpha\dfrac{p_k}{(y_i - p_k)}\left[s_k + \dfrac{\sum_n \left(\frac{1}{\rho_n} - 1\right) s_n s_{j/n} s_{k/n}}{s_j}\right] & if \;\; j \neq k \end{cases}$$

where n denotes either origin or size, s_n stands for the share of nest n and $s_{j/n}$ is the share of car j if nest n is selected. If $j=k$ and a car does not share a nest with any other car (not the case in my dataset) or if (both) parameters ρ equals one then the own elasticity reduces to the multinomial logit result $\alpha p_j(1-s_j)/(y_i- p_j)$ For the cross elasticity, the terms of the summation reduce to zero for any nest which does not include both cars j and k.

Given the formulas of equation (5) it is straightforward to verify that for any two models j and k sharing nests –for example say we have a domestic (d) medium (m) sized car- then:

$$\eta_{dm,dm} \geq \left(\eta_{fm,dm}, \eta_{ds,dm}, \eta_{dl,dm}\right) \geq \left(\eta_{fs,dm}, \eta_{fl,dm}\right) and \left(\eta_{fm,dm}\right) \underset{>}{<} \left(\eta_{ds,dm}, \eta_{dl,dm}\right)$$

where η_{n_1,n_2} is the average cross-price elasticity of a car in nest n_2 with respect to a change in price of a car in nest n_1. That is, the two principles of differentiation (origin and size) are treated in a completely symmetric way.

Finally, the expression for s_{ij} has to be aggregated up to the product market share function. While aggregating I take advantage of income and population data available for Colombia. I define ten equally size deciles and compute the per capita income of consumers within each income class. I then calculate equation (4) for the average consumer in each income class and sum up to generate the aggregate market share. For Colombia however, not all income classes can afford a car. Recall the definition of V_{ij} above and note that $ln(y_{ij}-p_j)$ is only defined for positive numbers. I therefore only take into account values where the $ln(y_{ij}-p_j)$ is defined.

IV.ii. The Supply Side

A simple supply model will allow me to calculate the (unobserved) marginal costs, markups and the price cost margins for all cars in my sample. Also, elaborating on the model, I am able to estimate the exchange rate pass through for each model in my dataset with particular interest in the behavior of imported cars relative to domestic cars in the nineties.

Assume that in any given year *t*, there are *F* firms, each of which produce some subset J_f, of the $j=1...J$ different makes of cars. The firms profit function is given by

$$\pi_f = \sum_{J_f} (p_j - mc_j) M s_j(p) - C_f$$

where mc_j is the marginal cost, C_j is the fix cost of production and *M* is the total market size[14].

Under a pure Bertrand-Nash equilibrium, the resulting prices must satisfy the following first order condition,

$$s_j(p) + \sum_{r \in J_f} (p_r - mc_r) \frac{\partial s_r(p)}{\partial p_j} = 0$$

where $\delta s_r(p) / \delta p_j$ comes from the demand model.

The markups can be solved by defining a *JxJ* matrix Ω whose *(j,r)* elements are given by:

$$\Omega = \begin{cases} -\dfrac{\partial s_r}{\partial p_j}, & \text{if } r \text{ and } j \text{ are produced by the same firm}; \\ 0, & \text{otherwise} \end{cases}$$

In vector notation the above first order conditions becomes

(6) $$s(p) - \Omega(p - mc) = 0$$

Noting that *s(.)*, *p* and *mc* are *Jx1* vectors, the markup can be estimated by solving for $p - mc$

(7) $$(p - mc) = \Omega^{-1} s(p)$$

Therefore, solving for *mc* in (7) the estimated marginal cost mc^*, is

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[14] The market size is assumed to be the number of households that, given their income, could at least buy the cheapest car each year. This is approximately 80% of Colombian total households.

$$mc^{*} = \left[p - \Omega^{-1} S(p) \right] \tag{8}$$

where mc^{*} is a *Jx1* vector. Now, using equation (8) I can calculate the price costs margins for each car *j*, $(p_j - mc_j^{*})/p_j$.

As presented, the model is flexible enough to allow me to realize different counterfactual experiments. In particular, I am interested in the effects on prices of exchange rates changes, the so-called exchange rate pass through effect. In order to do so lets assume that each firms' marginal costs remain unchanged, except for the change in exchange rates. Once the marginal cost changes, firms will adjust price and will solve equation (6) for new equilibrium prices. Let *mc* be the estimated marginal cost defined as:

$$\begin{aligned} mc_j^{d} &= 0.3mc_j + 0.7(1+\tau_j^{d})mc_j \quad && if\ j \in domestic\ firm \\ mc_j^{f} &= (1+\tau_j^{f})mc_j && if\ j \in foreign\ firm \end{aligned}$$

where I am using the fact that domestic cars import 70% of their components, thus τ_j^{f} is CBU tariff and τ_j^{d} is the CKD tariff. Taking into account this marginal costs differential I totally differentiate for any given *j* equation (6) with respect to all prices and the marginal cost in order to obtain:

$$\Lambda dp^{n} = \Gamma dmc$$

where dp^{n} is a *Jx1* vector with each element equal to $dp_k^{n}, (k = 1, \cdots, J)$ and *n* stands for the new equilibrium price. Similarly, *dmc* is a *Jx1* vector with each element equal to $dmc_k^{*}, (k = 1, \cdots, J)$. *Λ* is a *JxJ* matrix with each j^{th} row and k^{th} column defined as follows

$$\begin{array}{ll} \dfrac{\delta s_j}{\delta s_k} + \displaystyle\sum_{l \in J_f} \dfrac{\delta^2 s_l}{\delta p_j \delta p_k}\left(p_l - mc_l\right) + \dfrac{\delta s_k}{\delta p_j} & if\ \ j\ and\ k\ are\ produced\ by\ the\ same\ firm \\ \qquad\qquad\qquad 0 & otherwise \end{array}$$

and *Γ* is a *JxJ* matrix with each j^{th} row and k^{th} column equal to $\frac{\delta s_k}{\delta s_j}$ if *j* and *k* are produced by the same firm, *0* otherwise. Inverting *Λ* gives:

$$\frac{dp^{n}}{dmc} = \Lambda^{-1}\Gamma \tag{9}$$

Equation (9) says that the change in price of car *j* is a function of the change in the marginal cost of car *r*, where $r=1\ldots J_f$. That is, firms will adjust its price according to the marginal costs variations of all its products.

V. Data Description and Some Initial Results

My dataset contains information of prices and characteristics per model sold in Colombia between 1986 and 1998. Indicator variables for whether the car has air conditioning (AC), power windows, power mirrors, power seats, alloy wheels, power door locks, assisted steering wheel and radio as standard equipment were obtained from the website www.motor.com.co, Internet version of the specialized auto magazine *Motor*. Other product characteristics, obtained from each models brochure going back to 1986, include the car dimensions (length, width and height), weight, engine displacement, horsepower and number of doors. Other characteristics available are kilometers per gallon, maximum speed, acceleration[15] and number of valves, but they are absent in a significant number of models.

The price variable is the list price as shown in several issues of the Colombian *Motor* auto magazine. All prices are deflated by the consumer price index and are (unless made explicit) in 1996 Colombian pesos. The sales variable corresponds to sales in Colombia.

The data used in the estimation process in only for automobiles. Though I had sales information for both SUV's and pickups, characteristics information was not available. However, before the reforms took place, SUV's and pickups' combined stood for less than 20% of total sales, while after the reforms, automobiles retained around 70% of the market.

Instead of using the cars dimensions (as used for example by Goldberg (1995)) as a principle of differentiation, I choose engine size as measured by cubic centimeters (CC). My choice is based on three reasons. First, the higher the CC the more expensive a car tends to be. Second, cars are legally classified in Colombia according to CC, among other things, for insurance purposes. And third, I segment by CC because it is common for many models to share chassis and body but they are equipped with different engines.

[15] As measured from 0 to 100 km. in seconds.

Therefore they have the same dimension, they look alike, but actually belong to a different segment.

Six hundred thousand cars were sold over the thirteen years time period. I was able to match price, quantity and characteristics to most of the cars in my dataset. However, 24,406 cars show up as *others* in the quantity dataset and therefore I was unable to identify them. I treat a model/year as an observation, which gives me a sample size of 936 models. Additionally, I was unable to find the price for ten observations, and so my final sample size is composed of 926 models. Throughout the paper I assumed that two models are the same in two subsequent years if they have the same name and the dimensions have not changed.

In addition, I had access to tariffs information as well as the value added tax and the real exchange rate[16]. The tariffs variable is disaggregated in two. On one hand I have compiled the tariffs for completely built up (CBU) imports, that is, fully assembled, ready-to-sell vehicles. On the other, I also have data on tariffs for the main inputs used in the assemble process, the CKD units. The difference is important since I am able to identify the origin of each model. Therefore, the relevant tariffs for a domestically produced car is the CKD tariff, while for the imported car, the CBU tariff is the appropriate one.

