RAND Journal of Economics
Vol. 29, No. 1, Spring 1998
pp. 193–214

The effect of the Arab boycott on Israel: the automobile market

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Recent progress toward a comprehensive peace in the Middle East has led to a relaxation of the enforcement of the Arab economic boycott of Israel. This in turn has led to the entry of all the major Japanese and Korean automobile manufacturers into the Israeli market. We examine the effect of the Arab economic boycott on this market. Using recent advances in estimating discrete-choice models of product differentiation, we estimate that the end of the boycott led to a per-purchaser gain of approximately $2,343 in 1995. This benefit can be interpreted as a "peace dividend."

1. Introduction

■ Economists are interested in the microeconomics of "supply interruptions" that arise in international trade and other contexts. Indeed, there is a large empirical literature on the effect of boycotts, voluntary export restraints (VERs), quotas, and other trade barriers. Despite the fact that most of the industries affected by supply interruptions are oligopolistic, the studies did not employ industrial organization "structural" models to estimate the associated economic effects.[1] Building on recent advances in the estimation of discrete-choice models of product differentiation,[2] we introduce some new techniques that can be used to carefully measure the impact of policy changes that

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We are grateful to the Pinhas Sapir Center for Development and the Armand Hammer Fund for Economic Cooperation in the Middle East for financial support and to Sarit Markovich for outstanding research assistance. We thank Editor Tim Bresnahan and two anonymous referees for suggestions that significantly improved the article; we are also grateful to Joshua Angrist, Gil Filer, Robert Hall, Ariel Pakes, Daniel Tsiddon, Manuel Trajtenberg, and seminar participants at the University of Haifa, the Hebrew University, INSEAD, the University of Maryland, the University of Michigan, the NBER Summer Institute, Stanford University, SUNY Stony Brook, Tel Aviv University, Texas A & M, and the University of Texas for helpful comments. We also thank Steve Berry, Jim Levinsohn, and Ariel Pakes for provision of data on product characteristics of automobiles sold in the United States.

[1] Dinopoulos and Kreinin (1988), for example, employ "hedonic" price regressions to empirically estimate the effect of Japanese automobile voluntary export restrictions (VERs) on automobile prices and welfare in the United States. Our approach differs from theirs in that we employ a structural (rather than a reduced-form) model.

[2] See our discussion below.

affect supply. This approach provides an improvement over traditional calibration studies, where parameter values are chosen in an ad hoc fashion. Our goal is to examine one particular case and estimate the associated welfare loss with the supply interruption.

The supply interruption we consider is the Arab economic boycott of Israel, one of the most enduring and comprehensive cases of the use of economic sanctions.[3] In 1922, the Fifth Palestine Arab Congress passed a resolution calling on Arabs to boycott Jewish businesses in Palestine. The boycott was institutionalized with the establishment of the Arab League in 1945. Although the boycott officially continues to this day, recent progress toward peace in the Middle East has led to a relaxation of the enforcement of the Arab economic boycott of Israel.

We examine the supply interruption that resulted from the boycott in one particular market: automobiles. We estimate the welfare loss due to the economic boycott, or equivalently the gain from its removal. In principle, the boycott likely affected the equilibrium price of the cars sold in Israel, the variety of cars available, the type of cars that were purchased, as well as the total number of cars purchased.[4] All these factors affect consumer welfare.

The boycott was especially successful in the automobile industry. In particular, the five major Japanese automobile manufacturers (Toyota, Honda, Nissan, Mazda, and Mitsubishi) and all Korean automobile manufacturers fully complied with the Arab boycott.

In our analysis, we employ recent advances in estimating discrete-choice models of product differentiation. These techniques, developed by Berry (1994) and Berry, Levinsohn, and Pakes (BLP) (1995), enable structural estimation of both the demand and oligopoly pricing aspects that characterize differentiated product markets. The techniques yield estimates of own and cross-price elasticities as well as estimates of cost-side parameters. BLP (1995) employ their model to estimate equilibrium in the U.S. automobile market. The automobile industry is especially attractive to study because (1) important characteristics are identifiable and easy to measure and (2) product-level data (quantities, prices, and product characteristics) are readily available to the researcher. Verboven (1996) extended the model developed in Berry (1994) to multiproduct firms[5] and to markets in which import quotas exist. Verboven then employed the model to examine international price discrimination in European automobile markets.

Other important contributions to this literature include Bresnahan (1987) and Goldberg (1995). Bresnahan (1987) was the first to employ a structural model to estimate both the demand and oligopoly pricing aspects that characterize differentiated product markets. He employed a vertical-differentiation model to examine whether U.S. automobile manufacturers colluded in the mid-1950s. Goldberg (1995) used both micro (individual household) and market-level data in her study of the automobile industry. See BLP (1995) and Verboven (1996) for detailed reviews of the rich literature on the automobile industry.

Estimating the economic effects of the Arab boycott poses some inherent difficulties. One strategy would be to estimate a dynamic model using a period that covers both "boycott" and "postboycott" equilibria and assess the gains over time; although

[3] Sarna (1986) provides a thorough historical account of the Arab boycott against Israel, qualitatively assesses its impact on Israel, and discusses countermeasures undertaken by third-party governments. In the 1970s, the United States, for example, enacted legislation prohibiting compliance with the boycott. In order to downplay the boycott's effect, Israel did not enact antiboycott legislation. For work on Israel's antiboycott policies, see Rolef (1989).

[4] There has never been any significant domestic automobile production in Israel.

[5] In such a case, a firm takes into account how the price of one product affects the demand for the other products it sells.

this approach is appealing, there were many significant changes in Israel (such as rapid income growth and major reforms in automobile taxation policies) over the last few years that make it virtually impossible to isolate the effect of the boycott or its removal.[6]

An alternative strategy, which we employ here, is to estimate the "postboycott" equilibrium and then evaluate or simulate the equilibrium that would have obtained in the market had the boycott continued. Using data for 1994 and 1995, we estimate the market (postboycott) equilibrium in the Israeli automobile market and then simulate the equilibrium that would have existed in 1995 had the boycott continued. The structural model approach is crucial for this methodology; we discuss this point in detail later.

We chose 1994 and 1995 for the postboycott equilibrium because by 1994 all the major Japanese and all but one of the Korean firms had entered the Israeli market. Figure 1, which shows how the Israeli market has grown over time, suggests that the postboycott equilibrium has been quite stable for the last two years.

The simulation reveals that had the boycott continued, the market would have been approximately 9 percent smaller in 1995 and that there would have been a leftward shift in the distribution to smaller (less-expensive) vehicles.[7] The main finding of this article is that had the boycott and its associated supply interruption continued, the welfare loss would have been on the order of $2,343 per purchaser in 1995. In other words, the expanded choice set and the lower prices following the relaxation in the enforcement of the boycott led to a $2,343 increase in welfare per purchaser in 1995. This benefit, which is primarily from increased variety, can be interpreted as a "peace dividend." Since the average (sales-weighted) price of a new car in Israel was approximately $24,665 in 1995,[8] the welfare gain is approximately 9.5% of the price of a new car. Given that 113,000 private automobiles were sold in the Israeli market in 1995, had the boycott continued, the cost to consumers would have been more than $264 million in that year.[9]

2. The boycott and the automobile industry

■ **The Arab economic boycott.** Following the establishment of Israel, the Arab League banned all commercial and financial transactions between Israel and the Arab states. In 1951, the Arab League set up a central boycott office (CBO) in Dasmacus, Syria, with branches in member states to administer the boycott. The formation of the CBO institutionalized two additional aspects of the boycott:

(i) The *secondary boycott,* in which foreign firms were prohibited from operating in Arab countries if they had trade or commercial dealings with Israel. The CBO maintains and updates a blacklist of firms that are banned from the Arab world.[10]

(ii) The *tertiary boycott,* which prohibits foreign firms from establishing partnerships or joint ventures with blacklisted foreign companies. Boycott resolutions also contain a provision banning the purchase of components that exceed 10% of the total cost of production from blacklisted firms.

