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Did U.S. Safeguard Resuscitate Harley Davidson in the 1980s? *

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Abstract

This paper examines the effect of U.S. safeguard on motorcycle imports in the period from 1983 to 1987. After receiving the temporary protection with the maximum tariff of more than 45%, Harley Davidson drastically recovered its sales. The paper conducts structural analyses of the motorcycle market, and finds that the safeguard contributed merely a fraction of Harley Davidson's profit. This finding is primarily due to small cross-price elasticity of demand between American and Japanese motorcycle models.

Keywords: Safeguard; Tariff-Rate Quota; Motorcycles; Harley Davidson

JEL: F13; F14; L13; L68

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1 Introduction

Ronald Reagan signed a recommendation from the U.S. International Trade Commission (ITC) calling for five years of new tariffs on heavyweight motorcycles in the period from 1983 to 1988. This tariff relief, called safeguard, was intended to protect against Japanese imports Harley-Davidson Motor Co., the U.S.'s last remaining motorcycle manufacturer. At that time Harley was under financial distress with merely four percent of the market that it once dominated in the early 1970s. The new tariffs were scheduled to start at 49.4 % of the wholesale price and decrease to 14.4 % in the fifth year, while the Japanese were allowed to ship the first 6000 cycles under the old 4.4 % tariff, and that allowance rose by 1000 units a year. After receiving temporary import relief in 1983, Harley-Davidson came back stronger than ever. Its sales increased dramatically with the annual rate of 10 % from 1983 to 1990. Indeed, Harley recovered so swiftly that it even requested that the final year of tariff protection be cancelled. The Harley-Davidson motorcycle case is now heralded as a great success of safeguard protection.

Some, however, hold a skeptical view on the role of import relief in Harley-Davidson's turnaround. Harley produced mostly heavyweight motorcycles with piston displacement of more than 900 cc in the 1980s. Irwin (2002) argues that, since the motorcycles imported from Japan were concentrated mostly on medium-weight bikes in the range from 700 to 850 cc, they did not directly compete with Harley-Davidson. Reid (1990) documents the story that Harley-Davidson saved itself from bankruptcy primarily because they restored employee commitment, fixed its lax inventory system, and revolutionized manufacturing processes. In their view, import relief had little to do with Harley-Davidson's turnaround. As safeguard policy has attracted a renewed attention amongst the surge of antidumping cases, it is imperative to empirically resolve these conflicting views on the effectiveness of the most famous safeguard case in U.S. history.

This paper takes an empirical approach to assess the extent to which the U.S. safeguard policy contributed to Harley-Davidson's recovery. We employ a random coefficient discrete choice model to estimate motorcycle demand in the U.S. market. The methodology controls for endogeneity of price, and allows for heterogeneity in consumer tastes. Combined with the estimates of supply-side model, we conduct counter-factual analyses to assess the effectiveness of the import relief on Harley-Davidson implemented in the period from 1983 to 1987. The paper finds that Harley-Davidson's recovery was not entirely due to the safeguard protection. The simulation exercises reveal that the temporary protection of the maximum tariffs of 45% increased Harley-Davidson's sales and profit by a mere six percent.

The rest of the paper is organized as follows. The next section presents an overview of the U.S. motorcycle market, and provides descriptive statistics from our data set. Section 3 introduces a model to illustrate both consumers transaction behavior and firms pricing behavior of motorcycles in the United States. The section also presents estimation procedure and instruments used to control for endogeneity in motorcycle prices in demand. Based on estimates obtained in Section 4, Section 5 conducts counterfactual exercises to measure the impact of the safeguard policy on American and Japanese motorcycle revenues. The section demonstrates that the safeguard provided by the U.S. government until 1987 explains merely a six percent of Harley-Davidson's sales recovery. The finding of this small safeguard effect on Harley-Davidson revenue is largely due to our estimation results indicating that the values of cross-price elasticities of consumer demand between American and Japanese motorcycles are considerably small. Thus, the tariff increases would have had little effect on shifting consumers from Japanese motorcycles to Harley-Davidson's. Our estimation results support the hypothesis that Harley-Davidson saved themselves out of bankruptcy. It should be taken as coincidence that Harley-Davidson recovered its profit when they received the import relief. Section 6 concludes, followed by data appendix.

2 Overview of the U.S. Motorcycle Market

Harley-Davidson had traditionally been the leader in the U.S. motorcycle market during the 1950s. The situation changed, however, with the entrance of Japanese motorcycle manufacturers. The new entrants sold only motorcycles of 250 cc's or less in the 1960s. These lightweight bikes quickly gained a reputation for high quality and advanced technology. By 1965, the U.S. market was dominated by lightweight motorcycles, with Honda controlling 85 % of the market. Indeed, Honda's sales leapt from $500,000 in 1960 to $77 million by 1965. Initially, this dramatic shift in the market was not perceived as a threat by Harley, the sole surviving American-owned motorcycle firm; since their territory of heavyweight motorcycles was left uninvaded and the market was expanding. However, when the lightweight market was successfully under their control, the Japanese producers ventured to the market with larger engine capacities, thereby competing directly with Harley-Davidson in the United States. Japanese launch of heavyweight bikes grew intense as Kawasaki and Honda opened plants in Nebraska in 1974 and Ohio in 1979 respectively, to produce heavyweight motorcycles. By the end of 1981, Harley-Davidson fell down to a distant fifth with a mere five percent of the U.S. motorcycle market, following Honda (38 %), Yamaha (25 %), Kawasaki (16 %), and Suzuki (14 %). The remaining share attributed primarily to BMW.

Harley-Davidson has long attributed its declining sales to lower priced Japanese imports. Sharp increases in the Japanese import in the early 1980s, along with the 1981 and 1982 recession, accumulated a large stockpile of inventory for both the American and Japanese companies. As a result, Harley-Davidson sought tariff protection in 1982, claiming that the inventories caused by the substantial increases in Japanese imports created the threat of serious injury to the American company. The Regan administration accepted the ITC's recommendation and adopted a tariff-rate quota on imports on motorcycles over 700cc from April 1983 to March 1988. The tariff-rate quota allows the certain amount of motorcycles to be imported under the normal tariff rate of 4.4 percent, and imports above that quantity have to pay the higher protective tariffs. The quotas in 1983 were set at 6000 units for Japan, 5000 units for West Germany (where BMW was located), and 4000 units for imports from all other countries. These levels were scheduled to increase each year of the relief period. The new tariff rates were set at 49.4 percent for the initial year, declined over the five years, and then returned to the normal tariff rate.