Tables I, II and III provide some summary statistics. Table I presents information on the main characteristics including price. These include horsepower over weight (HP/W), dimension, AC, power windows, power door locks, radio, engine displacement and alloy wheels. HP/W, measured as horsepower per kilogram, proxies for fuel efficiency as well as for power; it is expected to affect positively the utility of a consumer for a car. Dimension is defined as length times width. The effect is not clear, though one tends to believe that on average individuals prefer bigger cars. Finally, engine displacement is measured in liters and the indicator variables (1 if standard equipment, 0 if not) show how, on average, characteristics have changed over time.

A first overview of the data clearly illustrates the structural changes observed in the market after the reforms took place. Both table and figure 1 show significant changes

[16] Tariffs data is provided by the National Planning Department, value added by the Ministry of Finance and the real exchange index by the Colombian Central Bank, *Banco de la República*

between the pre-reform (1986-1991) and the post-reform period (1992-1998). On average, 22 models were offered between 1986 and 1991. By 1992, 71 different car models were offered, peaking 142 in 1997. Table II however, shows that the number of domestic models offered did not change much over the sample period.

The data also shows that prices in Colombia, in the 1980's, were abnormally high for international standards. In 1986 the mean price of a car was, in 1996 U.S. dollars, almost $23,000 while the average price for a car in the United States at the time was around $18,000[17]. By 1992, average prices in Colombia were over nineteen thousand dollars, approximately a thousand dollars higher than in the US. Towards the end of my period of analysis, on average a car could be bought in the US paying just over nineteen thousand dollars. In Colombia, that year, the average car was worth just below sixteen thousand dollars[18].

Between 1992 and 1994, immediately after the trade reforms were implemented, car sales radically increased. The annual average growth rate of car sales in that period was over 50%, significantly higher than the 10% growth rate over the entire period. As imports increased, the market share of domestic firms dropped. On average, importers gained in seven years over 40% of the car market in Colombia.

A closer look at the data shows that the number of domestic cars sold did expand as expected with the reforms, but only for a short period of time (Figure 1). Sales of domestically produced cars increased from an average of less than 30 thousand cars per year prior to the reforms to a peak of forty three thousand in 1994. Sales of domestically assembled cars have steadily gone down since then. For example in 1998 only 28,670 cars were sold, less than in 1986.

Lastly, I explore the direct effects of the liberalization reforms on prices. A simple hedonic regression of prices against characteristics and several control variables will serve this purpose. Results are shown in table IV. The regressors include vehicle attributes, tariffs, a competition proxy and time dummies. All included vehicle characteristics contribute positively to the log of price in a precise way. The domestic

[17] Average US price taken from the US Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts.

[18] To understand how expensive a car was for Colombian standards, note that in 1992, the US GDP per capita was 21,800 dollars while Colombia's was 1,300. The numbers for 1999 are 31,500 and 6,600 respectively.

dummy suggests that conditional on other included characteristics; foreign cars sell at a premium. Similarly, as expected, large cars tend to be more expensive than smaller cars.

The first two columns of table IV use as tariffs, the CKD tariff if the cars is domestically produced and the CBU tariff if the car is imported. As table II (column iv) shows, the average tariff fell only four points between pre and post reform periods. However, these numbers may induce to confusion because in fact, tariffs for imported cars declined from an average of 168% to only 35% (see table II, column iii). Similarly, table II (column ii) shows that input tariffs (namely, CKD) dropped from an average of 20% to an average of 3%. Columns 1 and 2 of table IV present the exercise using as the log of tariff this mixed version. The estimated coefficient is statistically significant and has the correct sign. That is, as tariffs drop, prices fall. However, the economic value is low due to the definition I am using here.

Consequently, for column 3 of table IV I use I use the CBU tariff for all the cars in my dataset (whether domestic or foreign). As expected, due to the strong decline in tariffs, the results are not only statistically significant, but also stronger from an economic point of view.

In all regressions I used a variable called competition to proxy for the increased number of vehicles sold in the market, and therefore to proxy for the increased competition due to the liberalization process. Competition is defined as the number of models, within the same segment, that compete with car j. Prices are expected to fall due to increased competition. Table IV says that a 10% increase in competition will force down the price of existing models by 1.5%.

VI. Estimation of the model

The predicted market share derived in equation (4), analytically obtained by solving the integral in equation (2), is a function of observed and unobserved product characteristics, as well as prices. A straightforward strategy to estimate the model is to choose parameters that minimize the distance between the predicted and the observed market shares:

(10) $$\underset{\theta}{Min}\| \; s(x_{.},p_{.},\xi_{.};\theta)-S_{.} \; \|$$

where *s()* are the predicted market shares and *S* the observed market shares. However, correlation between prices and the unobserved characteristics as well as other computational issues led Berry (1994) to develop a technique that deals with these complications[19].

Berry (1994) defines ξ as a structural error term, rather than as the difference between the observed and predicted market shares as is done in equation (10).

As shown in equation (1), the mean utility $\delta_j()$, is linear in ξ_j. Consequently, given the predicted and observed market shares I want to solve for δ the following system of $J+1$ equations[20]:

(11) $$s(\delta;\theta)=S_{.}$$

Equation (11) cannot be solved analytically due to the presence of three non-linear parameters, α, ρ_o and ρ_s. Therefore using a non-linear numerical procedure I solve for δ as a function of the observed market share and the non-linear parameters.

Define $Z=[z_1,\ldots,z_M]$ to be a set of instruments such that

(12) $$E\left[Z_m \cdot \omega(\theta^*)\right]=0, \;\; m=1\ldots M,$$

where ω, a function of the true parameters θ^*, is an error term defined as,

$$\omega=\delta(.)-X\beta)\equiv\xi$$

The moment condition given in equation (12) can be used to define the following generalized method of moment estimator (GMM):

(13) $$\min_{\alpha,\beta,\rho} L=\omega(\theta)'ZA^{-1}Z'\omega(\theta)$$

where *A* is a consistent estimate of E[Z'ωω'Z].

As is, the GMM estimator involves a potentially large set of parameters to estimate. However, noting that the β parameters enter linearly, the minimization in (13) can be performed only with respect to the non-linear parameters α and the ρ*'s*. I therefore estimate the β*'s* as follow:

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[19] Particularly when dealing with models where non-linearity's arise.
[20] Recall that we are normalizing the outside good to zero.

(14) $$\beta = \left(X'ZA^{-1}Z'X\right)^{-1} X'ZA^{-1}Z'\delta(s,\alpha,\rho),$$

and then substitute this expression into the objective function (13).

VII. Instruments

The estimation of equation (13) requires instrumental variables that satisfy equation (12). Ideally I would use (model-level) cost data as instruments. However, beyond the average cost of assembling a car for each of the three domestic firms I had no further access to direct cost data. This would be a valid, though insufficient, instrument if I were to estimate demand exclusively prior to 1992 when only domestic producers sold cars in Colombia.

Fortunately, some cost related data is available. Given that (after 1991) imported cars compose a significant share of total sales and that the main inputs of domestically produced cars are also imported I use both the real exchange rate index and import tariffs as instruments.

The advantage of using exchange rates and tariffs is that they are clearly exogenous to the car industry and that they both exhibit substantial variation, from year to year the former, and across cars and over time the latter. The obvious drawback of using exchange rate and tariffs as instruments is that neither of them is model specific, at most, tariffs are specific to a certain range of cars. Therefore, they are helpful, but not sufficient for identification. The sales tax, which I also use as an instrument has the same advantages and disadvantages of the previous two.

A second set of instruments is based on Bresnahan's (1981,87) assumption that the observed characteristics x_{jt} are exogenous (or predetermined). BLP (1995) built on this idea to generate instruments based on the assumption that $E(\xi/X)=0$. In particular, for each product characteristic x (excluding price), they use as instruments the (1) own characteristics and (2) the sum of characteristic x of all cars produced by the same firm f in the same year, and the sum of characteristic x of all cars produced in the same year by other firms. These set of instruments assume that the observed characteristics are uncorrelated with the unobserved characteristics, thus satisfying equation (12). Bresnahan, Stern and Trajtenberg (1997) follow a similar approach, but exploit their assumption about the group structure of product differentiation.

Therefore, based on the idea of the exogeneity of observed product characteristics and of the number of models available in the market per period, I build a second set of instruments. These are the average value of the characteristics by cluster (origin and size) and by shared cluster. I also use the total number of cars sold by cluster. The latter are competition based instruments in that they assume that the number of cars available in the market each year is correlated with prices but not with unobserved characteristics.

