The Welfare Effects of Trade Liberalization: Evidence from Used Automobiles

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Abstract

This paper investigates the welfare effects of trade liberalization by exploiting a natural policy experiment in the small open economy of Cyprus. A 1993 law relaxed import restrictions on used vehicles and facilitated the flow of used Japanese vehicles into the country. Imported vehicles were of high quality and considerably cheaper than local used cars. This led to a shift of consumer purchases from new to used cars and a substantial expansion of the overall market. We estimate a differentiated product demand system over a 12-year period surrounding the policy change and use the results to calculate the effects on consumer welfare. Estimated consumer welfare gains are of the order of several hundred dollars per purchaser, the exact number depending on the year. Gains of similar magnitude may apply to other countries that import used cars.

Keywords: automobile industry, differentiated products, trade in used goods, trade liberalization.

JEL Classification: F14, L13, L92.

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1 Introduction

It is often said that if there is one thing that all economists agree on, it is in the merits of free trade. This belief is supported by an extensive corpus of international trade theory that demonstrates how gains from trade can emerge through a variety of channels. Classical trade theory focuses on the gains from exchange and specialization; other channels like preference heterogeneity and imperfect competition have become prominent relatively recently. According to the theory, gains from trade can be realized when markets are imperfectly competitive because opening up to trade increases competition between domestic and foreign firms and thus enforces "market discipline". Gains from trade are also realized when consumers have heterogeneous preferences because trade increases the number of product varieties available.

Despite the theory's strong predictions, empirical evidence on the magnitude of gains from trade is somewhat limited. Most of the evidence comes from studies that use firm- or plant-level data from manufacturing surveys to measure the effects of trade liberalization on things like productivity, price-cost margins and product variety. Although they are very informative, these studies have some limitations. Because they use firm-level data, they can not tell us anything about what happens to prices and market shares in specific markets as a result of trade liberalization. Also, trade liberalization is frequently accompanied by other structural changes like financial liberalization, exchange rate adjustments, enforcement of competition policy, etc. Thus it is not obvious that the benefits that these studies often find should be attributed solely to trade liberalization.

In this paper I sidestep these issues by focusing on a specific experiment in trade liberalization in a single market of a small open economy. By doing so I am able to delve deeper into the specifics of the market and isolate the effects of trade liberalization on local market structure, prices and consumer welfare. Even though the particular market may be too small to allow for sweeping general conclusions, I feel that there are important lessons to be drawn from this experience.

The policy under examination is a relaxation of import restrictions on used auto-

mobiles implemented by the Cyprus government in 1993. At that time, the maximum allowable age of an imported used vehicle was raised from two to five years. This policy change facilitated the mass importation of used Japanese vehicles into the country and thus made Cyprus the theater of a fascinating policy experiment. Used Japanese imports came with many extras, they were in very good condition, and were selling at prices considerably lower than those prevailing in the local secondary market at the time. The consequences were dramatic. Registrations of used imports shot up from 7.2% of all first-time car registrations in 1992 to a high of 72.4% in 1998; they have since settled down to about 60%.

I estimate a differentiated product demand system over a 12-year period surrounding the policy change. Demand estimates are used to compute consumer welfare and compare the results to the counterfactual scenario of no policy change. I find that the influx of used cars lead to welfare gains of the order of several hundred dollars per purchaser, peaking at $1,042 in 1998. I also estimate that the new policy led to a sizeable increase in tax revenue for the government.

An additional contribution of this study is that the experiment in question involves used goods. Secondary markets have received considerable attention in the industrial organization literature, yet the ramifications of international trade in used goods have largely been ignored. This may be part of the reason why substantial trade barriers persist in many used good markets, and in particular the market for used automobiles. Many countries maintain severe restrictions on imports of used goods, even as they open up their other markets to foreign competition. Even within "free" trade zones, such as NAFTA and Mercosur, exceptions are made for used goods, and particularly for cars. For example, Mexican tariffs on used cars are not expected to be phased out for another 20 years. Despite these barriers, an international market for used automobiles does exist and it will only get bigger as trade barriers are removed. The policy analyzed in this paper provides an instructive account of the effects of increased trade in used goods.

The paper is organized as follows. Section 2 starts off with a literature review and section 3 discusses the international market for used cars. Section 4 describes the expe-

rience of Cyprus and presents the data. Section 5 presents and estimates a model of the Cyprus automobile market and discusses the welfare implications of the policy change. Section 6 concludes with a summary and a discussion of unresolved issues that call for further research.

2 Literature review

Many micro-econometric studies have exploited the extensive panel datasets that have become available in recent years in an effort to identify the effects of increased trade at the industry and firm level. In one of the first such studies, Levinsohn (1993) coined the "imports-as-market-discipline" hypothesis. He studied Turkey's trade liberalization experiment and found that price-cost margins in most industrial sectors decreased in the aftermath of liberalization. He interpreted this as evidence that trade liberalization increases competition and imposes market discipline. A number of other studies have been produced since, many of which find similar results. Tybout (2001) provides a comprehensive overview of this literature. Overall, the studies find that increased trade causes domestic firms in import-competing sectors to shrink in size, production to be allocated more efficiently among plants of different productivity levels, and price-cost margins to fall.

Few studies have analyzed the effects of trade liberalization on specific markets. One example is Nagaoka and Kimura (1999), who look at the effects of import liberalization in the Japanese oil product market. Another paper by Fershtman and Gandal (1998) is closely related to the present one in terms of the nature of the issue being investigated and the methodology used. In that paper the authors estimate the welfare effects of a supply interruption, the boycott of the Israeli market by a number of automobile manufacturers. They estimate demand for automobiles during and after the boycott and compare consumer welfare in each regime to assess the boycott's impact. Similarly, in this paper I estimate demand before and after the introduction of used imports and compare consumer welfare gains from the policy change.

A small number of empirical papers that deal with the interaction of the new and used markets for cars are worth noting. Bresnahan and Yao (1985) use variations in prices of used cars to assess the impact of emissions standards. Berkovec (1985) develops and estimates a general equilibrium model of the automobile market that features new car production and scrappage. Purohit (1992) finds that used car prices are influenced by changes in the characteristics of new cars. Adda and Cooper (2000) study the effects of scrapping subsidies on car replacement decisions in France. Recently, Esteban and Shum (2002) take a first stab at a dynamic oligopoly model in order to study the interaction of primary and secondary markets.