[6] Furthermore, market-share data by model are available only from 1992.

[7] We use 1995 in the calculations, since the final Korean firm (Kia) entered the Israeli market in 1995.

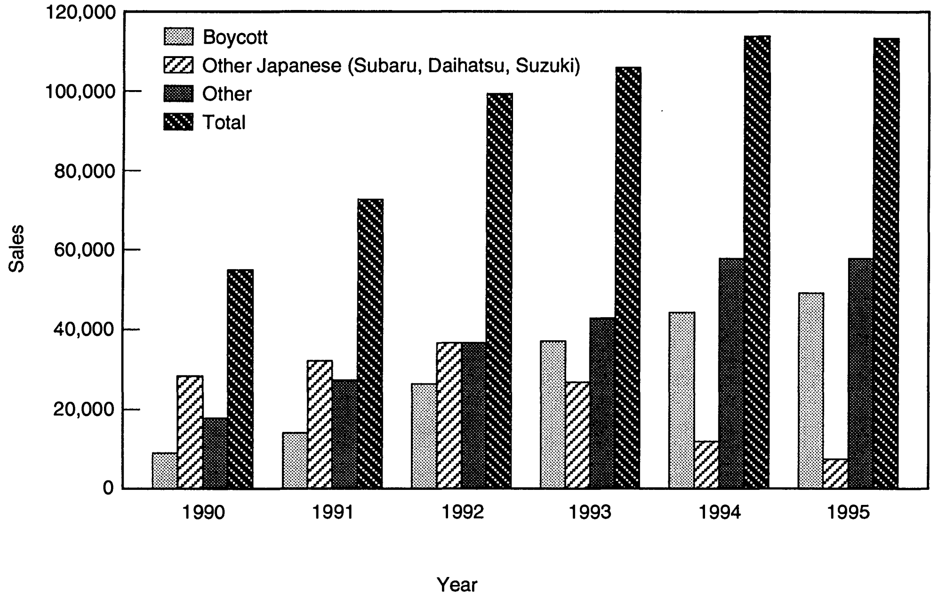
[8] Consumers pay either 128% or 144% in taxes and custom duties on automobiles sold in Israel.

[9] Of course, there were additional benefits from the relaxation of the enforcement of the boycott. The expansion in the market, for example, led to a very significant increase in tax revenues.

[10] Each member state also maintains a separate blacklist, that is, the decisions of the CBO are not binding on member states.

FIGURE 1

AUTOMOBILE SALES, ISRAEL (1990–1995)



Persian Gulf countries stopped enforcing the boycott following the Middle East Peace Talks in Madrid in 1991.[11] On October 1, 1994, the Gulf Cooperation Council officially announced that it would no longer enforce the secondary and tertiary boycotts.

The ending of the Arab boycott (and the resulting economic benefits) is viewed by the Israeli public as one of the important peace dividends. While no one doubts that the boycott has caused significant damage to the Israeli economy, structural economic models have not been employed to estimate its magnitude. Recently some numbers were thrown into the public debate, but they were not based on any formal analysis.[12] The public debate has so far focused on the effect of the boycott on foreign investment and on the closure of export markets. The secondary and tertiary boycotts also had a significant effect on local product markets. The dearth of product variety and the pattern of competition within Israel during the long period in which the boycott was enforced may have resulted in significant welfare losses.

□ **The boycott and the automobile industry.** Sarna (1986) writes that among the leading economic powers, Japan had the "most consistent record of compliance with the discriminatory and restrictive trade practices of the Arab boycott of Israel."[13] As was mentioned, the boycott was quite successful in the Japanese automobile industry: the five major Japanese automobile manufacturers fully complied with it. See Figure 2

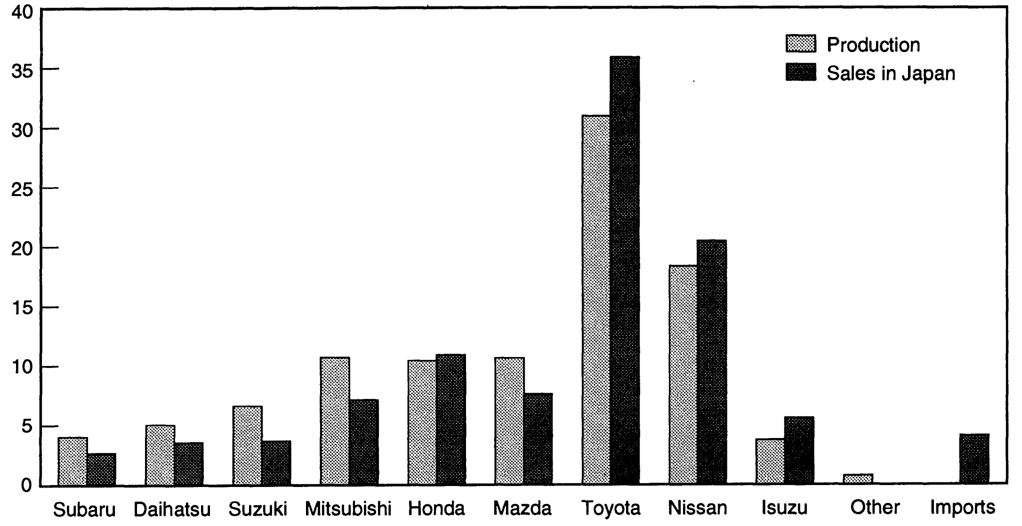
[11] According to the *Far Eastern Economic Review,* (Yaroslav, Trofimoc) "Peace Dividend," Vol. 157 (1994), p. 74.

[12] In a recent article ("Boycott Close-Up," *Chemical Business,* Vol. 11 (1993)), Danny Gillerman, president of the Israeli Chambers of Commerce and Danny Lipkin, an economic analyst, estimate the financial loss to Israel as a result of the Arab boycott at somewhere between $45 and $49 billion since 1950. These calculations were based on ad hoc assumptions about how exports and investment would have grown over time had there been no boycott.

[13] Sarna, p. 165. He denotes a whole chapter to what he calls "the surrender of Japan." The Japanese dependence on Middle East oil likely made it more susceptible to the boycott. Reingold and Lansing (1994) offer additional explanations for Japan's strict compliance with the boycott.

FIGURE 2

PERCENT OF TOTAL JAPANESE PRODUCTION (1991) AND PERCENT OF SALES IN JAPANESE MARKET (1991)



Total production by Japanese manufacturers (1991): 13.1 million. Total sales in Japan (1991): 4.0 million. (Sources: Production: *Automotive News*, May 27, 1992; Sales: *Tokyo Business Today*, September 1992).

for detailed information on world production and market shares of Japanese automobile manufacturers.

In 1968, the three largest Japanese automobile manufacturers, Toyota, Honda, and Nissan, were explicitly warned by boycott officials not to sell their products in Israel. The firms complied. Indeed, requests by potential Israeli importers to sell Toyota, Honda, Nissan, Mitsubishi, and Mazda automobiles were continually rejected. The manufacturers claimed that there was a "shortage of production."[14]

The effect of the Arab economic boycott on the automobile industry was not limited to the Middle East; compliance with the boycott often went beyond agreeing not to sell automobiles in Israel. In 1981, for example, Toyota announced plans to undertake a joint venture with the blacklisted Ford Motor Company;[15] the venture was to produce cars at Ford's unused plants in the United States. Saudi Arabia's minister of commerce warned that his country would ban all Toyota automobiles if the deal with Ford went through.[16] Indeed, following the warning, the joint venture was cancelled.

In contrast to the "big five" Japanese automobile producers, Subaru (Fuji Heavy Industries) did not sell any automobiles outside of Japan in 1968. Given that there were no Japanese automobiles in Israel at the time, in 1969 Subaru selected Israel as its initial export market. Until late 1988, the only Japanese competition to Subaru in Israel came from other small Japanese manufacturers: Daihatsu, which entered in 1983, and Suzuki, which entered in 1985.