As indicated in Figure 2, U.S. import quantities of larger motorcycles that Harley sought for protection dropped by half, when the highest tariff was implemented in 1983. Interestingly, they continued to decline in the safeguard period as the tariff-rate quota eased toward 1988. While the declined units of imported motorcycles are largely due to the decrease in U.S. motorcycle sales in this period, two other events may also account for this observation. The one is that the Japanese may have exported more motorcycles with smaller engine displacement, so that they could evade the tariff-rate quota and imported under the normal duty. Table 2 presents U.S. motorcycle sales of Harley-Davidson and the Japanese by engine displacement size. The data are from R. L. Polk, achieved in the U.S. Library of Congress, and the availability is limited in the period from 1983 to 1987. The table indicates that Japanese manufacturers indeed appear to have responded to the safeguard action; the sales shares of Japanese motorcycles with 699 or less jumped from 43 percent to more than 60 percent in 1983 and thereafter. The increase in sales was mostly substituted from the decrease in sales of Japanese medium-size motorcycles in the range from 700 to 1099 cc while the overall Japanese sales declined. The change in the sales composition by engine displacement would not be entirely accounted for by motorcycle prices, provided by the fact that average prices of Japanese medium-sized motorcycles dropped more than that of the smaller-sized.

The other event that may have contributed to the decrease in US imports is that, since the higher tariffs were not applied to domestic production, the foreign producers, namely Honda and Kawasaki, would have gradually shifted their production to the United States.[1] Though no data are publicly available on local production made by the Japanese companies, we take into account possible effects of local production in our empirical assessment of the motorcycle safeguard.

The tariff-rate quota affected not only on quantities of imports and sales, but also on motorcycle prices. Figure 2 shows the prime retail prices averaged over Harley-Davidson and the Japanese motorcycle makes. The prime retail prices are known to closely reflect transaction prices, and thus differ from manufacturer's suggested prices. The data are available from National Automotive Dealers Association (NADA) in the period from 1977 to 1987. The price data in the figure are in constant 1983 U.S. dollars, and weighted by quantities sold in each year. A observation worth

[1] Daily Automobile Newspaper, July 1985.

noting is that the prices of the Japanese motorcycles subject to higher tariffs did not increase in the first two years into the safeguard period. In fact, Harley-Davidson's prices maintained 70 % higher and increased at the rate three times faster than the Japanese counterpart. This observation might have been accounted for by the aftermath of large inventories accumulated by the Japanese in 1981 and 1982, as mentioned earlier in this section. According to the USITC (1984), the inventory at the beginning of 1983 took more than 20 percent of the U.S. motorcycle sales of that year. Since most of the inventory were motorcycles with 700 cc or greater, this supply glut would have had larger impact on Japanese motorcycles of that category. The Japanese prices began to increase in 1985 when the Plaza Accord was signed. Prices of Japanese motorcycles for both size categories increased with the devaluation of U.S. dollar; the rate of price increase was on average 10 percent, more than 50 percent faster than that of Harley-Davidson's. This observation witnesses that Japanese motorcycle prices in the 1980s were accounted for largely by imports, and probably less by local production made by Honda and Kawasaki.

To examine the safeguard effect on the prime retail prices, p_{mt}, for motorcycle model m and period t, we perform the following estimating regression in the period from 1977 to 1987:

$$\ln(p_{mt}) = \alpha_0 + \alpha_1 SG_{mt} + \alpha_2 SG_{mt} \cdot TD_{mt} + \alpha_3 TD_{mt} + \sum_{k=4} \alpha_k Z_{mkt} + \eta_{mt},$$

where SG is the safeguard variable, which takes 1 if model m is Japanese make with engine displacement of 700 cc or larger, and 0 otherwise. While some motorcycles that receive SG equal one must have been manufactured in the U.S, the data set is unable to distinguish imported motorcycles from locally produced ones. Thus, the coefficient of this variable would underestimate the effect of the safeguard policy. The control group that identifies the SG coefficient includes both Japanese motorcycles with the smaller engine displacement, and Harley-Davidson's. The period dummy TD captures aggregate factors that affect p over time in the same way for all the motorcycle models in the study period. It takes 1 if the model m was sold in the period from 1983 to 1987, and 0 if outside of the safeguard period. In an alternative specification, we define TD as the variable that takes 1 if the vintage year of the model m was in the safeguard period, and 0 otherwise. Note that as discussed shortly below, since the age variable is in the regression, the year and vintage year variables in principle cannot be used simultaneously.

The other variables that may have influenced the motorcycle prices are included in the fifth term of the LHS, whose k-th element is denoted by Z_{mkt}. Motorcycle and industry characteristics are incorporated in this term. For motorcycle characteristics, we use the variables of engine displacement, and dry weight (that is, the motorcycle weight with empty oil tank), both in a logarithmic form. Model age variable is also included to separate the effects of new and older motorcycles. For industry characteristics, we use the variables of exchange rate (US$ / Japanese Yen, in logarithm), trend variable, and the interaction term composed of the trend variable, and the Harley-Davidson dummy that takes 1 if the model m is manufactured by Harley-Davidson, and 0 otherwise. The imported motorcycle prices would have been influenced by the exchange rate between American and Japanese currencies. The coefficient of the variable reflects the extent to which the exchange rate passed through the retail transaction prices of motorcycles during the study period. We include a different trend term for Harley-Davidson, to control for unobserved differences between domestic and foreign-make motorcycles. Finally, the regression model includes the constant term, and the error term, η.

Table 2 presents estimation results. The first column (1-A) is based on the specification where the year dummy variable is used for TD, and the second column (2-A) is where the vintage-year dummy is used. The estimation finds that both specifications fit the data well, and most parameter estimates are precisely estimated. The coefficient of interest, α_2, captures the impact of the safeguard policy on motorcycle prices. The estimates of α_2 indicate that the introduction of the safeguard tariffs increased the motorcycle retail prices by the magnitudes ranging from 2.2 (found in 1-A) to 10.3 percent (in 2-A). In view of the fact that the safeguard tariff rates spanned from 15 to 45 percent, the tariffs did not fully penetrated to the domestic prices. This finding is consistent with the estimated coefficient on exchange rate, indicating incomplete pass-through of 11-13 percent. Our estimates of the pass-through rate appear much smaller than those reported in other existing studies (surveyed in, for example, Goldberg and Knettle, 2000); however, note that our analysis of retail prices is not directly comparable to unit values often used to examine in the previous work.

