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Perceived Quality of Asian Brands in the Automobile Industry

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The Big Three, Ford, Chrysler, and GM, have seen consistently dwindling market share from year to year. They are in fierce competition with foreign brand names, specifically Asian companies, such as Honda, Nissan, and Toyota. Asian brands have become best sellers in the passenger car market and American brands are redesigning their cars to try and keep up.

My research uses Lancaster's Theory of Consumption, that people consume characteristics of goods, and the hedonic pricing model to figure out which characteristics consumers are willing to pay for. The variables in the model are size, performance, gas mileage, safety, reliability, and brand. The brand variable is included to capture consumer perceived quality about a specific brand, and these variables will show whether Asian brands are perceived as better quality.

I. INTRODUCTION

Recently, American cars have been receiving criticism for poor quality while foreign car companies have been taking over the US market. The industry is very competitive and the American brands have been consistently losing market share to their foreign competitors. From 1983 to 2001 Chrysler went from 10.4% of the market to 6.6%, Ford had 17.2% and after peaking at 23% fell back down to 17.8%, and GM had a 44.3% market share which decreased to 27% (*Ward's Automotive Yearbook* 1993, 2001). The decrease in market share has forced car companies to redesign their cars and provide cars consumers want instead of designing cars they feel consumers *should* want.

The first step to designing a car consumers want is finding out what consumers value. Since individuals have different preferences, companies have made many different sizes, models, colors, and options available: sports cars, minivans, hybrids, sedans, luxury cars, pick-up trucks, wagons and economy cars. The possibilities are endless. After consumers choose the type of car, they select a certain brand, either foreign or domestic. From there consumers select which options they want or the specific model of the car. The purpose of this paper is to determine which characteristics consumers value most, whether it is a certain brand name, gas mileage, or another operating or design characteristic.

I use a hedonic pricing model to analyze which characteristics consumers are willing to pay more for, and to determine whether consumers are willing to pay more for one specific brand name when all other factors are held constant. Section II of this paper reviews previous research on demand for automobiles. Section III develops the theory, Section IV explains the empirical model, including the data set, Section V discusses the results, and Section VI concludes with suggestions for future research.

II. LITERATURE REVIEW

Some past studies on automobiles use price as the dependant variable, while others use market share. These studies explain automobile demand using demographic variables, income of consumers, as well as real and perceived quality variables. Past research also links perceived quality to brand equity (reputation of a brand) to explain why consumers may pay more for a certain brand.

Past studies find price and physical characteristics significant determinants of demand. (Wojcik 2000, McCarthy 2001). Charlotte Wojcik finds horsepower per 10 lbs. of vehicle weight, a dummy for whether air conditioning is standard or not, miles per gallon divided by the retail price of unleaded gas, and length times width in units of 10,000 square inches to be significant variables in predicting market share (Wojcik 2000). Patrick McCarthy's (2001) regression on "Income Elasticities and Market Price" finds similar results. With market price as his dependent variable, McCarthy finds vehicle safety, net horsepower, and length to be "important" variables in determining demand. He also concluded that an increase in perceived quality meant an increase in market price.

McCarthy's study not only explains demand with physical characteristics and price, but also shows a preference for foreign brands among different markets. He finds the demand for Asian vehicles is price inelastic and young consumers along with consumers on the west coast have less demand for domestic cars. David Sedgwick (2002) agrees with McCarthy, reporting that imports dominated the West Coast market and the New England region. Another article by Kim Kinter reports that domestic car manufacturers are targeting African-Americans to "woo them back from Japanese models." (Kinter 1995) This article suggests that race shapes brand preference.

Unlike McCarthy and Wojcik, Rodney Carlson (1978) finds income to be most significant in determining demand. Carlson uses time series and cross-sectional data and breaks the data into sub markets to control for preferences in automobile type. He develops a multi-equation model using linear, per capita data in a seemingly unrelated regression equation (SURE). He seeks to find the key variables in demand per capita for different sized automobiles and finds that income is the main factor, rather than price or any physical characteristics.