[14] Sarna (1986), p. 172.

[15] Ford Motor Company was blacklisted in 1966 for licensing an Israeli firm to assemble Ford trucks and tractors. Ford continued doing business with Israel and was banned from selling its automobiles in all Arab countries.

[16] Sarna (1986), p. 170, notes that in 1980, Toyota sold 256,000 cars in the Middle East; approximately 50% of these were sold in Saudi Arabia.

In 1988, Mitsubishi granted the "Kolomotor" agency in Israel the rights to sell Mitsubishi automobiles. Saudi Arabia and other Arab states put pressure on the Japanese company (there was even a meeting between the Saudi and Japanese economic liaisons in Washington), but Mitsubishi automobiles arrived in Israel in late 1988 (model year 1989).[17]

Shortly after the peace process began, the other major Japanese automobile manufacturers (Honda, Mazda, Toyota, and Nissan) began to sell in Israel.[18] No action has been taken by the CBO or any individual Arab state.

According to the Israeli finance ministry (see footnote 17), the Koreans were even more subservient to the CBO than were the Japanese. Indeed, there were no Korean automobiles in Israel until 1994. In that year, Daewoo and Hyundai entered the Israeli market and immediately attained a combined 14% market share. The other major Korean manufacturer (Kia) began selling its products in Israel in 1995. Hence, by 1995, all major Japanese and Korean manufacturers were active in the Israeli market.

The threat of blacklisting had less success with European and American automobile firms. Renault was blacklisted in 1955, and in 1959 it stopped selling its products in Israel. When the expected sales to the Arab world did not materialize, Renault returned to the Israeli market. In 1966, General Motors was warned not to open an assembly plant in Israel; the firm continued to trade with Israel but did not open the plant. By 1969, all European and American automobile manufacturers were selling their products in Israel.[19]

3. The model

■ We model the automobile industry as an oligopolistic market in which firms compete through prices. There are N firms, many of which sell several types of cars. Our model of the automobile market closely follows Berry (1994); the multiproduct aspect is as in Verboven (1996).

□ **Demand.** The utility of product j to consumer i, denoted u_{ij}, depends on both product and consumer characteristics. Following Berry, we employ a random-utility model of the form

$$u_{ij} = x_j\beta - \alpha p_j + \xi_j + \epsilon_{ij} + x_j(\beta_i - \beta), \tag{1}$$

where the first two terms are the mean valuations of product j's observed characteristics; x_j is a vector of observable product characteristics (such as engine size, weight, etc.) and p_j is the observed price of automobile j. The parameters α and β represent the mean valuations of the observable characteristics. The final three terms are the decomposition of the error term:[20]

(i) ξ_j represents the average value of product j's unobserved characteristics;

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[17] We thank Moshe Kobi, a senior member of the group in charge of boycott affairs at the Israeli finance ministry, for these details.

[18] Honda entered the Israeli market shortly before the peace process began. In the early 1980s, Honda began producing automobiles in America. By the late 1980s, there was pressure by Jewish groups to export Hondas produced in America to Israel. (U.S. law prohibits cooperation with the boycott.) In 1990, Honda opened a dealership in Israel. Until 1993, the Hondas sold in Israel were all produced in the United States.

[19] The enforcement of the boycott was uneven and did not solely depend on the country where the firm was based. It is likely that the optimal strategy of the CBO was not to punish all firms that did not comply with the boycott. It is possible that some firms were punished to ensure that the threat of blacklisting was credible.

[20] This decomposition and discussion follows both Berry (1994) and Bresnahan, Stern, and Trajtenberg (1997).

(ii) ϵ_{ij} is the deviation of buyer preferences around this mean;

(iii) $x_j(\beta_i - \beta)$ captures buyer heterogeneity in the valuation of the observable characteristics; β_i is buyer i's valuation for the observable characteristics.

The final two error terms introduce heterogeneity, and the distribution of these terms determines the substitution patterns among products. The multinomial logit model assumes that there is no buyer heterogeneity: in particular, the logit assumes that (1) $\beta_i \equiv \beta$ for all i, and (2) ϵ_{ij} are identically and independently distributed across consumers and choices with the extreme value (Weibull) distribution function.

Given the discrete-choice set, under these two assumptions it can be shown that the probability of choosing product j (the market share of product j) is

$$s_j = \frac{e^{\delta_j}}{\left(\sum_k e^{\delta_k}\right)}, \tag{2}$$

where

$$\delta_j = x_j\beta - \alpha p_j + \xi_j \tag{3}$$

is the mean utility level from product j. Despite its unrealistic substitution patterns among products, the logit distribution is popular because of the closed-form solution (equation (2)).

To overcome the implausible substitution patterns among products, many authors employ the "nested" multinomial logit model. In this model, products fall into certain (predetermined) classes. This yields a much more reasonable pattern of substitution among products.[21,22] For example, if automobiles are nested according to class, the introduction of a new compact car will reduce demand more for other compacts than for cars in other classes. Using the nested multinomial logit model, the probability of choosing product j belonging to group g is

$$s_j = \frac{e^{\delta_j/(1-\sigma)}}{D_g^{\sigma}\left(\sum_g D_g^{1-\sigma}\right)}, \tag{4}$$

where $D_g = \sum_{[j\in G_g]} e^{\delta_j/(1-\sigma)}$, G_g denotes the set of automobiles of type g, and $0 \le \sigma < 1$ measures the degree of substitution among the products in the classes or groups.[23] If $\sigma = 0$, the cross-elasticities among products do not depend on the particular classification of the products; in such a case, the simple (nonnested) multinomial logit model is appropriate. In the case in which σ approaches one, the cross-elasticity between any two products that belong to different groups is zero.

We use the nested (multinomial) logit model to estimate the equilibrium in the Israeli automobile market. Like the logit, the nested logit has a closed-form solution for market share (equation (4)). This feature is attractive because it makes the analysis that follows quite transparent.

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[21] It is assumed that there is a separate class that contains only the outside good, with a mean utility normalized to zero.

[22] For more on the general extreme value (GEV) models, see McFadden (1978).

[23] The mean utility from product j is again $\delta_j = x_j\beta - \alpha p_j + \xi_j$.

The nested logit specification is also appropriate to use in this setting. As Berry (1994) notes, the nested logit model is appropriate when the substitution effects among products depend primarily on predetermined classes of products. This assumption seems quite reasonable in the case of automobiles; indeed, industry groups employ a standard classification system (small, compact, medium, large, luxury/sport). Goldberg (1995) and Verboven (1996) also employ variants of the nested logit model in their studies of the automobile industry.[24]

Berry showed that by inverting the market share equation (4), one obtains[25]

$$\ln(s_j/s_0) = x_j\beta - \alpha p_j + \sigma \ln(\bar{s}_{j/g}) + \xi_j, \qquad (5)$$

where $\bar{s}_{j/g}$ is the share of product j in group g (the within-group share) and s_0 is the proportion of consumers that choose the outside good, that is, choose not to purchase a new car. Since prices and group shares are endogenous, estimates of the parameters (α, β, and σ) can be obtained by an instrumental variable regression on (5).

Since the proportion of consumers choosing the outside good (s_0) appears on the left-hand side of (5), this number must be estimated or assumed. For example, Greenstein (1994) estimates the share of the outside good. Following Verboven (1996) and Berry, Levinsohn, and Pakes (1995), we assume that the size of the potential market is known. Extensive experimentation reveals that only the constant β_0 changes when we change the size of the potential market. This is intuitive; a larger potential market means that more consumers chose the outside good than one of the available automobiles. This reduces the mean utility of all inside goods relative to the mean utility of the outside good. But β_0 has no effect on our welfare calculation, i.e., the estimated per-purchaser welfare gains are independent of the magnitude of β_0.

