

# Gains from Trade in Used Goods: Evidence from the Global Market for 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. This led to a dramatic shift of consumer purchases from new to used cars and a substantial expansion of the overall market. Estimated welfare gains are of the order of several hundred dollars per purchaser. The findings are indicative of the potential for substantial gains from liberalizing trade in used goods, which could also alter trade flows and production.

*Keywords:* automobile industry, differentiated products, gains from trade, 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 body of international trade theory that demonstrates how gains from trade can arise through a variety of channels. Classical trade theory has focused on the gains from pure exchange and from specialization. More recent work has emphasized other channels such as preference heterogeneity and imperfect competition. For example, gains from trade can be realized when markets are imperfectly competitive because opening up to trade increases competition between domestic and foreign firms. Or, when consumers have heterogeneous preferences, trade can raise welfare by increasing the number of product varieties available to consumers.

Despite economists' strong convictions, free trade remains a highly controversial issue. At least part of the reason is that empirical evidence on the existence and magnitude of gains from trade is surprisingly tenuous. This is not due to lack of effort; applied economists have produced numerous papers aiming to assess the impact of trade on the world's economies. Although the overall evidence is generally thought to be positive, it is certainly not conclusive. The macro literature has used cross-country growth regressions as the main tool to investigate the link between trade with economic growth. The idea is that if open economies grow faster, this would be evidence of the benefits of trade. Most studies find some evidence linking trade and growth but the conclusion is tainted by methodological and data problems.<sup>1</sup>

Micro studies aim to identify the effects of trade at the industry and firm level. They use firm- or plant-level data from manufacturing surveys to measure the effects of trade liberalization on things like productivity, price-cost margins, product variety, and technological diffusion. An early example is Levinsohn's (1993) study of Turkey's trade liberalization experiment. The author found that price-cost margins in most industrial sectors decreased in the aftermath of liberalization. He interpreted this as evidence that trade liberalization imposes "market discipline" by increasing competition. Many other studies have been produced since, many of which report similar findings. According to Tybout's (2003) comprehensive overview of this literature, 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.

These studies have contributed immensely to our understanding of firm responses to policy

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<sup>1</sup>Supplementary evidence comes other sources, such as country studies. See Harrison and Hanson (1999) and Rodriguez and Rodrik (2001) for critical overviews of the macro literature.

instruments, but they do have some limitations. Because they use firm-level as opposed to product-level data, they have little to say 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, better enforcement of competition policy, etc. It is not always obvious that the benefits documented in these studies 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 product market of a small economy.<sup>2</sup> By doing so I am able to focus on 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, the strength of the results and the uniqueness of the setting are highly instructive. Specifically, in 1993 Cyprus relaxed import restrictions on used automobiles by raising the maximum allowable age of an imported used vehicle from two to five years. This policy change facilitated the mass importation of used Japanese vehicles into the country and made Cyprus the theater of a fascinating policy experiment. Used Japanese imports were in very good condition, they came with many extras, 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%. This change was driven by two effects. First, there was a switch from new cars to used imports. Second, there was an overall market expansion as many consumers saw the opportunity to upgrade their existing car or buy a second one. There is also evidence that prices of *new* cars dropped in the aftermath of the policy change, presumably as a response to increased competition.

In order to quantify the welfare impact I estimate a differentiated product demand system for the Cyprus automobile market. 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 led to welfare gains of the order of several hundred dollars per purchaser, peaking at over a thousand dollars in 1998. Interestingly, most of the gains were due to the introduction of new products rather than the drop in prices of existing products. This finding provides strong support for theories suggesting that increased product variety is an important benefit of trade liberalization, perhaps more important than increased competition. I also estimate that the new policy led to a sizeable increase in tax revenue for the government.

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<sup>2</sup>Few studies have analyzed the effects of trade liberalization on specific markets. One exception is Nagaoka and Kimura (1999), who study the effects of import liberalization in the Japanese oil product market. The authors argue that liberalization lowered prices by causing the collapse of the domestic oil cartel.

An additional important contribution of this study is that it brings attention to international markets for 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 at least 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 until 2019. Despite these barriers, an international market for used automobiles does exist and it can only get bigger as trade barriers are removed. The policy analyzed in this paper provides an instructive account of the possibilities opened by increased trade in used goods and points to interesting questions regarding its possible effects on international trade flows and production.

## 2 Global trade in used goods and the market for used cars

Sen (1962) is thought to have been the first to point out 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. The implication is that used machines should be exported from high-wage to low-wage countries. Smith (1974, 1976) and Bond (1983) used this insight to develop formal models incorporating trade in vintage models.<sup>3</sup> 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. Panagariya (2000) has also made this point forcefully in the Indian context.

The impact of these arguments is difficult to gauge. Standard international trade statistics typically do not distinguish between new and used goods. Active global secondary markets do exist for some high-priced capital goods such as aircraft, ships, and weapons. Nonetheless, beyond some scattered sector-specific reports, there appears to be no centralized source of data on the size of international used good markets. Clothing is a noteworthy exception. The value of world exports in worn clothing (Harmonized System code 6309) was \$990 million in 2001, a

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<sup>3</sup>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.

tiny amount compared to the \$146 billion of new clothing (HS 61, 62).<sup>4</sup> This discrepancy is somewhat misleading, however, because the value of worn clothing is very small (about \$0.73 per kilogram). An alternative measure of the significance of the second-hand market would compare units or weight instead of value. However, weight data are not available for new clothing.<sup>5</sup> 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.<sup>6</sup>