James Wetzel and George Hoffer (1982) come to a different conclusion from McCarthy, Wojcik, and Carlson. Wetzel and Hoffer conclude that quality explains why sales and market share of foreign brands have been increasing. In their model, the quantity demanded is a function of price, economic activity, prices of complements and substitutes, and styling and technological changes. They divide the cars by size and run different regressions for each size. Price is the only significant variable for all of the sub markets and different variables are significant for different size vehicles. Consumer sentiment and a lagged motor fuel variable are significant for the intermediate market. Market size is a significant variable for the compact and import sub market. Although it is not significant, the negative income elasticity coefficient for American compact cars implies that they are inferior goods (Wetzel and Hoffer 1982). An important conclusion Wetzel and Hoffer makes is, "The long-run increase in import sales can be explained by the strong attraction new entrants in the market have for imports and by a belief, as reflected in the income elasticity of demand, that foreign cars are high quality, superior goods." (Wetzel and Hoffer1982)

General articles on brand equity and perceived quality support the idea that the product or company must have positive perceived quality to secure brand equity and sell a product. The Profit Impact of Market Strategy (PIMS) program, conducted by Robert Buzzell (2004) found a

correlation between quality and market share in his profitability study. Buzzell's study demonstrates that if car manufacturers are concerned with profitability (which most companies are), they should make quality products because that is what consumers buy.

Another article of Robert Buzzell, written with Bradley T. Gale (1989), explains even further that perceived quality can be just as important as actual quality in buying decisions. Perceived quality does not necessarily describe whether the product is actually better or worse than a comparable product, but whether the *customer thinks* the product is better or worse. "Superior perceived quality can be achieved by developing a set of product specifications and service standards that more closely meet customer need." (Buzzell and Gale 1989) They also state that superior perceived quality allows the business to charge a higher price, and the premium can be taken as profit or put back into research and development. Buzzell and Gale apply the perceived quality theory to Japanese automobiles. They explain, "By leapfrogging Detroit on several key attributes, Japanese companies rolled further up the quality-for-price curve." (Buzzell and Gale 1989)

Buzzell connects profitability with quality, whether it be perceived or actual, and David Aaker links perceived quality to higher prices, which does increase profits. In many different articles on brand equity Aaker argues that perceived quality is a necessary component to an effective brand strategy. In one article, he asks 250 business managers to name the biggest asset that gives a firm a competitive advantage, and the number one answer is perceived quality (Aaker 1992). He also lists perceived quality as a necessary measure to achieve good brand equity (Aaker 1996). Brand equity allows a brand to charge a higher price even though their product is comparable to other products.

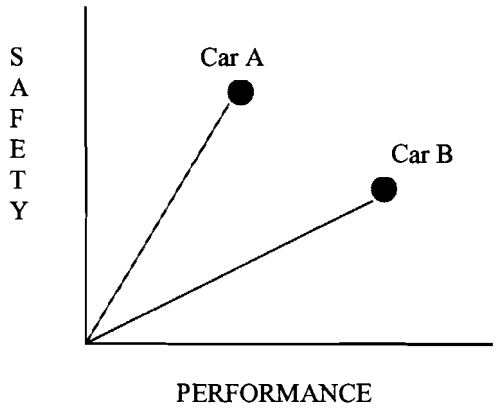
American cars have been recognized for their poor quality. *Business Week* (2001) states that American cars are lower quality than foreign cars. "Try as it might, the US auto industry can't shake its karma for shaky quality – even though its cars and trucks are better than ever." (*Business Week* 2001) The article claims the materials and the design of the car are poor quality. US manufacturers also end up spending more in warranty costs than foreign manufacturers. Articles, like this one, that appear in popular publications will affect consumers' perceived quality. GM recognizes the low-quality standard as low *perceived* quality. The company is responding to criticism by introducing its new fleet with a focus on improving the perceived quality (Witzenburg 2004).

