

The Effects a U.S. Free Trade Agreement with Japan would have on the U.S. Automotive Industry

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Abstract

Automotive trade has always been an important aspect of the United States and Japanese trading relationship. The value of Japanese manufactured vehicle exports and related parts to the United States peaked most recently at nearly \$60 billion in 2006. Due to the unbalanced nature of automotive trade between the two countries there is and continues to be a large deficit in automotive trade between the United States and Japan. The automotive trade deficit with Japan of \$42 billion constituted 67 percent of the total U.S trade deficit with Japan in 2011.

In the past, the ability of the Japanese government to intervene in currency markets kept the real value of the yen at predictable levels, thereby keeping the Japanese auto industry cost competitive. This can provide the Japanese auto manufacturers with both a stable planning horizon and a competitive advantage. However, the Japanese government's recent attempt to reverse the strong appreciation of the yen through intervention in currency markets (at least four times in the last year) has met with limited or no success.

In addition to currency intervention there are other measures recently called for by Japanese automobile executives to reverse the effects of the high yen. One of these is for Japan to enter into free trade agreements (FTAs) with markets that would eliminate tariffs on Japanese automotive imports.¹ The reduction of tariff rates on Japanese automotive products would increase their profit margins since tariffs are assessed by customs officials on declared retail values in the import market. The effect of such tariff reductions almost always leads to an increase in exports of the products subject to tariff reversal.

The Center for Automotive Research (CAR) has produced a model of Japanese automotive vehicle exports to the United States that estimates the likely effect of a tariff reduction brought on by a FTA between Japan and the United States that would be a characteristic of Japan's inclusion in the Trans Pacific Partnership (TPP). Japanese vehicle exports are estimated to increase by 105,000 units or \$2.2 billion (an increase of 6.2 percent) due to the elimination of a 2.5 percent tariff. U.S vehicle production is estimated to fall by 65,100 units which CAR estimates would result in a loss of 2,600 direct U.S. automotive manufacturing jobs. An additional loss of U.S. supplier jobs is estimated at 9,000 and the loss of spin-off jobs at 14,900. The total U.S. employment loss then for this scenario is 26,500 jobs.

CAR also examined the effect of changing exchange rates on Japanese vehicle exports. CAR's exchange rate model for Japanese vehicle exports estimates that if the real yen/dollar exchange rate changed from a level of 90 yen/dollar to 100 yen/dollar, it would result in an increase of vehicle exports to the U.S. market of 15.1 percent, and a decrease from 90 yen/dollar to 80 yen/dollar will result in a decrease in exports of -15.1 percent, and in each case, the elimination of the 2.5 percent U.S. vehicle import tariff would increase exports by a further 6.2 percent.

¹ Kitamura, Makiko. 2011. "Japan Auto Group Seeks Trade Accords to Compete With Hyundai, Kia Motors," *Bloomberg*. November 18. <http://www.bloomberg.com/news/2010-11-18/japan-auto-group-seeks-trade-accords-to-compete-with-hyundai-kia-motors.html>.

In summary, CAR believes Japan's inclusion in a FTA connected to the TPP will result in the increase in the number of Japanese vehicle exports to the United States, all other factors being equal, of about 105,000 vehicles per year. The CAR forecast scenario further estimates the loss of 65,100 units of U.S. domestic production and the loss of 26,500 U.S. jobs. Also, CAR's estimate of the increase in the number of Japanese vehicle imports is 362,800 in the case of the FTA and a depreciation of the real level of the yen/dollar exchange rate from 90 to 100. CAR's forecast of production and employment loss in this case of a change in the exchange rate from 90 to 100 yen/dollar and the elimination of the 2.5 percent tariff as a result of FTA is a loss of about 225,000 units of U.S. vehicle production.

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The Effects a U.S. Free Trade Agreement with Japan would have on the U.S. Automotive Industry

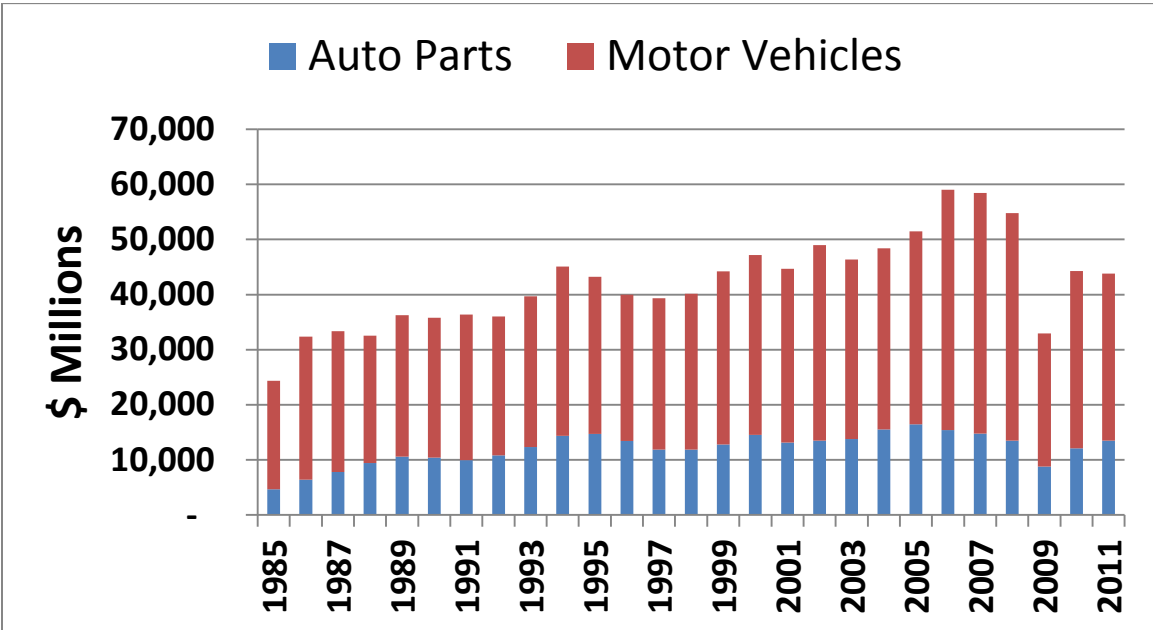
Automotive Trade between the U.S. and Japan

Automotive issues often dominate trade discussions between trading partners and for good reason. Due to the large economies of scale that are required in this sector and the high value-added nature of the goods and services that are produced, the ability to design, engineer, and manufacture an automobile is often viewed as a crowning achievement for any economy. The automotive industry continues to be a pillar industry for the majority of developing or developed economies and is often the cornerstone of any country's manufacturing capabilities. In addition, through the support of associated suppliers, dealers, and related services (e.g. financing), it has continually been demonstrated there is an "employment multiplier" of 9 or 10 jobs for every auto manufacturing assembly job that exists with a given market². With stakes like this, it is imperative that appropriate attention be given to this sector when considering new trade arrangements.

Automotive trade has always been an important aspect of the United States and Japanese trading relationship. As shown in Figure 1, the value of Japanese manufactured automotive exports and related parts to the United States peaked most recently at nearly \$60 billion.

² Kim Hill, Adam Cooper and Debbie Maranger Menk. **Contribution of the Automotive Industry to the Economies of All Fifty States and the United States**. Center for Automotive Research. Prepared for The Alliance of Automobile Manufacturers, The Association of International Automobile Manufacturers, The Motor & Equipment Manufacturers Association, The National Automobile Dealers Association and The American International Automobile Dealers Association. April, 2010.