Historically, trade 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 reckon that the export of used Japanese cars on a significant scale began in the 1970s.<sup>7</sup> 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. For the shaken to be renewed at the end of the three years the vehicle has to go through a rigorous and costly inspection process. Reported estimates of the average inspection cost start at \$1000 and get as high as \$2500. Non-pecuniary costs like time lost are also said to be substantial. Further renewals are required at two-year intervals. The high renewal cost leads many Japanese consumers to replace the cars after the shaken expires, thus creating a large supply of high quality used cars.<sup>8</sup> Put differently, the strict regulations translate to a higher rate of depreciation in the value of automobiles in Japan than in other countries with looser regulations. It is exactly this differential in depreciation rates that creates the opportunity for trade in used cars.<sup>9</sup>

As a result, used Japanese automobiles are exported to many countries where cars are driven on the left-hand side of the road and have their steering wheel on the right. These include Australia, New Zealand, Cyprus, a number of countries in the southeastern part of Africa, and even faraway United Kingdom. The fact that the steering wheel of Japanese cars is on the right is not prohibitive. According to a *New York Times* report, 200,000 used cars were imported from

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<sup>4</sup>Source: United Nations COMTRADE database.

<sup>5</sup>A fascinating account of the working of the US second-hand clothing industry can be found in “How Susie Bayer’s T-Shirt Ended Up on Yusuf Mama’s Back” (George Packer, *New York Times*, Mar. 31, 2000).

<sup>6</sup>Source: United States International Trade Commission online database, DataWeb (<http://dataweb.usitc.gov>).

<sup>7</sup>I base this conjecture on the observation that many Japanese export agents advertise the fact the they have been in business since then.

<sup>8</sup>For an account of the effects of the shaken policy see “Used Cars in Japan: Young Bangers”, *The Economist*, Dec. 21, 1991, p.85.

<sup>9</sup>Clerides and Hadjiyiannis (2004) develop a theoretical model that shows how asymmetric quality standards can give rise to trade in used durable goods. They also show that high quality standards may be an indirect way of boosting the domestic industry.

Japan into Russia (where cars are driven on the right-hand side of the road) in 2002.<sup>10</sup> Many cars also also imported into Russia from the west; a BBC report puts the total of used cars imported into Russia in 2001 at 360,000. 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.<sup>11</sup> A recent *Wall Street Journal* report claims that about one million used cars worth \$2.7 billion are exported every year from Japan.<sup>12</sup>

Russia is not alone in trying to limit the inflow of used vehicles. Many other countries also have regulations banning or restricting the importation of used cars. Just as 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), the Philippines (since 2002), Kenya (since 2000), and others. Even within NAFTA, Mexican tariffs on used cars have been allowed a long phase-out period that will begin in 2006 and be completed in 2019. Pelletiere (2003) constructed an index of the degree of used car import restrictions in 132 countries. Only 58 countries are assigned a value of zero, which implies minimal or no restrictions. Of the rest, 21 countries prohibit the practice outright while the rest impose restrictions of various kinds. Pelletiere and Reinert (2004) find that the existence of a domestic industry is one of the most important predictors of a restrictive policy.

Even countries without 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 argument against trade in used goods is that it is more susceptible to fraud. The BBC recently uncovered a large-scale operation that moved stolen cars from Japan into the UK.<sup>13</sup> The *New York Times* also recently reported on this problem.<sup>14</sup>

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 western Europe. The importance of the used

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<sup>10</sup>“Japan’s Used Cars Find New Lives On Russian Roads” (James Brooke, *New York Times*, Feb. 12, 2003).

<sup>11</sup>“Russia Hammers Used Car Imports,” BBC News, Sep. 1, 2002, available at <http://news.bbc.co.uk/2/hi/business/2228873.stm>.

<sup>12</sup>Todd Zaun and Jason Singer, “Driving Change: How Japan’s Second-Hand Cars Make Their Way to Third World; Sophisticated Market Handles Big Used-Vehicle Surplus; Way Station in Dubai; Odyssey of a White Corolla,” *The Wall Street Journal* (Eastern edition), Jan. 8, 2004.

<sup>13</sup>See [http://www.bbc.co.uk/watchdog/guides\\_to/carfraud/](http://www.bbc.co.uk/watchdog/guides_to/carfraud/) for the story.

<sup>14</sup>“Japan Battles an Alliance of Gangs That Trades in Stolen Cars” Jan. 6, 2002.

Table 1: Imports of used cars in selected countries

<i>Mostly from Japan:</i>			<i>Mostly from western Europe:</i>		
Country	Year	Used cars imported	Country	Year	Used cars imported
Australia	1999	25,000	Bulgaria	2001	120,000
Cyprus	2000	10,000	Czech Rep.	1999	145,000
Kenya	1999	30,000	Estonia	2000	12,000
New Zealand	2000	116,000	Hungary	2000	40,000
Philippines	2001	50,000	Poland	1999	200,000
Russia	2002	200,000	Russia	2001	160,000
United Kingdom	1998	60,000	Slovakia	2000	10,000

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.

### 3 The policy experiment

There is no automobile production in Cyprus; 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 taxes 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. 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. Asymmetric information was also a problem; 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.<sup>15</sup> 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 their already established network should have put them at an advantage. They also refused to service used imports.<sup>16</sup> 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 citing safety and environmental concerns or, recently, compatibility issues with European standards.