In summary, the instruments that I use are, the *cost* based set, the BLP type by cluster and the cars own characteristics. Table I of the appendix supports the validity of the instruments used as the first stage F-test of the instruments is 20.66, significant at the 1% level. Further, a Hausman test of overidentifying restrictions returns a value 19.71, not enough to reject the null hypothesis.

VIII. Results

The main results from my primary specification are summarized in Table V. They differ significantly from the logit and IV logit results presented in table II of the appendix. In particular, the estimates of the logit models are imprecisely estimated while the results for the IV logit improve significantly. The sign of most characteristics is the expected but are not statistically significant and it is promising the increase in the coefficient for the marginal utility of income, α.

The results of the PD GEV model shown in Table V are promising. The coefficients are precisely estimated and appear to be reasonable from an economic point of view. The results suggest that individuals prefer bigger cars as well as high horse power relative to weight. The coefficient on power windows remains negative, as in the logit and IV logit models, the only counterintuitive result. Finally, the marginal utility of income has the correct sign and it is statistically different from zero and both ρ_o and ρ_s lie in the unit interval as required to be consistent with utility maximization.

Further, the demand estimation shows that both substitution parameters are significantly different from zero and one. The estimated coefficients of these parameters suggests that there is indeed a significant degree of market segmentation along both origin and size dimensions.

The positive and statistically significant coefficient for the domestic dummy implies an outward shift of the demand curve if a car is Colombian made. This observed home bias means, given ρ_o less than one, that a car will enjoy certain degree of protection against foreign competition if it is domestically produced. Under similar reasoning, small cars seem to enjoy stronger preferences relative to medium and large cars.

Once accurate demand estimates are available, I apply equation (5) to calculate own and cross price elasticities. Table VI reports own price elasticities by origin and size. On average demand elasticities are higher for domestic cars, though over time this pattern tends to change. Similarly, medium sized cars tend to have higher elasticities than small and large cars. However, consumers tend to be more price sensitive prior to the reforms.

Table VII reports cross price elasticities averages by origin and size. The estimate of ρ_o suggests that consumers tend to view products of the same origin –either domestic or foreign- as closer substitutes than products of different origin. Indeed table VII (partially) confirms this. As the price of a domestic automobile goes up, individuals are more likely to substitute towards domestic rather than switching to foreign cars. On the contrary, for most years, an increase in the price of a foreign car will result in stronger substitution patterns towards domestic rather than foreign cars.

Similarly, the estimate of ρ_s implies that consumers tend to substitute towards cars of the same size. Table VII confirms this finding, as substitution towards other size vehicles is very low, mostly concentrated in medium sized vehicles.

Tables VIII, IX and X report a sample of own and cross price elasticities for several cars in three different years, 1987, well before the reforms, 1992, beginning of the reforms and 1996, when such reforms are expected to be consolidated. Several points can be extracted from these tables. First, as expected, luxurious cars have very inelastic demands, while middle priced cars tend to be more price sensitive, possibly induced by a stronger competition in the medium sized segment (see table II, column vii). Second, cross elasticity patterns seem to be consistent with the idea that similar cars tend to be closer substitutes for one another. For example, in 1992 a 1% increase in the price of a small Chevrolet Sprint will have no effect over a Mercedes or BMW, but it will have considerable effect over a less expensive Mazda 323 HS or Renault 9 Brio. And third, these tables strongly suggest that the functional form is not driving the results. More precisely, opposite to simple logit or IV logit models, prices do not drive own price elasticities as explained in Nevo (2000).

Once elasticities have been calculated, I use equation (7) to recover the price cost margins. Theory (and intuition) suggests that with increased competition, margins should fall. Table XI reports average markups (*p-mc*) by origin and size. As expected, markups did fall, but only until 1994. After that, markups remained relatively stable. By origin, foreign cars clearly have higher markups, though over time some convergence is observed between imported and domestic cars. By size, results are the expected, that is, large cars have higher markups, while smaller cars have lower markups.

Table XII reports the average price cost margins (PCM) defined as *(p-mc)/p*100*. Figure 2 decomposes the PCM between domestic and foreign cars. The decline in margins before 1992, a period where only domestic firms were present in the market may seem surprising. This behavior is explained mostly by the observed fall in prices, which in turn was caused by a series of events. First, the government sold its share to foreign private investors. Specifically, Mazda's headquarters in Japan bought CCA (Mazda producers in Colombia) and Renault and Toyota bought (Sofasa). Second, led by GM, the government intervention was significantly reduced. No more price regulation was to be set, and all three firms began to operate in Colombia under the same conditions. Third, Sofasa introduced a new model, the Renault 21, that turn out to have assembling defects. This forced the company, not only to inspect all models sold previously, but also to lower the price of all Renault 21's sold afterwards. Finally, as the companies further integrated with their headquarters guidelines, an increase in the market share became their main objective. It was a combination of these factors that induced a stronger competitive behavior in the automobile market even before the reforms took place.

As prices declined, with costs relatively unchanged, price cost margins dropped. Costs fell drastically in 1992 due to the trade reforms. CKD tariffs declined by almost 20%, CBU tariffs dropped from 75% to 38%, non-tariff barriers such as import license requirements were eliminated and further a real revaluation process began to take place. All this together implied a significant drop in costs and consequently an increase in PCM.

Many of the imported cars in 1992 were large expensive cars, hence autos with high margins. As competition increased, margins began to fall. By 1994 domestic car margins reached a historic low. At that moment, PCM for foreign vehicles stabilized, but domestic PCM began to increase. Three reasons explain this behavior. First, though domestic firms did not prepare in anticipation for foreign competition, they did so when competition arrived. As such, Sofasa and GM for example installed modern equipment to improve the painting process. These improvements entered the assembly line between 1995 and 1996. Similarly, all three firms reorganized the assembly plant and developed new technical training centers. Second, in 1996 the government implemented a differential sales tax. If a car under 1.4 liters was assembled domestically the sales tax would be 20% if it was imported the corresponding sales tax would be 35%. This 15% difference together with the already existing 30% difference on average between the CKD tariff (recall, 70% of a domestic car) and the CBU tariff gave domestic cars extra artificial advantages. Finally, the real appreciation process ended and devaluation began to increase at the end of my sample period.

The supply model developed earlier allows me to calculate the exchange rate pass through by car model. Figure 3 shows that the exchange rate pass through of domestic cars is consistently lower than for foreign cars. This behavior is due to the fact that domestic cars have *only* 70% of its components imported. Further, domestic firms import relatively larger amounts of CKD units as different models use the same unit in the assembly process

Moreover, figure 3 shows a strong correlation between the exchange rate pass through of foreign vehicles and the real exchange rate index. This result suggests that foreign firms are more vulnerable to the exchange rate fluctuation than domestic firms. Anecdotal evidence collected while visiting Colombian firms, supports this result, as domestic firms imports are more dependent on the guidelines and the conditions given by the headquarters than on external shocks[21]. Foreign car importers, on the contrary, rarely have any direct link with the headquarters world guidelines, and in occasions have had trouble importing the amount required of cars because Colombia is not a priority market for these firms. Thus, they are much more exposed to the exchange rate fluctuations.

[21] Of course, these external shocks must remain at certain levels. Colombia nominal devaluation in the 1990's never was larger than the 25% reached in 1998.

Table XIII presents some cost data. No direct cost data was available beyond the average cost of domestic parts bought in Colombia and used in the assembly process. Column 1 of table XIII shows that on average these costs were almost half in the nineties than in the eighties. Specifically, these costs were on average 4.4 thousand dollars before 1991. By 1998 this number was less than 2.5 thousand dollars[22].

The remaining columns of table XIII show the marginal cost calculated from the model estimated above. Between 1986 and 1991 marginal costs remained relatively stable around 21 million pesos (16 thousand dollars). During the nineties these marginal costs dropped steadily to just over 10 million pesos reached in 1998 (around 9.5 thousand dollars)[23]. By origin, despite the observed convergence in costs, domestic cars still present lower costs than foreign cars.

It is worth noting that comparatively, Colombian average price cost margins are similar to those reported by Goldberg and Verboven (2001) for European cars and Berry et al (1999) for US autos. Goldberg and Verboven report price cost margins of around 20% with peaks in Italy of about 40%. Berry et al. margins vary from about 20% for cheap cars to around 40% for expensive luxurious vehicles. Brambilla's (2003) PCM for Brazil and Argentina are higher than those I find. She only reports the average result over time and over models. For Argentina, her estimates for own elasticities are similar to mine, but curiously her PCM are around 50%, much higher than those I find. In Brazil, with very inelastic own elasticities, the PCM is around 60%[24].

Finally, as prices decline, consumer welfare as measured by consumer surplus is expected to increase. The results, presented in Table XIV, show that consumer welfare behaved as expected. Consumer surplus increased, particularly in 1993 and 1994 immediately after the reforms took place. The average change in consumer welfare, when comparing the average consumer surplus of the pre-reform period with the post-reform period was of about three million pesos, around 3,346 1996 dollars.