Figure 1: Japanese Automotive Exports to U.S.: 1985-2011



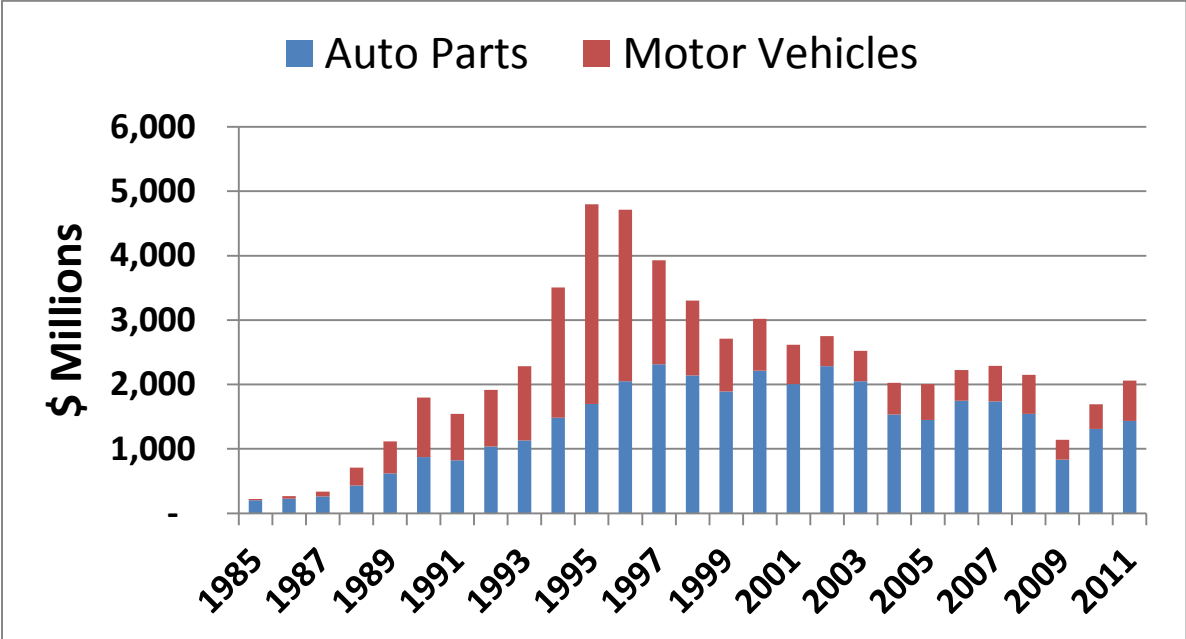
Source: United States International Trade Commission

Despite numerous attempts to establish their own presence in Japan, American automakers have been unable to achieve the same degrees of success as their Japanese competitors. Japanese manufacturers maintain a 95 percent share³ of their home market largely due to a variety of factors that include long-standing non-government, non-tariff barriers that have made it particularly difficult for American and European automotive manufacturers to penetrate the Japanese market.⁴ As a result, as shown in Figure 2, the total value of U.S manufactured vehicles and parts exported to Japan peaked at \$4.8 billion in 1995.

³ Japan Automobile Manufacturers Association (JAMA) Automobile & Motorcycle Registrations-Sales Statistics.

⁴ See for example: Sang Min Lee, “A Comparative Study of the Automobile Industry in Japan and Korea, from Visible to Invisible Barriers” Asian Survey, Vol. 51, No. 5 (September/October 2011), pp. 876-898.

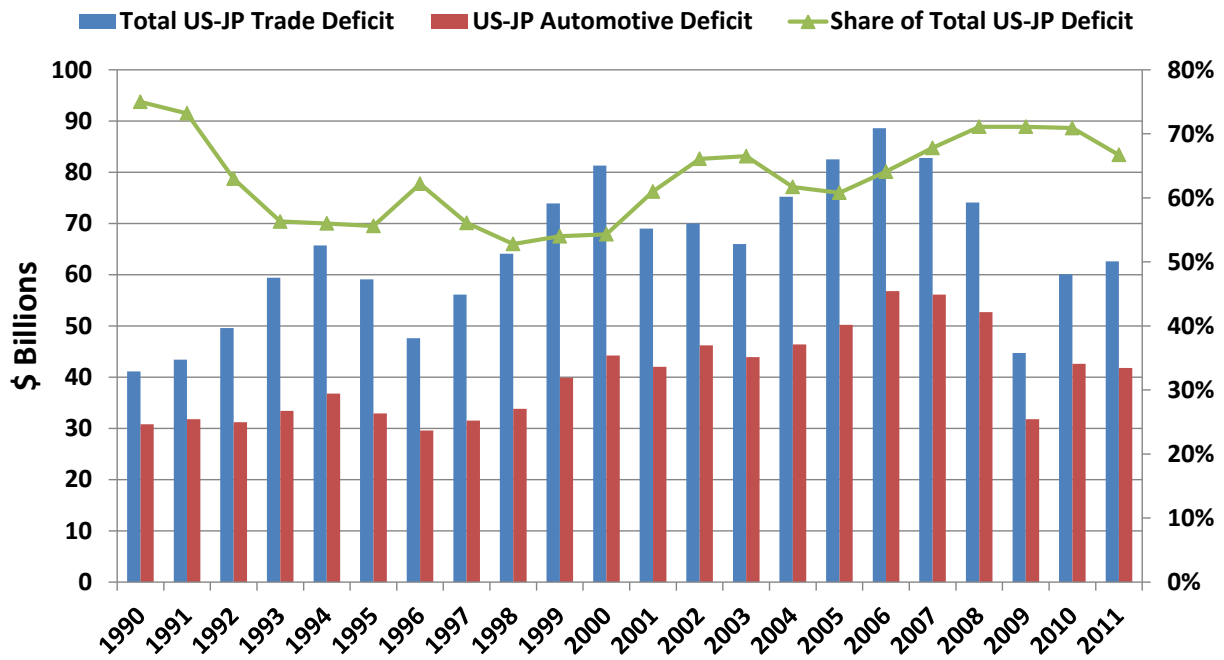
Figure 2: U.S Automotive Exports to Japan



Source: Transportation and Machinery Office, U.S. Department of Commerce

Due to the unbalanced nature of automotive trade between the two markets, there is and continues to be a large deficit in automotive trade between the United States and Japan. As shown in Figure 3, the automotive trade deficit with Japan of \$42 billion constituted 67 percent of the total U.S. trade deficit with Japan in 2011.