Sen (1962) was first to point out in a short note the scope for international trade in used machines. He attributed this trade opportunity to differential maintenance costs that arise due to the lower wages in underdeveloped countries. Smith (1974, 1976) developed a formal model incorporating trade in vintage models. Grubel (1980) was first to bring the idea over to consumer goods and in particular cars. He argued for the removal of barriers to free trade in used cars claiming that this would lead to substantial welfare gains for developing countries. A pair of papers by Navaretti, Soloaga, and Takacs (1998, 2000) examine the determinants of used versus new machinery trade using data from U.S. exports of metalworking machine tools. Their results suggest that technological factors, skill constraints and market size may be as important as factor prices in determining the choice of machine. Pelletiere and Reinert (2002a, 2002b) analyzed data on used car import restrictions in a large number of countries and find that the existence of a domestic industry is one of the most important predictors of a restrictive policy.

3 Global trade in used goods

Little is known about global trade in used goods. Standard international trade statistics typically do not distinguish between new and used goods. Clothing is a noteworthy exception. The value of world exports in worn clothing (Harmonized System code 6309) was $990 million in 2001, a tiny amount compared to the $146 billion of new clothing

(HS 61, 62).[1] This discrepancy is somewhat misleading, however, because the value of worn clothing is very small (about $0.73 per kilogram). A more useful measure of the importance of the second-hand market would compare units or weight instead of value. However, weight data are not available for new clothing.[2]

We do know that active global secondary markets exist in the case of some high-priced capital goods such as aircraft or ships. Nonetheless, beyond some scattered sector-specific reports, there appears to be no centralized source of data on the size of international used good markets. The United States is probably an exception in that it has assigned codes for certain used goods – including cars – in the Harmonized System used for tariff calculation. Indicatively, in 2001 the US exported about $17 billion worth of new cars and about $0.7 billion in used cars, while exports of new and used clothing amounted to $6.5 billion and $214 million respectively.[3]

The market for used cars. Until fairly recently, the international market in used cars was limited to high-end vehicles such as antiques, limited editions and models that were sold in some countries but not others. I conjecture that the export of used Japanese cars on a significant scale began in the 1970s.[4] To a large extent, the existence of this market is due to Japan's stringent quality requirements. New cars in Japan are sold with a "shaken", a fitness warranty that is valid for three years. At the end of those three years the shaken can be renewed, albeit at a substantial cost averaging around $1500. Further renewals are required at two-year intervals. The high renewal cost leads many Japanese to replace the cars after the shaken expires, thus creating a large supply of almost-new used cars.[5] Put differently, the strict regulations translate to a higher rate of depreciation in the value of automobiles in Japan than elsewhere in the world. It is exactly this differential in depreciation rates that creates the opportunity for trade in

[1] Source: United Nations COMTRADE database.

[2] A fascinating account of the working of the US second-hand clothing industry is given in "How Susie Bayer's T-Shirt Ended Up on Yusuf Mama's Back" (*New York Times*, March 31, 2000).

[3] Source: United States International Trade Commission online database, DataWeb (`http://dataweb.usitc.gov`).

[4] I base this assertion on the observation that many Japanese export agents advertise the fact the they have been in business since then.

[5] Presumably the purpose of these regulations is to boost the domestic industry.

used automobiles.

Used Japanese automobiles are sold in many countries that drive on the left-hand side of the road. These include Australia, New Zealand, Cyprus, the United Kingdom, and a number of African countries in the continent's southeast. However, the fact that the steering wheel of Japanese cars is on the right is not prohibitive. The BBC reports that eight out of ten of the 450,000 cars imported into Russia (where cars are driven on the right-hand side of the road) in 2001 were used; most probably came from nearby Japan. This is likely to change as the Russian government recently raised duties on second-hand cars in an effort to assist its troubled domestic car industry.[6] The Philippines is another country that used to import used Japanese cars even though it drives on the right; it has now shut down that market. Many other countries also have regulations banning or restricting the importation of used cars. Just an in Russia, these regulations are usually designed to protect the local automobile manufacturing industry. For example, the importation of used cars is severely restricted in the Mercosur countries, India (since 2001), Kenya (since 2000), and others. Even within NAFTA, Mexican tariffs on used cars are not expected to be phased out for another 20 years. On the other hand, Taiwan has recently opened up its market to used cars. The United Kingdom recently relaxed its own restrictions on the importation of used automobiles and the expectation was that this would have an effect on the price of new cars (*Autocar* magazine, October 21, 1998). Pelletiere and Reinert (2002b) construct an index of the degree of used car import restrictions in 132 countries. Only 58 countries are assigned a value of 0, which implies minimal restrictions. Of the rest, 21 countries prohibit the practice outright while the rest impose restrictions of various kinds.

Even countries which do not have a local industry impose restrictions on used car imports. Cyprus was such an example before it changed its policy. Environmental and safety reasons are frequently cited, although the interests of new car dealers are probably foremost in policymakers' minds. Another disadvantage of trade in used goods is that it is more susceptible to fraud. The BBC recently uncovered a large-scale operation that

[6]BBC News, September 1, 2002, `http://news.bbc.co.uk/2/hi/business/2228873.stm`.

Table 1: Imports of used cars in several countries

Country	Year	Cars imported	% of total	Source
Mostly from Japan:				
Australia	1999	25,000		The Age news report
Cyprus	2000	10,000	60	Official national statistics
Kenya	1999	30,000		Associated Press story
New Zealand	2000	116,000	70	Evening Post news report
Philippines	2001	50,000	39	BusinessWorld (Philippines)
Russia	2001	360,000	80	BBC news report
United Kingdom	1998	60,000	ε	Waikato Times (New Zealand)
Mostly from Germany:				
Bulgaria	2001	120,000	90	Bulgarian News Digest
Czech Rep.	1999	145,000	42	Access Czech Rep. Business Bulletin
Estonia	2000	12,000	35	Estonian News Agency
Hungary	2000?	40,000	9	Czech News Agency
Poland	1999	200,000	20	Polish News Bulletin; estimate
Slovakia	2000?	10,000	10	Czech News Agency

moved stolen cars from Japan into the UK.[7] The *New York Times* also recently reported on this problem.[8]

In order to get a sense of the size of this market I searched through news reports looking for information on the number of used cars imported in several countries. The results of this search are presented in Table 1. The first panel lists some of the major destinations of used Japanese cars. The second panel lists a number of East European countries that are also major importers of used cars, most of which come from Germany. The importance of the used car market in many of these countries is immediately apparent both in the sheer number of cars being imported and in their share of the total car market. I have also found reports that West African countries import used cars from France, but I was unable to find any data.