The coefficients of the dry-weight and engine displacement variables are estimated significantly positive. A one-percent increase in dryweight would increase the motorcycle retail price by 0.54 percent. The estimated engine-displacement coefficient indicates that the price of Harley-Davidson's largest model with 1340 cc more than doubled the price of the Japanese 450cc motorcycles. The rate of obsolescence, calculated from the estimated age coefficient, is more than 12 percent.

Combining the findings made in Figure 1 and Table 1, we found that Harley-Davidson experienced the increases in both prices and sales quantities in the safeguard period. In the meantime, the Japanese companies had their prices increased at much a slower rate than Harley-Davidson, and their sales quantities substantially decreased in 1983 and thereafter. These market-level data witness that Harley-Davidson's recovery was not entirely due to the import relief, because motorcycle prices do not appear to play a major role in Harley-Davidson's sales expansion. It is rather natural to think that non-price elements in Harley-Davidson's motorcycles, quality and reliability for example, may have had accounted more for the recovery. Indeed, it was around 1983 that Harley-Davidson renovated their production system. They implemented a statistical control system that prompted employees to judge the quality of their own output, and a just-in-time inventory program that improved their production efficiency, along with massive layoffs that led their workforce to half. As a result, Harley-Davidson downshifted the percentage of defective bikes from about 50 % to less than 2 % (*Advertising Age*, August 10, 1987: S-27). They also created a new engine —"evolution" — which were more reliable than their old V-twin engine. Reid (1990) documents that the introduction of this new engine turned out successful in expanding the sale of large motorcycles, particularly with the piston displacement of 1380 cc, the Harley's best-selling motorcycle category.

The analyses in this section highlight that, in order to obtain an insight on the Harley Davidson's turnaround, we need to understand the demand structure of the U.S. motorcycle market: what economic factors drove consumers to Harley Davidson, instead of Japanese motorcycles, regardless of the price differences observed in Figure 2. In the next section, we examine consumers' transaction behavior on motorcycles.

3 Model for the U.S. Motorcycle Market

This section describes an estimation model we use to explain the new motorcycle market in the United States. We first introduce a demand system, derived from a random-coefficient discrete choice model of consumer behavior. We estimate demand for new motorcycles at the model level, incorporating important dimensions of motorcycle attributes. Since we do not observe the individual purchasing behavior, we aggregate across individual buyers to obtain the demand for a motorcycle model, while still allowing for heterogeneity across consumers. We then describe oligopolistic pricing behavior of American and Japanese motorcycle companies. We base our estimation on the differentiated-product Bertrand oligopoly model. We finally describe our estimation strategy.[2]

3.1 Discrete Choice Model

This section describes a random-coefficient discrete choice model of motorcycle demand. In any particular year, we take the motorcycle owner with 450cc or larger as the purchasing entity, where each owner has a unit demand for a new motorcycle model. Though this is not an accurate description of the potential buyers, different definitions of the market size would not influence our estimation results reported in Section 5.[3] The second-hand market was known as not of a negligible size in the study period. Though data are unavailable to us, we try to control for the existence of the second-hand market in the estimation model described below.

[2] We also investigate the robustness of our results to alternative specifications of firm pricing behavior.

[3] Different diffinitions of the market size include; the set of owners of all the motorcycles, including those with less than 450 cc as the potential buyers; and the set of all U.S. households.

Each consumer i is assumed to maximize the following indirect utility function at time t by choosing motorcycle model j among J_t+1 alternatives, one of which is the option of not purchasing a motorcycle:

$$u_{ijt} = x_{jt}\overline{\beta} + \xi_{jt} + \sum_k \sigma_k x_{jkt}\nu_{ik} + \alpha_i p_{jt} + \epsilon_{ijt}, \tag{1}$$

where u_{ij} is consumer i's utility from consuming the model j. The vector x_j is motorcycle model j's observed attributes including the constant and trend terms, and tri-annual dummies. The k-th component of this vector is denoted by x_{jk}. We include in x_j three characteristics of motorcycles; engine displacement, dryweight, and age. The utility function contains, ξ_{jt}, an unobserved (to an econometrician) product quality of motorcycle model j with $E\left(\xi_{jt}\right) = 0$. Note that $x_{jt}\overline{\beta} + \xi_{jt}$, where $\overline{\beta}$ is a set of parameters to be estimated, are common to all consumers. This term, denoted by δ_j, reflects the mean level of utility across consumers who purchase the model j.

To enable richer substitution patterns, we follow Berry, Levinsohn and Pakes (1999) and allow different consumers to have different intensities of preferences for characteristics. We rely on a random coefficients utility specification and include the last three terms in the left-hand side of (1). For each characteristic k, consumer i has a taste ν_{ik}, which is drawn from an i.i.d. standard normal distribution. The parameters σ_k capture the variance in consumer tastes. The outside good in our model, the consequence of not purchasing a motorcycle, includes used motorcycles and public transport. Although it is not possible to distinguish between changes in the constant term in (1) and changes in the mean and variance in consumers' tastes for the outside good, inclusion of the constant term do allow us to control for possible bias due to the presence of the second-hand market.

The term α_i is the consumer i's sensitivity to changes in real price, p_j, (in the 1983 constant USD). Using the idea from Berry, Levinsohn and Pakes (1999), we assume that the distribution of α_i varies with income;

$$\alpha_i = \frac{\alpha}{y_i}, \tag{2}$$

where y_i is the consumer i's income and α is a parameter to be estimated. Price sensitivity is modeled as inversely related to income. While we lack data on individual consumer's income, the income distribution for U.S. motorcycle owners is approximated by the log-normal distribution, with the mean and variance of the distribution being estmated by the data from the MIC (1985). [4]

[4] The mean and variance of the log-normal distribution for the motorcycle owner income is estimated as 24487 and 15434 (in terms of the 1983 constant USD), respectively.

The third and forth terms in the LHS of (1) can be considered as the deviation of the mean utility, and we denote by μ_{ij}. Let ϵ_{ij} represent the idiosyncratic taste of consumer i for product j, and follow the type I extreme value. This distributional assumption yields consumer i's choice probability of brand j as follows;

$$s_{ij} = \frac{\exp\left(\delta_j + \mu_{ij}\right)}{1 + \sum_{l=1}^{J} \exp\left(\delta_l + \mu_{il}\right)}. \qquad (3)$$

The market share of motorcycle model j, denoted by s_j, is obtained by taking integrals of s_{ij} over i with the distribution of consumers heterogenous tastes, ν_{ik}, for all the relevant k's, and the distribution of consumer's income, y_i. Thus, s_j is shown as a fraction of the total motorcycle owners including those who do not purchase a new motorcycle in a particular time.