In the same way American cars are perceived as low quality, Japanese goods are perceived to be high quality. Polly LaBarre rates the quality of goods made in different countries through surveys she conducted. Japanese goods rate second highest in the US survey and around the world (LaBarre 1994). In the US Japanese goods are second to US goods, but the survey is over 10 years old. In the world survey Japanese goods are second to German goods. Japan has a combined excellent/very good perceived quality rating around the world. After ten years, Japanese goods may have an even higher rating.

III. THEORY

This paper focuses on explaining the effect of quality related variables on price. It adds to the literature by using Lancaster's Theory of Consumption, which operates under two assumptions: 1) buyers demand/consume individual characteristics of goods and 2) utility is a function of bundles of characteristics of goods (Burk 1968). In my model, the bundle of characteristics is the set of quality variables consumers choose: i.e. performance and safety. The

alternative choices are the individual set of characteristics of other cars. The graph below is an example of how Lancaster's Theory of Consumption relates to automobiles.



There are two points on the graph. One point is Car A's mix of characteristics between performance and safety; the other point is Car B's mix between the two characteristics. The buyer of Car A values safety over performance, and vice versa for the buyer of Car B. This theory will test which, if any, of these characteristics are most important to the general consumer.

A basic assumption for this paper is that consumers obtain more utility the higher quality car they buy given a budget constraint. Quality is represented by specific characteristics such as: safety, gas mileage, performance, size, reliability, and brand.

According to this theory, brand name is a characteristic of a car. Since consumers base part of their purchase decision on perceived quality, the hedonic pricing model will show if consumers will pay more to own a specific brand name.

IV. EMPIRICAL MODEL

The dependent variable of the hedonic pricing model is the natural log of price. This dependent variable allows us to compute the percentage increase in price per one unit increase in

the variable using the coefficients of the independent variables (Leekley 2005). The coefficient is Ln(1+*r*), where *r* is the percentage increase in price per one unit increase in the variable. To find *r*, I take the antilog of the coefficient, subtract 1, and multiply by 100 (Leekley 2005). The independent variables are safety, reliability, performance, size, gas mileage, market share, and brand name.

The price used is the sticker price. The sticker price is used even though consumers may not actually pay that price, because it would be extremely difficult, if not impossible, to determine the exact selling price of a car. High quality cars may sell closer to sticker price, while lesser quality cars may sell at significant discounts. Sticker price is the most standardized data available for price. For comparison purposes, the price of the most basic model is used, without extra options. This ensures the comparison of the standard quality of the car the factory produces and not the extra options.

The safety variable comes from www.autos.msn.com, which uses the National Highway Traffic Safety Administration ratings. The NHTSA tests most new cars in a full front crash at 35 mph. The cars receive separate ratings for the passenger side and the driver side on a scale of 1 to 5 stars. To simplify the data, the lowest score out of the passenger- and driver-side tests is recorded. It turns into a case of "a chain is only as strong as the weakest link."

Also from www.Autos.msn.com is the reliability rating. This rating is included in the regression because it serves as a substitute to repair cost. If reliability is good, then the quality is good and repair costs should be minimal. The website's reliability rating is basically a standardized check plus or minus rating for each aspect of the car: transmission driveline, brakes, engine, steering and suspension, heating and air conditioning, starting and charging, and accessories. It gives an overall reliability score out of a possible five for each model year.

Reliability is lagged due to the assumption that one determines whether a car is reliable by whether last year's model or previous years were reliable. No tests on reliability can be done the first month a car is on the market because the reliability tests are done over time.

Performance is an important characteristic of an automobile that is often measured by horsepower. Powerful cars are attractive to many buyers; therefore the model needs some type of performance variable. I use horsepower/weight for a performance variable just as Charlotte Wojcik used in her research. Horsepower divided by vehicle weight yields a variable that controls for cars that have bigger engines to accommodate the more weight they pull. Since the weight is measured in pounds, it creates a very small decimal when divided into horsepower; therefore, this variable is multiplied by 1000 so the coefficient can be interpreted in a more logical manner and a one unit increase is more reasonable. The final performance variable is horsepower for every 1000 pounds.