Figure 3: U.S. - Japan Goods Trade Deficit: 1990-2011



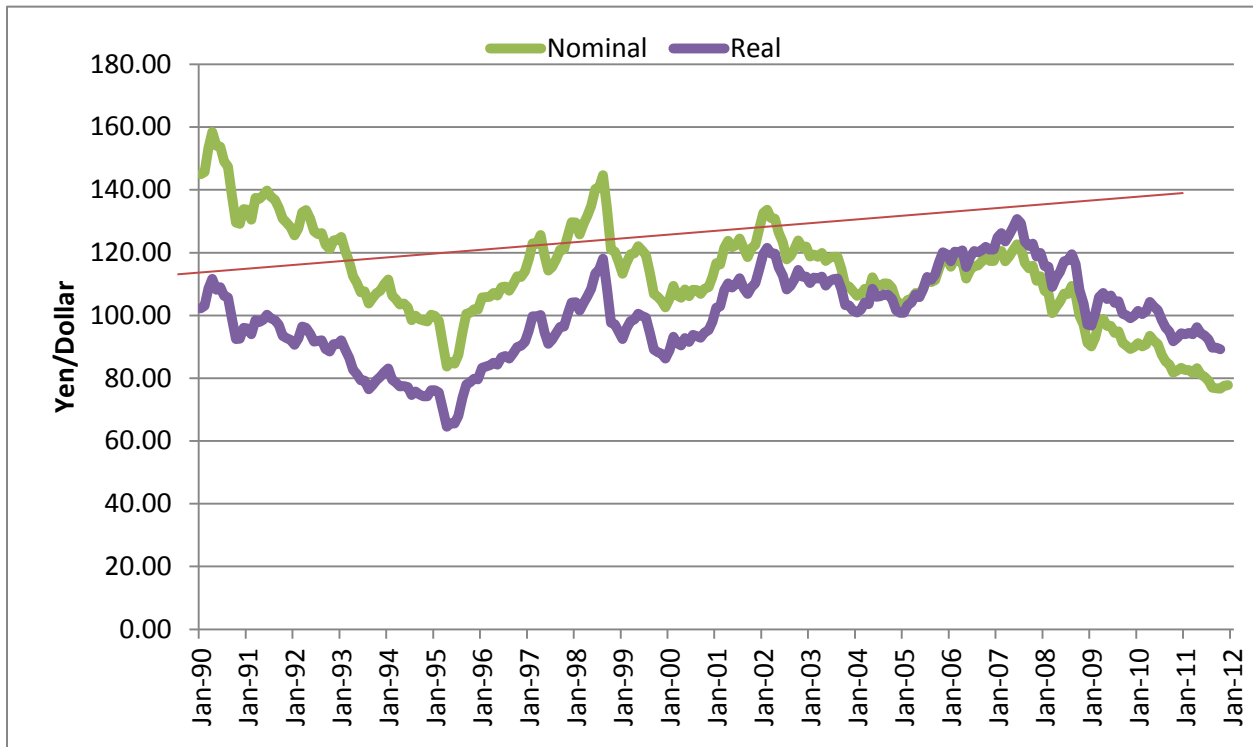
Source: Transportation and Machinery Office, U.S. Department of Commerce

The Linkage between Exchange Rates and Vehicle Exports from Japan

One of the enablers for Japan’s ability to continue to utilize the majority of its installed automobile manufacturing capacity has been the ability of the Japanese government to intervene in currency markets to keep the real value of the yen at predictable levels, thereby keeping Japanese auto production cost competitive. This can provide Japanese manufacturers with both a stable planning horizon as well as a competitive advantage. As shown in Figure 5, the movement of the nominal yen/dollar exchange rate in the past 21 years has been subject to great variability. The nominal value of the Japanese yen had been as low as 160 yen/dollar in 1990 and was as high as 83 yen/dollar in 1995. Even in real terms, the exchange rate could fluctuate by more than 20 percent in one year. Nonetheless, over this period, it is apparent the Japanese government has gone to some lengths to keep the yen/dollar exchange rate in a predictable range centered on the 100 yen/dollar (Real-Terms) level.

Figure 4: Yen/Dollar Exchange Rate: January 1990 -- January 2012

Source: U.S. Federal Reserve Economic Database



The Japanese auto industry suffered significant supply chain disruptions in 2011 due to both the Japanese earthquake and tsunami earlier in the year as well as the floods in Thailand later in the year (Thailand being a major parts supply source). While Japanese auto firms have now largely recovered from the effects of the 2011 tsunami and major floods in Thailand, they are still coping with the effects of an appreciated Japanese currency. Numerous executives from almost all of the Japanese automakers have stated that recent yen/dollar exchange rates have made automotive manufacturing unsustainable in Japan. Indeed, a number of Japanese automakers have recently announced major increases in capacity for their North American operations to offset the effects of the strong yen. It is also apparent that extreme measures to cut costs in Japan including the importation of less expensive Asia-sourced automotive parts, increased use of temporary labor, and further use of advanced automation will be inadequate to reverse the effects of the high value of the yen. The Japanese government, attempting to reverse the recent appreciation of the yen, intervened in currency markets at least four times in the last year to depreciate it against the dollar, but with only limited or no success.

The Trans Pacific Partnership (TPP) Agreement

In addition to currency intervention, there are other measures called for by Japanese automobile executives to reverse the effects of the high yen. One of these is for Japan to enter into free trade

agreements (FTAs) with markets that would eliminate tariffs on Japanese automotive imports.⁵ The reduction of tariff rates on Japanese automotive products would increase their margins since the tariffs are assessed by customs officials on declared retail values in the import market. In almost any market, the effect of such tariff reductions almost always leads to an increase in exports of the products subject to tariff reversal. The possible FTA known as the Trans Pacific Partnership (TPP), now being negotiated between the U.S government and a number of Pacific Rim nations would presumably reduce tariffs on imported vehicles eventually to a level of zero. Japanese vehicle imports into the U.S market now face tariffs that range from 2.5 to 25.0 percent. Presumably, if the real yen/dollar exchange rate remained consistently below 90, Japanese automakers would ultimately have to reduce their domestic capacity and relocate it closer to the end customer or other low-cost destinations, despite the existence of a FTA. Regardless, at the current real exchange rate at 90 yen per dollar, a reduction of tariffs on Japanese auto imports in a U.S. -Japan FTA is very likely to result in a delay of industry restructuring in Japan and hence the rate of capacity movements to other markets including North America.

A Model of Japanese Vehicle Exports to the U.S.

The Center for Automotive Research (CAR) has produced a model of Japanese automotive vehicle exports to the United States that estimates the likely effect of a tariff reduction brought on by a FTA between Japan and the United States as a result of Japan's inclusion in the TPP. The model forecasts Japanese vehicle exports to the United States in nominal yen. The model controls for such explanatory variables as the real yen-dollar exchange rate, total light vehicle sales in the U.S market, light vehicle production by the Detroit 3 in North America, light duty vehicle production by Japanese automakers in Japan, a special variable to allow for the effects of the great recession of 2009 and the great Japan earthquake in 2011, and the U.S inflation rate. The final explanatory variable is a reasonable proxy for the relative import price of Japanese vehicle exports to the United States. It is the empirical coefficient for this variable that is used to provide an "elasticity" effect of lowering the current U.S vehicle tariff of 2.5 percent to zero as a result of a FTA between the United States and Japan. The full specification of CAR's model is shown in Appendix 1 along with a description of the variables used and relevant test statistics.

The price elasticity coefficient was estimated at -2.5 which when multiplied by the tariff reduction of -2.5 percent results in an estimated increase in Japanese vehicle exports of 6.2 percent as a result of the tariff reduction holding the effects of all other variables constant. CAR then uses an average dollar value for Japanese vehicle exports (computed over the last 10 years) of \$35.4 billion to forecast an increase of \$2.2 billion in vehicle exports to the United States. The number of export vehicles is expected to rise by about 105,000. This number was derived by using a 10-year average declared customs value for Japanese vehicles of \$20,757. It should be remembered this value is

⁵ Kitamura, Makiko. 2011. "Japan Auto Group Seeks Trade Accords to Compete With Hyundai, Kia Motors," *Bloomberg*. November 18. <http://www.bloomberg.com/news/2010-11-18/japan-auto-group-seeks-trade-accords-to-compete-with-hyundai-kia-motors.html>.

measured by customs FOB and without dealership markup or other destination charges added in the United States.

CAR’s initial results for the effect of tariff reduction on Japanese vehicle exports are summarized in Table 1 below.