3.2 Oligopolistic Pricing Model

This section describes the way in which the safeguard tariffs would have affected the motorcycle prices in the United States. We assume that American and Japanese companies compete over price in supplying U.S. customers with motorcycles of differentiated attributes. As indicated in Table 1, each company manufactured more than 25 models in each year. We thus explicitly consider a multiproduct oligopolistic competition model. Consider that the situation where firm f $(= 1, ..., F)$ chooses prices over a set of their motorcycles, J_f, in order to maximize its profit. In the model presented below, we assume away three important elements in the U.S. motorcycle market in the 1980s; the presence of inventory, Japanese local production, and quota that allows for the Japanese to export to the U.S. at the normal tariff rate. We discuss the implications to our estimates created by these assumptions later in this section. With the caveat in mind, a solution to firm f's maximization problem for model j $(= 1, ..., J_f)$ is given by: [5]

$$s\left(p\right)\left(1+\tau\right)^{-1} + DB\left(p\right) \cdot \left(pt - mc\right) = 0 \qquad (4)$$

or

$$\begin{pmatrix} \frac{s_1(p)}{1+\tau_1} \\ \vdots \\ \frac{s_{J_F}(p)}{1+\tau_{J_F}} \end{pmatrix} + D \begin{bmatrix} \frac{\partial s_1(p)}{\partial p_1} & \frac{\partial s_2(p)}{\partial p_1} & \cdots & \frac{\partial s_{J_F}(p)}{\partial p_1} \\ \frac{\partial s_1(p)}{\partial p_2} & \frac{\partial s_2(p)}{\partial p_2} & \cdots & \frac{\partial s_{J_F}(p)}{\partial p_2} \\ \vdots & \vdots & \cdots & \vdots \\ \vdots & \vdots & \cdots & \frac{\partial s_{J_F}(p)}{\partial p_{J_F}} \end{bmatrix} \cdot \begin{pmatrix} \frac{p_1}{1+\tau_1} - mc_1 \\ \vdots \\ \frac{p_{J_F}}{1+\tau_{J_F}} - mc_{J_F} \end{pmatrix}$$

where $p = (p_1, \ldots, p_{J_F})'$, $s = (s_1 \ldots, s_{J_F})'$, $(1+\tau)^{-1} = diag(\frac{1}{1+\tau_1} \ldots, \frac{1}{1+\tau_{J_F}})$, and $mc = (mc_1, \ldots, mc_{J_F})'$. The tariff rate of model j is denoted by τ_j, which takes the safeguard tariff rates for Japanese motorcycles with the 700cc or larger engine displacement, and the normal tariff rate of 0.044 for Japanese

[5] The same technique is used for example in Ohashi (2002; 2003).

motorcycles with 699cc or less. Obviously it takes zero for Harley-Davidson. The marginal cost of manufacturing model j, mc_j, is assumed to be constant. Entry and exit by models make the size of B change over time. The ownership matrix is D, in which the (a, b) element takes a value of 1 if models a and b are marketed by the same firm and 0 otherwise. Note that under the assumption of collusion, all the models are supposed to be marketed by a single firm.

With demand estimates and the ownership matrix in hand, we are able to recover the marginal-cost vector, mc, from (4). We then estimate the following cost function;

$$\ln(mc_{jt}) = w_{jt}\gamma + \omega_{jt},$$

where w_{jt} includes the variables of engine displacement, and dryweight for model j at time t, exchange rate (in terms of USD / Japanese Yen) at time t, cumulative output for the company f that produced model j, along with the trend term and the make dummy variables. The company's cumulative output represents the effect of learning by doing, in an attempt to capture the decline of the marginal cost in response to accumulated experience. We construct the variable by summing over the number of motorcycles (with 250 cc or larger) produced starting from 1903 for Harley-Davidson, 1955 for Honda and Yamaha, 1965 for Kawasaki, and 1970 for Suzuki.[6] While in principle the presence of learning by doing makes the firm's dynamic pricing behavior important, we employ the static framework of oligopolistic competition in that the levels of cumulative output were already large enough in the beginning of the 1980s.

3.3 Estimation Procedure

The estimation model presented above requires the model-level data on quantities sold, prices and other physical attributes. Such data are available from R. L. Polk, achieved in the U.S. Library of Congress, and the availability is limited in the period from 1983 to 1987. The summary statistics of the data were presented in Table 1.

Following the literature (see, for example, Berry, 1994), we assume that x_j and ξ_j are not correlated with one another. This is a central identification assumption for the demand estimation. This assumption may not be accurate in that observed characteristics may be positively correlated with brand image or other attributes that we do not have data for. Nevertheless the assumption helps greatly by reducing the number of instruments needed in the estimation.

We are concerned that the variable of price may possibly correlated with the error ξ_j. It is likely that the observed characteristics may not cover all the important functions of motorcycles. Indeed, ξ_j is often interpreted as the unobserved quality error. If ξ_j is correctly perceived by consumers and

[6] The cumulative output data for the Japanese companies are obtained from Japan Automobile Dealers Association. Those for Harley-Davidson are from Conner (1996).

sellers in the market, this unobserved quality error is likely correlated with price: Better-quality motorcycles may induce higher willingness to pay, and sellers may be able to charge higher prices due to higher marginal costs, or oligopolistic market power.

In product differentiation model with exogenous characteristics, the characteristics of other firms are appropriate instruments. With market power in supply, the markup of each model depends on the distance from its neighbors in the characteristics space. The characteristics of other products are thus related to p_j, but since characteristics are assumed to be exogenous, they are valid instruments. We include the set of instruments the sum of characteristics of other motorcycle models owned by the firm, and that of models offered by competing firms. They may be negatively correlated with the price.[7]

We first estimate the demand model, and use the obtained estimates to calculate the marginal cost, by which we estimate the marginal cost function. The demand and marginal cost estimates are presented in the next section.

4 Estimation Results

This section presents estimation results of the demand and supply equations discussed in the previous section. Table 4 shows three estimation results from the demand estimation. Specifications (1) and (2) are based on a logit model, estimating (1) without μ_{ij}; (1) uses the ordinary least squared method, whereas (2) uses the instruments discussed in the previous section to control for possible endogeneity of motorcycle prices. Specification (3) estimates the full model of (1).