***Sales data.*** I have obtained 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 1988 and 2000. Figure 1 shows annual registrations of new and used cars for that period.<sup>17</sup> The magnitude 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 decomposes car imports into those coming from Japan versus those coming from all other countries. As expected, there is a sharp decline in the sales of new Japanese cars. On the other hand, there seems to be very little impact on sales 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. This is to be expected to a certain extent, since the two are close substitutes. Nonetheless, the apparent lack of any impact on sales of new European cars is striking. An alternative decomposition if provided is Figure 3. Cars are divided into four categories: small, midsize, large, and SUVs. Although used car sales increased in all four

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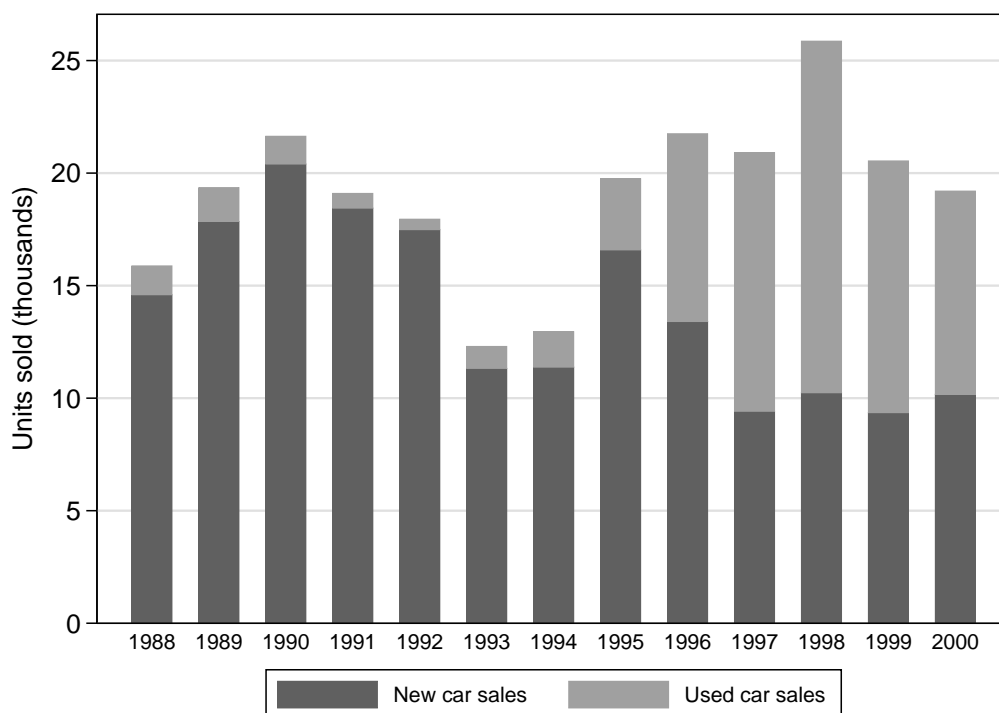
<sup>15</sup>In other words, there was no “lemons” problem. This is consistent with a number of studies that find little or no evidence of adverse selection in the used car market; for example, Bond (1982), Genesove (1993), Porter and Sattler (1999).

<sup>16</sup>The Honda dealer was a notable exception to both of those practices.

<sup>17</sup>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 1: Sales of new and used cars

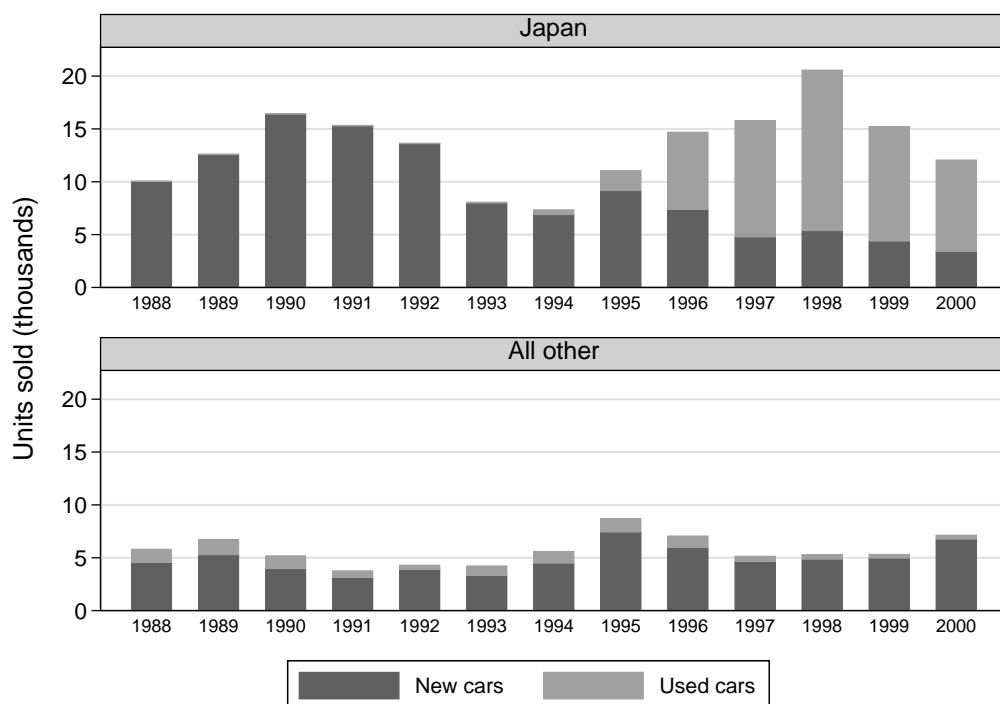


categories, the bulk of the increase seems to be in the midsize category. New car sales dropped dramatically in the small and midsize categories, but the drop was smaller (if any) for large cars and SUVs. Overall, the latter two categories experienced the biggest proportional increase in total sales. This suggests a shift in the size distribution of cars over time, from smaller to larger cars.