□ **Multiproduct oligopoly pricing.** Since Israel is a relatively small market, we assume that the marginal cost of producing each product is independent of the output levels and linear in a vector of cost characteristics. The assumption of constant marginal cost is common in the literature; in the case of Israel, the assumption seems quite reasonable. Even if marginal costs were falling, the small size of the Israeli market means that the effects of additional production on marginal cost would be very small.

The marginal cost of good j is

$$mc_j = w_j\gamma + v_j, \qquad (6)$$

where w_j is a vector of observable characteristics, v_j is an unobserved cost characteristic, and γ is a vector of unknown parameters. The profits of a multiproduct firm f selling F products are

$$\pi_f = \sum_{k=1}^{F} (p_k/(1 + t) - mc_k)q_k, \qquad (7)$$

where p_k is the retail price of product k, q_k is the corresponding quantity sold, t is the tax rate, and mc_k is the marginal cost of producing automobile k. Assuming that the firms compete on prices and that they only take into account the cross-elasticities among

[24] Bresnahan, Stern, and Trajtenberg (1997) note that if there is more than one level of nesting, the order of the nesting gives rise to undesirable patterns of substitution. In our setting there is a single (natural) nesting.

[25] The details are in Berry (1994).

their products within a group, and substituting the expression from (6), we have the following first-order condition (pricing equation) for product j:[26]

$$p_j/(1 + t) = w_j\gamma + \frac{(1 - \sigma)}{\alpha(1 + t)[1 - \sigma \sum_{k \in f_g} q_k/Q_g - (1 - \sigma) \sum_{k \in f_g} q_k/M]} + \nu_j, \quad (8)$$

where f_g represents the set of products that firm f is selling in group g, Q_g is the total number of sales in group g, and $M = \Sigma_{i=0}^{N} q_i$. The derivation is tedious. For the details, see Verboven (1996). Note that our model is a special case of his, in which there is a single classification (or nest) and that the mean utility is linear in prices. Instruments are also needed to estimate the pricing equation, since the last term on the right-hand side is endogenous.

Although (8) is slightly complicated, the intuition is quite straightforward. The price of each model depends on (i) marginal cost and (ii) a markup term. This additional term differentiates the analysis from the traditional studies of supply interruption that have used hedonic pricing methods. These studies simply regress price on marginal cost; there is no markup term. Such a term is crucial to the analysis we will conduct.

The markup depends on and is increasing in the "group" share of the firm in the particular class. This makes intuitive sense, since a larger group share gives the firm market power. Although there are approximately 20–30 models in each class in 1995, the group shares (within a class) and hence the markups are not necessarily small. Indeed, several firms sell multiple products and these firms often tend to specialize in a class.[27]

4. Estimation

■ The two-equation system to be estimated consists of the demand (5) and pricing (8) equations. It is likely that ξ_j (unobserved demand characteristics) and ν_j (unobserved cost characteristics) are correlated.[28] Additionally, two parameters (α and σ) appear in both equations. Finally, some of the parameters appear nonlinearly. This suggests that the appropriate method of estimating the full system is via the general method of moments (GMM). We use the GMM software package.[29]

□ **Instruments.** In order to identify our two-equation system, we need to find instruments for within-group shares ($\bar{s}_{j/g} \equiv q_j/Q_g$) and firm shares within a group ($\Sigma_{k \in f_g} q_k/Q_g$), in addition to prices. It is clear that many of the product characteristics (x_j) will be included in the vector of the cost characteristics (w_j); hence we use the characteristics of other models as well as cost shifters as instruments.

First consider instruments for the within-group shares. As Bresnahan, Stern, and Trajtenberg (1997) note, within-group share is negatively correlated with the number of other products in a group. Similarly, as the sum of the characteristics of the other products in the group increases, the other products become much stronger competitors and the within-group share of product j falls.

26 Using a general demand model, Caplin and Nalebuff (1991) established the existence of a pure-strategy Nash equilibrium in the case of single-product firms. For the symmetric nested logit model, Anderson and de Palma (1992) have established that a pure-strategy Nash equilibrium exists in the case of multiproduct firms.

27 For example, the market share of Fiat in the small class was approximately 36% in 1995.

28 A characteristic that might be contained in both error terms is style.

29 The software was written by Lars P. Hansen, John C. Heaton, and Masao Ogaki. See Hansen and Singleton (1982) for the theoretical foundations.

Now consider instruments for firm shares within a group. Clearly, the firm's share in a particular group is increasing in the number of other products it sells in the group and decreasing in the number of products sold by competitors. Further, a firm's share in the group is increasing in the sum of the characteristics of the other products it sells in the group and decreasing in the sum of the characteristics of products sold by competitors in the group.

Finally, consider instruments for price. From the first-order condition (8), the number of other products that a firm sells within the group will be positively correlated with price. Additionally, since we have data from both 1994 and 1995, one of the explanatory exogenous variables in the w_j vector is the change in the exchange rate between 1994 and 1995 for each of the importing countries' currencies versus the new Israeli shekel. This variable turns out to be a very important instrument for price. Table 1, which shows the percentage change in the exchange rate between 1994 and 1995 for the various currencies versus the new Israeli shekel (NIS) and 1994 and 1995 automobile sales in Israel, shows that countries whose currencies significantly appreciated (depreciated or remained unchanged) versus the shekel had lower (higher) sales in 1995 than in 1994.[30]

Of course, all of the instruments discussed above are appropriate for all endogenous variables and will be used for all endogenous variables. We make the distinctions in our discussion only in order to provide clear economic justification for the instruments we employ.

Due to multicollinearity, we can only use two of the following three variables: (i) the sum of the characteristics of the other products in the group, (ii) the sum of the characteristics of the other products sold by the firm in the group, and (iii) the sum of the characteristics of products sold by other competitors in the group. In addition to two of these variables, and the percentage change in exchange rates between 1994 and 1995, we also use the number of other products in the group and the number of other products that a firm sells in the group as instruments.[31]

□ **Data.** Approximately 113,000 private automobiles were sold in both 1994 and in 1995 in Israel in the following four classes: small, compact, medium, and large.[32] Despite the relatively small size of the Israeli market, there were more than 170 different products available in each year.[33] Many of these brands had only a few sales. We restricted the sample to brands that had more than 80 sales. This left a sample of 213 brands: 101 models in 1994 and 112 models in 1995. These brands accounted for 111,192 automobiles in 1994 and 111,279 automobiles in 1995, more than 98% of the total market in both 1994 and 1995.

In Israel, all import licenses are exclusive. For example, the "Kolomotor" agency has the exclusive rights to import Mitsubishi automobiles. Prices are set centrally by the exclusive dealer, and retail price maintenance is strictly enforced. Hence, our prices are transaction rather than list prices. Our price data come from the Yitzhak Levi pricebook (1994 and 1995), which provides comprehensive coverage of the Israeli car market. The prices are in new Israeli shekels.[34] The retail price includes taxes of 144%

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[30] The six countries shown in Table 1 account for 86% of the automobiles sold in Israel in 1994 and 1995.

[31] The instruments we use are included in the set of "optimal" instruments derived by Chamberlin (1987) and discussed by BLP (1995).

[32] In the case of the Israeli market, the luxury/sport class is extremely small, and hence only the first four classes are employed.

[33] Models with different engine sizes are considered to be different products.

[34] The average exchange rate in both 1994 and 1995 was 3.00 new Israeli shekels = $1.00.