Another variable taken from Wojcik's research is length times width, which measures size. Instead of using separate variables for length, height, and width, since there may be multicollinearity issues, length times width accounts for base area of the automobile. Since these measurements are taken in inches, length times width yields a very large number. In order to interpret this coefficient, the variable is divided by 144 square-inches (one square foot); the final variable is measured in square-feet to make a one unit increase more reasonable, just like the performance variable.

Gas mileage may or may not be an important variable. Recently gas prices have hit record highs of $2.16 a gallon (Knight-Ridder 2004). There have been no records of decreasing gas-guzzling SUV sales even with the high gas prices. However, the variable is included in this

research just in case it might be a factor in some consumers' decisions. Instead of including the price of gas, since it is the same for each person, gas mileage will be included for each car.

Market share lagged one year will also be included in the regression. This variable is important because it can explain the popularity of each specific car. As the market share increases, the car is seen more frequently on the road, and that in itself can be a promotion for the car. Also, as the market share increase every year, if one of the other variables gets a worse rating, it will take a bit longer to reduce the market share of the car since it is already so popular.

Brand is the dummy variable in the regression that tests whether consumers are willing to pay more because they perceive a specific brand to be better quality than another. There will be a dummy variable for the brands in Table 2 except for Chevrolet. All of the brand coefficients will be compared to that of Chevrolet. If the articles about high Japanese perceived quality are correct, the brand dummies for the Japanese brands should be positive and significant. It must be noted that the brand dummy is an imperfect measure of perceived quality. It can take into account different style characteristics for a single car since I only use one or two cars from each brand; however, it is the best measure available. The table below summarizes the variable definitions and expected signs.

TABLE 1: Definitions and Expected Sign

Variable	**Definition**	**Expected Sign**
Ln Price	**Price taken in dollars**	**Dependent**
Performance	(Horsepower/weight) x 1000	+
Size	Length x Width square feet	+
Gas Mileage	Gas mileage per gallon	+
Market Share Lagged	% of the segment's market share the model had the previous year	+
Reliability Lagged	Scale of 1-5 on previous year's model	+
Safety	Scale of 1-5 stars	+
Brand	Dummy variable for brand	+

The equation is:

$$\text{Ln Price} = \beta_1 + \beta_2 \text{performance} + \beta_3 \text{ safety} + \beta_4 \text{ reliability lagged} + \beta_5 \text{ gas mileage} + \beta_7 \text{ market Share lagged} + \beta_8 \text{ size} + \beta_9 \text{ brand}$$

The sample size is only 65 observations after all of the variables are computed. All of the coefficients should be positive. All of these variables should be something consumers will pay more for, but how much more is the question. The higher the coefficients for the independent variable, the more consumers value that characteristic.

Table 2 provides the mean values for each variable for each car to give an idea of comparable cars.

TABLE 2: Mean Values for Each Model

Data Source	Ward's Automotive	Ward's Automotive	Ward's Automotive	msn.com	Ward's Automotive	msn.com	msn.com
Car	Price	Performance	Size	Gas Mileage	Market Share	Reliability	Safety
Chevrolet Impala	18400	51.1	28.08	19.80	4.49	3.60	4.23
Chrysler Sebring	20151	50.3	23.37	20.67	1.00	4.75	4.17
Ford Taurus	18406	44.4	27.82	19.22	8.09	4.70	4.40
Chevrolet Cavalier	12064	44.4	24.97	24.11	9.52	3.90	3.40
Ford Escort	12127	40.0	26.75	27.87	8.44	4.12	3.57
Grand Am	13357	51.0	26.21	22.38	4.34	4.40	3.70
Honda Accord	16922	46.8	27.35	24.30	8.81	4.44	4.00
Nissan Altima	15931	53.7	26.64	22.75	3.29	5.00	3.69
Toyotal Camry	17651	44.8	27.01	22.45	8.70	4.40	4.00
Kia Sephia	11593	50.4	25.63	24.33	2.04	5.00	3.67
Hyundai Sonata	15005	48.3	26.75	21.13	.59	5.00	3.33
Eclipse	16208	49.6	24.09	22.75	1.60	5.00	4.14

Although these data are the most specific available, there could be potential problems with the data set in this model. Each car has different versions with slightly different names from year to year. The data for price and gas mileage are specific to each version; however market share, safety, and reliability were ratings for that general model. For example, I collected

data for all Honda Accords, but gas mileage and price were for the Honda Accord EX Coupe. Although this is not a major problem, because most of the specific models had similar gas mileage, it is worth noting.