**Price data.** 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 was 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

Figure 2: Sales of new and used cars by origin

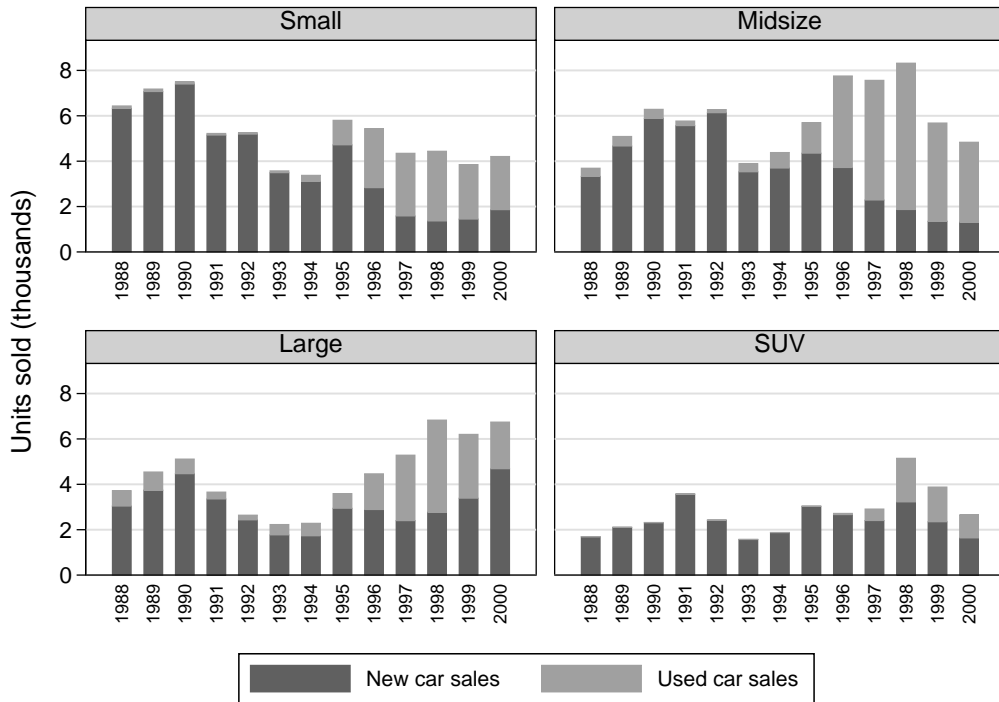


July 1995; starting in August 1995 it appears as “Alfa 146L A/C”, with the price remaining unchanged. Apparently at that point in time the dealer made air-conditioning part of the standard package. Similarly, the Ford Ka gets the “A/C” at the tail of its name starting in December 1997; the Mitsubishi 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. Fortunately, I was able to convince one of the biggest dealers of used imports to grant me access to his database. Thus I know the price and characteristics of every car sold by this dealer 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. Although the price differences

Figure 3: Sales of new and used cars by size



are substantial in absolute terms, the ratio of used price to new price (reported in the last column) is not strikingly different from the residual value of a typical model in a developed country. The price of a four-year old used car ranges from 36-57% that of the new version. The fact that there is so much demand for used cars at these prices is indicative of the high used car prices that must have prevailed in the local market prior to the introduction of used imports. It also reflects the fact the same percentage difference reflects a much larger difference in absolute prices in Cyprus than elsewhere because of high taxes.

#### 4 Impact on new car prices

The data presented in the previous section show a dramatic impact of the loosening of restrictions on used car imports on new car sales. One might expect that the increased competition of used imports also had an effect on new car prices. I test for this by estimating hedonic pricing equations of automobile prices on a set of firm and year dummies and on a number of characteristics. In addition, I control for exchange rate fluctuations as they shift importers'

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

Manufacturer	Model	Price new ( $P_N$ )	Price used ( $P_U$ )	Ratio $P_U/P_N$
Honda	Civic	12,212	5,381	0.44
Honda	CRV	17,566	7,311	0.42
Honda	Integra	13,870	6,363	0.46
Mazda	323	8,636	4,318	0.50
Mitsubishi	Colt	7,580	4,265	0.56
Mitsubishi	Lancer	8,655	4,913	0.57
Mitsubishi	Pajero	21,598	10,162	0.47
Nissan	Primera	11,369	5,935	0.52
Nissan	Sunny	9,817	4,770	0.49
Suzuki	Swift	8,657	3,147	0.36
Toyota	Corolla	9,468	5,338	0.56
Toyota	Land Cruiser	28,222	10,347	0.37
Toyota	RAV4	16,209	6,350	0.39
Toyota	Starlet	8,615	4,107	0.48

Prices are averages over reported years in 1995 Cyprus pounds.

marginal cost. I follow Goldberg and Verboven (2001) in specifying the regression function in the following way:

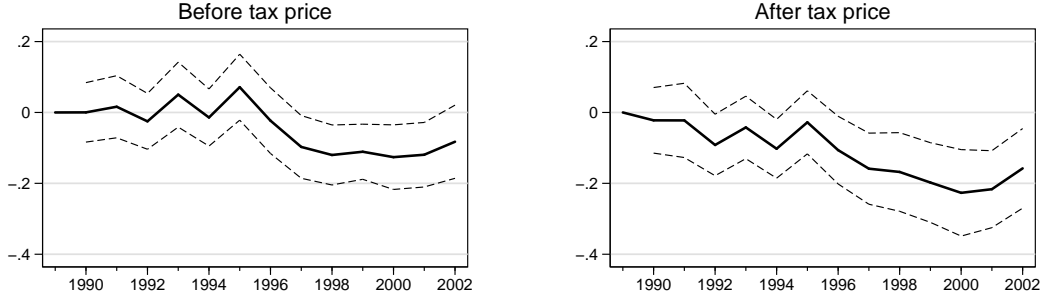
$$p_{it}^e = w'_{jt}\beta + \theta_m + \theta_t + \beta_p e_{ct} + \varepsilon_{it}. \quad (1)$$

where  $p_{it}^e$  is the natural logarithm of price (either before tax or after tax) expressed in exporter currency;  $w$  is a vector of product characteristics;  $\theta_m$  and  $\theta_t$  are sets of make and year dummies respectively;  $e_{ct}$  is the exchange rate of the exporting country, measured as units of exporter currency per Cyprus pound. The coefficient  $\beta_p$  is called the exchange rate pass-through or pricing-to-market coefficient. It measures the proportion of an exchange rate shock that is absorbed by the importer. If the importer absorbs exchange rate fluctuations completely then local prices are immune to exchange rate variation and  $\beta_p$  will take the value of 1. If, on the other hand, the entire change in exchange rate is passed on to the market price we will have  $\beta_p = 0$ .

The results are best viewed graphically.<sup>18</sup> The coefficients on the year dummies represent the premium paid on a particular model relative to its 1989 price, after we control for quality and exchange rate fluctuations. Thus a plot of the coefficients against the year shows the trend in quality-adjusted prices over time. This is displayed in Figure 4 for two specifications. One specification uses price before tax as the dependent variable while the other uses price after tax. The two figures look quite similar. Apart from year-to-year fluctuations, they both show

<sup>18</sup>Full results are available upon request.

Figure 4: Evolution of quality-adjusted prices of new cars



The bold line plots year dummy coefficients from equation (1); dashed lines show the 95% confidence interval.

Table 3: Structural break tests

	Price before tax		Price after tax	
TREND	0.002	(0.004)	-0.009*	(0.004)
POST96	-0.109**	(0.032)	-0.059*	(0.030)
Exchange rate	1.022**	(0.020)	1.016**	(0.017)
Number of obs	214		273	
$R^2$	.9983		.9978	

Significance levels : † : 10% \* : 5% \*\* : 1%. Results are obtained from estimating equation (2). Heteroscedasticity-consistent standard errors given in parentheses.

a substantial one-time drop in prices after 1996. This roughly coincides with the time that the sales of used autos started taking off. Although it is not possible to link this price drop directly to used imports, it seems likely that they were the main force behind it.

In order to quantify the price drop I estimated a variant of equation (1) where year dummies are replaced by a trend variable and a dummy variable that aims to capture the structural break:

$$p_{it}^e = w'_{jt}\beta + \theta_m + \text{TREND}_t + \text{POST96}_t + \beta_p e_{ct} + \varepsilon_{it} \quad (2)$$

The variable POST96 takes the value of 0 for years up to 1996 and 1 thereafter. Table 3 presents the results for the variables of interest; coefficients on manufacturer dummies and model characteristics are suppressed for brevity.

The results confirm that prices in the second half of the sample period were significantly lower than prices in the first half. The estimated price drop is 10.9% of pre-tax price and 5.9% of after-tax price. The results are stronger in the case of pre-tax price even though there are fewer observations. The price decline is not as dramatic as the changes in sales, but it's certainly not negligible. I note also that this drop is a lower bound. As discussed earlier, one of the ways

new car dealers responded to the new challenge was to improve the quality of the base product by incorporating “extras” into the standard model. Since I do not have information on these upgrades, I cannot adjust fully for improvements in quality over time. Thus, if this improvement in quality did indeed occur, the results here are understating the decrease in quality-adjusted prices. I also estimated versions of these pass-through regressions that allow the time effects to differ according to the region of origin (notably Japan and Europe). There is no evidence that prices of Japanese cars were affected more than their European competitors. Again this is in contrast to the case of sales, where Japanese automobiles were hit much harder than cars from other producers.

The estimated pass-through coefficient is essentially one, indicating that importers absorb all exchange rate shocks. Typical estimates from studies of the automobile market in other countries are usually lower. For example, in Goldberg and Verboven (2001) the estimated coefficients range from .16 to .79 for different countries, with the overall effect being .46. The results here suggest that new car prices in Cyprus are completely insulated from exchange rate fluctuations. This may be at least partially explained by the fact that many dealers of new Japanese vehicles carry out their financial transactions with the manufacturers in currencies other than the yen (usually the British pound).

The invariance of local prices with respect to exchange rate fluctuations may also indicate the presence of substantial market power. If new car dealers earn a high enough profit margin, they may be willing to absorb exchange rate fluctuations in the interest of maintaining stable prices. This is in contrast to the used car market, where estimates from a similar regression implied a pass-through of 23.3%.<sup>19</sup> Although this level of pass-through is not large, it is certainly larger than the zero pass-through we obtained for new cars and it may be interpreted as evidence that the used car market is more competitive than the new car market.