TABLE 1 Exchange Rate Changes and Automobile Sales by Country

Country	Percent Change in Exchange Rate	Sales (in Number of Automobiles)	
		1994	1995
Japan	9	39,540	35,024
France	11	16,062	14,601
Korea	−3	15,576	20,615
Italy	−1	13,493	13,137
United States	0	5,841	9,615
Germany	13	4,854	3,499

on automobiles subject to custom duties, and taxes of 128% on automobiles not subject to custom duties.[35]

Since Israel is a small market, for each model available, many premium features are either included as standard equipment or not available. For example, dual airbags were standard equipment on all Honda Accords sold in Israel. In the case of GM, only the top-of-the-line automobiles are imported to Israel; automatic transmission, air conditioning, power steering, and antilock braking systems were included as standard equipment in these automobiles. In addition to the prices, the Levi pricebook includes the car features described above; hence, for each price observation, we know what additional features were available.[36] We now describe the other data.

The variable *ENGINE* is the engine size in liters. We also have data on size (length and width), horsepower, and weight. There is a high degree of correlation between these characteristics, and for that reason we included only one of them in our model. Data on these physical characteristics were obtained from three sources: *Katalog Der Automobil Review,* Hallwag Publishers, Berne, Switzerland (this source has data on all automobiles sold in Europe), *Automotive News Market Data Book* (this source has data on all automobiles sold in the United States), and in some cases the importers themselves. This is because some of the automobiles sold in Israel are not sold in the United States or in European markets.

The dummy variables *SMALL, COMPACT, MEDIUM,* and *LARGE* each take on the value one if the automobile falls into one of these predetermined classes. The dummy variable *YEAR95* takes on the value one if the data are from 1995 and zero if the data are from 1994. The variable *EXCHANGE* takes on the value zero if the model is sold in 1994 and takes on the value equal to the percentage change (from 1994 to 1995) in the exchange rate of the country's currency versus the new Israeli shekel if the model is sold in 1995. The dummy variables *JAPAN95, KOREA95, USA95, ITALY95, GERMANY95* and *FRANCE95* take on the value one if the automobile is produced in that country and if the model year is 1995.[37]

[35] Automobiles that are imported from the United States and European countries are exempt from customs duties because of free-trade agreements. Automobiles from Japan and Korea are not exempt from customs duties.

[36] In the case in which options are available, the Levi pricebook will list the price with and without the options. In such a case, we took the observation with the fewest options.

[37] Similar to other authors, we include Hondas produced in America as Japanese automobiles.

TABLE 2 Automobile Sales by Group

	Small	Compact	Medium	Large	Total
1994					
Total sales	25,026	58,075	19,004	9,087	111,192
Models	19	37	20	25	101
Japanese and Korean sales	3,733	36,773	13,031	1,579	55,116
Japanese and Korean models	5	11	10	6	32
Boycott sales	1,240	28,848	12,206	1,579	43,873
Boycott models	1	8	8	6	23
1995					
Total sales	31,155	57,129	15,381	7,614	111,279
Models	33	33	27	19	112
Japanese and Korean sales	2,241	47,763	4,744	891	55,639
Japanese and Korean models	6	16	12	2	36
Boycott sales	1,467	41,945	4,497	891	48,800
Boycott models	2	13	11	2	28

The dummy variable *AIRCONDITION* (*AUTOMATIC*) takes on the value one if the model has air conditioning (automatic transmission) and zero otherwise. The variable *AIRBRAKE* takes on the value two if the model has both airbags and antilock brakes. If the model has only one of the features, the variable takes on the value one. If the model has neither of the features, the variable takes on the value zero.[38] The Appendix contains descriptive statistics on the available data.

The two models with the greatest sales per model in 1994 (the Mitsubishi Lancer 1.6 liter engine (11,447) and the Daewoo Racer 1.5 (10,658)) were in the compact class. Together these two models accounted for 20% of the 1994 sample. The top two models in 1995 were again from the compact class (the Mitsubishi Super Lancer 1.6 (9,203) and the Daewoo Super Racer 1.5 (6,178)), but their market shares were smaller; together they accounted for 14% of the 1995 sample. Hence, four models in the compact class account for 17% of the total sales. Table 2 shows that the compact class accounted for slightly more than 50% of the sample in both 1994 and 1995 and that the Japanese and Korean compact automobiles are extremely popular.

□ **Traditional hedonic pricing estimation.** We first estimate the model using the "traditional" hedonic pricing approach employed by earlier studies of supply interruption. Hence we estimate equation (8) without the markup term. The hedonic pricing equation assumes that prices are exogenous. We then estimate the demand equation under the assumption that prices are exogenous.[39] The results from (1) the hedonic pricing regression and (2) the demand equation (using GMM, but with prices treated as exogenous) are shown in Table 3. We know that this estimation technique will lead

[38] Since most of the models that have one of these features also have the other feature, it seemed best to define the variable in this fashion.

[39] Of course, we still need instruments for the group share.

TABLE 3 Hedonic Pricing Regression and GMM Demand Estimation with Price Exogenous

	Demand Equation		Hedonic Pricing Equation	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
α	8.6×10^{-6}	1.9×10^{-6}		
σ	.59	.09		
CONSTANT	−3.21	.36	−2,116	2,070
ENGINE	−.15	.09	16,741	1,311
AIRBRAKE	−.11	.06	7,088	726
AUTOMATIC	.05	.10	2,409	1,154
AIRCONDITION	.14	.09	1,796	1,319
COMPACT	.64	.10		
EXCHANGE			2,123	503
YEAR95			−4,965	2,696
GERMANY95			−13,308	4,856
JAPAN95			−12,021	2,967
FRANCE95			−14,757	3,829
USA95			4,458	3,526
KOREA95			10,566	4,398
ITALY95			8,786	3,653
R^2			.851	

to biased estimates of the demand-side parameters. Indeed, a comparison with Table 4, which includes the same variables but assumes that price is endogenous, bears this out. We return to this point when we present the GMM estimation results for the two-equation (equations (5) and (8)) system.

□ **GMM estimation of the full system.** We estimated several different models. All of these models included engine size and whether the car has air conditioning, automatic transmission, antilock brakes, and airbags; these features appear both in x_j and w_j. Additionally, all of these models included the variables *EXCHANGE, YEAR95, JAPAN95, KOREA95, USA95, ITALY95, GERMANY95,* and *FRANCE95* in the w_j (cost-side characteristic) vector. These country dummy variables are included for 1995 only, since we have only two years of sales.[40] These variables will help us examine the predicted changes in marginal cost relative to the average 1994 automobile. We would expect that countries whose currencies appreciated relative to the NIS from 1994 to 1995 would have experienced increases in marginal costs.

In all cases, the instruments employed are the sum of the engine sizes of the other products in the group, the sum of the engine sizes of the other products that a firm sells in the group, the number of other products in the group, the number of other products that a firm sells in the group, and the change in the average exchange rate between 1994 and 1995. The theoretical justification for these instruments was provided above.

[40] Country dummies for 1994 would have no meaning, since *EXCHANGE* takes on the value zero if the model is sold in 1994 and takes on the value equal to the percentage change (from 1994 to 1995) in the exchange rate of the country's currency versus the new Israeli shekel if the model is sold in 1995.

TABLE 4 GMM Results for Full System: Model II: *COMPACT*

	Demand Equation		Pricing Equation	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
CONSTANT	−2.56	.34	−5,849	3,449
ENGINE	.13	.15	14,517	1,663
AIRBRAKE	.15	.09	7,467	1,045
AUTOMATIC	.15	.08	3,463	1,349
AIRCONDITION	.19	.09	2,203	1,081
COMPACT	.72	.09		
EXCHANGE			640	48
YEAR95			−2,293	3,452
GERMANY95			47	8,340
JAPAN95			−1,182	4,806
FRANCE95			−1,648	6,199
USA95			1,893	4,426
KOREA95			3,204	5,700
ITALY95			3,423	4,140
Both equations	**Coefficient**		**Standard Error**	
α	2.1×10^{-5}		8.6×10^{-6}	
σ	.70		.07	
GMM OBJ	16.61			

The models differ in the following respect: In model I we have included a dummy variable in the x_j (demand-side characteristic) vector for Japanese and Korean compact automobiles (denoted *JKCOMPACT*), whereas in model II we have included a dummy variable in the x_j (demand-side characteristic) vector for all compact automobiles (denoted *COMPACT*).[41]

Comparisons between the models. There are indications that both models fit the data reasonably well. The estimates of the marginal cost of air conditioning and automatic transmission are in line with the option prices that are occasionally listed separately in the Levi pricebook.[42]

Both models also predict that the marginal cost of producing French, German, and Japanese automobiles increased significantly in 1995 relative to the average 1994 automobile, owing to increases in the exchange rate. According to model II, the marginal cost of producing a French car in 1995 increased by 3,099 NIS relative to the average 1994 automobile.[43] Similarly, the marginal cost of producing Japanese and German cars increased significantly (by 2,285 NIS and 6,075 NIS respectively).[44] On the other hand,

[41] We also estimated a model without a dummy variable for compact automobiles or Japanese and Korean compact automobiles. But this model produced results that were less satisfactory than either model I or model II. Hence, we do not discuss this model in any detail.