Specification (1) does not fit the data well. The price coefficient is neither economically and statistically insignificant. While many coefficients are estimated significantly different from zero, we are concerned that endogeneity in prices may lead to a correlation between the price and the unobserved error. If the price is responsive to the unobserved quality, the resulting bias in the price coefficient could be severe. The IV estimator reported in (2) accounts for this bias. The price estimate indicates the successful elimination of the endogeneity in the positive correlation with the unobserved quality.

The estimated coefficient of engine displacement is not significantly different from zero, indicating that consumers do not appear to care for the size of engine displacement in the choice of motorcycle model. If unmeasured quality presumably makes certain models survive in the market, the age coefficient may capture this unmeasured quality difference among the surviving models. Being conditioned by ξ_j, the age coefficient may be appropriately interpreted as a rate of obsolescence. The estimated coefficient indicates that the one-more year of obsolescence is worth 114 USD

[7] The same set of instruments are used by Berry, Levinsohn and Pakes (1999) and Petrin (2002), among others.

(in terms of the 1983 constant price), approximately three percent of the average motorcycle price in the study period. The coefficients of the period dummy variables indicate that summer is high season and winter is low. The estimated coefficients of the industry and Harley-Davidson's trend variables reflect the information shown in Figure 1: The U.S. motorcycle sales declined and the Harley-Davidson's expanded in the period of 1983 to 1987.

Specification (3) reports the estimates from the random-coefficients demand model, derived from (1). We allow for the variables of engine displacement, dryweight, and constant to have the random coefficients. Based on the finding of endogenous price coefficient in (1), we apply the instruments on this specification in the same way as we did on (2). The estimated mean coefficients take similar values to those found in (2).

Dryweight is a major characteristic of motorcycle: it represents the degree of stability in riding. The high significance in the estimated mean coefficient appears to reflect the consumers' perception on dryweight. The variable can also serve as a proxy for luxuriousness of motorcycle equipment, such as the confortableness of seats. Although consumers perception on dryweight might have differed, the random coefficient on dryweight does not capture such heterogeneity.

It is interesting to note that the coefficient of engine displacement is estimated statistically insignificant in the mean, but significant in the standard deviation. The estimates might indicate that the average consumer did not value motorcycles with larger engine sizes, but that individual consumers had different tastes on different sizes of engine displacement. The latter finding seems to make sense for consumer purchase on motorcycles; some consumers buy heavyweight motorcycles intended for a long trip, and others prefer medium-sized motorcycles for scurrying inside the city. The random coefficient on the constant term may imply consumers' heterogenous responses to the outside good; different individual owners have different demand for new motorcycles, perhaps because of the condition of used-motorcycles market.

Using the obtained demand estimates, we present average values of estimated own- and cross-price semi-elasticities. Semi-elasticity is defined as the percentage change in market share of motorcycle in the row associated with a \$100 increase in the price of the column motorcycle. We calculated the value of semi-elasticity between a pair of all the motorcycle models covered in our data set, and calculate for each entry of the table the average of the values using the model-sales share as a weight. The table indicates that the averaged own semi-elasticity of Japanese motorcycle models is 40 percent higher in the absolute value than that of Harley-Davidson. In general, cross-price elasticities are larger for motorcycles with similar sizes of engine displacement. Note that Harley-Davidson made its sales mostly from motorcycles with 1100 cc or above.

Table 5 presents the estimation result. We use the estimates when simulating the effects of safeguard tariffs in the next section. Though not shown in the table, the result changes little when we include the quadratic terms of the explanatory variables. Most of the parameters are precisely estimated. The estimated coefficient of learning by doing indicates that one-percent increase in cumulative output decreases the marginal cost of motorcycle production by 7 percent. The interaction term of the trend and the Harley-Davidson dummy variables might imply that the production efficiency of Harley-Davidson improved during the study period.

5 Simulating the Effect of Safeguard

Did the import relief implemented in the period from 1983 to 1987 resuscitate Harley-Davidson out of the brink of bankruptcy? Or Harley-Davidson saved themselves by their managerial efforts? In this section, we explore the extent to which the safeguard tariffs on motorcycle imports of engine displacement of 690cc or above contributed to the increase Harley-Davidson's sales and profit.

We conduct a following experiment to assess the effectiveness of the safeguard policy, leaving such long-run effects as product mix constant. For the period of 1983 to 1987, we assume that all the Japanese motorcycles of 699 cc or above were imported at the normal tariff rate of 4.4 percent, the same tariff rate applied to those below 700 cc. Under this counterfactual circumstance, American and Japanese motorcycle companies are assumed to compete with one another over price; that is, we compute an equilibrium of the mode by each tri-annual period t, using demand equation, (3) and the supply equation (4). In this simulation exercises, I assume that all the Japanese motorcycles were subject to the safeguard tariffs, in contrast to the fact that some of the Japanese motorcycles sold in the U.S. either received the quota-tariff rate of 4.4 percent, or escaped the tariff altogether if locally manufactured. Thus, in the counterfactual exercises discussed in this section, we probably over-estimate the impacts of the motorcycle safeguard policy. On the supply side, we assume multi-product Bertrand competition when simulating the model.[8] Note that the experience with the simulated no-safegurad situation is allowed to change in the cost function.

In Table 7, we present the simulated prices in comparison with the actual prices by make and by size of engine displacement. The table indicates that the safeguard tariffs would have increased the prices of Japanese motorcycles of the engine displacement targeted by the safeguard policy. The prices of Japanese motorcycles with 700 cc or above were affected directly by the introduction of the safeguard tariffs. The actual prices began 18 percent higher than the simulated prices under no-safeguard regime in 1983, and the differences between the actual and simulated prices declined in general, as the safeguard tariffs phased out toward 1987.[9] Note that the prices would not

[8] We ignore the presence of inventory accmulated in the early 1983. Since the inventory did not receive the safeguard duties, our treatment of the inventory adds another reason why our simulated policy effect is overstated. We plan to calculate other modes of firm competition, including collusion among Japanese makers, and collusion in the U.S. market.

[9] The effect on prices appears smaller in 1983 than in 1984, because of the fact that the safeguard was implemented

have increased by the same magnitude of the safeguard tariff rates, primarily because the own-price elasticities discussed in the previous section are found elastic. The prices of the small-sized motorcycles would have been lower by 22 percent.

Prices of Harley-Davidson's in the engine displacement from 700 to 1099 cc was found to have increased by 12 percent, while those of larger motorcycles was merely two percent. The magnitudes of the safeguard effect on Harley-Davidson's prices differ because the cross price elasticities with Japanese motorcycles of 700cc or above was found higher for the Harley's motorcycles.

