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Quantifying the Impact of Export Restraints:
The Case of Japanese Auto Exports to the United States

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Summary

This paper assesses the extent to which restraints placed by the Japanese authorities on the export of autos to the U.S. market affected car sales and prices in the period 1981-84. The estimates are obtained by comparing actual outcomes during the period with values predicted by a small model of the U.S. auto sector estimated over the period preceding the imposition of the restraints. A major difference between the present study and other estimates of the impact of the Japanese export restraints is that the model developed in this paper explicitly allows for the effects of the quotas on the average quality of cars purchased. By distinguishing between pure price effects and quality effects, it is possible to assess the welfare costs and income transfers resulting from the imposition of the restraints.

The results presented in the paper suggest that the restraints on exports of Japanese cars to the United States had a substantial impact. The average transactions prices for all new cars in the United States increased by nearly 50 percent over the period 1981-84, compared with an increase of 27 percent which would have been expected in the absence of the quotas. The higher prices resulted from a combination of "pure" price increases and shifts in the composition of car sales toward larger units with more extensively installed optional equipment. The restraints are estimated to have raised the average price of a new car by more than \$1,600 in 1984. Constant dollar expenditures on new cars during 1981-84 were reduced by 3 percent and sales by 4 million units as a result of the quotas, while the value of expenditures was raised by \$5 1/4 billion as increases in average transactions prices more than offset the effects of the restraints on the number of cars sold. At the same time, the quotas served to increase the market share of the U.S. auto industry, and expenditures on U.S. cars were \$17 1/2 billion higher than they otherwise would have been; expenditures on Japanese autos were nearly \$15 billion lower.

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The rise in car prices (adjusted to exclude price increases due to changes in the quality of automobiles purchased) induced by the export restraints is estimated to have cost car purchasers nearly \$17 billion during the period 1981-84. Of this increase in purchasers' costs, \$6-12 billion represented a transfer to the U.S. automobile industry. The remaining \$5-11 billion is accounted for by a transfer to foreign producers and a deadweight loss to purchasers, and it can be interpreted as a measure of the loss to the domestic economy as a whole stemming from the restraints on Japanese exports.

I. Introduction

In May 1981, the Japanese authorities imposed restrictions on exports of automobiles to the United States to pre-empt more stringent controls being proposed in Congress. Export controls have been maintained since that time, although the quantitative limits were relaxed substantially in March 1985. This paper estimates the extent to which these restraints affected car sales and prices in the United States during the period 1981-84. These estimates are used to assess the impact of the restraints on net revenues of the domestic automobile industry and foreign producers, and to measure the costs of the restraints to auto purchasers in the United States.

In theory, the restraints on Japanese automobile exports would be expected to have affected the prices, sales, and types of cars purchased in the U.S. market. Under the export quotas, individual Japanese producers were constrained in the number of cars they could export to the United States. To maximize profits subject to this constraint, Japanese producers would have had an incentive to raise the prices they charged for given models of cars. This would have reduced competitive pressures on U.S. producers and non-Japanese importers, and prompted them to raise their own prices in turn, although probably by less than the increase in Japanese car prices. Faced with higher prices on most models, U.S. auto purchasers would have been expected to buy fewer new cars. Nevertheless, sales of domestic autos and imports of non-Japanese cars may have been increased as purchasers shifted away from relatively more expensive Japanese cars.

In addition to these effects, the restraints on Japanese auto exports may have had a significant impact on the average quality of cars purchased in the U.S. market. To maximize the profits derived from each unit sale, Japanese producers would have had an incentive to shift the mix of cars exported to the United States toward larger or more luxurious models which could be sold at higher prices. Producers may also have been expected to install more "optional" equipment in each unit. These actions would have tended to raise the average quality of imported Japanese cars and to limit the effects of quotas on real

expenditures for Japanese automobiles. ^{1/} The average transactions prices of Japanese cars sold in the United States would have tended to increase, reflecting the higher average quality of each unit. The average quality of domestic cars would also have been raised to the extent that Japanese cars were relatively closer substitutes for higher quality domestic cars than for lower quality domestic cars.

This paper attempts to quantify the effects of the Japanese export restraints by comparing actual outcomes during the period 1981-84 with values predicted by a small model of the U.S. auto sector estimated over the period preceding the imposition of the restraints. The central assumption underlying this approach is that the Japanese export quotas were the main explanatory variable affecting the auto market during the period 1981-84 which was excluded from the model.

A major difference between the present study and other attempts to assess the impact of the Japanese export restraints ^{2/} is that the model developed in this paper directly allows for the effects of the quotas on the average quality of cars purchased. The estimated effect of the restraints on the average transactions prices of new cars is divided between pure changes in price and changes in price associated with variations in the mix of cars being sold. The ability to distinguish between pure price effects and quality effects makes it possible to assess the welfare costs and income transfers resulting from the imposition of the export restraints.

Section II of this paper briefly describes events leading up to the imposition of the quotas in 1981 and reviews developments in the auto industry through 1984. Section III describes the model of the U.S. auto sector that forms the basis for the estimation of the effects of the export restraints that are presented in Section IV. Using these estimates, Section V assesses the welfare costs and income transfers associated with the Japanese export restraints. An appendix provides a formal presentation of the model.

^{1/} See Carlos Alfredo Rodrigues, "The Quality of Imports and the Differential Welfare Effects of Tariffs, Quotas and Quality Controls as Protective Devices", Canadian Journal of Economics, XII, No. 3, August 1979, pp. 439-449, for a formal treatment of the effects of quotas on the quality of imports.

^{2/} See, for example, Wharton Motor Vehicle Service, The Japanese Quota, Wharton Econometric Forecasting Associates (1983); Robert W. Grandall, "Import Quotas and the Automobile Industry: The Cost of Protectionism", the Brookings Review, Summer 1984, pp. 8-16; and United States International Trade Commission, A Review of Recent Developments in the U.S. Automobile Industry Including an Assessment of the Japanese Voluntary Restraint Agreements, USITC Publication 1648 (1985).



II. Developments in the U.S. Auto Sector

In the late 1970s, the U.S. auto industry was faced with severe difficulties as total sales of passenger cars dwindled and foreign imports took up an increasing share of the market (Table 1). Japanese imports increased particularly rapidly, and accounted for over 21 percent of total U.S. sales in 1980 compared with less than 10 percent five years earlier. Net income of U.S. producers shifted from a profit of \$4.9 billion in 1978 to a loss of \$4.2 billion in 1980, while production and employment were sharply curtailed (Table 2). In June 1980, the industry filed a petition for import relief under the escape clause, on the grounds that both automobiles and trucks were being imported in such quantities as to damage the domestic industry. The U.S. International Trade Commission (ITC) ruled that, while increased imports were a contributing factor, the "substantial" causes of the industry's difficulties were a general decline in the demand for automobiles and a switch by consumers toward more fuel-efficient vehicles. The ITC recommended that no restrictive action be taken.