[42] *AIRBRAKE* is most likely a proxy for other premium features such as power locks, power windows, and metallic paint; hence its estimated marginal cost is somewhat high.

[43] The calculation is as follows: $(-2{,}293 + 640 * 11 - 1{,}648)$.

[44] Most of the German cars sold in Israel are large luxury models.

the marginal cost of producing Italian cars increased slightly (by 470 NIS), while the marginal cost of producing American and Korean cars fell slightly (by −400 NIS and −1,009 NIS respectively). The calculations for model I are similar.

Finally, both models predict that there is a reasonably significant degree of competition in the Israeli automobile market. In the case of model I, the mean (sales-weighted) price-cost margins (price less marginal cost divided by price) are approximately 16%, while in the case of model II, the price-cost margins are approximately 10%. The BLP (1995) study conducted on the U.S. automobile industry had price-cost margins that were slightly higher.

Additionally, there is a reasonably high correlation between the predicted markup (price less predicted marginal cost) and price itself for both models. In the case of model I the correlation is .48, while in the case of model II this correlation is .57. Further, the markup is, on average, increasing in the size of the automobiles. In the case of model II, the markup for compacts was under 6,000 NIS, while the markup for large automobiles was nearly 14,000 NIS.

Finally, it is reassuring that for both models I and II the instruments are indeed reasonably correlated with the variables for which they are instrumenting; "first-stage" regressions of the endogenous variables on the relevant instruments and the other exogenous variables in the relevant equation yield reasonably high R^2 values.

There are differences, however, between the two models: There is a higher correlation between the actual and predicted sales in 1995 in the case of model I (.40) than in the case of model II (.33). Both of these numbers are quite good for discrete-choice models with large observations (112 in this case); indeed, many automobile models in the sample have the same observable characteristics (and quite similar prices), yet they have very different sales. This type of variation in the data, which is quite common (and typically quite large) in markets with differentiated products, cannot be explained by any model.

Other goodness-of-fit summary statistics indicate that the models fit the data well: the correlation between the actual number of sales per class (small, compact, medium, large) and the predictions per class is over .99 for both models. Additionally, the correlation between actual and predicted prices for the 112 models in the 1995 sample is relatively high: .85 for model I and .90 for model II.

Model I fits the sales data better because some of the Japanese and Korean compact models are quite popular (see Table 2). If we were solely interested in "fitting" the 1994 and 1995 sales data, model I would be our preferred model. Model I fits the sales data better, however, because there was a very dramatic shift in consumption toward "Asian" cars. It is likely that this reflects a "pent-up demand" effect, due to the fact these models were unavailable in Israel until recently. Indeed, Mitsubishi sales were extremely high the first few years that their automobiles were available in Israel and have since declined (as other new Japanese and Korean firms entered the Israeli market). The same may be true for Korean automobiles, which captured a large percentage of the Israeli market in 1995. Hence, it is likely that the long-run demand for Japanese and Korean cars will be lower than it is today. This suggests that model I will overstate the welfare gains from the end of the boycott; hence model II is our preferred model for estimating the welfare effects of the boycott.[45] Table 4 has the GMM estimates for our preferred model. The results from the GMM estimation of model I are in the Appendix.

Finally, before we examine the effect of the boycott, we compare the demand-side estimates from our preferred model with the demand-side estimates from the case in which price is exogenous. Both estimation techniques include the same explanatory

[45] We thank two anonymous referees for this point.

variables. Theory tells us that if we treat price as exogenous, the estimate of α, the coefficient on price, will be biased downward.[46] A comparison of Tables 3 and 4 shows that the estimate of α is smaller in Table 3. Indeed, all of the demand-side coefficient estimates (except for the constant) in Table 3 are smaller than the demand-side coefficient estimates in Table 4; some of these coefficients are negative in Table 3.

Of course, if we were only interested in obtaining consistent estimates for the demand-side parameters, it would be sufficient to instrument for price and group share, that is, there would be no need for an explicit model of the supply side. But without the oligopoly pricing term in the model, we could not estimate any of the "pricing" effects of the boycott. The pricing effects are important; to estimate changes in consumer surplus associated with the supply interruption, we need to know what would have happened to prices in the equilibrium that would have existed in 1995 had the boycott continued. A fully specified structural oligopoly model is necessary to rigorously examine this issue.[47] We discuss this further in the following section.

5. Simulation: The effect of the boycott

■ In order to conduct our experiment, we now employ the results from our preferred model to compare two simulated oligopoly equilibria: (1) the full-choice set or "postboycott equilibrium" and (2) the reduced-choice set or "boycott equilibrium." In the case of the postboycott equilibrium in 1995, this amounts to solving 224 nonlinear equations, i.e., 112 demand equations (equation (5)) and 112 pricing equations (equation (8)) for each model without the error terms.[48] In the case of the boycott equilibrium, this amounts to solving the 84 demand and pricing equations for each model that would have been available had the boycott continued. In this simulation we include the Subaru, Daihatsu, and Suzuki models, since these firms did not participate in the boycott. A comparison of the two simulations yields the following results:

(i) The new car market in Israel would have been approximately 9% smaller in 1995 had the boycott continued.

(ii) Table 5 shows (a) the actual distribution of new car sales according to group, (b) the "predicted" distribution of new car sales according to group for the full-choice set equilibrium and (c) the "predicted" distribution of new car sales according to group for the "boycott" equilibrium. Had the boycott continued, the second and third rows of Table 5 show that there would have been a leftward shift in the distribution to smaller (less expensive) vehicles.

(iii) A comparison of the predicted prices reveals that prices would not have been too much higher had the boycott continued in 1995. This is due to the fact that the Israeli market is relatively competitive and that close substitutes exist for nearly every model in the market.

□ **Welfare.** Trajtenberg (1989, 1990) developed a methodology for measuring the gains from product innovation; he used the methodology to estimate the benefits associated with computed tomography scanners. His methodology offers a significant improvement over hedonic price regressions.[49] We employ his methodology to estimate

[46] Indeed, some studies have obtained pricing coefficients with the "wrong" sign. See Berry (1994) for a discussion.

[47] To the extent that a market is relatively competitive and close substitutes exist (so that prices are not expected to change significantly due to a supply interruption), it will be possible to get rough estimates of changes in consumer surplus associated with a supply interruption without formally modelling the supply side.

[48] This system was solved using the GAUSS nonlinear simultaneous-equations subroutine.

[49] For a detailed discussion of this point, see Trajtenberg (1990).

TABLE 5 Distribution of Automobile Sales by Group

	Small	Compact	Medium	Large	Total
1995 actual distribution (112 models)	.28	.51	.14	.07	1.00
1995 full-choice set equilibrium (112 models)	.27	.47	.18	.10	1.00
1995 boycott equilibrium (84 models)	.30	.43	.17	.11	1.00

the benefits associated with the entry of the Japanese and Korean automobiles into the Israeli market.