Cars change from year to year as well. They are remodeled, renamed, or modified slightly. Very rarely does a car stay exactly the same from year to year. That is the whole point of introducing new cars every year – changing and improving them from the last year and adding different standard options. For example, if the 2000 Impalas did not have sun-roofs and sold for a specific price, but the next year Chevrolet offered sun-roofs standard on all cars and the price increased, it would be hard to tell how much of the increase was due to the sun-roofs, perceived quality, or any other option offered. Wojcik touched on this idea using the variable for whether air-conditioning was standard, and she found it significant. However, one can test many other standard options. This data set does not control for standard options in cars.

V. RESULTS

The results are presented in Table 3.

TABLE 3: Results: Dependent Variable is Ln (Price)

Variable	Coefficient		*r*%	Brand Dummy	Coefficient		*r*%
Constant	7.022			Mitsubishi	.45775		58.05
	(11.949)	**			(5.297)	**	
Performance	.01082		1.09	Chrysler	.44903		56.68
	(3.507)	**			(6.915)	**	
Size	.02512		2.54	Nissan	.28735		33.29
	(5.436)	**			(4.258)	**	
Gas Mileage	-.00376		-.38	Toyota	.24258		27.45
	(-.395)				(5.546)	**	
Market Share Lagged	.01031		1.04	Hyundai	.20156		22.33
	(2.412)	*			(2.696)	**	
Reliability Lagged	-.06257		-.607	Honda	.19083		21.03
	(-2.632)	**			(4.074)	**	
Safety	-.00956		-.95	Pontiac	.15429		16.68
	(-.438)				(3.319)	**	
				Ford	.13970		14.99
					(3.651)	**	
				Kia	.10975		11.60
					(1.233)		
Adjusted R- Squared	**.827**			**Sample Size**	**65**		

Significant to the .05 level*
Significant to the .01 level**
T statistics in parenthesis

Most of the results are as expected; performance, size, and market share are positive and significant. A one-unit increase in performance yields a 1.09% increase in price. Size has a

price increase of 2.54% with a one-unit increase in square feet. Also, as the car gains popularity, a one-unit increase in market share lagged allows for a 1.04% increase in price.

As far as the results for the brand dummies, Mitsubishi and Chrysler have surprisingly high price premiums compared to Chevrolet. However, below these two brands, the rest of the results seem to make sense, and all but Kia are significant. The results are listed in order of highest premium to lowest compared to Chevrolet in the Table 3. Mitsubishi's high premium is a little unexpected, but could be the result of Mitsubishi being the only Japanese company with a 10-year warranty. It could also be due to discounting. I only have the list price available, but if the Mitsubishi Eclipse is consistently sold at a lower price than the list price, the results may be skewed. Chrysler's high premium could be due to the fact that the car used in this data set is the Sebring, which is also a convertible, and that may have gotten wrapped into the dummy variable. The Chrysler premium then represents how much more, holding all else constant, consumers will pay for a convertible, and not just a Chrysler.

The other unexpected results are that consumers will not pay extra for safety, reliability or gas mileage. One reason the safety variable may be insignificant may be the minimum standards the government imposes. As long as a car meets minimum safety standards, consumers may not be willing to pay more for the extra safety features. The safety variable is a score of one to five, and few of the observations had ratings of one or two stars; most had three or four. People may be satisfied with the average safety and the cost of increased safety may not be worth it to consumers.