Table 1. Sales in U.S. Auto Market

(Millions of units, unless otherwise indicated)

	1978	1979	1980	1981	1982	1983	1984
Total sales	11.2	10.6	9.0	8.5	8.0	9.2	10.4
Domestic ^{1/} (Percent of total)	9.2 (82.1)	8.2 (77.9)	6.6 (73.3)	6.2 (72.7)	5.8 (72.2)	6.8 (74.0)	8.0 (76.5)
Foreign (Percent of total)	2.0 (17.9)	2.3 (22.1)	2.4 (26.7)	2.3 (27.3)	2.2 (27.8)	2.4 (26.0)	2.4 (23.5)
Of which: Japanese (Percent of total)	1.4 (12.2)	1.8 (16.8)	1.9 (21.3)	1.9 (21.8)	1.8 (22.6)	1.9 (20.9)	1.9 (18.3)

^{1/} Includes imports from Canada; such imports accounted for roughly 10 percent of total sales in 1984.

Following the ITC decision, pressures for protection of the U.S. auto industry remained intense and led to legislation being introduced in the Congress to restrict Japanese imports of passenger cars. In May 1981, the Japanese government responded by announcing measures to restrain exports of automobiles to the United States for two years. These restraints limited exports of Japanese passenger cars to the United States to 1.68 million units in the year ended March 1982, about 8 percent below their 1980 level. Within this total, individual Japanese auto producers were each allotted export quotas based on their market share prior to the imposition of the restraints. In the second year of the restraints, shipments were to be held at the first year level, with a provision for an increase in shipments if a rise in domestic U.S. auto sales occurred; in the event, this increment did not materialize.

Total sales of autos in the United States continued to decline in 1981 and 1982, reflecting the general weakness of the U.S. economy and high levels of interest rates. At the same time, the Japanese share of the U.S. market increased further, albeit at a much slower rate than in previous years.

In 1983 and 1984, U.S. demand for automobiles picked up sharply, reflecting a substantial decline in interest rates and the strengthening of economic activity in the United States. Domestic producers increased production in line with growing sales, and were able to achieve record profits in 1983 and 1984 after several years of weak earnings (Table 2). The restraints on Japanese car exports were extended for a third and a fourth year; the ceiling was held fixed in the third year and raised by 10 percent in the fourth year to 1.85 million units. ^{1/} Sales of Japanese autos remained roughly unchanged in this period, and the market share of imports from Japan declined significantly, dropping to 18 1/4 percent in 1984.

^{1/} Sales of Japanese cars in the United States have exceeded the export quota level as inventories have been run down.



Table 2. Performance of Domestic Auto Companies 1/

	1978	1979	1980	1981	1982	1983	1984
Net income (in billions of dollars)	4.9	3.0	-4.2	-1.3	0.3	6.2	9.8
Auto production (in millions of vehicles)	9.2	8.4	6.4	6.2	5.0	6.5	7.5
Employment of production workers (in thousands)	1,025	991	795	783	676	716	784

1/ General Motors, Ford, Chrysler, and American Motor Company.

The record levels of net income achieved in 1983 and 1984 by U.S. automakers were earned on sales volumes similar to those registered in 1980, when the auto industry incurred unprecedented losses. In part, this turnaround reflected efforts by the industry to control production and inventory costs. Capital spending by the industry was at exceptionally high levels during 1979-81, although it dropped somewhat in 1982-84; much of this investment was directed toward raising labor productivity as well as improving product quality. In conjunction with this investment, employment was cut back sharply, while increases in hourly compensation were moderated by union wage concessions in 1981-82. As a result of these measures, the rate of increase of unit labor costs fell substantially, and was well below that in the nonfarm business sector as a whole during 1981-84.

Despite improvements in the cost performance of the U.S. auto sector, the gap between the cost of producing a car in the United States and in Japan did not appear to narrow significantly. Hourly compensation of production workers in the Japanese auto sector (expressed in terms of U.S. dollars) rose at a somewhat slower rate than hourly compensation in the U.S. industry during 1981-84, although there is some evidence that productivity may have improved somewhat more rapidly in the United States than in Japan. In 1984, estimates of the Japanese cost advantage in producing a sub-compact car were in the range of \$1,500-\$2,500, roughly the same as in 1980. 1/

1/ For further information on comparative cost and productivity movements in the U.S. and Japanese auto industries, see ITC, op. cit., pp. 10-13 and U.S. Department of Commerce, The U.S. Automobile Industry, 1983, Report to the Congress from the Secretary of Commerce, December 1984, pp. 45-51.

A dramatic feature of the period 1981-84 was the rapid increase in auto prices, which far exceeded the rate of consumer price inflation. The average transactions price of new passenger cars jumped 17 1/2 percent in 1981 alone and increased by 49 percent during 1981-84 as a whole; the consumer price index for all items (CPI) rose only 26 percent during this period (Table 3). Much of the increase in auto prices during this period apparently reflected an upgrading in the average quality of cars sold. The new car component of the CPI, which is adjusted for quality changes in an attempt to isolate pure changes in price, ^{1/} rose by only 18 percent during 1981-84. The 31 percentage point difference between the rate of increase in average transactions prices and in the CPI for new cars during this period would imply an unusually large change in the quality of the average car. By way of comparison, during 1975-79 average transactions prices increased only 1 1/2 percentage points per year faster than the new car component of the CPI.

Table 3. Price Indicators
(Percentage change at annual rates)

	Average 1975- 1979	1980	1981	1982	1983	1984
Average transactions prices for new cars	8.3	10.6	17.8	10.2	7.7	6.5
Consumer price index for new cars	6.8	8.0	6.1	3.8	2.5	2.9
Consumer price index for all items	7.8	13.5	10.3	6.2	3.2	4.3

A significant portion of the apparent upgrading in the quality of cars purchased during 1981-84 resulted from compliance with federal safety and emission regulations. It has been estimated that compliance with such regulations may have raised production costs by about \$700 per car during the period, which would imply an increase in transactions

^{1/} The CPI for new cars is a fixed-weighted price index that is adjusted for changes in standard equipment mandated by federal government regulations or made at the manufacturer's discretion by using data for the production costs of such equipment changes.



prices of about 10 percent. 1/ The remaining increase in the quality of cars would be accounted for by such factors as a shift in the mix of cars purchased toward larger vehicles and increased installation of factory or dealer options. In this regard, there was some shift in the composition of car sales away from compact and subcompact cars toward intermediate and larger models during 1981-84 (Table 4).