The equations in (4) are a system of probabilistic demand functions for individual *i*. Trajtenberg shows that the demand system exhibits all the properties of deterministic demand functions; therefore, consumer surplus can be calculated. In the case of the nested logit model, Trajtenberg (1989) shows that consumer surplus (per consumer) up to a constant is given by

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

where C is the constant of integration. It can easily be verified that indeed $-(\partial W/\partial p_j)$ equals the expression for market share (demand) in (4) above. Hence, using Roy's identity, $s_j = -(\partial W/\partial p_j)/(\partial W/y)$, we see that $C \equiv y$, where y is income. Our measure of the welfare gain from the end of the enforcement of the boycott for 1995 is simply

$$W(112) - W(84), \tag{10}$$

where $W(112)$ is the per-person consumer surplus associated with the postboycott equilibrium (from (9)), and $W(84)$ is the per-person surplus associated with the boycott equilibrium. To compute these welfare measures we need equilibrium prices for the boycott and postboycott equilibria in 1995. We employ the predicted prices from our simulations.

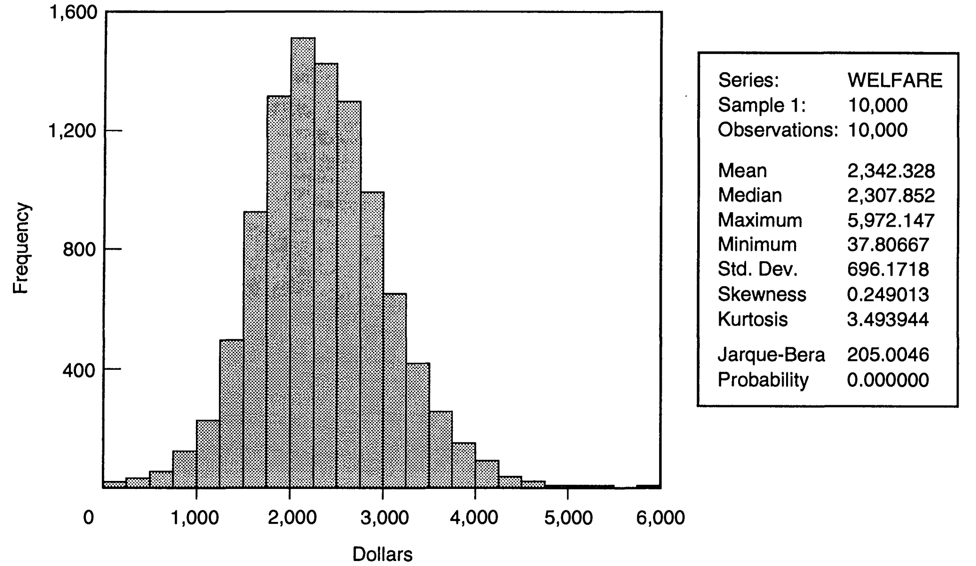
The calculations reveal that the welfare gain associated with the end of the Arab economic boycott amounted to $2,343 per purchaser (or $993 per purchaser before taxes) in 1995.[50]

In order to get some sense of the precision of the estimated welfare gain, the following "bootstrap" experiment was performed. It was assumed that the estimated coefficients from Table 4 were the true means and the estimated standard deviations were the true standard deviations of the unknown parameters. Further, we assumed that each of these parameters was normally distributed. We then computed 10,000 estimates of the welfare gain. The results are shown in Figure 3. The estimated standard deviation of the welfare gain is approximately $696.

[50] This assumes an average tax rate of 136%. Recall that automobiles from Europe and the United States are taxed at a 128% rate, while automobiles from other parts of the world (including Japan and Korea) are taxed at a 144% rate. Since approximately 50% of the sales are from the United States and Europe in both 1994 and 1995, it seemed reasonable to use the average of these tax rates to make the calculation.

FIGURE 3

PER-CAPITA WELFARE GAIN IN DOLLARS



Recall that the (sales-weighted) average price of an automobile sold in Israel in 1995 was approximately $24,665; hence the associated welfare gains are approximately 9.5% of the price of the average car. Since there were approximately 113,000 automobile purchases in 1995, the welfare gain to consumers totalled more than $264 million in that year.[51]

□ **Further discussion.** The simulations predict that prices would not have increased significantly had the boycott continued. Indeed, fully 84.6% of the welfare gain comes in the form of increased variety. To compute this percentage we employ the predicted prices for the postboycott equilibrium. In particular, in performing this calculation we first compute the welfare (per purchaser) associated with the full-choice set. We then calculate the welfare associated with the reduced (boycott) choice set under the assumption that prices would not have changed had the boycott continued. This calculation gives us the welfare gain from increased variety.

Our result that most of the welfare loss from the boycott came from "variety" rather than "price" effects is consistent with evidence from recent studies of blockaded trade in oligopolistic industries. Berry, Levinsohn, and Pakes (1996) find that voluntary export restraints (VERs) on Japanese vehicles in the early 1980s "did *not* significantly raise prices when they were first initiated." An earlier study by Feenstra (1988) on the same episode found that some of the price increases for Japanese cars were due to increases in quality, i.e., more horsepower, larger vehicle size, added features, etc.

Much of the welfare loss is simply the removal of the 28 brands that would not have been available in the market had the boycott continued. We now delineate the

[51] Since a continuation of the boycott would have led to a smaller number of consumers in 1995, it is not clear what number should be used to multiply the per-capita welfare gain. We use the actual 1995 market size, but an argument could be made to use the "predicted" 1995 market size under the assumption that the boycott had continued.

welfare gain due to variety ($1,984) according to automobile class: small (5.4%), compact (71.1%), medium (21.5%) and large (2.0%). Most of the welfare gain comes from the compact class, which consists of 50% of all automobile sales.

In closing this section, we discuss the robustness of the results to changes in the specification. We focus on changes in the demand-side specification, since welfare depends directly on demand and only indirectly on supply assumptions (recall that there is no domestic production). The welfare results are robust to the elimination of any one of the following demand-side characteristics: automatic transmission, air conditioning, airbags, or antilock brakes.

The welfare results are sensitive to the inclusion of a dummy variable for Japanese and Korean compact automobiles in place of a dummy variable for all compact vehicles. This is because the four automobiles with the greatest sales (by far) are Japanese and Korean compact cars (as we discussed in Section 4). These four automobiles accounted for nearly 17% of all sales. Hence, when we estimate model I (see the Appendix), the estimated coefficient for the parameter associated with Japanese and Korean compact automobiles is .94, while the parameter estimate for the dummy variable for the compact class (model II) is only .72. Further, the estimates of some of the other parameters of the demand-side characteristics (*AIRBRAKE* and automatic transmission) using model I are significantly smaller than in the case of model II. Hence, in the specification of model I, much of the welfare comes from Japanese and Korean compacts. Indeed, if the simulations are conducted using the estimates from model I, the welfare gain from the end of the boycott is $6,231 per purchaser in 1995.[52] Because of the pent-up demand effect, we believe that this number significantly overstates the welfare gain from the end of the boycott.[53]

6. Concluding remarks: The effectiveness of the boycott

■ The boycott clearly was effective in that the major Japanese and all of the Korean firms stayed out of the Israeli market during the period in which the secondary and tertiary boycotts were strictly enforced. Our analysis suggests that consumer welfare loss due to the boycott was not insignificant.

On the other hand, the effectiveness of the boycott was mitigated by the incentive that it created for small Japanese firms to enter the Israeli market. In the case of Subaru, Daihatsu, and Suzuki, the choice was between becoming small players in the large Arab automobile markets and being very large players in the small Israeli market. Using our preferred model, we estimate that had none of these Japanese firms entered the Israeli market, the size of the boycott market would have been 12% smaller than the size of the postboycott market; further, we estimate that the gain in consumer surplus from the end of the Arab boycott would have been approximately 28% larger, that is, on the order of $3,007 per purchaser in 1995. Since there will typically be incentives for some firms to enter markets that others are boycotting, the effectiveness of boycotts will to some extent depend on the ability of the sponsors of the sanctions to enforce the prohibition on trade.