Table 1: CAR Forecast of the Effect of a 2.5 Percent Tariff Reduction on Japanese Vehicle Exports to the United States

	Japan Light Vehicle Exports to US (Units)	Japan Light Vehicle Exports to US (\$ Million)	Per vehicle price (\$)
10-Yr avg	1,713,002	35,401	\$20,757
Price elasticity		-2.4638	
Tariff Effect		-2.50%	
Impact on Exports (\$Mil.)		2,180.52	
Impact on Exports (Units)		105,049	

The Effect of Higher Japanese Automotive Vehicles Exports on U.S. Employment

Since 1992, CAR has produced the great majority of studies that measure the effects of automotive manufacturing on the U.S economy. These “contribution” studies used a well-known and tested national input-output model of the U.S. economy (REMI, Inc.) and actual compensation and employment data supplied by the automakers. The increase in Japanese vehicles exports due to the elimination of U.S tariffs estimated above can be converted to potential job losses in the U.S auto industry through the use of CAR’s results in recent automotive contribution studies.⁶ It is assumed that a higher level of Japanese exports will displace sales of Japanese vehicle produced in North America and vehicles produced by non-Japanese firms in North America or elsewhere. This study will assume the most likely scenario for potential job losses in the U.S economy that are the result of increased Japanese vehicle exports. This scenario, “All Automakers,” that the increase in Japanese vehicle exports will result in an equivalent reduction in sales spread across all automakers (at recent market shares in 2011) in the U.S market. The loss in U.S production, then, is derived by using a CAR estimate of U.S built vehicles as a source for total U.S. sales (see Appendix 2).

The scenario, “All Automakers” in Table 2 below, assumes all automakers (including Japanese U.S transplants) selling vehicles in the U.S market suffer lost sales because of increased Japanese vehicle imports. CAR estimates that about 62 percent of U.S sales net of Japanese imports are assembled in the United States (See Appendix 2). Thus, the loss of vehicle production in the U.S

⁶ Kim Hill, Adam Cooper and Debbie Maranger Menk. Contribution of the Automotive Industry to the Economies of All Fifty States and the United States. Center for Automotive Research. Prepared for The Alliance of Automobile Manufacturers, The Association of International Automobile Manufacturers, The Motor & Equipment Manufacturers Association, The National Automobile Dealers Association and The American International Automobile Dealers Association. April 2010.

would be 65,130 units. CAR relies on a 2010 economic contribution study performed for the Alliance of Automobile Manufacturers (AAM) and other auto associations for its estimate of the employment impact of this loss of production (see appendix 3).⁷ The automakers as a group averaged 24.662 vehicles per direct employee in this study. As shown in Table 2, the loss of 65,130 units of production produces a loss of 2,641 direct U.S employees. The loss of U.S supplier jobs is estimated at 8,992 and the loss of spin-off jobs at 14,867. The total U.S employment loss then for this scenario is 26,501.

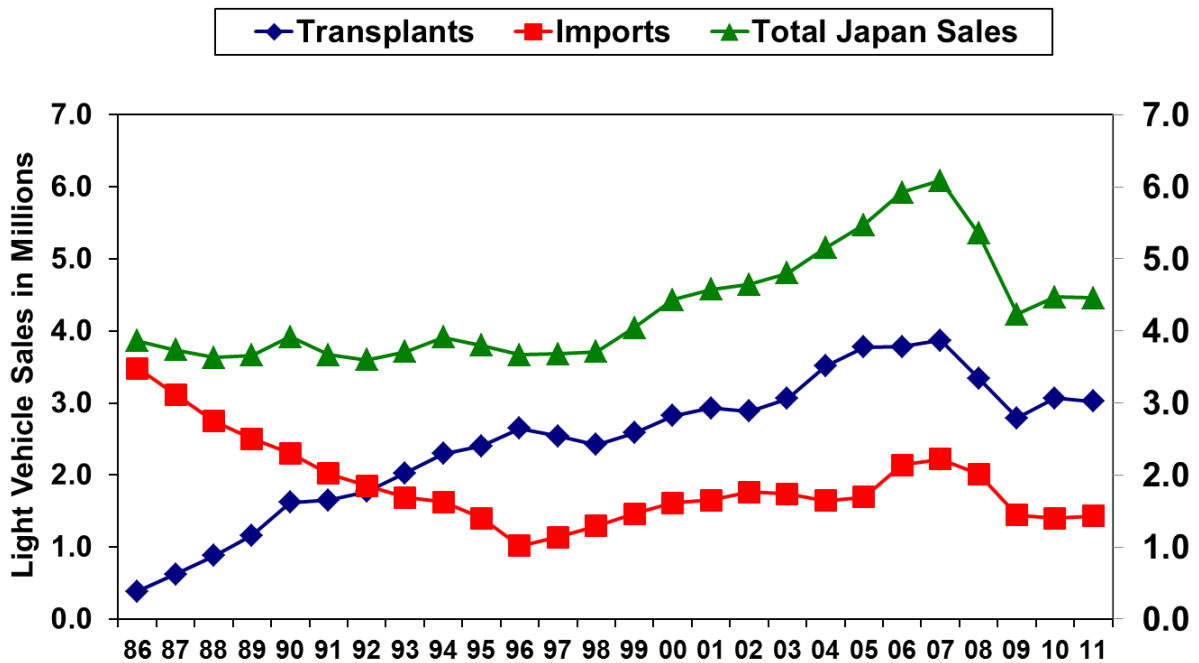
Table 2: Scenario of Job Loss Due to Increased Japanese Vehicle Exports

Export Scenarios	All Automakers
U.S. Vehicle Sourcing	62%
Impact on U.S. Production	(65,130)
Vehicles Per Employee	24.662
# of Direct jobs	(2,641)
Supplier jobs divided by direct jobs	3.405
# of Supplier jobs	(8,992)
Spin-off Jobs/(supplier+direct) Jobs	1.278
# of Spin-off Jobs	(14,867)
Total Job Loss	(26,501)

CAR believes the scenario for export substitution labeled “All Automakers,” contains the most likely jobs impact outcome for the projected increase in Japanese vehicle exports to the U.S market as a result of the decrease in the tariff. As Figure 5 shows below, the Japanese effectively replaced import vehicle sales in the U.S one-for-one with North American transplant vehicle sales (from N. America) during 1986-1996, a period of strong yen/dollar appreciation. In fact, from 1996 through 2007, a period of real yen/dollar stability and depreciation, the Japanese automakers grew both import and transplant sales simultaneously in the U.S to achieve a peak share of the market. This pattern fits CAR’s likely scenario well and indicates the loss of U.S jobs due to increased vehicle imports as a result of an FTA would total more than 26,501 or even higher if Japanese transplant sales were protected from Japanese import substitution.

⁷ Hill, K., et al, 2010.