Table 4. Composition of Car Sales
(Percent of total)

	1979	1980	1981	1982	1983	1984
Sub-compact	34.8	40.9	41.5	44.1	42.5	42.6
Compact	19.5	20.0	19.9	16.4	12.7	12.5
Intermediate	22.1	20.5	20.4	20.3	24.5	23.9
Full-size	16.2	12.0	11.1	11.6	12.6	11.7
Luxury	7.5	6.7	6.9	7.6	7.7	9.3

Transactions prices of imported cars generally increased more rapidly than those of domestic cars; imported car prices rose 61 percent from 1980 to 1984 while domestic car prices rose 45 percent (see Table 5). In part, the rapid growth of imported car prices resulted from a substantial change in the composition of European imports away from small cars, reflecting a shift toward U.S. production by a major manufacturer and the declining popularity of several models. 2/ Japanese car prices also have increased considerably since the imposition of quotas, although at a lesser pace than non-Japanese imports. Data available from the Department of Commerce suggest that transactions

1/ See Robert W. Crandall, *op. cit.*

2/ Direct information on the extent to which the rise in transactions prices of import cars reflected a rise in average quality is not available; the CPI for new cars is not broken down between domestic and imported cars.

prices of Japanese cars increased 38 percent from 1980 to 1984. ^{1/} Part of the rise in transactions prices of Japanese cars would be accounted for by an increase in the average quality of cars sold. In this regard, there was a marked shift in the mix of sales of Japanese cars toward medium and high-priced models, ^{2/} and a significant rise in both factory and dealer installed options. However, substantial increases in list prices on standard models and in dealer markups also took place.

Table 5. Imported Car Prices
(Percentage change)

	Average 1975-					
	1979	1980	1981	1982	1983	1984
Average transactions prices for imported cars	11.3	11.8	18.4	9.1	12.0	10.3
Average transactions prices for Japanese cars	8.7	3.4	10.3	11.0
Unit value index for imports of cars from Japan	12.4	3.2	20.3	7.6	7.7	10.4

^{1/} This figure may be somewhat low given that the unit value index of passenger cars imported from Japan rose by 55 percent during the same period. It might be expected that transactions prices of Japanese cars would rise more rapidly than import unit values during the quota period as the latter statistic would not include any effect of the quotas on dealer markups or dealer-installed options. An overstatement of the average transactions price in 1980 and 1981, related to problems in estimating dealer premiums or discounts from list prices, may help to explain the slower rise in transactions prices than in import unit values in 1981 and 1982.

^{2/} The share of subcompacts in total sales of Japanese cars declined from 67 percent in 1980 to 48 percent in 1984. During the same period, the share of compacts in total sales of Japanese cars increased from 21 percent to 33 percent, and the share of luxury cars in total sales of Japanese cars rose from 12 percent to 18 percent. See ITC, *op. cit.*

In early 1985, the U.S. authorities judged that the domestic auto industry had been able to adjust to import competition, and announced that they would not ask Japan to extend the restraints for an additional year. Nevertheless, the Japanese Government decided to extend the restraints for a fifth year, running April 1985-March 1986. In this year, the ceiling on auto exports was raised by 24 percent to 2.3 million units, while the export shares allotted to individual producers were reallocated to increase the shares of producers that previously had received relatively small shares. In February 1986, the Japanese authorities renewed the restraints for an additional year, setting the quota at the same level as in the previous year.

III. Quantifying the Effects of the Export Restraints

To quantify the effects of the Japanese restraints, a simple model of the U.S. auto sector was estimated on annual data over a period preceding the imposition of the restraints (1968-80). This model was then used to predict values for prices, sales, and imports during the period 1981-84. The differences between the actual values and the values predicted by the equations provide a broad indication of the impact of the export restraints. These estimates are subject to a considerable degree of uncertainty because shifts in the coefficients of the model or factors not included in the model may be responsible for part of the differences between actual and predicted values. However, attempts have been made to allow for factors, such as changes in relative gasoline prices and federal safety and emission regulations, that may have been particularly important during 1981-84.

The full model of the U.S. auto sector developed here is presented in an appendix. It consists of six behavioral equations and 26 identities. Behavioral equations are estimated for the consumer price index for all new cars, the average transactions price of all new cars, and real purchases of new cars by consumers and businesses. ^{1/} Separate consumer price and transactions price equations are estimated in order to assess the impact of quotas on the mix and quality of cars purchased. The two price equations and the real expenditures equation, together with a series of identities, are used to assess the impact of the quotas on constant dollar auto expenditures (including expenditures related to changes in the quality of cars purchased) and on the number of cars sold.

^{1/} Constant dollar auto expenditures are used instead of units as the measure of new car sales in the model because the latter measure does not reflect changes in the mix of cars sold and changes in equipment installed. Constant dollar auto expenditures are derived as the total value of sales of new cars divided by the consumer price index for new cars.

To avoid problems of simultaneity between prices and sales, an instrumental variables approach is used in estimating the price and real expenditures equations. The two price equations both express prices as a function of production costs and an instrumental variable for the inventory-sales ratio to represent demand pressures. 1/ The estimated equations indicate that changes in production costs are passed fully through into prices. Constant dollar purchases of new autos are specified as a function of real income, the price of new cars relative to other consumer goods, the auto loan rate, and consumer confidence (as proxied by the change in the unemployment rate). 2/ Fitted values from the equation for the consumer price index for new cars are used to construct the relative price variable used in the equation. The equation estimated suggests that the demand for new cars is both income and price inelastic.

To distinguish the effects of the restraints on the U.S. auto industry and on foreign producers, equations are estimated for the transactions price of domestic cars relative to imported cars and the share of purchases of domestic cars in total auto expenditures. The equation for the relative transactions price of domestic cars includes as explanatory variables a measure of labor costs in the United States relative to those of competitors and the price of gasoline relative to other consumer prices. Fitted values derived from this equation for the relative price of domestic cars are used as an instrumental variable in the share equation to avoid simultaneity problems. Also included in the specification of the share equation are the relative gasoline price and a time trend.

Estimates for the impact of the restraints on Japanese producers are derived using the assumption that the restraints had the same impact on the average transactions price and the sales of non-Japanese imports

1/ The instruments include the rate of change in real GNP and a linear time trend. The price of gasoline relative to other consumer prices was also included in the transactions price equation to reflect the effects of fuel costs on the size distribution, and hence the average price, of new cars. However, the variable was not found to have a significant coefficient.

2/ The cost of operating a car also might be included in the equation specification as suggested by Tishler, "The Demand for Cars and the Price of Gasoline: The User Cost Approach", Review of Economics and Statistics, May 1982, pp. 184-90. However, in estimating the equation, operating costs, as measured by the relative price of gasoline, were not found to be significant.



as on prices and sales of domestic cars. ^{1/} This assumption seems reasonable on the grounds that domestic cars and non-Japanese imports would be closer substitutes; hence it would be expected that the restraints would have had roughly the same impact on demand for domestic and non-Japanese imports.