[22] In 1996 dollars.
[23] Pesos measured in 1996 pesos, dollars measured in 1996 dollars.
[24] The mean own price elasticity for all models in Brazil is –1.7.

IX. Specifications Checks

It is always uncertain if the characteristics chosen are the proper ones to use. Table XV checks the robustness of the PD GEV model estimates as compared to my main specification model 1. Model 2 runs the regression without the Air Conditioning dummy giving its non-significance in Model 1. Results are maintained both in terms of point estimates and statistically significance.

Model 3 runs the same regression as model 1, but excluding dimension. As one of my principles of differentiation I chose engine displacement as a measure of size. In principle, it may be of concern to include dimension as measured by length times width with size dummies. The results from excluding dimension in model 3 suggest that my results in model 1 are valid since my estimates do not change significantly.

X. Conclusion

In this paper I use a discrete choice random utility model to determine the factors that influence demand for cars as economic reforms took place. The demand estimates allow me to calculate own and cross price elasticities which together with a supply model give me price cost margins estimates. I also calculate consumer surplus as a measure of consumer welfare and determine the exchange rate pass through over domestic and foreign cars.

To estimate the demand parameters I use product level data of sales, prices and car characteristics over a thirteen-year period. My primary focus is to determine the effects of trade liberalization over the car market in Colombia. In order to do so, I take advantage of the one shot decrease in tariffs observed in late 1991. As a consequence, previously unavailable imported cars became available in the domestic market.

The demand estimation procedure requires the use of instrumental variables for proper identification. I am looking for variables that are correlated wit the price of the car but exogenous to the unobserved characteristics. As instruments I use the characteristics of competing cars and I exploit the fact that, even if domestically produced, all cars have an important share of imported components. Thus, I use as instruments tariffs and exchange rate. Further, I use the sales tax and a proxy for competition, the number of competing cars per segment.

The results suggest that trade liberalization had important effects over the industry. As tariffs dropped, previously unavailable foreign cars were introduced into the market. Further, domestic firms improved the quality of their product and were forced to reduce price due to competition. This elements combined implied that consumer welfare increased by almost three thousand dollars on average per consumer. Domestic firms were forced to decrease their price cost margins in order to compete with imports, particularly in the years following the reforms.

As competition increased domestic firms were forced to improve efficiency in their plants. However, though the reforms facilitated the introduction of new models in the Colombian market, still domestic firms retained significant level of protection, both externally and internally. Higher tariffs for foreign cars the former and lower sales tax for domestic cars the latter. Moreover, importers of foreign cars are for the most part small domestic firms importing cars with no strong link with the multinational headquarters, while domestic firms depend directly on the headquarters. This structure makes imported cars much more dependent on external shocks, such as the fluctuations of the exchange rate.

In conclusion, the liberalization reforms had the expected effect, but they seem to be still half way through. As of today, it is scheduled that in 2007 tariffs be reduced to 0% for imported cars from Mexico and Venezuela. Moreover, currently Colombia is negotiating the Free Trade Area of the Americas and simultaneously seeking to reach a bilateral agreement with the U.S. This is not just the case of Colombia but of many developing countries, particularly of Latin America.

This suggests future extensions based on the model and the results found of the paper. It is interesting to determine how models in Colombia were affected by external competition in order to understand the behavior of firms under intense competition. How did firms renew vehicles once the market was liberated? Do they renew faster as the effects of the reforms vanish?

If tariffs fall to zero, and domestic firms lose market share, one would be interested in further understanding the cause of the strong exchange rate pass through over imported cars. Conditional on zero tariffs will the domestic market become more volatile due to dependence on external shocks?

Last, the trade reform was implemented jointly with financial and labor reforms among others. Anecdotal evidence suggest that the boost in sales observed was not only due to lower prices and increased variety, but also because of the easier access to credit and cash due to the particularities of these financial and labor reforms. Depending on data availability one could directly test the effects of such reforms, individually over prices.

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Table I
Summary Statistics
Means (Sales Weighted)
(Standard Deviation in Parenthesis)

	No. of Models	Price[1]	HP/W[2]	Engine Displacement[3]	Dimension[4]	AC[5]	Power Windows[5]	Power Door Locks[5]	Radio[5]	Alloy Wheels[5]
1986	18	28.956	0.078	1.516	6.836	0.091	0.152	0.093	0.107	0.034
		(8.277)	(0.013)	(0.337)	(0.874)	(0.296)	(0.369)	(0.299)	(0.318)	(0.185)
1987	23	32.906	0.079	1.508	6.831	0.177	0.243	0.267	0.268	0.132
		(10.452)	(0.011)	(0.377)	(0.910)	(0.389)	(0.438)	(0.452)	(0.452)	(0.345)
1988	19	31.415	0.078	1.459	6.652	0.275	0.416	0.242	0.224	0.137
		(10.782)	(0.013)	(0.382)	(0.989)	(0.458)	(0.506)	(0.440)	(0.428)	(0.353)
1989	21	29.588	0.078	1.462	6.675	0.281	0.406	0.205	0.326	0.122
		(9.532)	(0.013)	(0.365)	(0.976)	(0.460)	(0.503)	(0.413)	(0.480)	(0.334)
1990	27	30.509	0.079	1.473	6.718	0.212	0.390	0.319	0.354	0.150
		(9.902)	(0.012)	(0.358)	(0.911)	(0.416)	(0.496)	(0.474)	(0.487)	(0.363)
1991	26	27.679	0.080	1.464	6.663	0.195	0.298	0.272	0.329	0.134
		(9.533)	(0.009)	(0.333)	(0.880)	(0.404)	(0.466)	(0.453)	(0.479)	(0.347)
1992	71	25.971	0.082	1.508	6.889	0.289	0.325	0.238	0.360	0.363
		(13.625)	(0.013)	(0.345)	(0.722)	(0.456)	(0.471)	(0.429)	(0.483)	(0.484)
1993	82	25.782	0.083	1.509	6.941	0.294	0.406	0.282	0.433	0.333
		(12.654)	(0.014)	(0.353)	(0.723)	(0.458)	(0.494)	(0.453)	(0.498)	(0.474)
1994	122	21.214	0.082	1.447	6.823	0.308	0.367	0.282	0.447	0.401
		(8.944)	(0.0129)	(0.317)	(0.719)	(0.463)	(0.483)	(0.452)	(0.499)	(0.492)
1995	127	19.540	0.081	1.425	6.736	0.276	0.348	0.287	0.401	0.492
		(8.398)	(0.013)	(0.295)	(0.671)	(0.449)	(0.478)	(0.454)	(0.492)	(0.501)
1996	133	17.157	0.081	1.386	6.601	0.299	0.265	0.230	0.403	0.466
		(7.351)	(0.0123)	(0.262)	(0.664)	(0.460)	(0.442)	(0.422)	(0.492)	(0.500)
1997	142	15.947	0.083	1.386	6.591	0.188	0.240	0.237	0.472	0.427
		(6.399)	(0.012)	(0.239)	(0.674)	(0.392)	(0.428)	(0.426)	(0.501)	(0.496)
1998	115	15.662	0.086	1.418	6.653	0.328	0.274	0.227	0.547	0.463
		(6.876)	(0.012)	(0.246)	(0.709)	(0.471)	(0.448)	(0.421)	(0.500)	(0.501)
1986-98	926	22.825	0.082	1.448	6.735	0.259	0.318	0.249	0.390	0.335
		(10.936)	(0.013)	(0.314)	(0.771)	(0.438)	(0.465)	(0.433)	(0.488)	(0.472)
1986-91	22	30.175	0.079	1.480	6.729	0.205	0.317	0.233	0.268	0.118
1992-98	113	20.182	0.083	1.440	6.748	0.283	0.318	0.255	0.437	0.421

[1] Price in millions of 1996 pesos

[2] HP/W: measured in Horse Power (HP) per Weight (in kilograms)

[3] Engine Displacement measured in Cubic Liters

[4] Dimension is width*length. Square meters

[5] Indicator Variables, 1 if it has the characteristic as standard equipment, 0 otherwise

Table II
Summary Statistics
(sales weighted)