In closing, we note that our work sheds some light on how to measure the effectiveness of economic sanctions. In recent years, economic sanctions have been employed against Haiti, Iraq, Serbia and Montenegro, and China. Indeed, economic

[52] We also made an additional calculation. We used the estimates from model II and calculated the welfare gain using a dummy variable for Japanese and Korean compacts, rather than a dummy variable for the compact class. In this case, the welfare gain associated with the end of the Arab economic boycott is approximately $3,730 per purchaser in 1995.

[53] Nevertheless, if the demand for Japanese and Korean compact vehicles remains very high in the future, our $2,343 per purchaser estimate understates the benefit from the end of the boycott. We thank the referees for this point.

sanctions are employed frequently. Do they work? As G. Hafbauer notes, "sanctions rarely change the policies of large powerful countries, no matter how brilliantly implemented."[54] Nevertheless, sanctions often have significant effects.

Despite the frequent use of economic sanctions and a fairly large literature on the topic,[55] there has been no attempt to quantitatively measure their effects using structural economic models. We believe that our methodology could be employed to formally assess the effect of economic sanctions.

Appendix

TABLE A1 Descriptive Statistics

Variable	Mean	Maximum	Minimum
PRICE	68,481	194,962	29,999
QUANTITY	1,044	11,447	80
ENGINE	1.63	3.8	1.00
AIRCONDITION	.88	1.00	.00
AUTOMATIC	.21	1.00	.00
AIRBAGS	.12	1.00	.00
AIRBRAKE	.07	1.00	.00
SMALL	.25	1.00	.00
COMPACT	.52	1.00	.00
MEDIUM	.16	1.00	.00
LARGE	.07	1.00	.00
JAPAN	.34	1.00	.00
KOREA	.16	1.00	.00
FRANCE	.13	1.00	.00
ITALY	.12	1.00	.00
USA	.07	1.00	.00
GERMANY	.04	1.00	.00
EXCHANGE	4.91	13	−3
YEAR95	.50	1.00	.00

Note: Except for the variable quantity, the mean values in Table A1 are weighted by sales. In the case of *EXCHANGE,* the data refer to 1995. Recall that in the case of options, we took the model with the fewest options. Thus in the case of *AUTOMATIC,* for example, .21 cannot be interpreted as the percentage of new cars that have automatic transmissions.

[54] G. Hufbauer, "The Futility of Sanctions," *The Wall Street Journal,* June 1, 1994, p. 14A.

[55] See Leyton-Brown (1987), a conference volume consisting of fifteen articles on the use of economic sanctions as a policy instrument, and Hufbauer, Schott, and Elliot (1990), a qualitative study of the use of economic sanctions in this century.

TABLE A2 GMM Results for Full System: Model I: *JKCOMPACT*

Variable	Demand Equation Coefficient	Demand Equation Standard Error	Pricing Equation Coefficient	Pricing Equation Standard Error
CONSTANT	−3.46	.35	−14,481	4,625
ENGINE	.20	.11	16,509	1,639
AIRBRAKE	.04	.11	7,169	982
AUTOMATIC	.09	.11	2,463	1,084
AIRCONDITION	.22	.12	2,069	1,343
JKCOMPACT	.94	.15		
EXCHANGE			1,223	629
YEAR95			−2,566	3,171
GERMANY95			−3,033	6,935
JAPAN95			−5,383	3,969
FRANCE95			−7,444	5,151
USA95			1,615	3,171
KOREA95			5,869	5,109
ITALY95			4,409	3,735
Both equations	**Coefficient**		**Standard Error**	
α	1.9×10^{-5}		8.0×10^{-6}	
σ	.51		.07	
GMM OBJ	7.59			

References

ANDERSON, S.P. AND DE PALMA, A. "Multiproduct Firms: A Nested Logit Approach." *Journal of Industrial Economics,* Vol. 40 (1992), pp. 261–276.

BERRY, S.T. "Estimating Discrete-Choice Models of Product Differentiation." *RAND Journal of Economics,* Vol. 25 (1994), pp. 242–262.

———, LEVINSOHN, J., AND PAKES, A. "Automobile Prices in Market Equilibrium." *Econometrica,* Vol. 63 (1995), pp. 841–890.

———, ———, AND ———. "Voluntary Export Restraints on Automobiles." NBER Working Paper no. 5235, 1996.

BRESNAHAN, T.F. "Competition and Collusion in the American Auto Industry: The 1955 Price War." *Journal of Industrial Economics,* Vol. 35 (1987), pp. 457–482.

———, STERN, S., AND TRAJTENBERG, M. "Market Segmentation and the Sources of Rents from Innovation: Personal Computers in the late 1980s." *RAND Journal of Economics,* Vol. 28 (1997), pp. S17–S44.

CAPLIN, A. AND NALEBUFF, B. "Aggregation and Imperfect Competition: On the Existence of Equilibrium." *Econometrica,* Vol. 59 (1991), pp. 25–54.

CHAMBERLAIN, G. "Asymptotic Efficiency in Estimation with Conditional Moment Restrictions." *Journal of Econometrics,* Vol. 34 (1987), pp. 305–334.

DINOPOULOS, E. AND KREININ, M. "Effects of the U.S.-Japan Auto VER on European Prices and on U.S. Welfare." *Review of Economics and Statistics,* Vol. 70 (1988), pp. 484–491.

FEENSTRA, R. "Quality Change under Trade Restraints in Japanese Autos." *Quarterly Journal of Economics,* Vol. 103 (1988), pp. 131–146.

GOLDBERG, P. "Product Differentiation and Oligopoly in International Markets: The Case of the U.S. Automobile Industry." *Econometrica,* Vol. 63 (1995), pp. 891–952.

GREENSTEIN, S. "From Super-Minis to Super-Computers: Estimating Surplus in the Computing Market." NBER Working Paper no. 4899, 1994.

HANSEN, L.P. AND SINGLETON, K.J. "Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models." *Econometrica,* Vol. 50 (1982), pp. 1269–1286.

HUFBAUER, G.C., SCHOTT, J.J., AND ELLIOT, K.A. *Economic Sanctions Reconsidered: History and Current Policy.* 2d ed. Washington, D.C.: Institute for International Economics, 1990.

LEYTON-BROWN, D., ed. *The Utility of International Economic Sanctions.* New York: St. Martin's Press, 1987.

MCFADDEN, D. "Modelling the Choice of Residential Location." In A. Karlqvist et al., eds., *Spacial Interaction Theory and Planning Models.* Amsterdam: North-Holland, 1978.

PAKES, A. "Dynamic Structural Models, Problems and Prospects: Mixed Continuous Discrete Controls and Market Interactions." In C. Sims, ed., *Advances in Econometrics: The Sixth World Congress of the Econometric Society, Vol II.* New York: Cambridge University Press, 1995.

REINGOLD, R. AND LANSING, P. "An Ethical Analysis of Japan's Response to the Arab Boycott of Israel." *Business Ethics Quarterly,* Vol. 4 (1994), pp. 335–353.

ROLEF, S.H. "Israeli Anti Boycott Policy." Davis Institute of Policy Studies (Hebrew University) Working Paper no. 28-1989.

SARNA, A.J. *Boycott and Blacklist.* Totowa, N.J.: Roman & Littlefield Publishers, 1986.

TRAJTENBERG, M. "The Welfare Analysis of Product Innovations, with an Application to Computed Tomography Scanners." *Journal of Political Economy,* Vol. 94 (1989), pp. 444–479.

———. *Economic Analysis of Product Innovation: The Case of CT Scanners.* Cambridge, Mass.: Harvard University Press, 1990.

VERBOVEN, F. "International Price Discrimination in the European Car Market." *RAND Journal of Economics,* Vol. 26 (1996), pp. 240–268.