IV. Effects of the Quotas on Automobile Prices, Purchases, and Imports

1. Overall effects

Table 6 presents estimates of the impact of the export restraints on overall automobile prices and purchases. These estimates are derived by comparing actual values for prices and purchases with values for the period 1981-84 predicted by the price and real expenditure equations. According to this method, the consumer price index for new cars was nearly 6 percent higher in 1984 than it would have been in the absence of the export restraints; over the 1981-84 period, the CPI for new cars increased by 16 percent compared with a rise of 10 percent that would have been expected in the absence of quotas. In dollar terms, the export restraints are estimated to have added an average of about \$625 to the basic price of a given car model in 1984.

In order to estimate the effects of the restraints on the average transactions price of new cars, the values predicted by the transactions price equation were adjusted to reflect the impact on prices of federal government safety and emissions regulations during the period 1981-84. ^{2/} On this basis, the average transactions price of new cars is estimated to have been 17 percent (or about \$1,650) higher in 1984 than it otherwise would have been. From 1980 to 1984, these prices increased nearly 50 percent compared with a rise of 27 percent that would have occurred if restraints had not been imposed. The effect of the quotas on the average transactions price would be expected to be larger than their effect on the CPI for new cars because of the quotas' impact on the mix of cars sold and the installation of optional

^{1/} This assumption is made because data on the average transactions price of and expenditures on Japanese cars before 1980 are not available. These data would be needed in order to estimate separate price and share equations. It is not clear how much this assumption may bias the estimates; however, the bias stemming from this assumption is not expected to be significant because of the small number of non-Japanese imports relative to Japanese imports. Estimates of the share of Japanese cars in total unit sales in the absence of quotas derived using this assumption are in line with those predicted by extrapolating a simple time trend, fitted to the Japanese share of unit sales in the period before the imposition of the restraints.

^{2/} Adjustments for the costs per automobile of safety and emissions regulations were derived from Robert Crandall, op. cit.

equipment. The estimates suggest that such an improvement in car quality due to the export restraints would account on average for about \$1,000 of the cost of autos in 1984.

Table 6. Estimated Effects of Japanese Export Restraints on Auto Prices and Purchases

	1980	1981	1982	1983	1984
Consumer price index for new cars (1967=100)					
Actual	179.3	190.2	197.6	202.6	208.5
Predicted	--	186.1	187.4	193.4	196.8
Difference (percent)	--	2.2	5.4	4.8	5.9
Average transactions price for new cars (dollars)					
Actual	7,580	8,895	9,826	10,586	11,279
Predicted	--	8,463	8,720	9,300	9,630
Difference (percent)	--	5.1	12.7	13.8	17.1
Auto expenditures (billions of constant 1972 dollars)					
Actual	41.75	43.94	43.63	52.76	62.03
Predicted	--	44.95	45.12	54.45	64.41
Difference (Percent)	(--)	(-2.2)	(-3.3)	(-3.1)	(-3.7)
Auto expenditures (billions of current dollars)					
Actual	67.29	75.10	77.61	96.26	116.23
Predicted	--	75.12	76.12	94.83	113.94
Difference (Percent)	(--)	(-0.1)	(2.0)	(1.5)	(2.0)
Units (thousands)					
Actual	8,979	8,535	7,979	9,179	10,394
Predicted	--	8,978	8,818	10,293	11,932
Difference (Percent)	(--)	(-4.9)	(-9.5)	(-10.8)	(-12.9)

With regard to auto expenditures, the export restraints are estimated to have lowered constant dollar expenditures by 3 3/4 percent in 1984 and by 3 1/4 percent in the period 1981-84 as a whole. At the same time, the value of auto expenditures was about 2 percent (or \$2 1/4 billion) higher in 1984 and 1 1/2 percent (or \$5 1/4 billion) higher in 1981-84 as a result of the restraints, reflecting the inelastic response of auto demand to price changes. In terms of units, the estimates indicate that some 1 1/2 million fewer cars were sold in 1984 and nearly 4 million fewer cars were sold during 1981-84 than would have been sold without the quotas. ^{1/}

2. Effects on domestic autos

On the basis of estimates derived from the equation for the relative average transactions price of domestic cars, the quotas had less impact on prices of domestic cars than on those of imported cars. The average transactions price of domestic cars in 1984 is estimated to have been 12 percent (or \$1,187) more than it would have been in the absence of quotas (Table 7). Over the restraint period, transaction prices of domestic cars increased 45 percent compared with a predicted increase of 30 percent. At the same time, according to the market share equation, the quotas increased the share of U.S. producers by 6 3/4 percentage points in 1984, sufficient to leave domestic unit sales unaffected despite the decline in overall unit sales. As a result the value of sales of domestic autos was 12 percent (or nearly \$9 1/2 billion) higher in 1984 and 7 percent (or more than \$17 1/2 billion) higher in the period 1981-84, than would have been the case without the quotas.

^{1/} The number of units that would have been purchased in the absence of quotas is calculated as the predicted value of sales divided by the predicted average transactions price.

Table 7. Estimated Effects of Japanese Export Restraints
on Purchases of Domestically Produced Autos

	1980	1981	1982	1983	1984
Average transactions price of new domestic cars (dollars)					
Actual	7,612	8,905	9,886	10,504	11,067
Predicted	--	8,497	8,842	9,505	9,880
Difference (percent)	--	4.8	11.8	10.5	12.0
Share of domestic autos in total auto expenditures (percent)					
Actual	73.3	72.5	72.3	73.1	74.7
Predicted	--	71.7	70.5	68.7	68.0
Difference (percentage points)	--	0.8	1.8	4.4	6.7
Expenditures on domestic autos (billions of current dollars)					
Actual	49.33	54.47	56.13	70.38	86.84
Predicted	--	53.89	53.66	65.15	77.47
Difference	--	0.58	2.47	5.23	9.37
(Percent)	(--)	(1.1)	(4.6)	(8.0)	(12.1)
Expenditures on domestic autos (billions of constant 1972 dollars) ^{1/}					
Actual	30.60	31.89	31.56	38.57	46.32
Predicted	--	32.23	31.81	37.40	43.79
Difference	--	-0.34	-0.25	1.17	2.53
(Percent)	(--)	(-1.1)	(-0.8)	(3.1)	(5.8)
Units of domestic autos sold (thousands)					
Actual	6,581	6,209	5,758	6,793	7,952
Predicted	--	6,438	6,155	6,949	7,946
Difference	--	-229	-397	-156	-6
(Percent)	(--)	(-3.6)	(-6.5)	(-2.2)	(0.1)

^{1/} Assuming equal pure price effects on domestic and imported autos
resulting from the export restraints.

Separate consumer price indexes are not published for new domestic and imported cars; therefore, there is no readily available indication of the extent to which changes in transactions prices of domestic cars reflected pure changes in prices rather than changes in quality and composition. ^{1/} A working assumption is that the pure price effect of the quotas was the same for domestic and imported cars; on this basis, changes in relative transactions prices of domestic and imported cars would reflect changes in relative quality only. Estimates of the effect of the export quotas on constant dollar expenditures shown in Table 7 are derived using this assumption. On this basis, constant dollar purchases of domestic cars were little affected by the quotas in 1981 and 1982 but were raised by 3 percent in 1983 and 5 3/4 percent in 1984.