## 5 Estimation of welfare gains

Theory suggests that trade liberalization can benefit consumers in two ways. First, increased competitive pressure from imports lowers prices of existing products (the “market discipline” effect). Second, the introduction of new product varieties means that consumer preferences are better matched with existing products and thus consumer well-being is enhanced. The aim of this section is to quantify the welfare impact of used car imports in terms of these two channels. This is achieved by specifying and estimating a structural model of demand for automobiles

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<sup>19</sup>The coefficient on the exchange rate was estimated at .767, with a standard error of .120.

which is amenable to welfare comparisons in this context. I follow the large recent literature on this topic in employing a discrete choice model of differentiated products.<sup>20</sup> Such models have been used to quantify the benefits of new products ever since Trajtenberg (1989). Two papers in particular are directly relevant to the present study. Fershtman and Gandal (1998) 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. Petrin (2002) quantifies the welfare effects of the introduction of the minivan in the US market. He first estimates demand for automobiles, including minivans, and computes consumer welfare in this market. He then removes minivans from the dataset and calculates counterfactual sales of all other models in the absence of minivans. Consumer welfare in the counterfactual scenario is compared with actual welfare; the difference between them is the welfare gain from the introduction of the minivan. I follow a similar approach in this paper. I first estimate demand for automobiles using data over a fourteen year period before and after the introduction of used imports. I then remove used car models from the consumers' choice set and calculate counterfactual shares of new models. The difference between actual and counterfactual welfare is the consumer welfare gain from the policy change.

**The model.** 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  $M_t$  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,  $g = 0, 1, \dots, G$ , 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 utility obtained by consumer  $i$  from product  $j \in \mathcal{J}_g$  in period  $t$  is given by

$$U_{ijt} = e^{\phi a_j} \cdot e^{x_{jt}\beta + \alpha p_{jt} + \xi_{jt} + \zeta_{igt}(\sigma) + (1-\sigma)\varepsilon_{ijt}}. \quad (3)$$

for  $i = 1, \dots, M_t$ ,  $j = 1, \dots, J_t$ ,  $t = 1, \dots, T$ . The vector  $x$  includes observable product characteristics such as engine size,  $p$  is the price and  $\xi$  is an unobserved product characteristic. The variable  $a_j$  denotes the age of the good, hence the parameter  $\phi$  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  $\sigma$  measures the extent to which products within the same group are substitutes to each other. As  $\sigma$  tends to 1 the group-specific random coefficient dominates and consumer valuations for products within the group become perfectly

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<sup>20</sup>Early examples are the work of Bresnahan (1987), Berry, Levinsohn, and Pakes (1995) and Goldberg (1995).

correlated. If  $\sigma = 0$  the  $\zeta_{igt}$  term vanishes, meaning that the grouping is irrelevant.

Taking the natural logarithm of (3) gives

$$u_{ijt} = \phi a_j + x_{jt}\beta + \alpha p_{jt} + \xi_{jt} + \zeta_{igt}(\sigma) + (1 - \sigma)\varepsilon_{ijt}. \quad (4)$$

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  $\delta_j$  as the mean quality of product  $j$ . The option of no purchase (the outside good) delivers utility

$$u_{i0t} = \delta_{0t} + \zeta_{i0t}(\sigma) + \varepsilon_{i0t}. \quad (5)$$

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  $\delta_{jt}$  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  $\varepsilon_{ijt}$  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 ( $s_0$ ). From these expressions it is easy to derive the following equation that links market shares to prices, car characteristics and the within-group share:<sup>21</sup>

$$\ln(s_{jt}/s_{0t}) = \phi a_j + x_{jt}\beta + \alpha p_{jt} + \sigma \ln(s_{j|g,t}) + \xi_{jt}, \quad j = 1, \dots, J_t. \quad (6)$$

This is a straightforward linear equation that can be taken to the data. It is well known, however, that estimation of (6) by OLS will yield inconsistent estimates if the error term  $\xi_{jt}$  is correlated with price or the within share. This will be the case, for example, if firms observe  $\xi_{jt}$  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. Tax rates are also good instruments for price.<sup>22</sup>

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<sup>21</sup>The details can be found in Berry (1994).

<sup>22</sup>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



I note that, because of the dramatic effects 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 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 sales and price data coming from different sources. This presented two challenges. First, the sales data did not always identify the car model, especially in the early years of the sample. This was handled through a painstaking process of 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 being sold. 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. Price was specified to be 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.<sup>23</sup> The cars were then aggregated to the model level and the median price was assigned as the model price. The main advantage of this method is that it enables us to include all sales. The disadvantage is that we are not using actual prices.<sup>24</sup>

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 variable taking the value of 0 for new cars and 1 for used cars, and the parameter  $\phi$  measures the four-year depreciation rate.

**Demand estimates.** The model was estimated using data for the period 1989-2000. As is common in models of automobile demand, the different models were split into groups on the basis of engine size. I created three size categories (small, medium, large) and a fourth group for

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estimation because of multicollinearity problems.

<sup>23</sup>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.

<sup>24</sup>Using an estimated regressor adds variance to the estimates which should, in principle, be accounted for. On the other hand, models of this type always require the aggregation of different editions of models into one nameplate. List prices are also used, as opposed to transaction prices. The variance introduced by the estimated regressor is probably small compared to the measurement error from these sources.