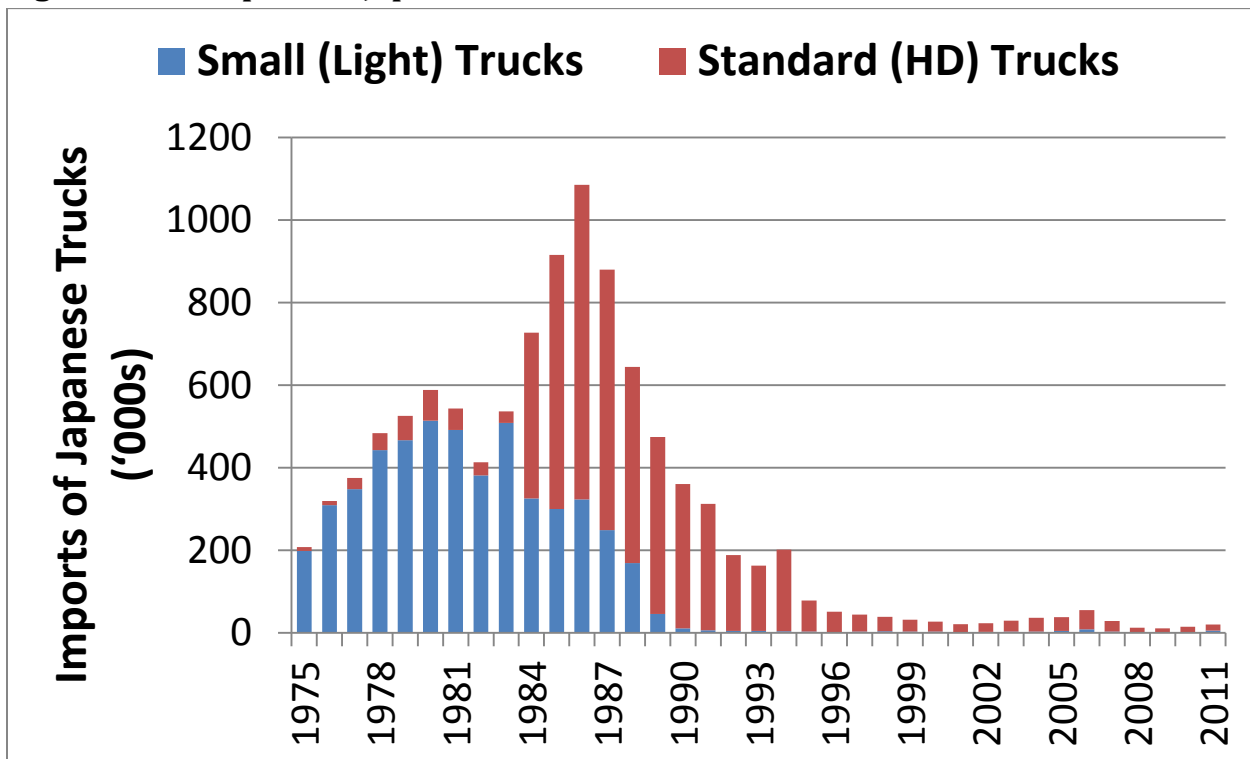
Figure 5: Japanese U.S. Light Vehicle Sales: 1986 – 2011



Source: Automotive News

Finally, it should be mentioned that the actual U.S tariff on imported trucks for cargo use is 25.0 percent, not 2.5 percent, or 10 times the rate for passenger cars. As shown in Figure 6, sales of imported Japanese trucks peaked at almost 1.1 million units in 1986 and then rapidly declined thereafter. The reasons included the rapid appreciation of the Japanese yen; the replacement of captive import Japanese trucks sold by the Detroit 3 with U.S -built domestic models, and eventually the construction of Japanese truck assembly facilities in North America. Japanese imported trucks were sold, however, despite the 25.0 percent truck tariff (in place since 1963) before 1986. The elimination of this tariff as the result of an FTA between Japan and the United States could still result in a significant increase in exports of Japanese truck models with fuel efficient engines. This potential is not covered by the estimation presented in Tables 1 or 2 above and is all the more likely in the event of a significant depreciation of the yen against the U.S dollar.

Figure 6: U.S. Imports of Japanese Trucks: 1975-2011



Note: Small light trucks are those with engines smaller than 2.0 liters, and Standard trucks are those with engines 2.0 liters and larger. Source: Japan Automobile Manufacturers Association (JAMA)

The Effect of a Changing Exchange Rate

The previous model estimates the effects of a United States-Japan FTA -- through a tariff reduction and thus reduced vehicle price -- on Japanese light vehicle exports to the United States. The essential findings show that eliminating the 2.5 percent U.S. motor vehicle tariff will result in an increase in Japanese light vehicle exports of 6.2 percent. Of course, fluctuations in the yen/dollar exchange rate could mask the effect of the elimination of the 2.5 percent tariff reduction or appear to magnify it in a very short period of time because of the power of the exchange rate to affect exports.

As shown in Figure 4 in the earlier section, the movement of yen/dollar exchange rate in the past 21 years has been subject to great variability. The nominal value of the Japanese yen had been as low as 160 yen/dollar in 1990 and was as high as 83 yen/dollar in 1995. Even in real terms, the exchange rate could fluctuate by more than 20 percent in one year. The yen exchange rate can directly affect Japanese vehicle prices and hence Japanese vehicle exports to the U.S market.

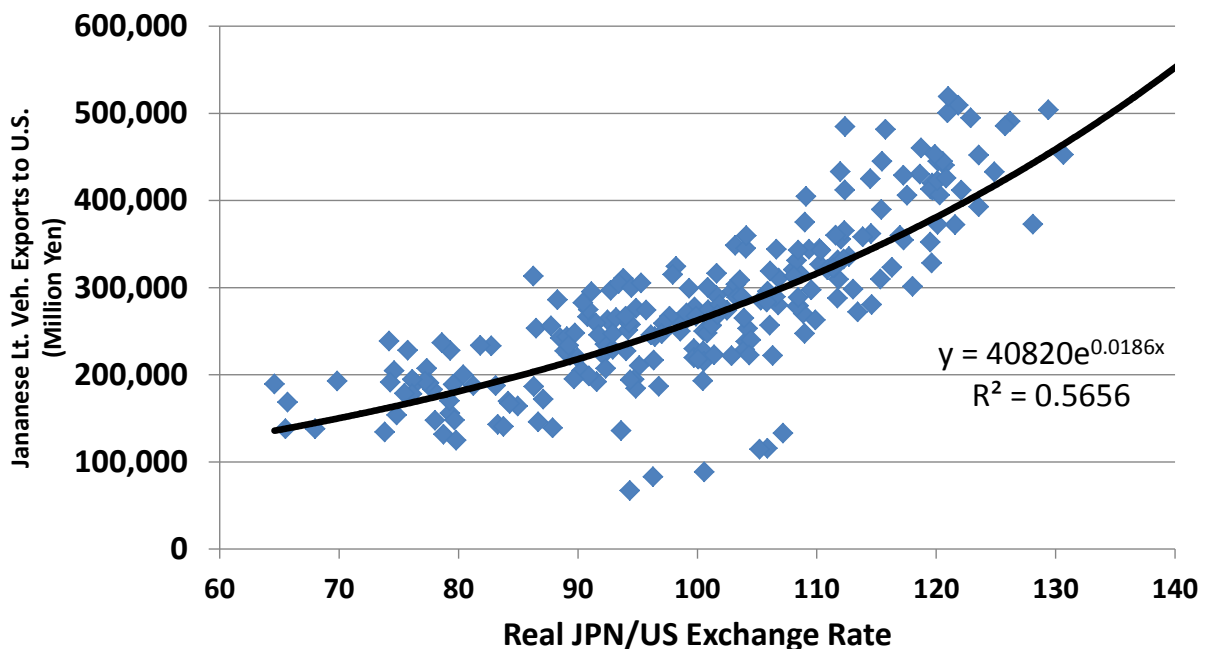
Due to statistical limitations in the data which are discussed in detail in Appendix 4, the previous import price model found the impact of the exchange rate on exports to be inelastic. In order to address the concerns of the exchange rate on price and on exports, CAR constructed a second model to investigate the impact of the exchange rate on Japanese vehicle exports to the United States. The model uses data from 1993 and includes the previous yen peak value. The model investigates 12

combinations of exports and price indicators and records the pattern of the results, which is shown in Appendix 5 and Appendix 6.

CAR's exchange rate model finds that the *mean* elasticity of yen/dollar *real* exchange rate (by controlling both countries' price inflations) on Japanese vehicle exports to United States is 1.36 (See Appendix 6 for complete results).

CAR believes findings from the second model serve as evidence and validation of the observed relationship between the yen/dollar exchange rate and Japanese vehicle exports to the United States.

**Figure 7: Yen/Dollar Exchange Rate and Japanese Vehicle Exports
January 1993 -- December 2011**



Source: CAR Research

Figure 7 shows there is an exponential relationship between the yen exchange rate and Japanese vehicle exports and the exponential index is approximately 1.86. This index should not be seen as the direct impact or elasticity on exports because this diagram does not control other variables that could also affect exports. This index, however, can be seen as an upper boundary of actual elasticity of exchange rate on exports. When controlling other variables such as U.S market size and Japanese domestic production, the index decreases to an average of 1.36 as expected.