Rather than supposing that the pure price effects of the export restraints were the same for domestic and imported cars, it may be assumed that the quotas had identical effects on the average quality of domestic and imported cars. On the basis of this alternative assumption, the pure price effect of the quotas is estimated to be 1 1/2 percent for domestic cars (rather than 6 percent) in 1984 indicating that real expenditures on domestic autos were increased by 10 1/2 percent (rather than 5 3/4 percent). The actual effects of the quotas on domestic prices and real expenditures would lie somewhere between the alternative estimates. It should be noted that estimates of the effects of the quotas on transactions prices, current dollar expenditures, and unit sales are not sensitive to the change in assumption.

From the estimates of the effects of the export restraints on real expenditures for domestic automobiles and crude estimates of the elasticity of employment with respect to output, ^{2/} it is possible to derive a rough indication of the magnitude of the impact of the quotas on employment of automobile production workers in the United States. The effects of the quotas on employment appear to have been minimal in 1981 and 1982 because the restraints had only minor effects on real expenditures for

^{1/} It would be possible to measure pure price changes by directly estimating changes in quality of automobiles using "hedonic" regressions in which model prices are regressed on characteristics, as suggested in Zvi Griliches, "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change", in Zvi Griliches (ed), Price Indexes and Quality Change, Cambridge, Harvard University Press (1971). Robert Feenstra has used this method to estimate the change in quality of Japanese and U.S. cars between 1980 and 1981; see Robert Feenstra, "Automobile Prices and Protection: The U.S.-Japan Trade Restraint", Journal of Policy Modeling, Spring 1985. He estimated that the quality of Japanese cars rose 6 percent between these years, while the quality of small U.S. cars rose 0.7 percent and that of large U.S. cars rose 4.7 percent. However, Feenstra's approach does not establish whether the quality changes estimated are due to the quotas or to other factors.

^{2/} Estimates of the employment elasticity are derived from data on manhours and output.

domestic automobiles. However, in the period 1983-84, the quotas had a significant impact on real expenditures and may have boosted employment by 40,000-75,000 workers. 1/

3. Effects on imported cars

Estimates of the quotas' effects on Japanese cars are derived by assuming that the restraints had equivalent effects on average transactions prices and unit sales of domestic and non-Japanese imported cars. On this basis it is estimated that in the absence of restraints, the average transactions price of Japanese cars in 1984 would have been 22 1/2 percent (or \$1,700) lower and that unit sales would have been almost 45 percent (or more than 1.5 million units) higher (Table 8). Expenditures on cars from Japan were reduced by more than 32 percent (or nearly \$8 1/2 billion) with the Japanese share of the market being 7 1/2 percentage points lower because of the restraints. Over the period 1981-84, expenditures on Japanese autos were 20 percent (or \$15 billion) less than they otherwise would have been.

On the assumption that the quotas had equal pure price effects on all cars, constant dollar expenditures on Japanese automobiles are estimated to have been 36 percent less in 1984 and 23 percent less during 1981-84 than they would have been in the absence of the quotas. Alternatively, if it is assumed that the quotas had the same impact on the quality of all cars sold, then it is estimated that the quotas reduced real purchases of Japanese cars by 44 percent in 1984 and by 29 percent during the period 1981-84.

Given the assumption that the restraints had the same effect on average transactions prices and unit sales of non-Japanese imports as on domestic cars, it is estimated that the share of such imports in total auto expenditures was increased by nearly 1 percentage point in 1984 as a result of the quotas (Table 9). Expenditures on these cars were \$1 1/4 billion higher in 1984 and \$2 1/2 billion higher over 1981-84 owing to the restraints.

1/ It is interesting to note that because of the integration of the U.S. and Canadian automobile industries, the restraints on exports of Japanese cars to the United States also boosted employment in Canada. Employment in the Canadian industry may have been increased by 8,000-15,000 man years in 1983-84 as a result of the quotas.

Table 8. Estimated Effects of Japanese Export Restraints
on Purchases of Japanese Autos

	1980	1981	1982	1983	1984
Average transactions price of new Japanese cars (dollars)					
Actual	6,709	7,292	7,538	8,317	9,229
Predicted	--	6,946	6,724	7,149	7,526
Difference (percent)	--	5.0	12.1	16.4	22.6
Share of Japanese autos in total auto expenditures (percent)					
Actual	19.0	18.0	17.5	16.6	15.1
Predicted	--	19.0	19.5	21.6	22.7
Difference (percentage points)	--	-1.0	-2.0	-5.0	-7.6
Expenditures on Japanese autos (billions of current dollars)					
Actual	12.81	13.55	13.58	15.92	17.52
Predicted	--	14.28	14.88	20.46	25.86
Difference	--	-0.73	-1.30	-4.54	-8.34
(Percent)	(--)	(-5.1)	(-8.7)	(-22.2)	(-32.3)
Expenditures on Japanese autos (billions of constant 1972 dollars) ^{1/}					
Actual	7.95	7.92	7.63	8.73	9.37
Predicted	--	8.54	8.82	11.75	14.62
Difference	--	-0.62	-1.19	-3.02	-5.25
(Percent)	(--)	(-7.3)	(-13.5)	(-25.7)	(-35.9)
Units of Japanese autos sold (thousands)					
Actual	1,910	1,859	1,802	1,915	1,906
Predicted	--	2,056	2,213	2,862	3,450
Difference	--	-197	-411	-947	-1,554
(Percent)	(--)	(-9.6)	(-18.6)	(-33.1)	(-44.8)

^{1/} Assuming equal pure price effects on domestic and imported autos resulting from the export restraints.

Table 9. Estimated Effects of Japanese Export Restraints
on Purchases of Non-Japanese Imported Autos

	1980	1981	1982	1983	1984
Average transactions price of new other imported cars (dollars)					
Actual	10,562	15,131	18,824	21,138	22,247
Predicted	--	14,438	16,837	19,129	19,863
Difference (percent)	--	4.8	11.8	10.5	12.0
Share of other imported autos in total auto expenditures (percent)					
Actual	7.7	9.5	10.2	10.3	10.2
Predicted	--	9.3	10.0	9.7	9.3
Difference (percentage points)	--	0.2	0.2	0.6	0.9
Expenditures on other imported autos (billions of current dollars)					
Actual	5.15	7.08	7.90	9.96	11.87
Predicted	--	6.99	7.58	9.22	10.65
Difference	--	0.09	0.32	0.74	1.26
(Percent)	(--)	(1.3)	(4.2)	(8.0)	(11.9)
Expenditures on other imported autos (billions of constant 1972 dollars) ^{1/}					
Actual	3.20	4.13	4.44	5.46	6.34
Predicted	--	4.18	4.49	5.30	6.00
Difference	--	-0.05	-0.05	0.16	0.34
(Percent)	(--)	(-1.2)	(-1.1)	(3.0)	(5.7)
Units of other imported autos sold (thousands)					
Actual	488	467	421	471	536
Predicted	--	484	450	482	536
Difference	--	-17	-29	-11	--
(Percent)	(--)	(-3.6)	(-6.5)	(-2.2)	(--)

^{1/} Assuming equal pure price effects on domestic and imported autos resulting from the export restraints.