Table 4: Demand estimates

	OLS		IV	
<i>Structural parameters</i>				
$\alpha$	-1.76e-5**	(6.02e-6)	-2.59e-4**	(7.39e-5)
$\sigma$	0.830**	(0.018)	0.401**	(0.117)
$\phi$	0.036	(0.085)	-1.938**	(0.642)
<i>Model characteristics</i>				
Engine size	-1.677**	(0.211)	1.041 <sup>†</sup>	(0.562)
(Eng. size) <sup>2</sup>	0.273**	(0.041)	0.304**	(0.109)
Engine power	-0.002 <sup>†</sup>	(0.001)	-0.004*	(0.002)
Diesel	0.354**	(0.111)	-0.465 <sup>†</sup>	(0.248)
Cylinders	0.057	(0.047)	0.244 <sup>†</sup>	(0.130)
<i>Country dummies (relative to Japan)</i>				
CzechRep	-0.496**	(0.136)	-1.797**	(0.325)
England	-0.640**	(0.081)	-0.023	(0.198)
France	-0.777**	(0.076)	-0.699**	(0.159)
Germany	-0.728**	(0.076)	0.730*	(0.292)
Italy	-0.783**	(0.087)	-0.723**	(0.134)
Korea	-0.108	(0.098)	-0.639**	(0.207)
Russia	-0.602**	(0.090)	-2.000**	(0.367)
Spain	-0.947**	(0.160)	-1.392**	(0.167)
Sweden	-1.512**	(0.199)	0.680	(0.632)
<i>Year dummies (relative to 1989)</i>				
1990	-0.027	(0.096)	-0.024	(0.188)
1991	-0.164*	(0.084)	-0.405*	(0.197)
1992	-0.156 <sup>†</sup>	(0.083)	-0.220	(0.187)
1993	-0.715**	(0.105)	-0.590**	(0.201)
1994	-0.603**	(0.113)	-0.926**	(0.222)
1995	-0.244*	(0.106)	-0.059	(0.187)
1996	-0.078	(0.089)	0.126	(0.195)
1997	0.289**	(0.105)	0.247	(0.190)
1998	0.536**	(0.106)	0.135	(0.210)
1999	0.286**	(0.104)	0.187	(0.199)
2000	0.201*	(0.098)	0.150	(0.192)
Intercept	-3.126**	(0.240)	-6.575**	(0.608)
Number of obs		1039		1039
Hansen J statistic ( $\chi^2$ )			2.505 (p-val: 0.286)	
F-test	131.07 (p-val: 0.0000)		13.91 (p-val: 0.0000)	
Root MSE		.598		1.067

Significance levels : <sup>†</sup> : 10% \* : 5% \*\* : 1% .

Reported standard errors are robust to heteroscedasticity.

sport utility vehicles.<sup>25</sup> Estimation results are presented in Table 4. In comparing OLS and IV estimates, recall that the OLS estimate of the price coefficient will be biased towards zero if the endogeneity problem exists. This is because price is positively correlated with the error term, which represents unobserved quality. This is clearly the case here: the coefficient on price drops substantially when we instrument for price. Similarly, the coefficient on the other endogenous variable, the within-share, is positively correlated with unobserved quality and it also drops once we instrument for it.

The value of the  $\sigma$  coefficient means that there is a correlation of .401 between consumer preferences for models belonging to the same group. The median price elasticity corresponding to the  $\alpha$  and  $\sigma$  coefficients from the IV regression is 5.02, similar to estimates from other automobile markets. The  $\phi$  coefficient implies that the utility obtained from a used car is about 14.4% of that of a new car with the same characteristics. This seems low, but recall that the basis of comparison is not the price of the same car when it was new but the price of a new car in the current incarnation of the model. Estimated coefficients on model characteristics take reasonable values with the exception of engine power which is highly correlated with engine size. The signs on country dummies are also what we might expect: German and Swedish cars are highly regarded, Russian and Czech cars are not. The year dummies proxy for changes in the outside good. The automobile market's downturn in 1993 and 1994 was a natural lull in the market after the boom years of the early 90s.

**Welfare.** With demand estimates in hand, I now proceed to compute welfare. Trajtenberg (1989) showed that welfare in this model is given by

$$W = \frac{1}{\alpha} \ln \left[ \sum_g D_g^{(1-\sigma)} \right] + C, \quad (7)$$

where  $C$  is the constant of integration. 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 re-calculate welfare. The difference between the actual and counterfactual welfare measures gives us the welfare gain by consumers.<sup>26</sup> The results are tabulated in Table 5 under the heading 'Counterfactual A'. The first column gives welfare gain per purchaser and the second one aggregates over all purchasers. In the first years

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<sup>25</sup>I experimented with different nestings, including two-level nests. Because of the relatively small number of models per year, the second level coefficient was never precisely estimated.

<sup>26</sup>The calculation is essentially the same as in Fershtman and Gandal (1998).

Table 5: Welfare gains and effects on tax revenue

Year	Counterfactual A (new car prices fixed)			Counterfactual B (new car prices 10% higher)	
	Gain per purchaser (US\$)	Aggregate gain (US\$ mil.)	Change in tax revenue (US\$ mil.)	Gain per purchaser (US\$)	Aggregate gain (US\$ mil.)
1994	11	.1	1.2	11	.1
1995	73	.9	3.4	180	2.3
1996	321	4.3	12.4	416	5.7
1997	671	8.3	32.6	754	9.2
1998	1,048	14.4	45.1	1,142	15.5
1999	615	7.9	34.5	696	8.8
2000	468	6.1	31.4	552	6.9

All figures are in US dollars, converted from 2001 Cyprus pounds at the 2001 exchange rate CY£1 = US\$ 1.7.

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. The total welfare gain over the seven year period 1994-2000 amounts to \$42 million.