Two Exchange Rate Regions: From 90 to 100 and from 90 to 80

When the yen/dollar *nominal* exchange rate appreciated to below 80 yen in the second half of 2011 and early 2012, the *real* exchange rate was just touching the 90 yen/dollar level and was well above the historic low of 65 yen/dollar in 1995. However, numerous comments from Japanese auto

executives in the trade and industry press in recent months clearly indicate Japanese manufacturing, and the automotive industry in particular, is feeling the pain of a serious *Endaka* or rapid appreciation of the Japanese currency. (The press articles containing the executive comments are listed in this report's references.) The comments seem to strongly indicate the current Japanese auto industry is competitive at exchange rate levels above 90 yen/dollar, close to break-even at roughly 85 yen/dollar, and clearly non-competitive below 80 yen/dollar. Indeed, many Japanese auto executives maintain they will have to move vehicle capacity out of Japan to such regions as North America if the rate remains below 80 yen/dollar.

CAR provides a forecast or prediction of Japanese exports to the United States for two regions of the exchange rate by shocking the current exchange rate up or down by a certain degree and examining the effect on exports. CAR shows its forecast of the effect of two exchange rate shocks, with and without the impact of 2.5 percent tariff reduction in Table 3 below.

Table 3: The effect of exchange rate shocks on Japanese vehicle exports to U.S.

Exchange rate shocks	Effect on Japanese vehicle exports	
	Include Tariff Reduction	No Tariff Reduction
From 90 to 100 yen/dollar ¹	21.3%	15.1%
From 90 to 80 yen/dollar	-9.0%	-15.1%
<i>Real exchange rate was 90 yen/dollar as of Nov/Dec 2011.</i>		

Table 3 shows the effect of changes in the exchange rate on Japanese exports in a predictable pattern. Above 90 yen/dollar, a depreciation of 10 yen increases vehicle exports by 15.1 percent without the tariff reduction and 21.3 percent with a tariff reduction. A movement of 10 yen below the 90 yen/dollar level reduces exports by 15.1 percent without the tariff reduction but only -9.0 percent with the tariff reduction. In each case the result is altered by a 6.2 percent increase in vehicle exports with the tariff reduction compared to the alternative without it. This job impact (from the tariff elimination) is the same, then, for each exchange rate change case in Table 3 and is the same as shown in Table 2.

CAR estimates the job impact for two of the exchange rate shocks in the case of an FTA in Table 4. The second column of results in Table 4 merely replicates CAR's results from Table 2 (no change in the exchange rate) for comparative purposes. The results without a change in the exchange rate estimate a loss of 65,130 units of U.S vehicle production and a loss of 26,501 total U.S jobs. Column 3 in Table 4 contains CAR's forecast of production and employment loss for the case of a change in the exchange rate from 90 to 100 yen/dollar and the elimination of the 2.5 percent tariff. As shown in Table 4, CAR estimates a loss of 224,916 units of U.S vehicle production and a total loss in U.S employment of 91,515. In contrast, Column 4 in Table 4 contains CAR's forecast of production and employment increase for the case of a change in the exchange rate from 90 to 80 yen/dollar and the elimination of the 2.5 percent tariff. As shown in Table 4, CAR estimates a gain of 94,655 units of U.S vehicle production and a total gain in U.S employment of 38,514.

Table 4: Impact of Japanese Exports on U.S. Vehicle Production and Employment

Export Scenarios	Impact of Japanese Exports Affect All Automakers		
	FTA Only	FTA + Yen Depreciation ¹	FTA + Yen Appreciation ²
Impacts on Japanese Exports (Units)	105,049	362,767	(152,669)
Impact on U.S. Production	(65,130)	(224,916)	94,655
Vehicles Per Employee	24.662	24.662	24.662
# of Direct jobs	(2,641)	(9,120)	3,838
Supplier jobs divided by direct jobs	3.405	3.405	3.405
# of Supplier jobs	(8,992)	(31,053)	13,069
Spin-off Jobs/(supplier+direct) Jobs	1.278	1.278	1.278
# of Spin-off Jobs	(14,867)	(51,341)	21,607
Total Job (Loss)/Gain	(26,501)	(91,515)	38,514

1. Assumes real yen/dollar exchange rate moves from 90 to 100.

2. Assumes real yen/dollar exchange rate shifts from 90 to 80.

The FTA + yen depreciation scenario (90 to 100 yen/dollar) shown in Table 4 is particularly harsh for the U.S. automotive industry. The loss of almost 225,000 units of production could almost certainly result in the shutdown of a major U.S. vehicle assembly plant and possibly a powertrain plant with obvious consequences for U.S. suppliers to these plants. It should also be pointed out that the depreciation with an FTA scenario can result in a general decline in prices for light vehicles in the U.S. market. If a full pass-through rate of 100 percent for the change in the exchange rate and the elimination of the tariff are assumed, the full price decline for Japanese vehicle exports could total -12.5 cents per dollar (-10.0 cents from the exchange rate change and -2.5 cents from the elimination of the tariff). This would, of course, result in a significant gain in consumer surplus in the short run but also a serious hardship for other manufacturers in the U.S. automotive market.

Conclusions

CAR has investigated the likely effect of a FTA between Japan and the United States on Japanese vehicle exports to the U.S and the resulting effect on U.S. employment. Japanese vehicle exports are

estimated to increase by 105,000 units or \$2.2 billion (or an increase of 6.2 percent) due to the elimination of a 2.5 percent tariff. U.S vehicle production is estimated to fall by 65,100 units. Total U.S employment losses, at least in the short term, would be 26,500 as a result of lower U.S vehicle production.

CAR also examined the effect of changing exchange rates on Japanese vehicle exports. CAR's exchange rate model for Japanese vehicle exports estimates that an increase in the real exchange rate from 90 yen/dollar to 100 yen/dollar will result in an increase of vehicle exports to the U.S market of 15.1 percent while, a decrease from 90 yen/dollar to 80 yen/dollar will result in a decrease in exports of -15.1 percent, and in each case, the elimination of the 2.5 percent U.S vehicle import tariff would increase exports by a further 6.2 percent.

In summary, CAR believes that Japan's inclusion in a FTA will result in the increase in Japanese vehicle exports, all other factors being equal, of about 105,000. CAR's FTA forecast scenario further estimates the loss of 65,000 units of U.S production and 26,500 U.S jobs. However, CAR's forecast of production and employment loss in the case of a change in the exchange rate from 90 to 100 yen/dollar and the elimination of the 2.5 percent tariff as a result of an FTA results in a loss of about 225,000 units of U.S vehicle production and a total loss in U.S employment of about 91,500, 26,500 from the FTA, and 65,000 from an appreciation of the yen.

Appendix 1: Empirical Model of Japanese Vehicle Exports to the U.S.