[7] See `http://www.bbc.co.uk/watchdog/guides_to/carfraud/` for the story.

[8] "Japan Battles an Alliance of Gangs That Trades in Stolen Cars" Jan. 6, 2002.

4 The Cyprus experience

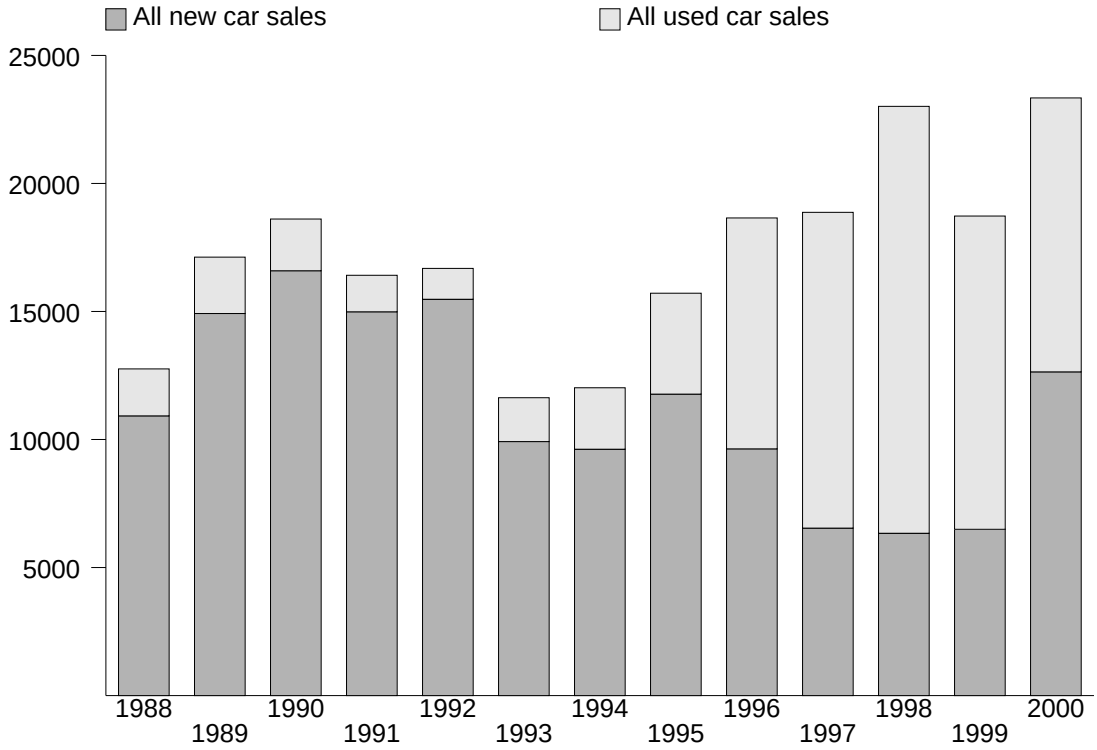
There are no automobile manufacturers in Cyprus, so all vehicles are imported from the major automobile manufacturing countries. The local market operates on an exclusive dealership system. Each manufacturer designates a local dealer who is the sole distributor of his products in Cyprus and thus has substantial market power. Import duties for automobiles were phased out during the 1990s, with the exception of a 10% duty on cars originating from countries outside the European Union. On the other hand, cars are subject to very high consumption taxes: an ad valorem tax which ranges from 80%-130% (depending on automobile size) and a specific (per-unit) tax which also depends on engine size. All these are payable once upon registration.

High taxes on automobiles magnify differences in the value of cars that are caused by the high depreciation rates of automobiles in Japan and thus create an obvious trade opportunity. However, prior to 1993 this trade channel had been blocked by Cyprus legislation that prohibited the importation into the country of cars that were more than two years old. In 1993 this restriction was relaxed and the maximum allowable age of an imported vehicle was raised from 2 years to 5 years. Thus the gates were opened to the mass importation of used Japanese vehicles.

The full effects of the policy change did not appear until 2-3 years later. It took some time for new dealers to enter the market and set up distribution channels. In addition, there was an information problem, as consumers were skeptical about the quality of the new product for which little information was available. In order to overcome consumer hesitation, used car dealers offered warranties and other incentives. Their efforts were effective and by 1995 uncertainty regarding the quality of used imports had essentially been resolved in a positive way. Dozens of new dealers of used cars entered the market following the policy change, most of them dealing exclusively in Japanese imports.

The new state of affairs presented a challenge to new car importers. Their reaction seemed to stem mostly from indignation and they failed to predict the magnitude of the coming change. Most of them opted not to enter the used car market, even though