The reliability rating is significant, but may be negative due to warranties. If a car is not reliable in the first couple years most people will not have to pay for the maintenance costs because they will be covered under the warranty. The cars are split between a 3, 5, or 10-year

warranty. Therefore, people may not want to pay for the reliability because they will not have to pay even if it is not reliable. I tried to include warranty in the regression, but since there is no variation in length of warranty among brands, it is perfectly correlated with the brand dummy variables.

There could be some correlation between gas mileage, size, and safety. A smaller car may be less safe, but have a higher gas mileage. The Pearson Correlation Coefficient for gas mileage and size is -.741 and significant to the .01 level. This coefficient shows a high correlation between the two variables. There was no significant correlation between gas mileage and performance. The explanation to why gas mileage is not significant is unclear. Normally, the smaller cars have better gas mileage (due to less weight and smaller engines), and the smaller cars are relatively less expensive. Therefore, as gas mileage increases, people are actually paying less for the smaller vehicle. Gas mileage may also be insignificant because gas prices were not particularly high from 1993-2001.

VI. CONCLUSION

This paper has sought to determine which characteristics are most important to consumers buying a car and whether or not perceived quality of foreign or American brands mattered. All of the brand dummy variables except for Kia had positive coefficients and were significant to the .01 level compared to Chevrolet. The interpretation of the coefficients concluded that people will pay for specific brands in addition to specific quality characteristics. Japanese brands had a higher premium, excluding Chrysler (since the variable may be biased for the convertible style). Perceived quality does matter; people do base part of their decision to buy a car and how much they will pay for a car on brand name. This should tell car manufacturers to

spend time and money on marketing the brand rather than on marketing a specific model. The physical characteristics were also significant and positive, just as Wojcik and McCarthy found.

Safety and reliability ratings may not matter that much to average consumers. With warranties and government minimum standards, the cost to add safety features or make cars more reliable may not be worth it to consumers. Safety may also be correlated with size and when consumers are buying smaller cars income is a main factor as Carlson found. Therefore, people cannot afford to pay for the extra safety features.

The regression results were conclusive with a high R-squared and many significant variables, but further research could be done to test whether or not there is a bias from the source of the safety and reliability ratings, which I took from www.autos.msn.com. This website may or may not mean as much to consumers as *Consumer Reports.* Although MSN takes the safety rating from the NHTSA, maybe people rely more on the credibility of *Consumer Reports.*

New quality variables could be used in the future research, such as standard options (AC, leather interior, sunroof, etc) or warranty. The length of the warranty could be a deciding factor between cars with similar prices and styles. This information also comes from www.autos.msn.com. Foreign brands, such as Hyundai and Kia have been pushing their 10-year, 100,000-mile warranties, which may have a significant effect on their gain in market share.

Another variable that could be included in future research is country in which the cars are produced. This is a dummy variable. Many car manufacturers are using "Made in America" to sell their cars. "Several automakers, both domestic and foreign, are draping themselves in red, white, and blue with advertising campaigns and corporate messages to trumpet their commitment to building vehicles in America and hiring U.S. workers." (*Detroit News* 2004) This variable may be significant for the Japanese brands that have high perceived quality and are producing

their cars in the United States. I did not include this dummy variable because it too was correlated with the brand dummy variables.

Future research could also be done with more models of each brand, a more perfect measure of perceived quality, and actual price instead of list price. The data set includes mainly one car from each brand except Ford and Chevrolet, which have two. This could be a problem because the brand dummy could capture style characteristics for the specific model and not just the brand. This problem is most noticeable with the Chrysler Sebring. As I previously suggested, the dummy variable may include a buyer's preference for a convertible, but more Chrysler cars in the data set might produce a more accurate coefficient for perceived quality of the Chrysler brand in general. Actual price and a better measure of perceived quality would make the results more accurate by controlling for discounting.

Overall, the results explain that brand names do matter in purchase decisions and people will pay more to own any brand relative to Chevrolet. The physical characteristics such as size and performance are also significant determinants of price. Mitsubishi has the largest coefficient, but Nissan and Toyota are two Japanese brands that, excluding Chrysler, have the next highest coefficients showing that perceived quality of Japanese brands is high.

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