How important is this welfare gain? Annual family income during that period was of the order of \$25,000. Taking the numbers for the year 2000 to represent the ‘steady state’ welfare gain, the gain per purchaser amounts to 1.5% of annual family income. In aggregate terms, the gain corresponds to 0.066% of Cyprus GDP. This is quite substantial, especially given that it arises from the opening of a single market. By comparison, the annual welfare gain in Fershtman and Gandal (1998) from the lifting of the Arab boycott of the Israeli market is 0.30% of Israeli GDP, while the corresponding figure for Petrin’s (2002) minivans is 0.017%.<sup>27</sup> The relative magnitude of the change is reasonable. The market share of minivans in the United States in the first few years was a few percentage points. In Israel, by contrast, cars from boycott companies captured a market share of 30-40% once they entered the market, while in Cyprus used cars captured 60% of the market.

The scenario analyzed above assumes that prices and characteristics of new cars are the same under the counterfactual as they are in reality. The evidence presented in the previous section suggests that this is not the case: new car prices dropped in the second half of the 1990s. 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

<sup>27</sup>The last two ratios are based on my calculations using information provided in those papers.

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. This, however, requires making additional assumptions about market conduct. 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 B’ in Table 5 reports welfare effects of one such 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 increased variety as opposed to price changes. In other words, the biggest beneficiaries from the policy change were the individuals who purchased the new varieties; that is, used cars buyers. Consequently, the gain per used car buyer is substantially larger than that reported in Table 5, which is averaged over buyers of used *and* new vehicles.

This last finding relates to an important debate in the international trade literature. The potential for gains from trade due to increased variety has been recognized at least since Krugman (1979). Yet empirical evidence of such gains and their magnitude relative to gains from lower prices is virtually nonexistent.<sup>28</sup> The finding here suggests that increased variety is a much more important channel of gains from trade than increased competition. This has important implications relating to the distributional impact of the policy. The new varieties introduced by trade liberalization were of lower quality than existing ones. Low income consumers are more likely to purchase lower quality goods, hence most of the benefits from the policy change accrued to low income people. The common argument that trade liberalization hurts the poor simply does not hold here.

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 switch to used cars, which are cheaper. On the other hand, more cars were sold. The effects on government tax revenue by year in our two counterfactual scenarios are shown in Table 5. The estimates indicate that the sales effect outweighs the price effect, leading to a sizeable increase in tax revenue. I have been unable to confront those calculations with actual data on tax revenues. The only data I could find are for the period 1998-2000. These are reassuringly close to tax calculations generated by the model for those years, but they are not enough to test the prediction of increased tax revenue. Given that there have been widespread reports of tax evasion by used car importers, it is likely that the actual increase in revenue was much

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<sup>28</sup>In a recent study, Broda and Weinstein (2004) calculate gains from variety using aggregate data and price index methodology. They estimate that welfare gains from variety growth in US imports is 2.8% of GDP.

smaller.<sup>29</sup>

**Robustness.** The welfare results of this model are robust to various specifications and different methods of aggregating individual car registrations. At a broader level, however, it is now well-known that discrete choice models of the type used here make restrictive assumptions with undesirable implications about the nature of demand. The nested logit model in particular has been shown to overestimate welfare gains from the introduction of new goods.<sup>30</sup> These caveats notwithstanding, the welfare benefit per buyer implied by the results seems quite reasonable.<sup>31</sup>

## 6 Summary and conclusions

In this paper I exploit the opening of the Cyprus market to used Japanese automobiles in order to investigate the effects of trade in used goods on consumer welfare. 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. The bulk of the gains were due to an increase in product variety and benefited predominantly low income consumers. Gains of similar magnitude are likely to accrue to consumers in other countries that have been on the receiving end of international trade in used vehicles. On the other hand, it is important to note that our results were obtained in the case of a small country that has no automobile production of its own. This means that the only group hurt by this policy is a small number of new car dealers. The welfare calculation would be more complicated in a country that has – or wants to develop – a car manufacturing industry. A second caveat is that our implicit assumption of an infinitely elastic supply of used cars is not always reasonable, especially in the case of large countries.

These caveats notwithstanding, the magnitude of the results is significant, especially 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. Many populous and relatively poor countries like India and Mexico are currently almost completely closed to used vehicle imports. If and when they open up, they are likely to start importing used vehicles in the millions from the United States or Japan. Developed country consumers will replace their vehicles more frequently; old vehicles will be shipped overseas. This change in the pattern of trade could also have an impact on production. Lower demand for new cars in developing countries might slow

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<sup>29</sup>I have not been able to obtain official data to quantify this

<sup>30</sup>See Akerberg and Rysman (forthcoming) for a Monte Carlo analysis. Petrin (2002) provides data-based evidence but his basis of comparison is the simple logit, not the nested logit. Bajari and Benkard (2003) provide a useful overview of the problems associated with discrete choice models.

<sup>31</sup>As the owner of two used Japanese imports, I would have had no reservations about paying that extra amount.

down or even reverse the migration of automobile manufacturing plants to developing countries if the main reason for this trend is to satisfy foreign markets. On the other hand, production will not be affected if relocation of auto plants is driven by lower production costs overseas.

It is worth noting that exporting countries are 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 will induce domestic consumers to replace their vehicles more often, thus increasing domestic sales. 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 to set up and susceptible to fraud and corruption once 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.

As the debate on the merits and perils of globalization continues unabated, it is important to be able to draw lessons from specific experiments in trade liberalization. The policy experiment studied in this paper contributes to the debate by quantifying the benefits of openness in a unique and uncontroversial setting. Moreover, and perhaps more importantly, it points to the previously overlooked potential of increased international trade in used goods to generate significant gains from trade. Although the empirical findings here are suggestive, further research is warranted in order to investigate the potential impact of trade in used goods on welfare, trade patterns and production.

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