Figure 1: Sales of new and used cars



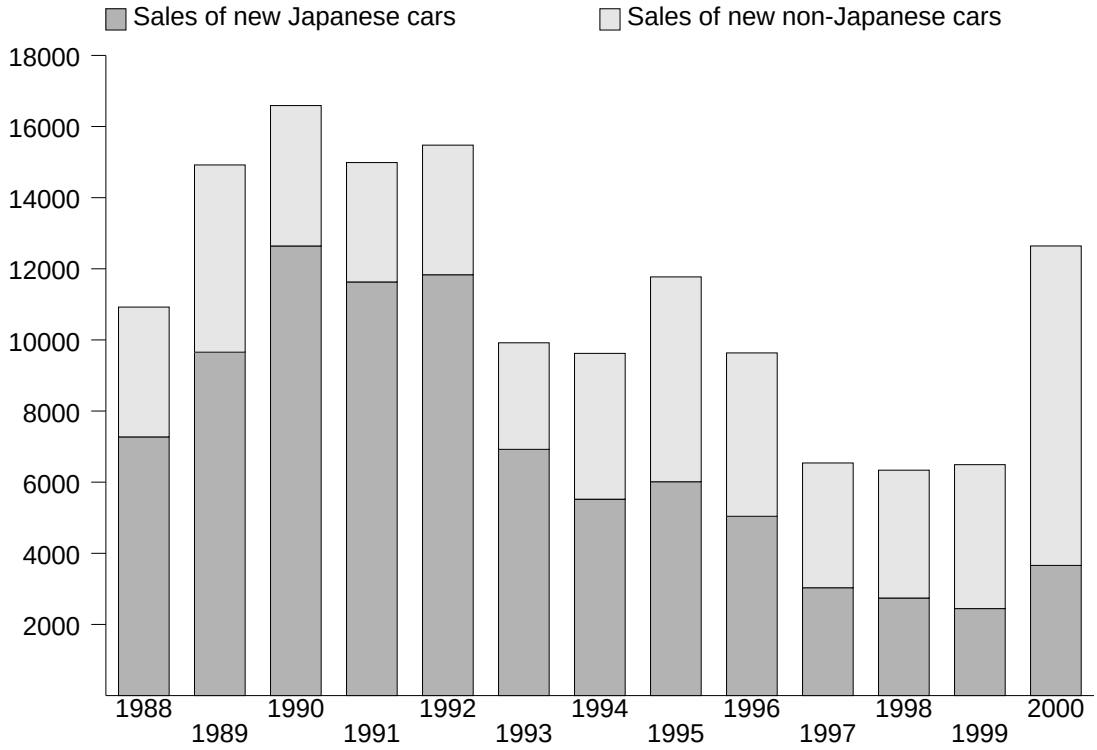
their already established network would probably have put them at an advantage. They also refused to service used imports.[9] Conventional wisdom in the marketplace points to a twofold response by new car dealers to the new competition. First, they lowered prices on new cars or at least resisted raising prices on new models. Second, they offered improved packages at the base price. Equipment that had previously been considered an 'extra' (such as air-conditioning, electric windows, power steering, etc.) became a standard feature. Moreover, they lobbied intensely but without success for the reversal of the policy policy citing safety and environmental concerns or, recently, compatibility issues with European standards.

Data. I have been able to obtain detailed information on car sales from the Cyprus Road Transport Department, which keeps track of vehicle registrations. The data includes information on every car registered in Cyprus between 1971 and 2000. Figure 1 shows annual registrations of new and used cars for the period 1988-2000.[10] The magnitude

[9]The Honda dealer was a notable exception to both of those practices.

[10]Note that these are first-time registrations only and do not include transfers of ownership. Hence they do not include local used car transactions.

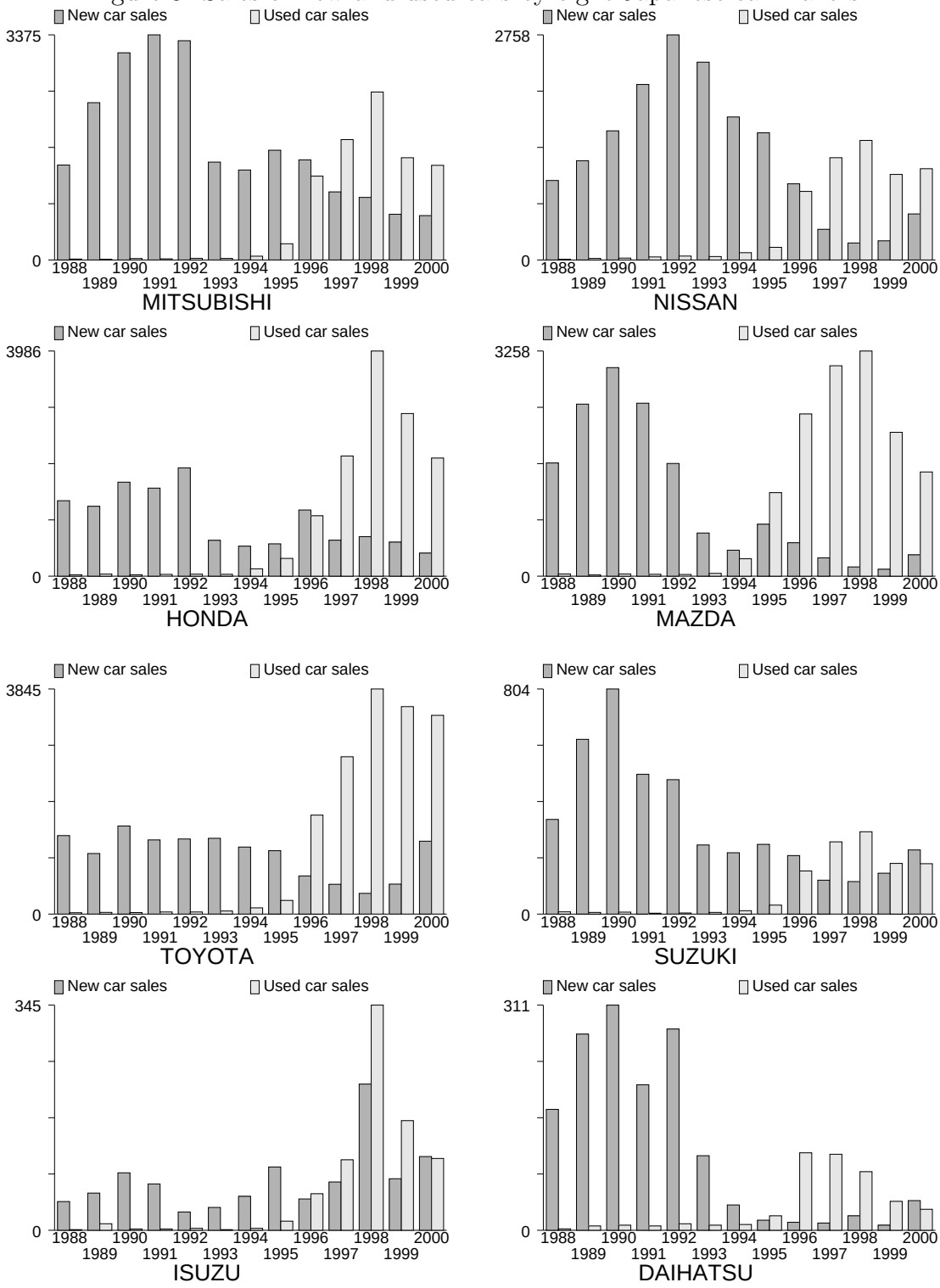
Figure 2: Sales of Japanese and non-Japanese cars



of the effect of the policy change is clearly illustrated in this figure. Starting in 1995, two significant changes become apparent. One is an overall increase in sales volume; the other is a shift in the composition of automobile sales from new to used cars. Figure 2 shows a decomposition of new car sales into Japanese and non-Japanese. While there is a sharp decline in the sales of new Japanese cars, the same cannot be said of vehicles from other (mostly European) countries. This picture suggests that the main losers from the influx of used Japanese cars were new Japanese automobiles. Figure 3 presents the same numbers for eight different Japanese car manufacturers. The shift from new to used automobiles is striking.