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)					(viii)				ix)		
	Price[1]	CKD (Input) Tariffs[2]	CBU (imported car) Tariffs[3]	Tariffs[4]	Sales Tax	Real Exchange Rate Index	Number of Models Offered					Market Share[5]				(Number of Cars Sold		
							Domestic	Foreign	Small	Medium	Large	Domestic	Small	Medium	Large	Total	Domestic	Foreign
1986	28.956	19.94	200.00	19.94	26.55	113.96	18	-	5	8	5	100.00	31.28	46.47	22.25	29,150	29,150	-
1987	32.906	20.67	200.00	20.66	26.86	114.77	23	-	6	10	7	100.00	43.62	30.11	26.27	34,277	34,277	-
1988	31.415	19.52	200.00	19.52	25.95	113.78	19	-	6	6	7	100.00	47.54	27.04	25.42	36,775	36,775	-
1989	28.916	20.24	218.00	20.24	26.88	120.60	21	-	6	8	7	100.00	47.68	30.07	22.25	30,471	30,471	-
1990	30.509	20.53	116.00	20.53	27.35	130.99	27	-	7	11	9	100.00	48.47	28.79	22.74	25,786	25,786	-
1991	27.679	19.44	75.00	19.45	26.45	114.75	26	-	7	11	8	100.00	45.14	34.04	20.82	22,206	22,206	-
1992	25.971	3.00	38.83	13.20	28.50	108.71	27	44	13	28	30	71.53	44.36	36.09	19.55	34,230	24,485	9,745
1993	25.782	3.00	38.12	18.38	28.80	110.29	23	59	14	36	32	56.22	42.60	39.89	17.51	62,324	35,037	27,287
1994	21.214	3.00	35.00	15.92	27.16	102.87	25	97	21	63	38	59.62	52.66	35.10	12.24	72,452	43,199	29,253
1995	19.540	3.00	35.00	14.96	26.48	104.46	28	99	26	67	34	62.64	56.67	35.00	8.33	66,191	41,462	24,729
1996	17.157	3.00	35.00	14.21	26.28	100.00	36	97	30	71	32	64.97	64.98	30.82	4.21	61,442	39,921	21,521
1997	15.947	3.00	34.64	18.12	27.12	92.77	32	110	37	81	24	52.01	53.62	44.04	2.34	74,687	38,999	35,688
1998	15.662	3.00	34.83	19.53	27.81	100.99	25	90	29	74	12	48.07	39.01	57.27	3.73	59,643	28,670	30,973
1986-91	30.063	20.06	168.17	20.06	26.67	118.14	22	-	6	9	7	100.00	43.96	32.75	23.29	29,778	29,778	-
1992-98	20.182	3.00	35.92	16.33	27.45	102.87	28	85	24	60	29	59.29	50.56	39.74	9.70	61,567	35,968	25,599
1986-98	24.74	10.87	96.96	18.05	27.09	109.92	25	85	16	36	19	78.08	47.51	36.52	15.97	46,895	33,111	25,599

[1] Million of 1996 Pesos

[2] Tariffs for the CKD units used by domestic producers (%)

[3] Tariff for imported cars (%)

[4] Tariffs used in regression. It uses CKD tariffs for domestically produced cars and assembled car tariffs for foreign cars (%)

[5] As defined by total sales

Table III
Summary Statistics

Variable	Mean	Std Dev	Min	Max
Sales Tax	32.41	7.33	20	45
Real Exchange Rate Index	104.28	8.1	92.77	130.99
Tariffs[1]	26.82	13.48	3	40
CKD Tariffs[2]	11.05	10.86	3	30
Assembled Car Tariffs[3]	58.69	54.27	31.5	218

[1] CKD tariffs for Domestic cars, Assembled Car Tariffs for Foreign
[2] Tariffs for main components of domestically assembled cars
[3] Tariffs for imported cars

Table IV
Hedonic Regression
Dependant Variable log(price)

log(Size)	1.431 (0.103)***	0.777 (0.105)***	1.420 (0.103)***
Log(HP/weight)	0.599 (0.061)***	0.325 (0.065)***	0.592 (0.060)***
AC	0.109 (0.019)***	0.116 (0.018)***	0.108 (0.020)***
Pwr Windows	0.088 (0.023)***	0.073 (0.023)***	0.086 (0.023)***
log(Engine Displacement)		0.939 (0.090)***	
Domestic			-0.051 (0.016)***
Small	-0.296 (0.040)***		-0.296 (0.040)***
Medium	-0.149 (0.0338)***		-0.134 (0.036)***
Competition	-0.152 (0.0538)***	-0.113 (0.091)***	-0.171 (0.056)***
Tariffs	0.017 (0.006)***	0.012 (0.012)***	0.574 (0.275)***
Constant	2.471 (0.273)***	2.438 (0.024)***	-0.434 (1.433)
Time Dummies (p-value)	0.000	0.000	0.000
Observations	926	926	926
R^2	0.78	0.81	0.79

*** Significant at 1% level; ** 5%; * 10%
Robust standard errors in parenthesis

[x] See text for variable definitions

Table V Demand Estimates	
	PD GEV
	Model 1
α	4.529 (1.931)***
ρ_o	0.636 (0.220)***
ρ_s	0.444 (0.255)*
Domestic	0.682 (0.193)***
Small	0.727 (0.202)***
Medium	0.206 (0.104)**
Dimension	1.298 (0.582)**
HP/W	3.829 (2.334)*
AC	0.016 (0.071)
Pwr Windows	-0.149 (0.079)**
Constant	-19.735 (6.759)***
GMM	21.72

*** Significant at 1% level; ** 5%; * 10%
Robust standard errors in parenthesis

Table VI
Average Own Elasticities
(Sales Weighted)

	Total	**Domestic Cars**	**Foreign Cars**	**Small Cars**	**Medium Cars**	**Large Cars**
1986	-3.82	-3.82	-	-3.19	-4.17	-3.98
1987	-3.78	-3.78	-	-3.25	-4.99	-3.27
1988	-4.10	-4.10	-	-3.98	-5.15	-3.19
1989	-4.63	-4.63	-	-4.59	-4.28	-5.19
1990	-4.22	-4.22	-	-4.34	-4.17	-4.01
1991	-5.36	-5.36	-	-4.55	-6.49	-5.28
1992	-4.15	-4.37	-3.60	-4.28	-4.09	-3.98
1993	-4.42	-4.56	-4.24	-4.93	-4.19	-3.69
1994	-4.76	-5.13	-4.20	-5.21	-4.21	-4.37
1995	-4.44	-4.58	-4.20	-4.53	-4.17	-4.92
1996	-3.95	-3.88	-4.08	-3.52	-4.95	-3.16
1997	-3.52	-3.50	-3.54	-3.10	-3.95	-4.83
1998	-3.27	-3.08	-3.44	-3.35	-3.53	-3.22
1986-91	-4.32	-4.32	-	-3.99	-4.88	-4.15
1992-98	-4.07	-4.16	-3.90	-4.13	-4.16	-4.02
1986-98	-4.19	-4.23	-3.90	-4.06	-4.49	-4.08

Table VII Average Cross Elasticities (Sales Weighted)											
	Total	**Domestic vs Domestic**	**Foreign vs Foreign**	**Domestic vs Foreign**	**Foreign vs Domestic**	**Small vs Small**	**Medium vs Medium**	**Large vs Large**	**Small vs Other**	**Medium vs Other**	**Large vs Other**
1986	0.0434	0.0434	-	-	-	0.0614	0.1254	0.1434	0.004	0.007	0.004
1987	0.0310	0.0310	-	-	-	0.0769	0.0844	0.0855	0.003	0.007	0.003
1988	0.0346	0.0346	-	-	-	0.0768	0.1126	0.0987	0.003	0.008	0.003
1989	0.0437	0.0437	-	-	-	0.1024	0.1190	0.1460	0.002	0.007	0.003
1990	0.0436	0.0436	-	-	-	0.1041	0.1208	0.1336	0.002	0.007	0.002
1991	0.0574	0.0574	-	-	-	0.0908	0.2594	0.1503	0.002	0.006	0.002
1992	0.0397	0.0653	0.0296	0.0086	0.0104	0.1475	0.0333	0.0764	0.002	0.011	0.002
1993	0.0283	0.0519	0.0189	0.0118	0.0220	0.1079	0.0213	0.0551	0.005	0.009	0.002
1994	0.0346	0.0700	0.0120	0.0096	0.0228	0.1068	0.0142	0.0486	0.001	0.009	0.002
1995	0.0330	0.0652	0.0087	0.0053	0.0213	0.0890	0.0150	0.0681	0.001	0.007	0.002
1996	0.0201	0.0335	0.0117	0.0064	0.0133	0.0399	0.0165	0.0276	0.001	0.006	0.002
1997	0.0155	0.0279	0.0097	0.0069	0.0159	0.0253	0.0308	0.0234	0.003	0.006	0.002
1998	0.0147	0.0213	0.0145	0.0110	0.0124	0.0269	0.0250	0.0647	0.004	0.005	0.001
1986-91	0.0423	0.0423	-	-	-	0.0854	0.1369	0.1263	0.0026	0.0069	0.0028
1992-98	0.0266	0.0479	0.0150	0.0085	0.0169	0.0776	0.0223	0.0520	0.0025	0.0077	0.0017
1986-98	0.0338	0.0453	0.0150	0.0085	0.0169	0.0812	0.0752	0.0863	0.0025	0.0073	0.0022

Row *i*, column *j* gives the percentage change in the market share of car *j* given a 1% change in the price of car *i*.