Table 8 presents the effects of safeguard tariffs on sales and profits of both American and Japanese motorcycle companies. The higher import duties reduced the Japanese sales and profits by 15 and 22 percent, respectively. Although, as shown in Figure 1, Harley-Davidson's sales had rapidly increased since the introduction of the safeguard in 1983, the safeguard tariffs contributed merely 6 percent to Harley's sales and profits. This simulation result indicates that the effect on price of the safeguard duties would not have been accountable for Harley Davidson's recovery. Instead, the improvement of quality and attributes of Harley's motorcycles would have made a primary cause of their sucess.

6 Conclusion

In this paper, we examined the effect of U.S. safeguard duties on heavy motorcycles in the period from 1983 to 1987. When Harley-Davidson sought tariff protection in 1982, the sole surviving American motorcycle company was on the verge of bankruptcy: they held merely a five percent of the the U.S. market, following four Japanese new comers. After receiving the temporary import relief in 1983 on heavy motorcycle imports, Harly-Davidson's sales drastically recovered. Indeed, Harley-Davidson recovered so swiftly that it even requested the final year of tariff protection be cancelled. It is no surprise that Harley-Davidson motorcycle case has been heralded as a success of safeguard protection.

This paper performed quantitative analyses to assess the extent to which the motorcycle safeguard affected on Harley-Davidson. The examination of the data cast some doubt on the effectiveness of the import relief; Harley-Davidson experienced the increase in both prices and quantities sold in the safeguard period, while the Japanese companies had their prices increased at much a slower rate than Harley-Davidson, and their sales quantities substantially decreased in 1983 and thereafter.

The demand estimates derived from the random-coefficient discrete choice model indicate that Harley-Davidson's motorcycle characteristics were well perceived by consumers. Based on the

in the second quarter of 1983, and thus its effect was not fully reflected in the prices of 1983.

obtained estimates, we conducted simulation exercises to measure the extent to which the safeguard tariffs contributed to the recovery of the American motorcycle company. The simulation results demonstrated that the safeguard tariffs explained merely a six percent of Harley-Davidson's sales and profit recovery. The finding of this tiny safeguard effect on Harley's profit and quantities sold was largely due to our demand estimation results, indicating that the values of cross-price elasticities of consumer demand between American and Japanese motorcycles were considerably small. Thus, the tariff increase would have had little effect on shifting consumers from Japanese motorcycles to American ones. Our estimation results support the hypothesis that Harley-Davidson saved itself out of bankruptcy. Indeed, it was around 1983 when Harley-Davidson was known to have renovated their production system; they implemented both a statistical control system and a just-in-time inventory program that improved their production efficiency. Harley also created a new and more reliable engine than the old V-twin engine. Based on the paper's analyses, the import relief had little to dow with Harley-Davidson recovery in 1983 and thereafter.

A Data Appendix

Motorcycle design differed according to the type of use for which the vehicle was intended. Off-road machines, used almost extensively for recreation, had more robust frames with higher ground clearance, studded tires to increase traction in mud and sand, various engine modifications to ensure maximum pulling power rather than speed, and unmuffled exhaust to increase power. On-road machines carried the necessary safety equipment, e.g., lights, rear-view mirrors, signals. They were designed for high cruising speeds, rider comfort, and good handling at high speeds. Combination or enduro machines were supposed to serve both functions; some models were designed with a bias toward on-road use, others toward off-road.

The safeguard implemented in 1983 applied to on-road motorcycles, on which this paper focused. The motorcycles with the piston displacement of 450 cc or larger are classified as on-road motorcycles. The data sources of such motorcycles are described below.

Sales quantity data (i.e., the number of new registrations) are obtained from the "Motorcycle Statistics by Make and Model" published by R.L. Polk. As far as we searched, this publication is available only for the period from 1983 to 1987, archived at the Library of Congress, Washington DC in the United States. This publication lists sales quantity by make and by model.

Motorcycle price and characteristics data are from "Motorcycle and Moped Appraisal Guide," a tri-annual magazine published by National Automotive Dealers Association. The data are available from 1977 to 1987. For the price variable, we employ the prime retail price, known to be reflecting transaction prices. Listed prices, or manufacturers suggested prices, could be another candidate for the price variable; however, they never changed their values through our study period.

The motorcycle population is used in the calculation of the market size, and the income distribution of motorcycle owners is used in the construction of the income data. Both are obtained from "Motorcycle Statistical Annual" published by the Motorcycle Industry Council (MIC) in the 1985 issue. The quantity data by make (but not by model) are also available from the MIC in the period from 1977 to 1995. The data on exchange rate are from International Financial Statistics, and the values and quantities of U.S. motorcycle imports are available from FT246 published by U.S. Census Bureau.

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TABLE 1
U.S Motorcycle Sales by Engine Displacement

Harley

	1100cc-			700-1099cc			Total Sales (Unit)
	Sales (%)	Price (USD)	No. Models	Sales (%)	Price (USD)	No. Models	
1983	72.11	6831	54	27.89	4395	15	26675
1984	66.79	6636	54	33.21	4198	12	26636
1985	71.51	6771	26	28.49	3890	7	27564
1986	76.41	7128	39	23.59	3626	8	29940
1987	72.42	7115	56	27.58	3535	11	33426
Average	71.85	6896	46	28.15	3929	11	28848

Japanese firms

	1100cc-			700-1099cc			450-699cc			Total Sales (Unit)
	Sales (%)	Price (USD)	No. Models	Sales (%)	Price (USD)	No. Models	Sales (%)	Price (USD)	No. Models	
1983	2.64	4628	36	53.98	3187	39	43.38	2139	57	324652
1984	9.31	5089	31	27.74	2743	41	62.95	1970	99	305399
1985	14.60	5136	11	21.68	3011	15	63.72	2052	29	231966
1986	15.18	5347	9	22.77	3263	12	62.05	2161	19	186820
1987	14.50	5500	7	24.59	3355	9	60.91	2287	14	191496
Average	11.25	5140	19	30.15	3112	23	58.60	2122	44	248067

Notes:
Harley-Davidson made no motorcycle below 700cc in the period discussed in the paper.
Price is CPI-deflated in the year of 1983.
Sales are the number of motorcycles newly registered in a particular year, and price is the quantity-weighted average by the size of engine displacement. The table does not contain police bikes.