V. Welfare Costs of the Japanese Export Restraints

The estimates of the effects of the Japanese export restraints on prices, sales, and imports presented in Section IV can be used to quantify the overall costs imposed by these restraints on auto purchasers in the United States and the associated benefits to domestic and foreign producers.

1. Costs to purchasers

The implications for the welfare of domestic auto purchasers stemming from the pure price increase induced by the quotas are illustrated in Figure 1. ^{1/} The line DD relates the demand for real expenditures on automobiles to the consumer price index for new cars. P_a and Q_a are the actual values of the consumer price index for new cars and total real expenditures on new cars; P_p and Q_p are the values predicted for these variables in the absence of the restraints; Q_{js} is the actual value of real expenditures on domestic new cars. The welfare cost to domestic purchasers arising from the effect of the export restraints on auto prices is then represented by the sum of the areas A, B, and C. Areas A and B represent transfers from purchasers to the domestic industry and foreign producers, respectively, arising from the pure increase in prices, while area C represents a deadweight loss.

As shown in Table 6, the export restraints are estimated to have raised the level of the consumer price index for new cars throughout 1981-84. This index was 6 percent higher in 1984 than it would have been otherwise, implying that the average price of a standard passenger car model was raised by \$617. On the basis of these figures, domestic purchasers of autos were more than \$6 1/2 billion worse off in 1984 due to higher prices, with a deadweight loss of \$130 million (Table 10). Over the four-year period 1981-84, the export restraints cost domestic purchasers \$16 3/4 billion, with a deadweight loss of \$280 million.

^{1/} As drawn, Figure 1 is based on the assumption that the pure price effects of the quotas on domestic and imported cars are the same.



FIGURE 1

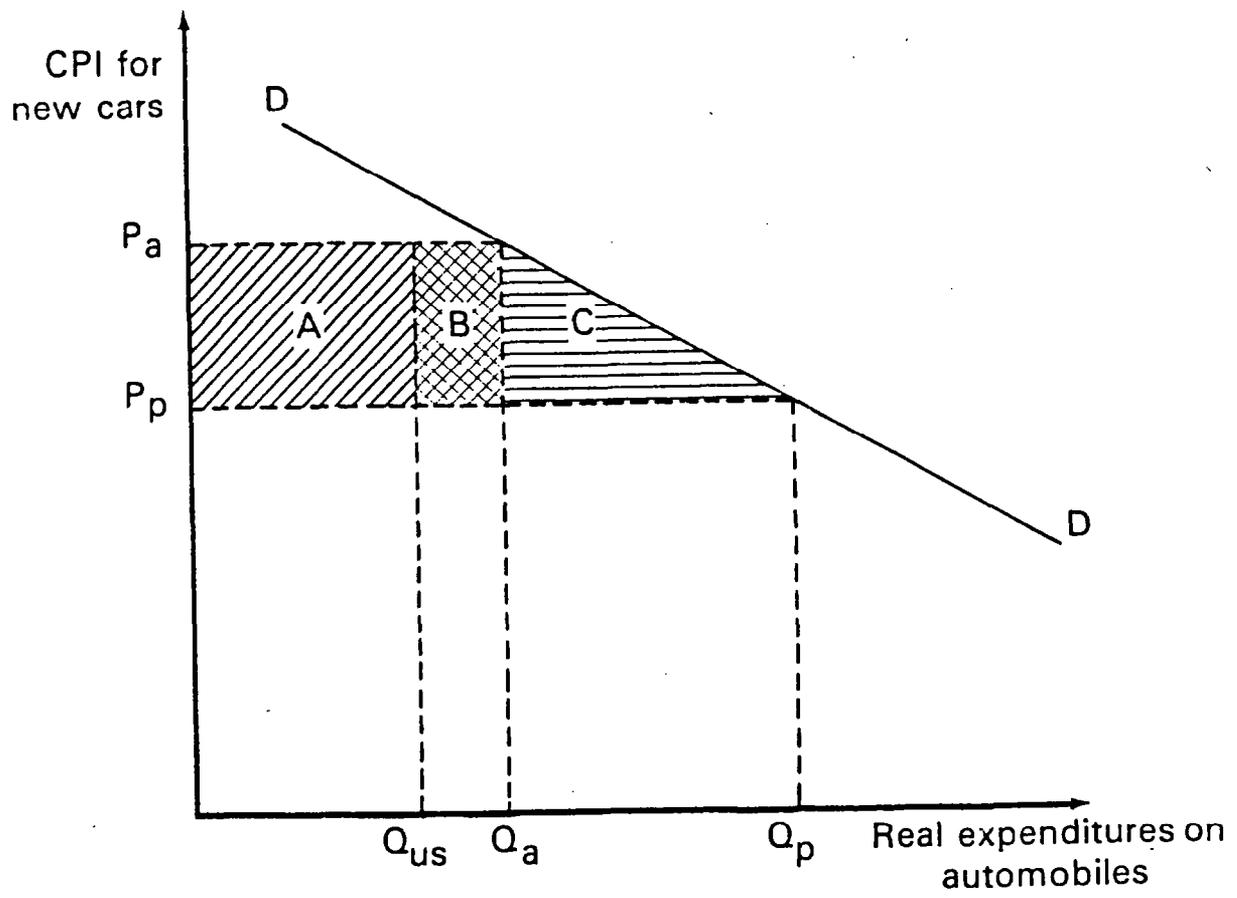








Table 10. Cost of Japanese Export Restraints to Automobile Purchasers

	1981	1982	1983	1984
(Dollars per car)				
Effects of restraints on:				
Prices	191	500	478	617
Quality	241	606	808	1,032
Total cost	432	1,106	1,286	1,649
(In billions of dollars)				
Cost of restraints to purchasers				
resulting from effects on prices	1.65	4.11	4.48	6.60
Of which: deadweight loss to purchasers	0.01	0.07	0.07	0.13

These estimates of the welfare loss to purchasers reflect only the pure price effects of the export restraints. In addition, purchasers would be worse off to the extent that the quotas restricted the effective range of choice available to them. It was estimated above that the export restraints may have led suppliers to sell larger cars with more optional equipment, and that this effect may have raised the transactions price of the average car sold by over \$1,000 in 1984. On this basis, purchasers spent an extra \$10 3/4 billion on increasing car quality in 1984 and \$25 billion during 1981-84. The welfare cost of this additional spending on quality would depend on the degree to which purchasers were willing to substitute quality for quantity. This elasticity of substitution has not been estimated; however, the additional welfare cost to purchasers due to reduced choice may have been substantial.