Dependent Variable: LN_JPNEXPORTVN
 Method: Least Squares
 Sample (adjusted): 1995M02 2011M10
 Included observations: 201 after adjustments
 Convergence achieved after 17 iterations
 MA Backcast: 1995M01

	Coefficient	Std. Error	t-Statistic	Prob.
LN_JPNVEHRELP	-2.463827	0.666045	-3.699192	0.0003
LN_REALEXR	0.484176	0.204611	2.366326	0.0190
LN_USMKT	0.170056	0.064935	2.618847	0.0095
LN_NAPRODUS	-0.065221	0.052094	-1.251986	0.2121
LN_NAPRODJPN	0.163835	0.086616	1.891516	0.0601
LN_JPNLVPROD(-1)	0.586633	0.064295	9.124078	0.0000
BLACKSWAN	-0.342979	0.058709	-5.841990	0.0000
INFUS(-1)	-6.043691	2.274230	-2.657467	0.0085
C	-1.490742	1.707555	-0.873027	0.3838
AR(1)	0.973171	0.014032	69.35226	0.0000
MA(1)	-0.731746	0.055413	-13.20524	0.0000
R-squared	0.892321	Mean dependent var		12.50154
Adjusted R-squared	0.886654	S.D. dependent var		0.331005
S.E. of regression	0.111439	Akaike info criterion		-1.497502
Sum squared resid	2.359555	Schwarz criterion		-1.316724
Log likelihood	161.4990	Hannan-Quinn criter.		-1.424352
F-statistic	157.4503	Durbin-Watson stat		2.061838
Prob(F-statistic)	0.000000			
Inverted AR Roots	.97			
Inverted MA Roots	.73			

Description of Analytic Variables

The following section describes the variables used in the above empirical model. While only the exchange rate and price variables are of primary concern in this study, the remaining variables are economically important and control for possible confounding factors. All variables (except for BLACKSWAN, INFUS, AR(1) and MA(1)) are in natural logarithms, thus, the coefficients are sensitivities. Each variable is a non-seasonally adjusted series spanning the observation period of 1995M01 to 2011M12. Lagged variables are denoted by (-1). The software package Eviews was used to estimate the unknown parameter coefficients β , ρ (MA coefficient), and θ (AR coefficient). Since the model is not linear in parameters, Eviews uses least squares iterative approach to produce estimates of the parameter coefficients

LN_JPNEXPORTVN is U.S imports of Japanese Passenger Vehicles and Light-trucks in nominal Japanese yen. To compute this variable CAR multiplied the reported dollar value of Japanese Passenger Vehicles and Light-truck imports by the yen-dollar exchange rate. The dollar value of imported Japanese Passenger Vehicles and Light-trucks is obtained from the U.S International Trade Commission (USITC).

LN_JPNVEHRELP is the Japanese imported vehicle price index relative to other imported vehicles. The basic equation used to compute this ratio is the following:

$$PRICE_{Imports} = PRICE_{JapanImports} * w_1 + PRICE_{OtherImports} * w_2 \quad (1)$$

where $PRICE_{Imports}$ is the Import Price Index of Passenger Cars, new and used (all countries), produced by U.S Bureau of Labor Statistics (BLS) and released under U.S Import and Export Price Indexes. $PRICE_{JapanImports}$ would be ideally the U.S import price of Japanese vehicles but due to the sensitivity of the methodology BLS uses to construct import price indices; CAR could not obtain the necessary information. Therefore a reliable proxy was developed. At least 20 percent of the value of the U.S import price index for Japanese goods was due to Japan's vehicle imports during the investigation period of 1995-2011. In the last 10 years the minimum share for Japanese vehicles was 25 percent, and the maximum share of 30 percent occurred in 2006, 2007 and 2008. CAR assumes this closely mirrors the true value of U.S import price of Japanese vehicles. The weights w_1 and w_2 are the monthly trade weights derived from the number of vehicles imported from Japan and from the rest of the world. All the weight information is obtained through the USITC - U.S General Custom's database. Thus equation 1 becomes equation 2 as shown below.

$$PRICE_{Imports} = CPI_{Japan} * w_1 + PRICE_{OtherImports} * w_2 \quad (2)$$

$$CPI_{Japan} = \text{Japanese Consumer Price Index, Bank of Japan}$$

Since the only variable not known is $PRICE_{OtherImports}$, which is defined to be the U.S import price of all other vehicles, it can be easily computed by rearranging equation 2 into equation 3.

$$PRICE_{OtherImports} = \frac{PRICE_{Imports} - CPI_{Japan} * w_1}{w_2} \quad (3)$$

The final step in the derivation of LN_JPNVEHRELP divides CPI_{Japan} by $PRICE_{OtherImports}$. CAR uses the resulting variable to derive estimates of the impact of Japan entering a FTA with the United States

LN_REALEXR is the real Yen-Dollar exchange rate derived by deflating the nominal Yen-Dollar exchange rate by the ratio of U.S CPI: All items to Japan CPI: All Items. The source for U.S CPI: All items are described below, while the source for Japan CPI: All Items is the Organization for Economic Co-Operation and Development (OECD) under the Main Economic Indicators release. The nominal Yen-Dollar exchange rate was taken from the Board of Governors of the Federal Reserve System Table H.10.

LN_USMKT is total light-duty vehicle sales in the United States. This was taken from the Bureau of Economic Analysis' monthly release entitled, "Motor Vehicle Unit Retail Sales – Table 6: Light Vehicle and Total Vehicle Sales."

LN_NAPRODUS is total light-duty vehicle production by the Detroit 3 OEMs in North America. This data was made available to CAR by LMC Automotive and is part of their North America Production series.

LN_NAPRODJPN is total light-duty vehicle production by Japanese OEMs in North America and is also taken from the North America Production series that is compiled by LMC Automotive.

LN_JPNLVPROD is total light-duty vehicle production by Japanese OEMs in Japan. This was obtained from the Japanese Automotive Manufacturing Association (JAMA).

BLACKSWAN is a dummy variable to account for the "Great Recession" and the 2011, earthquake in Japan. The dates this variable takes on a value of one are: 2009M01 - 2009M05 and 2011M04 - 2011M06, otherwise it has a value of zero.

INFUS is the growth in U.S aggregate price level and is derived by taking the first difference of the natural logarithm of the U.S Consumer Price Index for All Urban Consumers: All items series. The CPI release was obtained from the U.S Department of Labor Bureau of Labor Statistics.

AR(1) is the autoregressive term or previous fitted value.

MA(1) is an error correction term.

Appendix 2: Calculation of U.S. Sourcing Ratios

U.S. Light Vehicle Sales Sourcing by Japanese Company

Automaker	2011 Total U.S. LV Sales	CANADA Sourced	JAPAN Sourced	MEXICO Sourced	U.S. Sourced
Suzuki	26,619	48	24,444	-	2,127
Mitsubishi	79,020	-	46,185	-	32,835
Mazda	250,426	-	212,019	-	38,407
Subaru	266,989	-	117,392	-	149,597
Nissan	1,042,534	-	357,470	214,721	470,343
Honda	1,147,285	188,205	171,330	38,631	749,119
Toyota	1,644,660	348,052	615,271	43,175	638,162
Total JAPAN OEM LV	4,457,533	536,305	1,544,111	296,527	2,080,590

Sources: Ward's Automotive, LMC, Inc., CAR Research

Japan Sourcing % = U.S. sourced / (2011 Total U.S. LV Sales – Japan Sourced) = 71 percent

Appendix 2: Calculation of U.S. Sourcing Ratios (Continued)

2011 U.S. Light Vehicle Sales by Segment with True U.S. Domestic vs. Import Split

Segment	Market Share	Total Sales	DOM-US	%DOM-US	IM-Non-US	%IM-Non-US
Total Car	48%	6,089,421	2,687,285	44%	3,402,136	56%
Total CUV	25%	3,130,585	1,503,341	48%	1,627,244	52%
Total SUV	8%	998,317	865,786	87%	132,531	13%
Total Van	6%	734,109	431,717	59%	302,392	41%
Total Pickup (Non-Commercial. Chessis.)	14%	1,779,105	1,415,727	80%	363,378	20%
Total U.S. LV Sales	100%	12,731,537	6,903,856	54%	5,827,681	46%

Sources: Ward's Automotive, LMC, Inc., CAR Research

All OEM Sourcing % = DOM-US / (Total Sales – Japan Sourced) X 100 = 62 percent

Appendix 3: U.S. Employment Contributions of Automaker U.S. Manufacturing

Employment Impact	All Automakers
Employment	
Direct	313,449
Intermediate	1,067,321
Total (Direct plus Intermediate)	1,380,770
Spin-Off	1,764,643
Total (Direct plus Intermediate plus Spin-off)	3,145,413

CORRESPONDING VEHICLE UNIT PRODUCTION	7,730,257 2010
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Source: *Ward's Automotive Yearbook, 2011*

Kim Hill, Adam Cooper and Debbie Maranger Menk. Contribution of the Automotive Industry to the Economies of All Fifty States and the United States. Center for Automotive Research. Prepared for The Alliance of Automobile Manufacturers, The Association of International Automobile Manufacturers, The Motor & Equipment Manufacturers Association, The National Automobile Dealers Association and The American International Automobile Dealers Association. April 2010.