Table VIII A Sample from 1987 of Estimated Own and Cross Price Elasticities										
	Renault 21 RX	Mazda 626 L	Chevrolet Monza SLE	Renault 9 GTS	Mazda 323 NX	Mazda 323 HS	Chevrolet Chevette	Chevrolet Sprint	Renault 4	**PCM**
Renault 21 RX	**-1.690**	0.148	0.002	0.002	0.002	0.002	0.000	0.004	0.002	0.62
Mazda 626 L	0.075	**-1.944**	0.002	0.002	0.002	0.002	0.000	0.004	0.002	0.55
Chevrolet Monza SLE	0.003	0.002	**-2.020**	0.106	0.122	0.004	0.042	0.010	0.006	0.53
Renault 9 GTS	0.003	0.002	0.046	**-5.141**	0.217	0.004	0.325	0.015	0.011	0.21
Mazda 323 NX	0.003	0.002	0.046	0.155	**-4.377**	0.004	0.338	0.014	0.010	0.24
Mazda 323 HS	0.004	0.003	0.003	0.005	0.005	**-2.229**	0.002	0.111	0.081	0.47
Chevrolet Chevette	0.004	0.002	0.043	0.152	0.222	0.004	**-2.090**	0.013	0.008	0.53
Chevrolet Sprint	0.004	0.002	0.002	0.004	0.004	0.024	0.002	**-2.753**	0.280	0.37
Renault 4	0.004	0.003	0.003	0.004	0.004	0.023	0.002	0.223	**-1.701**	0.63

Row *i*, column *j* gives the percentage change in the market share of car *j* given a 1% change in the price of car *i*.

Cars are sorted by price, the top car is the most expensive.

Table IX
A Sample from 1992 of Estimated Own and Cross Price Elasticities

	Mercedes E320	BMW S320	Honda Integra LS Mec	Subaru Legacy	Mazda 626L	Chevrolet Swift 1.6	Mazda 323 HS	Renault 9 Brio	Chevrolet Sprint	**PCM**
Mercedes E320	**-1.165**	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.86
BMW S320	0.000	**-1.213**	0.001	0.002	0.009	0.000	0.000	0.000	0.001	0.83
Honda Integra LS Mec	0.000	0.000	**-3.596**	0.001	0.001	0.004	0.000	0.000	0.001	0.29
Subaru Legacy	0.000	0.001	0.001	**-2.911**	0.123	0.000	0.000	0.000	0.001	0.35
Mazda 626L	0.000	0.001	0.000	0.007	**-2.657**	0.001	0.002	0.002	0.003	0.40
Chevrolet Swift 1.6	0.000	0.000	0.002	0.000	0.002	**-3.964**	0.011	0.019	0.034	0.26
Mazda 323 HS	0.000	0.000	0.000	0.000	0.002	0.003	**-2.005**	0.056	0.117	0.52
Renault 9 Brio	0.000	0.000	0.000	0.000	0.002	0.003	0.031	**-4.281**	0.421	0.24
Chevrolet Sprint	0.000	0.000	0.000	0.000	0.002	0.002	0.032	0.141	**-3.155**	0.33

Row *i*, column *j* gives the percentage change in the market share of car *j* given a 1% change in the price of car *i*.

Cars are sorted by price, the top car is the most expensive.

Table X
A Sample from 1996 of Estimated Own and Cross Price Elasticities

	BMW S328	Mercedes C230	Citroen ZX	Mazda 626 L	VW Golf GL	Mitsubishi Lancer	Chevrolet Corsa L 5d	Daewoo Racer GTI	Hyundai Accent LS	Skoda Felicia GLX	Ford Festiva Hatch	Renault 9 Brio	Mazda 323 Coupe	Chevrolet Sprint	**PCM**
BMW S328	**-1.712**	0.001	0.000	0.021	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.584
Mercedes C230	0.001	**-1.163**	0.000	0.027	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.888
Citroen ZX	0.000	0.000	**-3.539**	0.000	0.005	0.005	0.000	0.008	0.003	0.013	0.009	0.000	0.000	0.000	0.283
Mazda 626 L	0.001	0.002	0.000	**-2.225**	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.472
VW Golf GL	0.000	0.000	0.001	0.000	**-2.460**	0.004	0.000	0.011	0.002	0.009	0.006	0.000	0.000	0.000	0.407
Mitsubishi Lancer	0.000	0.000	0.000	0.000	0.002	**-4.628**	0.009	0.004	0.009	0.045	0.027	0.011	0.025	0.034	0.216
Chevrolet Corsa L 5d	0.000	0.000	0.000	0.000	0.000	0.002	**-3.435**	0.000	0.003	0.018	0.010	0.034	0.073	0.098	0.298
Daewoo Racer GTI	0.000	0.000	0.001	0.000	0.007	0.004	0.000	**-3.020**	0.004	0.017	0.011	0.000	0.000	0.000	0.332
Hyundai Accent LS	0.000	0.000	0.000	0.000	0.002	0.008	0.010	0.004	**-2.395**	0.045	0.026	0.014	0.032	0.045	0.418
Skoda Felicia GLX	0.000	0.000	0.000	0.000	0.002	0.007	0.014	0.003	0.009	**-2.077**	0.026	0.019	0.044	0.061	0.483
Ford Festiva Hatch	0.000	0.000	0.000	0.000	0.002	0.007	0.012	0.004	0.009	0.045	**-2.298**	0.017	0.039	0.055	0.436
Renault 9 Brio	0.000	0.000	0.000	0.000	0.000	0.002	0.026	0.000	0.003	0.021	0.011	**-2.179**	0.076	0.103	0.465
Mazda 323 Coupe	0.000	0.000	0.000	0.000	0.000	0.003	0.027	0.000	0.003	0.023	0.012	0.036	**-2.151**	0.107	0.470
Chevrolet Sprint	0.000	0.000	0.000	0.000	0.000	0.003	0.027	0.000	0.003	0.024	0.012	0.037	0.080	**-2.058**	0.495

Row *i*, column *j* gives the percentage change in the market share of car *j* given a 1% change in the price of car *i*.

Cars are sorted by price, the top car is the most expensive.

Table XI
Average Price - Marginal Cost
Million of 1996 Pesos
(Sales Weighted)

	Total	Domestic	Foreign	Small	Medium	Large
1986	8.484	8.484	-	6.924	7.989	11.713
1987	10.601	10.601	-	7.499	9.526	16.984
1988	9.587	9.587	-	6.564	6.794	18.210
1989	7.136	7.136	-	4.952	8.608	9.825
1990	8.306	8.306	-	5.565	8.555	13.835
1991	6.445	6.445	-	5.973	5.343	9.268
1992	8.070	5.741	13.923	4.751	7.756	16.178
1993	7.276	5.935	8.997	4.229	6.645	16.126
1994	5.451	4.385	7.025	3.412	6.264	11.892
1995	5.462	4.259	7.480	3.617	6.075	15.445
1996	4.974	4.569	5.724	4.312	4.753	16.801
1997	4.987	4.694	5.307	4.741	4.748	15.086
1998	5.277	5.173	5.373	4.835	5.045	13.481
1986-91	8.426	8.426	-	6.246	7.803	13.306
1992-98	5.928	4.965	7.690	4.271	5.898	15.001
1986-98	7.081	6.563	7.690	5.183	6.777	14.219

Table XII
Average Price Cost Margins
(P-MC)/P
(Sales Weighted)

	Total	Domestic	Foreign	Small	Medium	Large
1986	32.79	32.79	-	33.48	31.41	34.33
1987	31.96	31.96	-	33.03	30.52	33.09
1988	29.44	29.44	-	30.06	20.58	36.51
1989	24.42	24.42	-	22.43	25.66	24.72
1990	25.40	25.40	-	22.00	24.57	29.05
1991	24.76	24.76	-	29.51	21.60	24.95
1992	35.78	27.55	40.82	26.94	30.33	44.69
1993	33.01	25.70	35.86	24.93	28.74	41.37
1994	30.59	23.44	32.44	21.89	29.61	37.03
1995	32.72	24.39	35.08	25.49	28.89	45.79
1996	31.35	26.74	33.06	32.86	25.44	43.05
1997	33.65	29.83	34.76	38.35	28.83	42.66
1998	34.09	34.77	33.90	40.20	30.81	43.60
1986-91	28.13	28.13	-	28.42	25.72	30.44
1992-98	33.03	27.49	35.13	30.09	28.95	42.60
1986-98	30.77	27.78	35.13	29.32	27.46	36.99