2. Benefits to the domestic industry

Estimates of the transfer from purchasers to the domestic industry (and to foreign producers) depend on the assumption made concerning the distribution of the pure price effects of the export restraints. Under the assumption that the quotas led to equivalent pure price effects on domestic and imported cars, the U.S. auto sector is estimated to have gained \$5 billion in 1984 and almost \$12 1/4 billion over 1981-84 (Table 11). Under the alternative assumption according to which pure price increases for domestic cars are estimated to have been less than



those for imported cars, the income transfer to domestic producers was \$1 1/4 billion in 1984, and \$6 billion over 1981-84. ^{1/}

Table 11. Effects of Japanese Export Restraints on the Domestic Automobile Industry

	1981	1982	1983	1984
(Dollars per car)				
Assuming equal pure price effects, impact of restraints on:				
Prices	191	500	478	617
Quality	217	544	521	570
Total cost	408	1,044	999	1,187
Assuming equal quality effects, impact of restraints on:				
Prices	167	438	191	155
Quality	241	606	808	1,032
Total cost	408	1,044	999	1,187
(In billions of dollars)				
Transfers from purchasers to the domestic industry:				
Assuming equal pure price effects	1.19	2.93	3.23	4.93
Assuming equal quality effects	1.04	2.53	1.30	1.22

3. Benefits to foreign producers

Foreign producers benefited from the pure price effects of the export restraints by over \$1 1/2 billion in 1984 and almost \$4 1/2 billion in 1981-84, assuming that the pure price effects of the quotas were the same for imported and domestic cars (Table 12). Under this assumption, Japanese producers are estimated to have received an income transfer of \$1 billion in 1984 and \$2 3/4 billion over the 1981-84 period. Making the alternative assumption of equal quality effects, foreign producers are estimated to have received a transfer of nearly \$5 1/2 billion in

^{1/} These estimates are based on the assumption that the auto industry achieves constant returns to scale in production. If the industry in fact achieves increasing returns to scale then the benefits to producers would be somewhat higher than the figures presented here.



1984 and a total of \$10 1/2 billion over 1981-84, of which Japanese producers received \$5 1/4 billion in 1984 and \$9 3/4 billion in 1981-84.

Table 12. Effects of Japanese Export Restraints on Foreign Producers

	1981	1982	1983	1984
(Dollars per car)				
Assuming equal pure price effects, impact of restraints on:				
Prices	191	500	478	617
Quality	295	734	1,472	2,208
Total cost	486	1,234	1,950	2,825
Assuming equal quality effects, impact of restraints on:				
Prices	245	628	1,142	1,793
Quality	241	606	808	1,032
Total cost	486	1,234	1,950	2,825
(In billions of dollars)				
Transfers from purchasers to foreign producers:				
Assuming equal pure price effects	0.45	1.12	1.19	1.67
Of which: transfers to Japanese producers	0.45	0.71	0.73	1.00
Assuming equal quality effects	0.60	1.52	3.11	5.38
Of which: transfers to Japanese producers	0.46	1.16	2.93	5.21

It should be noted that these aggregate numbers are likely to obscure considerable divergences in the effects of the quotas on different companies in Japan. Real expenditures on imports are likely to have been adversely affected for all Japanese companies, while the gain in profit due to the pure price effects of the quotas would mainly accrue to companies with established market shares prior to 1981 since these companies were able to obtain the bulk of the export rights to the U.S. market.

VI. Conclusion

According to the results presented in this paper, the restraints on exports of Japanese cars to the United States during the period 1981-84 had substantial effects. The average transactions price for all new cars increased by nearly 50 percent during this period compared with an estimated increase of 27 percent in the absence of the quotas. The higher transactions' prices resulted from a combination of a pure price increase and a shift in the composition of car sales toward larger units with more extensively installed optional equipment. As a result of the quotas, real expenditures on new cars during 1981-84 were reduced by more than 3 percent, and new car sales by 4 million units. The value of expenditures on new cars was raised by \$5 1/4 billion as increases in average transactions prices more than offset the effects of the restraints on volumes sold. The restraints bolstered the domestic auto industry's market share and raised real expenditures on domestic cars by 2-4 percent and the value of such expenditures by almost \$18 billion during 1981-84. At the same time, expenditures on Japanese automobiles were 23-29 percent lower in real terms and nearly \$15 billion lower in value terms.

The rise in car prices induced by the export restraints (adjusted to exclude price increases due to changes in the quality of automobiles purchased) is estimated to have cost car purchasers nearly \$17 billion during the period 1981-84. Of this increase in purchasers' costs, \$6-\$12 billion represented a transfer to the U.S. automobile industry. The remaining \$5-\$11 billion is accounted for by a transfer to foreign producers and a deadweight loss to purchasers, and it can be viewed as a measure of the loss to the domestic economy as a whole stemming from the restraints on Japanese exports. The net loss may in fact have been larger if account is taken of the loss in welfare stemming from the reduced range of choice facing auto purchasers.

Finally, the 2-4 percent increase in real expenditures on domestic autos induced by the quotas during 1981-84 is estimated to have boosted employment in the auto sector by 40,000-75,000 man years. These figures imply that the net cost to the economy of each job created by the quotas was on the order of \$110,000 to \$145,000.



Appendix: A Model of the U.S. Automobile Sector

This appendix describes the model of the U.S. auto sector developed to estimate the effects of the Japanese automobile export restraints. The model consists of six behavioral equations and 26 identities. The behavioral equations in the model are estimated using annual data for the period preceding the imposition of the restraints (1968-80). These equations are estimated using two-stage least squares, where it is appropriate, in order to avoid problems of simultaneity between prices and sales. In what follows, a lower case letter represents the natural logarithm of the variable; t-ratios are shown in parenthesis. The variables are defined in Section 3 of this appendix.