TABLE 2
The Effect of Sageguard on Motorcycle Prices

	1-A		2-A	
	Coef.	S. E.	Coef.	S. E.
SG * year	0.028 [a]	0.009	0.104 [a]	0.008
SG	-0.034 [a]	0.009	-0.031 [a]	0.009
TD	-0.040 [a]	0.009	-0.017 [b]	0.008
Exchange Rate	0.131 [a]	0.023	0.117 [a]	0.019
Engine Displacement	0.654 [a]	0.018	0.633 [a]	0.018
Dry Weight	0.535 [a]	0.017	0.537 [a]	0.016
Age	-0.125 [a]	0.003	-0.126 [a]	0.002
Harley Davidson	-0.685 [a]	0.122	-0.609 [a]	0.101
Harley Davidson * Trend	0.037 [a]	0.002	0.039 [a]	0.002
Trend	0.003 [c]	0.001	-0.004 [a]	0.001
constant	9.283 [a]	0.123	9.214 [a]	0.101
R-sq	0.907		0.908	
Number of observations	5592		5592	

Note:
The superscripts, a, b, indicate significance at the 99- and 90-confidence levels.

TABLE 3
Summary Statistics

Variable	Harley Mean	Std. Dev	Min	Max	Honda Mean	Std. Dev	Min	Max
Quantity	637	543	50	2833	2491	2734	57	18660
Price	6223	1295	3238	8328	2672	1184	1070	8306
Cc (1000)	1.256	0.149	0.883	1.340	0.748	0.239	0.447	1.182
Dryweght (1000)	0.596	0.086	0.457	0.761	0.488	0.094	0.297	0.772
Age	13.178	6.003	4.000	44.000	15.349	9.106	1.000	35.000
Tariff	0.000	0.000	0.000	0.000	0.163	0.166	0.044	0.494
Number of observations	239				244			

Variable	Kawasaki Mean	Std. Dev	Min	Max	Suzuki Mean	Std. Dev	Min	Max
Quantity	946	1132	52	7060	1045	1049	50	5246
Price	2934	1149	1351	6393	2688	1094	1186	7188
Cc (1000)	0.828	0.236	0.454	1.286	0.810	0.253	0.448	1.360
Dryweght (1000)	0.512	0.100	0.372	0.840	0.478	0.085	0.342	0.763
Age	16.606	10.870	1.000	49.000	15.858	8.730	2.000	35.000
Tariff	0.195	0.161	0.044	0.494	0.171	0.162	0.044	0.494
Number of observations	187				137			

Variable	Yamaha Mean	Std. Dev	Min	Max
Quantity	1127	1250	64	7096
Price	2750	1020	1270	6332
Cc (1000)	0.812	0.237	0.494	1.294
Dryweght (1000)	0.483	0.086	0.269	0.732
Age	14.435	9.442	1.000	36.000
Tariff	0.182	0.164	0.044	0.494
Number of observations	186			

TABLE 4
Demand Estimates

Variables	(1) OLS Logit Coef.	(1) OLS Logit S.E.	(2) IV Logit Coef.	(2) IV Logit S.E.	(3) Random Coefficients Coef.	(3) Random Coefficients S.E.
Price	-0.0001	0.0001	-0.0006 [a]	0.0001	-34.61 [a]	10.3450
Means (β)						
Engine Displacement	-1.49 [a]	0.24	-0.44	0.31	-1.43	1.29
Dryweight	2.26 [a]	0.76	5.74 [a]	1.03	5.92 [a]	1.39
Age	-0.05 [a]	0.00	-0.07 [a]	0.01	-0.08 [a]	0.01
Period2	0.54 [a]	0.07	0.57 [a]	0.08	0.54 [a]	0.11
Period3	-0.46 [a]	0.08	-0.42 [a]	0.08	-0.63 [a]	0.22
Harley*trend	0.08 [b]	0.04	0.34 [a]	0.06	0.37 [a]	0.06
Trend	-0.13 [a]	0.03	-0.15 [a]	0.03	-0.14 [a]	0.03
Constant	-6.96 [a]	0.27	-7.83 [a]	0.31	-6.13 [a]	0.57
Std. Deviations (σ)						
Engine Displacement	-	-	-	-	1.51 [a]	0.652
Dryweight	-	-	-	-	-0.53	1.478
Constant	-	-	-	-	0.10	0.981
R^2	0.3487		-		-	
J-statistics (degrees of freedom)			22.18 (7)		16.38 (7)	
1st stage R-sq	-		0.92		0.92	
1st stage F-test	-		91.36		91.36	
Number of observations	920		920		920	

Note:
The variables of engine displacement and dryweight are divided by 1000.
The superscripts, a, b, indicate significance at the 99- and 90-confidence levels.

TABLE 5
Cost Estimates

	(i)		(ii)	
	Coef.	S.E.	Coef.	S.E.
Engine displacement	0.99 [a]	0.079	3.81 [a]	0.406
(Engine displacement)^2	-	-	0.96 [a]	0.389
Dryweight	1.89 [a]	0.180	1.29	1.290
(Dryweight)^2	-	-	9.51 [a]	1.947
(Engine displacement)*(Dryweight)	-	-	-9.42 [a]	1.726
Learning	-7.25 [a]	0.819	-7.19 [a]	0.795
Exchange rate	-	-	-	-
harley	108.45 [a]	11.573	106.54 [a]	11.214
honda	116.75 [a]	12.599	114.64 [a]	12.207
kawasaki	108.30 [a]	11.642	106.25 [a]	11.279
suzuki	106.76 [a]	11.473	104.75 [a]	11.116
yamaha	110.81 [a]	11.926	108.77 [a]	11.554
harley*trend	-0.35 [a]	0.038	-0.35 [a]	0.037
trend	0.54 [a]	0.056	0.54 [a]	0.055
R^2	0.9986		0.9987	
Number of Observations	920		920	

Note:
The superscripts, a, b, indicate significance at the 99- and 90-confidence levels.

TABLE 6
Own and Cross Semi-Elasticities

	Harley-Davidson	Japanese with 450-549cc	Japanese with 550-699cc	Japanese with 700-849cc	Japanese with 850cc-
Harley-Davidson	-6.368	0.045	0.062	0.076	0.114
Japanese with 450-549cc	0.083	-10.402	0.148	0.152	0.156
Japanese with 550-699cc	0.211	0.270	-9.362	0.319	0.359
Japanese with 700-849cc	0.102	0.105	0.129	-9.009	0.181
Japanese with 850cc-	0.277	0.184	0.242	0.287	-7.852

Note: The (i, j) elemnt in the matrix indicates the share weighted average percentage change in market share of product i with a $100 increase in the price of j.