The price data come from a local car magazine, Οδηγός & Αυτοκίνητο (Driver & Car). The magazine has been publishing monthly prices of most major models since 1988. Various vehicle characteristics (such as horsepower, weight, fuel efficiency, etc.) are also reported starting in 1995; only engine capacity and number of doors were reported prior to that. This dataset has the benefit of broad coverage but also the disadvantage that different versions of the same model might be reported from year to year. I were

Figure 3: Sales of new and used cars by eight Japanese car makers



also unable to locate all past issues, so data are missing for some months, mostly in the earlier years. The number of models listed per month ranges from 25 to 57.

The price data provide some informal evidence on the reported quality improvement of new cars. For example, Alfa Romeo's Alfa 146L appears in the dataset under that name until July 1995; starting in August 1995 it appears as "Alfa 146L A/C", with the price remaining unchanged. Apparently at that point in time the dealer made air-conditioning part of the standard package. Similarly, the Ford Ka gets the "A/C" at the tail of its name starting in December 1997; the Mitsubishi Carisma in February 1996 (the price rises in this case, only to fall below the original price by September of the same year); the Mitsubishi Lancer in February 1996; and the Seat Ibiza in November 1994 (with price increase).

Prices of used automobiles are not as easy to come by. In many countries market prices of used vehicles are reported in magazines or special publications (widely known as "blue books"). Unfortunately no such publication exists in Cyprus. Nonetheless, I was able to convince one of the biggest dealers of used imports to grant us access to his database. Thus I know the price and characteristics of every car sold by this firm starting in August 1997. As with sales, I have no information on the prices of locally traded used cars.

Table 2 shows new and used car prices for selected models. The prices are averages over the reported years. Moreover, used car prices are averaged over different vintages. The reported price should be thought of as the price of a four-year old model. The differences are quite substantial. The last column reports the ratio of used price to new price. For most models the price of a four-year old used car is less than half that of the new version, while in some cases it is even below 40%.

Table 2: Sales and used prices of new and used versions of selected models

Manufacturer	Model	Sales		Prices (CY£)		
		New	Used	New	Used	P_U/P_N
Honda	Civic	352	793	12,212	5,381	0.44
Honda	CRV	77	95	17,566	7,311	0.42
Honda	Integra	32	177	13,870	6,363	0.46
Mazda	323	194	1,531	8,636	4,318	0.50
Mitsubishi	Colt	128	398	7,580	4,265	0.56
Mitsubishi	Lancer	176	367	8,655	4,913	0.57
Mitsubishi	Pajero	253	369	21,598	10,162	0.47
Nissan	Primera	33	301	11,369	5,935	0.52
Nissan	Sunny	197	43	9,817	4,770	0.49
Suzuki	Swift	21	46	8,657	3,147	0.36
Toyota	Corolla	268	717	9,468	5,338	0.56
Toyota	Land Cruiser	62	109	28,222	10,347	0.37
Toyota	RAV4	47	471	16,209	6,350	0.39
Toyota	Starlet	53	457	8,615	4,107	0.48

Prices are averages over reported years in 1995 Cyprus pounds.

5 A model of automobile demand

The main objective of this paper is to assess the impact of used cars on consumer welfare. This requires dependable estimates of consumer demand. Thus, in this section I specify and estimate a structural model of demand for automobiles. I follow the large recent literature on this topic in employing a discrete choice model of differentiated products.[11]. Our point of departure will be the nested logit model in the form analyzed by Cardell (1997) and Berry (1994). I consider a market with M consumers. Every period t each consumer faces the decision of purchasing one automobile among the J_t choices that are available, or making no purchase (choice $j = 0$). The J_t products are grouped into $G + 1$ disjoint sets, $g = 0, 1, \ldots, G$, which are determined by the econometrician. The outside option is the only member of group 0. Let $\mathcal{J}_g$ denote the set of products in group g. The

[11]See Bresnahan (1987), Berry, Levinsohn, and Pakes (1995), Goldberg (1995), Fershtman and Gandal (1998), Petrin (2002).

utility obtained by consumer i from product $j \in \mathcal{J}_g$ in period t is given by

$$U_{ijt} = e^{\phi a_j} \cdot e^{x_{jt}\beta + \alpha p_{jt} + \xi_{jt} + \zeta_{igt}(\sigma) + (1-\sigma)\varepsilon_{ijt}}. \tag{1}$$

for $i = 1, \ldots, M,\ j = 1, \ldots, J_t,\ t = 1, \ldots, T$. The vector x includes observable product characteristics such as engine size, p is the price and ξ is an unobserved product characteristic. The variable a_j denotes the age of the good, hence the parameter ϕ is a negative number that denotes the depreciation rate of the utility delivered by the good. The term $\zeta_{igt}(\sigma)$ is a group-specific random coefficient that allows goods that belong to the same group to contribute a common component of utility to the individual. The parameter σ measures the extent to which products within the same group are substitutes to each other. As σ tends to 1 the group-specific random coefficient dominates and consumers only consider products from their preferred group. If $\sigma = 0$ the ζ_{igt} term vanishes, meaning that the grouping is irrelevant.