1. Behavioral equations

Inventory-sales ratio

$$i = 1.95 - 1.82 \dot{Y} - 0.79 t \quad (1)$$

(3.2) (7.4)

$$\bar{R}^2 = 0.830 \quad D.W. = 2.49$$

Consumer price index for new cars

$$Pc = 2.27 + 0.99 c - 0.50 \hat{i} - 1.03 t \quad (2)$$

(4.9) (2.9) (2.2)

$$\bar{R}^2 = 0.988 \quad D.W. = 1.32 \quad \rho = 0.67$$

(2.3)

Average transactions price for new cars

$$Pa = 9.97 + 1.22 c - 0.73 \hat{i} - 1.06 t \quad (3)$$

(15.78) (7.53) (5.26)

$$\bar{R}^2 = 0.997 \quad D.W. = 2.74$$

Real expenditures on new automobiles

$$e = 0.78y - 0.72 \hat{p} - 0.70 r - 0.30 \dot{L} \quad (4)$$

(10.9) (4.2) (2.9) (4.5)

$$\bar{R}^2 = 0.932 \quad D.W. = 2.52$$

Relative average transactions price of new domestic cars

$$d = -0.18 + 0.044 w_{-1} - 0.036 g \quad (5)$$

(4.4) (2.9)

$$\bar{R}^2 = 0.902 \quad D.W. = 2.41$$

Share of domestic producers in total new auto sales

$$s = 1.78 - 5.54 \hat{d} - 0.44 g - 0.53 t \quad (6)$$

(4.7) (7.4) (7.7)

$$\bar{R}^2 = 0.970 \quad D.W. = 2.03$$

2. Identities

Total new automobile sales

$$E_{\S} = P_c \cdot E$$

$$U = E_{\S} / P_a$$

Domestic new automobiles

$$P_a^d = D \cdot P_a$$

$$E_{\S}^d = S \cdot E_{\S}$$

$$U^d = E_{\S}^d / P_a^d$$

$$E_c^d = E_{\S}^d / P_c^d$$

$$P_c^d = P_c; \text{ if equal pure price effects are assumed.}$$

$$P_c^{d'} = P_c'$$

$$P_c^{d*} = [(P_a' - P_a^* - (P_c^*/P_c') \cdot P_a' + P_a^{d*}) / P_a^{d'}] \cdot P_c'$$

} if equal quality effects are assumed. A ' denotes an actual value; and * denotes a predicted value.

ported new automobiles

$$S^f = 1 - S$$

$$E_{\$}^f = S^f \cdot E_{\$} = E_{\$} - E_{\d$

$$U^f = U - U^d$$

$$P_a^f = E_{\$}^f / U^f$$

$$E^f = E_{\$}^f / P_c^f$$

$$P_c^f = P_c; \text{ if equal pure price effects are assumed.}$$

$$P_c^{f'} = P_c'$$

$$P_c^{f*} = \left[(P_a' - P_a^* - (P_c^*/P_c') \cdot P_a' + P_a^{f*}) / P_a^{f'} \right] \cdot P_c'$$

} if equal quality effects are assumed. A ' denotes an actual value; and a * denotes a predicted value.

on-Japanese new automobile imports

$$E_{\$}^n = P_a^n \cdot U^n$$

$$E^n = E_{\$}^n / P_c^n$$

$$P_c^n = P_c; \text{ if equal pure price effects are assumed.}$$

$$P_c^{n'} = P_c'$$

$$P_c^{n*} = \left[(P_a' - P_a^* - (P_c^*/P_c') \cdot P_a' + P_a^{n'}) / P_a^{n'} \right] \cdot P_c'$$

} if equal quality effects are assumed. A ' denotes an actual value; and a * denotes a predicted value.

Predicted values for the average transactions price of non-Japanese imports and unit sales are derived assuming the following (where a ' denotes an actual value and a * indicates a predicted value):

$$P_a^{n*} = P_a^{n'} / (P_a^{d'} / P_a^{d*})$$

$$U^{n*} = U^{n'} / (U^{d'} / U^{d*})$$

Japanese new automobile imports

$$U^j = U^f - U^n$$

$$E_{\$}^j = E_{\$}^f - E_{\n$

$$P_a^j = E_{\$}^j / U^j$$

$$S^j = E_{\$}^j / E_{\$}$$

$$E^j = E_{\$}^j / P_c^j$$

$$P_c^j = P_c; \text{ if equal pure price effects are assumed.}$$

$$P_c^{j'} = P_c'$$

$$P_c^{j'} = [(P_a' - P_a^* - (P_c^* / P_c') \cdot P_a' + P_a^{j*}) / P_a^j] \cdot P_c'$$

} if equal quality effects are assumed. A ' represents an actual value and a * represents a predicted value.

3. Definition of variables

- C = an index of production costs, derived as a weighted average of unit labor costs in motor vehicle manufacturing and the producer price indexes for metals and metal working machinery. Weights used are based on coefficients in the 1972 output-input tables of the United States.
- D = average transactions price of domestic cars as a percentage of the average transactions price of all cars sold in the U.S. market.

- \hat{D} = fitted values for the relative price variable derived from equation (5).
- E = real consumer and producer expenditures on new automobiles.
- E^d = real consumer and producer expenditures on new domestic automobiles.
- E^f = real consumer and producer expenditures on new imported automobiles.
- E^j = real consumer and producer expenditures on new imported Japanese automobiles.
- E_n = real consumer and producer expenditures on new imported non-Japanese automobiles.
- $E_{\$}$ = current dollar consumer and producer expenditures on new automobiles.
- $E_{\d = current dollar consumer and producer expenditures on new domestic automobiles.
- $E_{\f = current dollar consumer and producer expenditures on new imported automobiles.
- $E_{\j = current dollar consumer and producer expenditures on new imported Japanese automobiles.
- $E_{\n = current dollar consumer and producer expenditures on new imported non-Japanese automobiles.
- G = ratio of the consumer price index for gasoline to the consumer price index excluding energy products.
- I = ratio of automobile inventories to sales.
- \hat{I} = fitted values for the inventory-sales ratio derived from (1).
- \dot{L} = change in the unemployment rate.
- \hat{P} = an instrumental variable for the relative price of new cars, derived as the ratio of fitted values for the consumer price index for new cars from equation (2) to the consumer price index for all items.
- P_a = average transactions price for new cars.

- P_a^d = average transactions price for new domestic cars.
- P_a^f = average transactions price for new imported cars.
- P_a^j = average transactions price for new imported Japanese cars.
- P_a^n = average transactions price for new imported non-Japanese cars.
- P_c = consumer price index for new cars.
- P_c^d = consumer price index for new domestic cars, derived depending on the assumption used regarding the pure price and quality effects of the export restraints.
- P_c^f = consumer price index for new imported cars, derived depending on the assumption used regarding the pure price and quality effects of the export restraints.
- P_c^j = consumer price index for new imported Japanese cars, derived depending on the assumption used regarding the pure price and quality effects of the export restraints.
- P_c^n = consumer price index for new imported non-Japanese cars, derived depending on the assumption used regarding the pure price and quality effects of the export restraints.
- R = interest rate on 36-month new auto loans at commercial banks.
- S = share of domestic cars in total expenditures on new automobiles.
- S^f = share of imported cars in total expenditures on new automobiles.
- S^j = share of imported Japanese cars in total expenditures on new automobiles.
- T = a linear time trend.
- U = total unit sales of new cars.
- U^d = unit sales of new domestic cars.
- U^f = unit sales of imported cars.
- U^j = unit sales of imported Japanese cars.

U^n = unit sales of imported non-Japanese cars.

W = relative unit labor cost in the U.S. manufacturing sector
vis-à-vis other countries.

Y = real GNP.

\dot{Y} = rate of change in real GNP.