Table XIII COST DATA (1996 Million Pesos)				
	Avg. Cost of Domestic Parts	Estimated Marginal Costs		
	Bought by Domestic Firms	Total	Domestic	Foreign
1986	5.443	20.472	20.472	-
1987	5.520	22.305	22.305	-
1988	6.809	21.828	21.828	-
1989	6.348	22.452	22.452	-
1990	6.386	22.202	22.202	-
1991	6.000	21.630	21.63	-
1992	5.031	17.901	16.684	20.959
1993	3.998	18.506	17.192	20.193
1994	3.529	15.762	15.422	16.265
1995	3.147	14.077	13.661	14.774
1996	2.813	12.184	11.623	13.223
1997	2.570	10.960	10.353	11.623
1998	2.707	10.385	9.7978	10.929
1986-91	6.084	21.815	21.815	-
1992-98	3.399	14.254	13.533	15.424
1986-98	4.638	17.743	17.356	15.424

Table XIV Welfare (1996 Pesos)	
1986	5,219,904
1987	5,341,483
1988	5,028,351
1989	3,948,972
1990	3,114,208
1991	2,621,229
1992	3,996,102
1993	10,240,489
1994	7,836,787
1995	6,877,790
1996	7,736,788
1997	7,575,488
1998	5,993,639
1986-91	4,212,358
1992-98	7,179,583
1986-98	5,810,095

Table XV
Demand Estimates
Specification Checks

	PD GEV	PD GEV	PD GEV
	Model 1	Model 2	Model 3
α	4.529 (1.931)***	5.909 (1.683)***	4.466 (1.586)***
ρ_o	0.636 (0.220)***	0.667 (204)***	0.713 (0.173)***
ρ_s	0.444 (0.255)*	0.427 (0.234)*	0.425 (0.299)
Domestic	0.682 (0.193)***	0.725 (0.200)***	0.740 (0.206)***
Small	0.727 (0.202)***	0.732 (0.183)***	0.651 (0.206)***
Medium	0.206 (0.104)**	0.160 (0.094)*	0.166 (0.117)
Dimension	1.298 (0.582)**	1.906 (0.619)***	
HP/W	3.829 (2.334)*	5.294 (2.738)**	3.679 (2.844)
AC	0.016 (0.071)		0.02 (0.080)
Pwr Windows	-0.149 (0.079)**	-0.123 (0.076)	-0.129 (0.094)
Constant	-19.735 (6.759)***	-24.724 (5.896)***	-18.273 (5.081)***
GMM	21.72	22.14	27.42

*** Significant at 1% level; ** 5%; * 10%
Robust standard errors in parenthesis

Figure 1
Evolution of Prices and Units Sold
1986-1998

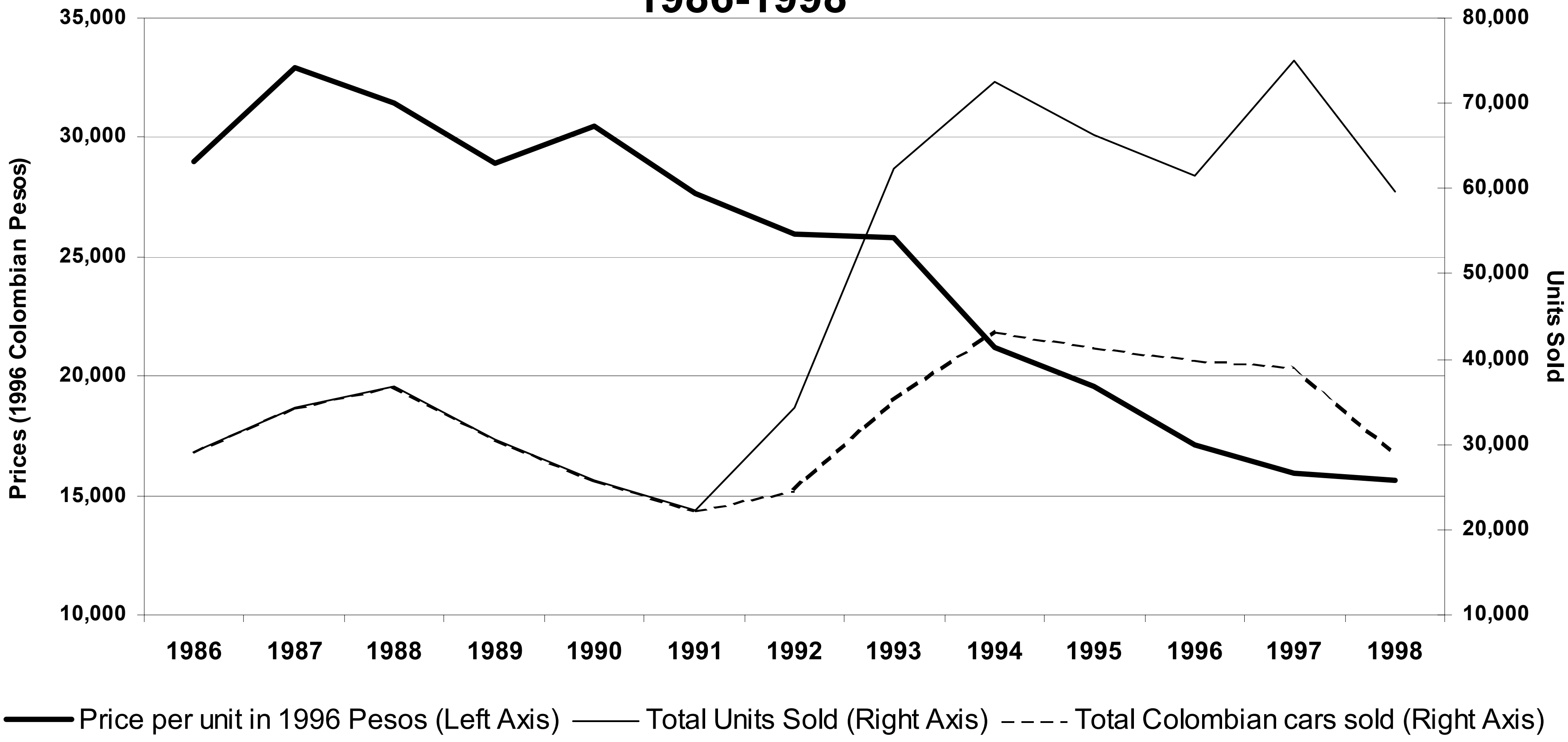
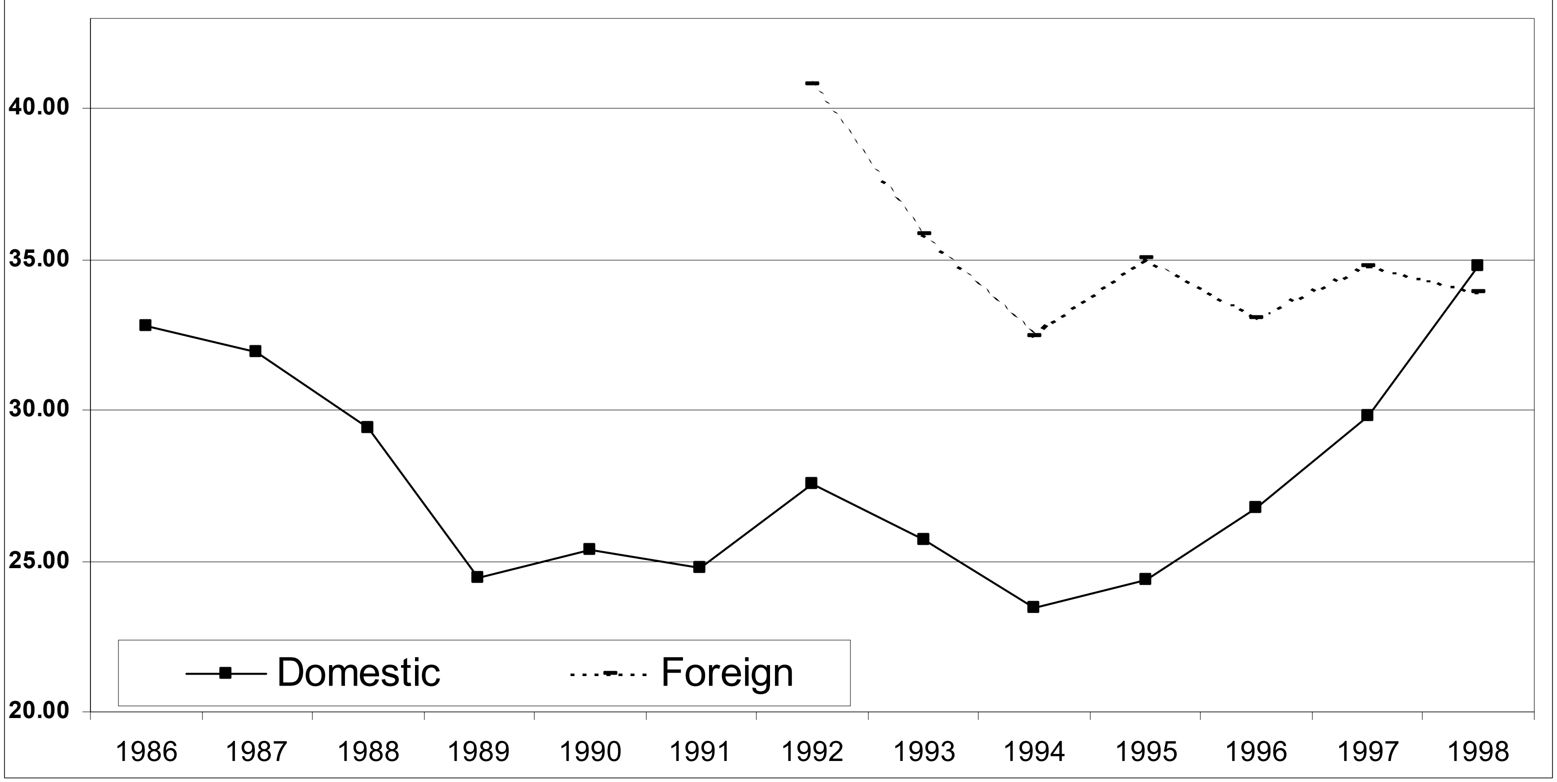