TABLE 7
Comparison between Actual and Counterfactual Prices by Make and CC

	Harley-Davidson		Japanese Makers		
	700-1099cc (%)	1100cc- (%)	450-699cc (%)	700-1099cc (%)	1100cc- (%)
1983	-0.11	-0.15	-1.01	17.31	19.21
1984	0.18	0.13	0.00	23.03	26.29
1985	0.22	0.00	0.04	15.85	18.13
1986	0.09	0.10	-0.17	11.17	12.91
1987	0.25	0.03	0.03	11.53	12.18
Average	0.12	0.02	-0.22	15.78	17.74

Notes:
Japanese Makers include Honda, Yamaha, Suzuki, and Kawasaki.
Each value in the table is calculated by:

100*(Actual Prices - Counterfactual Prices) / Actual Prices

in which, counterfactual prices are obtained by the procedure described in Section 5.
Harley-Davidson did not manufacture motorcycles with the range between 450 and 699 cc.

TABLE 8
Effects of Safeguard Tariffs on Sales and Profits

Effects on Harley-Davidson

	Actual Sales (Units)	Simulated Sales (Units)	Safeguard Effects on Sales (%)	Actual Profit (Million USD)	Simulated Profit (Million USD)	Safeguard Effects on Profit (%)
1983	26675	24681	8.08	42.4	39.5	7.48
1984	26636	24688	7.89	41.7	38.5	8.17
1985	27564	26062	5.76	44.9	42.2	6.42
1986	29940	28794	3.98	47.9	46.0	4.12
1987	31413	30393	3.36	47.3	45.7	3.43
Average			5.81			5.92

Effects on Japanese Makers

	Actual Sales (Units)	Simulated Sales (Units)	Safeguard Effects on Sales (%)	Actual Profit (Million USD)	Simulated Profit (Million USD)	Safeguard Effects on Profit (%)
1983	324652	398971	-18.63	325.1	444.6	-26.87
1984	305399	368480	-17.12	300.7	404.5	-25.66
1985	231966	272085	-14.74	235.7	298.0	-20.89
1986	186820	210737	-11.35	194.1	233.2	-16.78
1987	161626	180993	-10.70	135.6	164.3	-17.44
Average			-14.51			-21.53

Note:
Simulated sales and profits are calculated under the assumption that all Japanese motorcycles sold in the U.S. were subject to the normal tariff of 4.4 percent in the period of 1983 to 87.

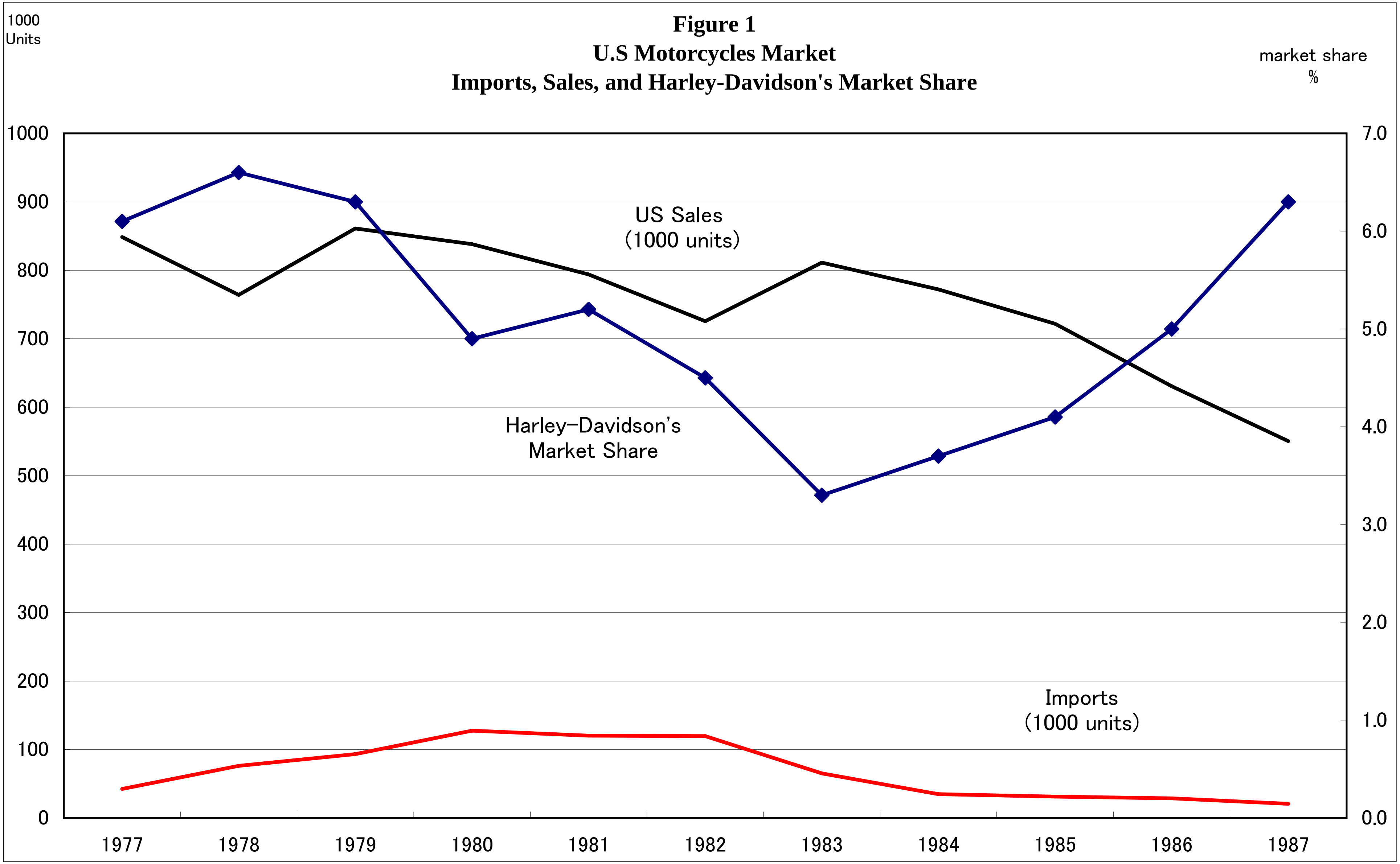
1000
Units
Figure 1
U.S Motorcycles Market
Imports, Sales, and Harley-Davidson's Market Share
market share
%
US Sales
(1000 units)
Harley-Davidson's
Market Share
Imports
(1000 units)
1000
900
800
700
600
500
400
300
200
100
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987

FIGURE 2
Motorcycle Prices and Safeguard Tariffs