Appendix 4: Limitations of the First Empirical Model of Japanese Vehicle Exports to the United States

CAR's estimation model for Japanese vehicle exports raised several statistical concerns that are worthwhile to address.

1. The autoregressive terms AR (1) and MA(1) helped to correct the systematic autoregressive issue, but it also weakened the explanatory power of key variables such as vehicle price.
2. The vehicle price and exchange rate are correlated to each other. Using both variables in a model results in a multicollinearity issue.
3. Due to the data availability of some explanatory variables, the model is constrained to the period 1995 to 2011.

To address these concerns, CAR constructed a second empirical model to investigate the impact of exchange rate on Japanese vehicle exports to the United States. The differences between these two models are:

1. Removal of the autoregressive terms. The overall model explanatory power drops, but the power of individual variable increases.
2. Choosing a series of exchange rate and price combinations are chosen. The results help to investigate the cross influence of exchange rate and price.
3. Omission of the data series that do not have pre-1995 observations so the model can run on the data from 1993 to 2011 and capture the exchange rate fluctuation prior to 1995.

Appendix 5: Statistical Structures of Exchange Rate Models

There are a total of twelve empirical models constructed and estimated to investigate the influence of several different price variables on the magnitude of the exchange rate coefficient:

Model 1 through Model 6 contains Japanese exports in real yen as dependent variable:

- (1) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1}$
- (2) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE1_t$
- (3) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE1_{t-1}$
- (4) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE2_t$
- (5) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE2_{t-1}$
- (6) $LN_JPNEXPOR TVN1_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_{USMKT}_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 JPNTOT_t$

Model 7 through Model 12 contain Japanese vehicle exports in nominal yen as dependent variable:

- (7) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1}$
- (8) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE1_t$
- (9) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE1_{t-1}$
- (10) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE2_t$
- (11) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_USMKT_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 VPRICE2_{t-1}$
- (12) $LN_JPNEXPOR TVN_t = \alpha + \beta_1 REALEXR_t + \beta_2 LN_{USMKT}_t + \beta_3 BLACKSWAN_t + \beta_4 INFUS_{t-1} + \beta_5 JPNVPROD_{t-1} + \beta_6 JPNTOT_t$

LN_JPNEXPOR TVN1 and **LN_JPNEXPOR TVN** represent U.S imports of Japanese Passenger Vehicles and Light-trucks in real and in nominal Japanese Yen, respectively. To compute the nominal figure CAR multiplied the reported Dollar value of Japanese Passenger Vehicles and Light-truck imports by the Yen-Dollar exchange rate. The real yen figure is computed by taking the nominal figure and deflating by the CPI Japan. The dollar value of imported

Japanese Passenger Vehicles and Light-trucks is obtained from the U.S International Trade Commission (USITC).

REALEXR is the real Yen-Dollar exchange rate derived by deflating the nominal Yen-Dollar exchange rate by the ratio of U.S CPI: All items to Japan CPI: All Items. The source for U.S CPI: All items are described below, while the source for Japan CPI: All Items is the Organization for Economic Co-Operation and Development (OECD) under the Main Economic Indicators release.

LN_USMKT is total light-duty vehicle sales in the United States. This was taken from the Bureau of Economic Analysis' monthly release entitled, "Motor Vehicle Unit Retail Sales – Table 6: Light Vehicle and Total Vehicle Sales."

BLACKSWAN is a dummy variable to account for the "Great Recession" and the 2011, earthquake in Japan. The dates this variable takes on a value of one are: 2009M01 - 2009M05 and 2011M04 – 2011M06, otherwise it has a value of zero.

INFUS is the growth in U.S aggregate price level and is derived by taking the first difference of the natural logarithm of the U.S Consumer Price Index for All Urban Consumers: All items series. The CPI release was obtained from The U.S Department of Labor: Bureau of Labor Statistics.

LN_JPNVPROD is total vehicle production by Japanese OEMs in Japan. This was obtained from the Japanese Automotive Manufacturing Association (JAMA).

VPRICE1 is the imported vehicle price index other than Japanese vehicles. **VPRICE2** is the Japanese imported vehicle relative price index to other imported vehicles. The variables are derived from the import price index of passenger cars (new and used) from all countries, and the import price index of all Japanese commodities. Both variables are obtained from BLS Import and Export Price Indexes. Please refer to Appendix 1 for detail.

JPNTOT is the import price index of all Japanese commodities from BLS Import and Export Price Indexes.

Appendix 6: Summary and Results of Exchange Rate Models

The numbers in the following tables represent the estimated elasticities of exchange rate and price on Japanese exports. Numbers in parentheses are t-statistics.

Table a: Elasticities on Japanese Vehicle Exports in real yen

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Japanese Export -Real					
Real Exchange Rate	1.76*** (24.48)	1.53*** (14.70)	1.57*** (14.96)	1.18*** (9.19)	1.21*** (9.73)	0.90*** (7.56)
Competitor Price (VPRICE1)	-	0.55*** (2.92)	-	-	-	-
Lagged VPRICE1	-	-	0.46** (2.44)	-	-	-
Relative Price (VPRICE2)	-	-	-	-0.78*** (-5.35)	-	-
Lagged VPRICE2	-	-	-	-	-0.74*** (-5.28)	-
Import Price Index (JPNTOT)	-	-	-	-	-	-2.87*** (-8.42)

***Estimates are significant at 1 percent level

**Estimates are significant at 5percent level

Table b: Elasticities on Japanese Vehicle Exports in nominal yen

	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	Japanese Export - Nominal					
Real Exchange Rate	1.47*** (21.98)	1.29*** (13.20)	1.32*** (13.52)	1.05*** (8.60)	1.08*** (9.11)	0.93*** (8.49)
Competitor Price (VPRICE1)	-	0.45** (2.52)	-	-	-	-
Lagged VPRICE1	-	-	0.35** (1.98)	-	-	-
Relative Price (VPRICE 2)	-	-	-	-0.56*** (-4.02)	-	-
Lagged VPRICE2	-	-	-	-	-0.52*** (-3.11)	-
Import Price Index (JPNTOT)	-	-	-	-	-	-1.88*** (-5.97)

***Estimates are significant at 1 percent level

**Estimates are significant at 5 percent level

When omitting the price variable, as in Model 1 and Model 7, the exchange rate elasticity is strongest. When the influence of price increases, the exchange rate elasticity becomes less elastic. The results are consistent with exports in real and in nominal terms.

The results indicate the exchange rate elasticity ranges from 0.90 to 1.75 on exports in real terms, and from 0.93 to 1.46 in nominal terms. The exchange rate elasticity appears elastic in 10 cases. Two cases (model 6 and 12) indicate the elasticity is somewhat inelastic. The *mean* elasticity on *nominal* Japanese vehicle exports is 1.19 and the *mean* elasticity on *real* Japanese vehicle exports is 1.36. The complete statistical results are available upon request.

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