Figure 2
Price Costs Margins Evolution



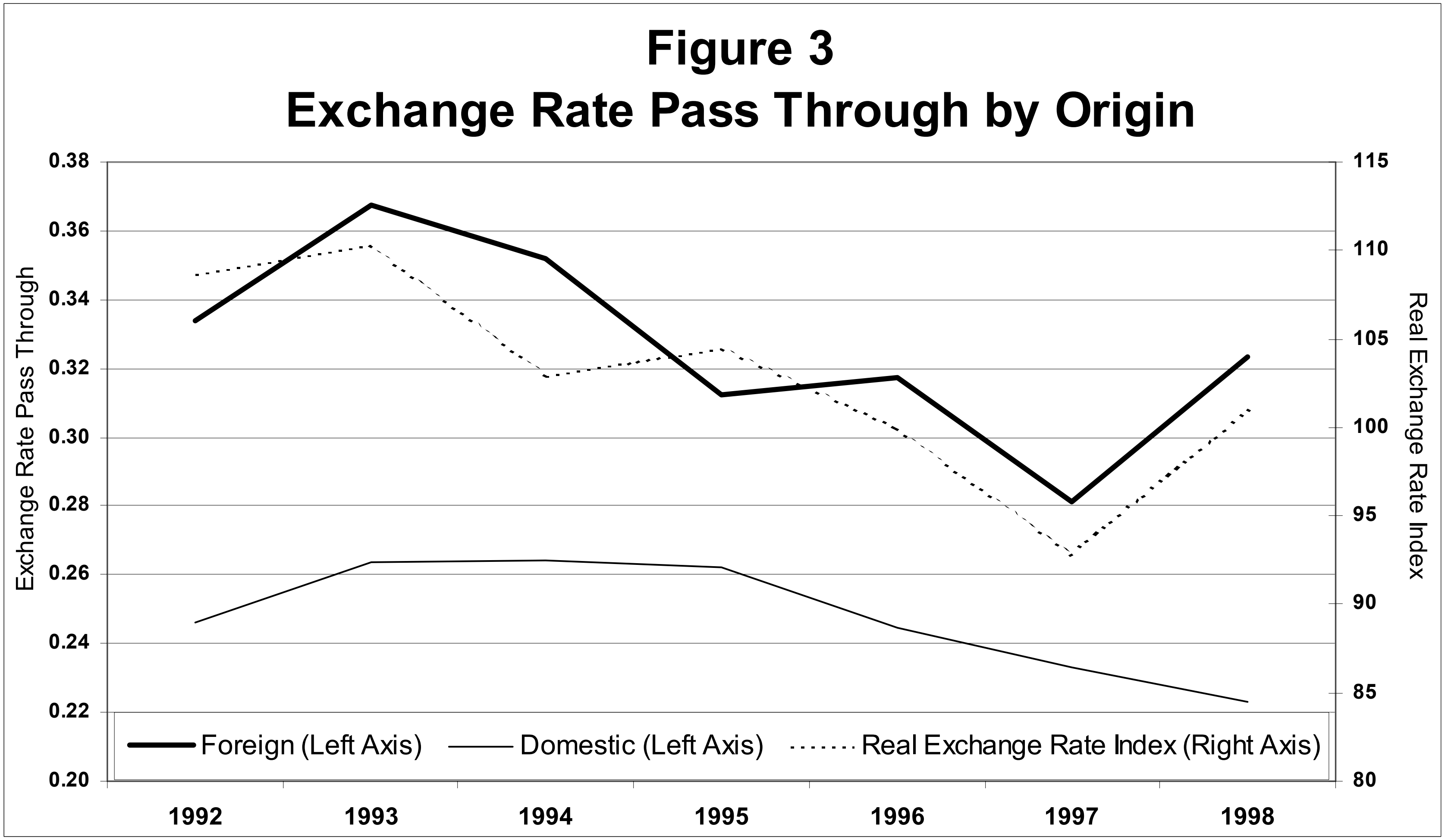


Figure 3
Exchange Rate Pass Through by Origin
Exchange Rate Pass Through
Real Exchange Rate Index
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
115
110
105
100
95
90
85
80
1992
1993
1994
1995
1996
1997
1998
Foreign (Left Axis)
Domestic (Left Axis)
Real Exchange Rate Index (Right Axis)

Table A.1
First Stage Results for Demand

	Coefficient	S.E.
Dimension	-0.553	(0.040)***
HP/W	-1.750	(0.183)***
AC	-0.040	(0.007)***
Pwr Windows	-0.029	(0.008)***
Domestic	0.008	(0.087)
Small	-0.123	(0.060)**
Medium	-0.103	(0.038)***
IV 1	-0.539	(0.260)**
IV 2	-0.098	(0.833)
IV 3	0.003	(0.002)
IV 4	-1.833	(1.611)
IV 5	-2.675	(3.932)
IV 6	0.734	(0.211)***
IV 7	-0.081	(0.056)
IV 8	0.024	(0.108)
IV 9	-0.007	(0.002)***
IV 10	0.064	(0.059)
IV 11	-0.109	(0.165)
IV 12	0.003	(0.002)
IV 13	0.002	(0.000)***
IV 14	0.000	(0.001)
IV 15	-0.008	(0.002)***
IV 16	0.002	(0.001)**
IV 17	-0.004	(0.001)***
1st Stage R^2:	0.860	
F Test of excluded instruments	20.66	
(p-value)	0.00	
Exogeneity Test	19.709	
(p-value)	0.18	

IV1=The average dimension for cars sharing the size cluster
IV2=The average dimension for cars sharing the origin cluster.
IV3=Te average dimension for cars sharing both size and origin cluster.
IV4=The average HP/W for cars sharing the size cluster.
IV5=The average HP/W for cars sharing the origin cluster.
IV6=The average HP/W for cars sharing both size and origin cluster.
ÌV7=The average AC for cars sharing the size cluster.
IV8=The average AC for cars sharing the origin cluster.
IV9=The average AC sharing both size and origin cluster.
IV10=The average of power windows sharing the size cluster.
IV11=The average of power windows sharing the origin cluster.
IV12=The average of power windows sharing both size and origin cluster.
IV13=Total Number of models offered within the size cluster.
IV14=Total number of models offered within the origin cluster.
IV15=Real exchange rate index
IV16=Tariffs. For domestic cars it's the CKD tariff, for imported cars it's the CBU tariff.
IV17=Sales tax,
*** Significant at 1% level; ** 5%; * 10%
Time dummy variables are also included.
The F test is the F test of the excluded instruments

Table A.2
Dependant Variable:lnSjt-lnSot

	Logit	IV logit
α	1.799 (0.605)***	3.024 (1.274)***
Domestic	1.322 (0.111)***	1.308 (0.111)***
Small	1.048 (0.202)***	0.896 (0.221)***
Medium	0.356 (0.136)***	0.228 (0.156)
Dimension	0.239 (0.810)	1.702 (1.206)
HP/W	-1.536 (3.457)	2.867 (4.376)
AC	-0.038 (0.127)	0.032 (0.133)
Pwr Windows	-0.208 (0.136)	-0.132 (0.1433)
Constant	-10.956 (0.914)***	-13.315 (1.708)***

*** Significant at 1% level; ** 5%; * 10%