Taking the natural logarithm of (1) gives

$$u_{ijt} = \phi a_j + x_{jt}\beta + \alpha p_{jt} + \xi_{jt} + \zeta_{igt}(\sigma) + (1-\sigma)\varepsilon_{ijt}. \tag{2}$$

The portion of the utility function that is invariant across consumers can be summarized as $\delta_{jt} \equiv \phi a_j + x_{jt}\beta - \alpha p_{jt} + \xi_{jt}$. This is the mean utility each consumer derives from product j; we can also think of δ_j as the mean quality of product j. The option of no purchase (the outside good) delivers utility

$$u_{i0t} = \delta_{0t} + \varepsilon_{i0t}. \tag{3}$$

The outside option may include goods that are not included in the dataset like used cars from the local market, alternative modes of transportation, or even a vehicle the consumer already owns. The mean utility of the outside good can be parameterized as $\delta_{0t} = w_t\gamma$. However, the same effect can be accomplished by subtracting $w_t\gamma$ from δ_{jt} and setting $\delta_{0t} = 0$. In what follows I adopt this normalization because it simplifies the exposition. Note that this specification assumes away income effects.

Every period each consumer chooses from the $J_t + 1$ options the one that maximizes his utility. If the disturbance term ε_{ijt} has the extreme value distribution then analytic

solutions exist for the group shares (denoted by $\bar{s}_g$), for the market share of product j as a fraction of the total group share ($\bar{s}_{j|g}$), for the overall share of product j (s_j), and for the share of the outside good (s_0). The details can be found in Berry (1994); here I just report the relevant expressions. Define $D_g = \sum_{j \in \mathcal{J}_g} e^{\delta_j/(1-\sigma)}$. Then, omitting the time subscript to reduce clutter,

$$\bar{s}_{j|g}(\delta, \sigma) = \left[e^{\delta_j/(1-\sigma)}\right] / D_g \tag{4}$$

$$\bar{s}_g(\delta, \sigma) = \frac{D_g^{(1-\sigma)}}{\sum_g D_g^{(1-\sigma)}} \tag{5}$$

$$s_j(\delta, \sigma) = \bar{s}_{j|g}(\delta, \sigma)\, \bar{s}_g(\delta, \sigma) = \frac{e^{\delta_j/(1-\sigma)}}{D_g^{\sigma} \left[\sum_g D_g^{(1-\sigma)}\right]} \tag{6}$$

$$s_0(\delta, \sigma) = 1 / \left[\sum_g D_g^{(1-\sigma)}\right]. \tag{7}$$

From the expressions above it is easy to derive the following equation that links market shares to prices, car characteristics and the within-group share:

$$\ln(s_{jt}/s_{0t}) = \phi a_j + x_{jt}\beta + \alpha p_{jt} + \sigma \ln(s_{j|g,t}) + \xi_{jt}, \quad j = 1, \ldots, J_t. \tag{8}$$

This is a straightforward linear equation that can be taken to the data. However, estimation of (8) by OLS will yield inconsistent estimates if the error term ξ_{jt} is correlated with price or the within share. This will be the case, for example, if firms observe ξ_{jt} and take it into account when they observe prices. Since this is likely, I address the problem by estimating this equation using instrumental variable methods. I make use of the instruments usually used in this literature: the number of other products in a given product's group and the sum of the characteristics of other products in and outside the group. In addition I use tax rates and the exchange rate which are very good instruments for price.[12]

I note that, because of the policy change, the dataset exhibits uncharacteristically high variation both in the number of models available in different time periods and in the prices of models with similar characteristics. Viewed from the demand side, the policy

[12]Good discussions of instrument choice can be found in Berry, Levinsohn, and Pakes (1995), Bresnahan, Stern, and Trajtenberg (1997) and Fershtman and Gandal (1998). Note that not all possible instruments are used in estimation because of multicollinearity problems.

change had two effects. First, it changed market composition by causing some consumers to switch their choice from a new car to a used car. Second, it expanded the market by enabling consumers who would have otherwise opted out to make a purchase. These substitution patterns are crucial in identifying the demand parameters of the model.

Data issues. Estimation of the demand model presented above required combining the sales and price data which came from different sources. This presented us with two major challenges. First, the sales data did not always identify the car model, especially in the early years of the sample. I handled this by assigning cars to models on the basis of characteristics. Second, the number of models for which prices are available is much smaller than the number of models that have sales. I addressed this problem by estimating a pricing equation with the available price data and then using the results to impute a price for every vehicle. More specifically, I started by transforming prices to pre-tax prices and then I specified price as a function of engine capacity, engine capacity squared, the exchange rate, and year and manufacturer dummies. I estimated separate equations for new and used cars and used the results to impute a price for every car sold.[13] The main advantage of this method is that it enables us to include all sales. The obvious disadvantage is that we are not using actual prices.

As a result of the age constraint for imports and the nature of Japanese regulations, almost all used imports are between three and five years old. The narrowness of this range and the fact that sales of different vintages of the same model are quite small forced us to lump all vintages together in one group. Hence, for the purposes of the demand model, all used cars are assumed to be of the same age. The age variable a_{jt} reduces to a dummy taking the value of 0 for new cars and 1 for used cars, and the parameter ϕ measures the four-year depreciation rate.

I estimated this model using Cyprus data over the period 1989-2000. As is common in the models of automobile demand, I split the products into groups according to size. I created three size categories (small, medium, large), each of which is split according to

[13]In the used car pricing equation it was not possible to identify both the exchange rate and year dummies because all cars come from the same country. I chose to use the exchange rate.

Table 3: Demand estimates

	OLS		**IV**		**IV (new only)**	
Structural parameters						
α	-1.76e-5**	(6.02e-6)	-2.59e-4**	(7.39e-5)	-4.03e-4**	(1.52e-4)
σ	0.830**	(0.018)	0.401**	(0.117)	-0.579	(0.360)
ϕ	0.036	(0.085)	-1.938**	(0.642)		
Model characteristics						
Engine size	-1.677**	(0.211)	1.041†	(0.562)	4.463*	(1.900)
(Eng. size)^2	0.273**	(0.041)	0.304**	(0.109)	-0.079	(0.141)
Engine power	-0.002†	(0.001)	-0.004*	(0.002)	-0.007†	(0.004)
Diesel	0.354**	(0.111)	-0.465†	(0.248)	0.013	(0.550)
Cylinders	0.057	(0.047)	0.244†	(0.130)	0.725*	(0.301)
Country dummies (relative to Japan)						
CzechRep	-0.496**	(0.136)	-1.797**	(0.325)	-2.784**	(0.791)
England	-0.640**	(0.081)	-0.023	(0.198)	-0.146	(0.331)
France	-0.777**	(0.076)	-0.699**	(0.159)	0.314	(0.209)
Germany	-0.728**	(0.076)	0.730*	(0.292)	1.803**	(0.688)
Italy	-0.783**	(0.087)	-0.723**	(0.134)	-0.377	(0.247)
Korea	-0.108	(0.098)	-0.639**	(0.207)	-1.465**	(0.468)
Russia	-0.602**	(0.090)	-2.000**	(0.367)	-2.961**	(0.958)
Spain	-0.947**	(0.160)	-1.392**	(0.167)	-2.272**	(0.509)
Sweden	-1.512**	(0.199)	0.680	(0.632)	1.246	(1.010)
Year dummies (relative to 1989)						
1990	-0.027	(0.096)	-0.024	(0.188)	0.007	(0.367)
1991	-0.164*	(0.084)	-0.405*	(0.197)	-0.627	(0.419)
1992	-0.156†	(0.083)	-0.220	(0.187)	-0.360	(0.387)
1993	-0.715**	(0.105)	-0.590**	(0.201)	-0.319	(0.374)
1994	-0.603**	(0.113)	-0.926**	(0.222)	-1.143*	(0.479)
1995	-0.244*	(0.106)	-0.059	(0.187)	0.061	(0.368)
1996	-0.078	(0.089)	0.126	(0.195)	0.139	(0.390)
1997	0.289**	(0.105)	0.247	(0.190)	0.329	(0.482)
1998	0.536**	(0.106)	0.135	(0.210)	-0.010	(0.507)
1999	0.286**	(0.104)	0.187	(0.199)	0.038	(0.512)
2000	0.201*	(0.098)	0.150	(0.192)	0.018	(0.527)
Intercept	-3.126**	(0.240)	-6.575**	(0.608)	-14.848**	(3.140)
Number of obs		1039		1039		759
Hansen J statistic (χ^2)			2.505 (p-val: 0.286)		2.505 (p-val: 0.474)	
F-test	131.07 (p-val: 0.0000)		13.91 (p-val: 0.0000)		5.70 (p-val: 0.0000)	
Root MSE		.598		1.067		1.9289

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1% .
Reported standard errors are robust to heteroscedasticity.

the continent of origin (Europe or Asia). Finally, sport utility vehicles make up a group of their own. Overall, we have seven groups: small Asian, small European, medium Asian, medium European, large Asian, large European, and SUVs. Estimation results are presented in Table 3. In comparing OLS and IV estimates, recall that the OLS estimate of elasticity will be biased towards zero if the endogeneity problem exists. This is clearly the case here. The coefficient on price rises substantially when we instrument for price. The price elasticities corresponding to the reported coefficients are 1.15 with OLS versus 5.02 with IV. The value of the σ coefficient means that there is a correlation of 0.4 between consumer preferences for models belonging to the same group. The ϕ coefficient implies that the utility obtained from a used car is about 14.4% of that of a new car with the same characteristics. Given that the typical used car is four years old, this implies a somewhat high depreciation rate. Estimated coefficients on model characteristics with the exception of engine power which is probably highly correlated with engine size. The signs on country dummies also seem reasonable: German and Swedish cars are highly regarded. The year dummies proxy for changes in the outside good. It is not clear why 1993 and 1994 were bad years for the automobile market. Inclusion of GDP instead of the time dummies does not help explain that as that coefficient is statistically insignificant.

Recall that models of automobile demand are typically estimated using sales of new cars only. We would like to know how much the inclusion of the secondary market affects parameter estimates. To that end, I estimated the model using only new models; results are reported in the third pair of columns in Table 3. The within-share parameter σ comes out negative, which indicates possible misspecification. Nonetheless, since the hypothesis $\sigma = 0$ cannot be rejected I proceeded to calculate price elasticity using $\sigma = 0$. The estimated elasticity is 5.75, which is close to the estimate obtained with the full sample. Thus the common practice of ignoring the secondary market seems to hold up quite well with respect to price elasticities, but not with respect to the nesting.

Welfare. With estimates obtained from the nested logit demand system in hand, I now proceed to compute welfare as shown by Trajtenberg (1989). The welfare measure is

Figure 4: Actual and counterfactual sales

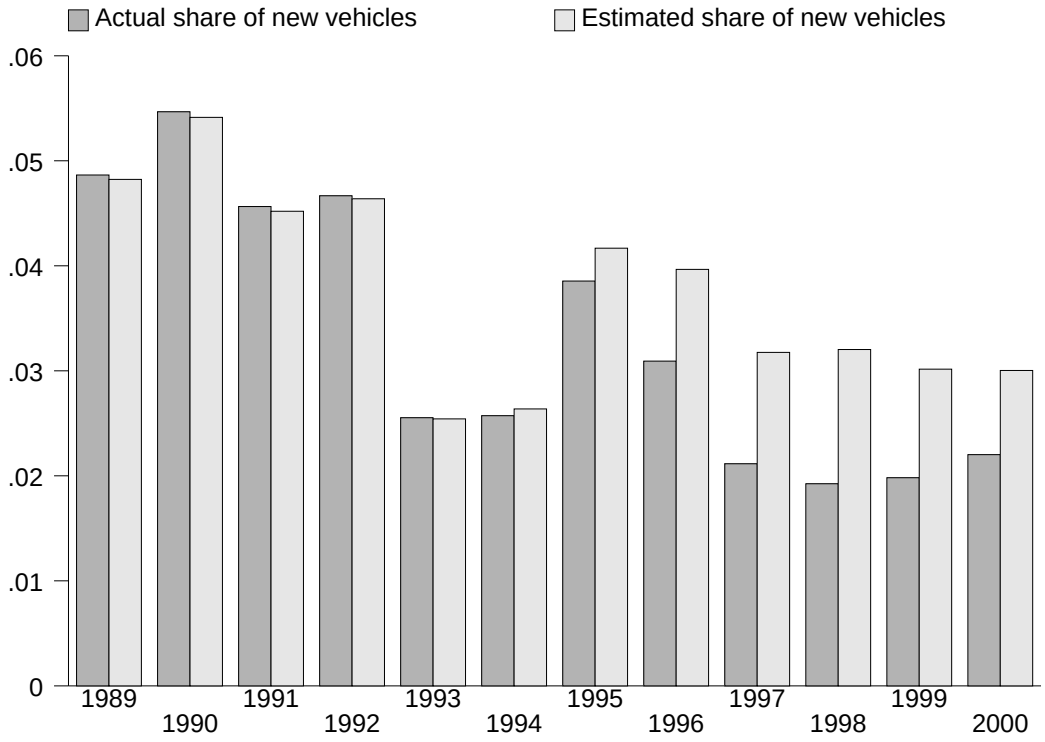


Table 4: Welfare gains and effects on tax revenue

	Counterfactual scenario 1		Counterfactual scenario 2		CF 1
Year	US$ per purchaser	Aggregate (US$ million)	US$ per purchaser	Aggregate (US$ million)	Δ(tax revenue) (US$ million)
1994	11	.1	11	.1	1.2
1995	73	.9	180	2.3	3.4
1996	321	4.3	416	5.7	12.4
1997	671	8.3	754	9.2	32.6
1998	1,048	14.4	1,142	15.5	45.1
1999	615	7.9	696	8.8	34.5
2000	468	6.1	552	6.9	31.4

All figures are in US dollars, converted from 2001 Cyprus pounds at the exchange rate CYP 1 = USD 1.7.

given by

$$W = \frac{1}{\alpha} \ln \left[\sum_g D_g^{(1-\sigma)} \right] + C, \tag{9}$$

where C is the constant of integration.[14] In order to gauge the welfare effects of the policy change I will compare the actual welfare received by consumers to the counterfactual scenario where no used imports are allowed into the market. The counterfactual scenario is easy to implement using our framework. We simply remove all used cars from the choice set, re-compute market shares of new cars under this scenario, and then calculate welfare. The difference between the actual and counterfactual welfare measures gives us the welfare gain by consumers.[15] Figure 4 shows the actual total market share of new cars as well as the counterfactual shares. The model predicts that – in the absence of used imports – new cars sales would have risen in 1995 and 1996, only to fall again thereafter. The welfare results of this change are tabulated in Table 4 under the heading 'Counterfactual scenario 1'. The first column gives welfare gain per purchaser and the second one aggregates over all purchasers. In the first years gains are small as few used car models are available. In 1996 the gains per purchaser reach \$321 and in 1998 they peak at \$1,048. This amount is a substantial proportion of family income. The total welfare gain over the seven year period 1994-2000 amounts to \$42 million.

Our counterfactual scenario assumes that prices and characteristics of new cars would be the same under the counterfactual as they are in reality. This is probably not the case. Evidence from the CPI suggests that new car prices actually decreased in the second half of the 1990's. Moreover, the quality of new cars reportedly increased after the influx of used imports through an improvement in the base package offered. Our inability to account for these changes implies that our welfare estimate is a lower bound. One way to correct for this is to model the supply side and use an equilibrium assumption to predict prices for the counterfactual. Alternatively, one can try to get a sense of the bias by entertaining different hypotheses on what new car prices would have been in the absence of used imports. 'Counterfactual scenario 2' in Table 4 reports welfare effects of one such

[14] It is easy to verify that differentiating this expression with respect to price delivers the demand equation in (4) above.

[15] The calculation is essentially the same as in Fershtman and Gandal (1998).

hypothesis where I assume that in the absence of used imports new car prices would have been 10% higher. The additional welfare gain from the reduction in prices is relatively small. As in Fershtman and Gandal (1998), most of the welfare gain for consumers comes from variety as opposed to price changes.

Finally, the model allows us to estimate the new policy's impact on public finances. There are two effects. On one hand, tax revenue per car decreased because of the decrease in prices and the shift to cheaper used cars. On the other hand, more cars were sold. The last column of Table 4 shows the effects on government tax revenue by year under counterfactual scenario 1. The sales effect outweighs the price effect, leading to a sizeable increase in tax revenue. I have yet to confront those calculations with actual data on tax revenues. Given that there have been widespread reports of tax evasion by used car importers, it is very likely that the predicted revenue increase did not materialize.

Robustness. The welfare results of this model are quite robust to various specifications and different methods of aggregating individual car registrations. Nonetheless, the model could be improved in a number of ways. The most severe limitation is probably the abstraction from income effects. In a future version of this paper I aim to estimate a model that allows for income effects, which will enable me to assess the distributional impact of the policy. Estimation of a full random coefficients model would improve demand estimates and allow for sharper predictions. Further, the inclusion of a supply side to the model would enable us to test whether the nature of competition among new car models changed following the influx of used cars.

6 Summary and conclusions

This paper exploits the policy experiment of opening the Cyprus car market to used Japanese automobiles to investigate the effects of trade in used goods. I find substantial welfare gains that exceeded $1,000 per purchaser in one year, while I estimate that government also benefited because of an increase in tax revenue. It is likely that gains of similar magnitude accrue to consumers in other countries that have been on the receiving

end of international trade in used cars.

The magnitude of these results is significant given the large and largely undocumented volume of international trade in used cars. Moreover, the scope for even more trade in this market is extremely large. One can only begin to wonder what would happen if Mexico and India were to abolish tariffs and other import restrictions on used cars and start importing them in the millions from the United States or Japan. Here it is important to note that the results in the present study were obtained in a country that has no automobile manufacturing of its own and hence the only people who are hurt by this policy is a small number of new car dealers. Things will be different in a country that has – or wants to develop – a domestic car manufacturing industry.

It is also worth noting that the exporting country is also likely to benefit from trade in used goods. The demand from abroad will raise the value of local goods and hence increase the welfare of local consumers. The effect on manufacturers is less obvious. On one hand they lose sales in the foreign country which switches to used cars. On the other hand the rise in the trade-in value of their cars may induce domestic consumers to replace their vehicles more often. Given that sales in the foreign country are small to begin with, the latter effect may very well outweigh the former.

Opponents of used car imports usually cite environmental and safety concerns. Although the right response to that seems to be a good inspection system rather than the prohibition of trade, one might counter such a system is expensive and often impractical to put in place. Although I do not address this question in this paper, I hope to be able to study the effects of this policy in the quality of the car stock in future work.

The usefulness of this study is not confined to a single industry but relates to the issue of trade liberalization in general. Our findings serve as an indication of the impact of trade liberalization in other areas of the economy. At a time when the debate on the merits and perils of globalization is getting heated, it is important to be able to draw lessons from specific experiments in trade liberalization.

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