Implications of Consumer Loyalty in The North American Automobile Market for Export Potential of Korean Auto Makers

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  I. Introduction
 II. Development of the Markov Probility Model
III. Markov Model for Analysing Automobile Market Shares
 IV. Data
  V. The Results and Analysis
 VI. Summary and Conclusions

I. Introduction

Passenger cars manufactured in Korea by the Hyundai Motor Co. (e.g., Pony, Excel and Stellar) have successfully penetrated the Canadian market where they have been sold since 1983. In 1985, Hyundai became the largest seller of imported cars in Canada (80,000 cars). In the U.S. market, Hyundai's Excel entered the market in January 1986 and the company hopes to sell about 100,000 units by the end of 1986. The recent introduction of passenger cars by Hyundai into the North American auto market intensified import competition in an area where the new passenger car market was approximately 12.1 million units in 1985. This is certain to continue in the years to come when other Korean manufacturers (e.g., Dae Woo, Samsung, Kia, etc.) start exporting.

It is felt that the extent to which the distribution of market share changes over time by type of vehicle and size category depends on the composite effects of economic and non-economic factors; the former includes the concept of

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consumer loyalty. Although it is difficult to quantify consumer loyalty, it is considered an important factor in consumer decision making when the product is highly differentiated[1]. This is particularly true for consumer durables such as passenger cars. It is generally known that the higher the degree of consumer loyalty with respect to an established product, the harder it is likely to be to penetrate its tradional market.

The objective of this study is to examine consumer loyalty as applicable to the automobile market, and to quantify it by means of a Markov Model, using both Canadian and American data. In other words, this paper attempts to determine if consumer loyalty plays a role in consumers' purchasing decisions in terms of: (a) the size of car (i.e., sub-compact, compact, interme- diate, full size and luxury)[2]; and, (b) auto maker in terms of country of origin (i.e., North America, Japan and all others). This information may clarify the market penetration potential of such newcomers to the North

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(1) In some situations, consumer demand for a particular commodity cannot be measured empi- rically, as a function of the prices of the particular brand and other brands. This is because prices are the same for all brands, when all brands of a commodity are homogeneous, at the price level determined by the industry's demand and supply schedules. In this case, demand for a particular brand could be influenced more by consumer loyalty to the brand rather than by prices of the brand. When products are differentiated extensively from one another, yet are substitutable, consumer loyalty to a brand is also a major factor affecting demand for or market share of the brand.

(2) The generally accepted description of car sizes in the industry are by five size categories. *Sub-compact* are the smallest vehicles that can be purchased in North America at the present time which include the Chevrolet Chevette, Dodge Colt, Dodge Omni/Charger and Honda Civic. While front seat room is adequate for two adults, these cars usually have rear seats only large enough for children to travel in comfort and they may be available solely in two-door configurations. Most are hatchback designs, offering extra luggage capacity with the rear seat folded down. *Compacts* are slightly larger than sub-compacts, these vehicles are more practical for families with older children. Examples of compact cars include the Ford Mustang, Chevrolet Cavalier and Oldsmobile Calais. *Intermediates* are four-door models with good cargo capacity and room for five or six persons. Current offerings include the Toyota Camry and Dodge 600. *Full size* cars offer comfort for five or six adults and ample room for luggage. Once generally known as mid- or standard-size, this class includes a number of automotive dinosaurs as well as newer, more technologically advanced and fuel efficient vehicles. Examples of cars downsized during the late 1970s but still large compared to most 1980s models are the Ford Crown Victoria and Chevrolet Caprice, Oldmobile Delta 88 Royale and Ford Taurus. *Luxury* vehicles appeal to those willing to pay a premium price for products at the cutting edge of either technology, creature comforts, or both. This group includes all Lincoln, Audi and Mercedes-Benz models (Consumers' Association of Canada and Consumers Union).

American auto industry as Hyundai from Korea.

II. Development of the Markov Probability Model

Consumers' decisions, when purchasing a new car, can be assumed to be generated via a simultaneous, dynamic and stochastic process which results in a random variable. Consequently, it is possible to estimate this process using a Markov Model.

The Markov Model assumes that the probability distribution of an outcome of a given trial depends only on the outcome of the preceding trial. This first order dependence is the same for all stages of a stochastic process and is as follows:

$$\Pr(X_t | X_{t-1},\ X_{t-2}\ldots) = \Pr(X_t | X_{t-1}) \tag{1}$$

where $\Pr(X_t | X_{t-1},\ X_{t-2}\ldots)$ and $\Pr(X_t | X_{t-1})$ are the conditional probabilities for an outcome X_t.

The joint probability for $X_0,\ X_1 \ldots X_T$ can be described on the basis of probability theory as

$$\Pr(X_0,\ X_1,\ \ldots X_T) = \Pr(X) \cdot \Pr(X_1 | X_0) \cdot \Pr(X_2 | X_0,\ X_1)$$
$$\cdot \Pr(X_3 | X_0,\ X_1,\ X_2)\ldots \tag{2}$$

This may be written for the Markov process using Equation (1) as

$$\Pr(X_0,\ X_1,\ \ldots,\ X_T) = \Pr(X_0) \cdot \Pr(X_1 | X_0) \cdot \Pr(X_2 | X_1)\ldots$$

$$= \Pr(X_0) \prod_{t-1}^{T} \Pr(X_t | X_{t-1}) \tag{3}$$

where $\Pr(X_1 | X_{t-1})$ is the transition probability for X_t for the given X_{t-1}.

The stochastic process can be applied to develop a Markov Model with two states X_t and X_{t-1}. If $X_t = S_j$ and $X_{t-1} = S_i$, then the transition probability for S_j given S_i is as follows:

$$\Pr(X_t = S_j | X_{t-1} = S_i) = P_{ji}\ (t) \tag{4}$$

where P_{ji} is the constant transition probability associated with a change from state S_i to S_j. For every pair of states, $S_i,\ S_j\ (i, j = 1, 2, \ldots r)$, P_{ji} must meet

the following conditions:

$$0 \leq p_{ji} \leq 1.0 \qquad i, j = 1, 2, \ldots, r \tag{4-a}$$

$$\sum_i p_{ji} = 1.0 \qquad j = 1, 2, \ldots, r \tag{4-b}$$

The joint probability for $X_t = S_j$ and $X_{t-1} = S_i$ is defined as

$$\Pr(X_{t-1} = S_i, \ X_t = S_j) = \Pr(X_{t-1} = S_i) \cdot \Pr(X_t = S_j | X_{t-1} = S_i) \tag{5}$$

Aggregating both sides of Equation (5) over S_i gives

$$\sum_i \Pr(X_{t-1} = S_i, \ X_t = S_j) = \sum_i \Pr(X_{t-1} = S_i)$$

$$\cdot \Pr(X_t = S_j | S_{t-1} = S_i). \tag{6}$$

Since $\sum_i \Pr(X_{t-1} = S_i, \ X_t = S_j) = \Pr(X_t = S_j)$, Equation (6) can be written as

$$\Pr(X_t = S_j) = \sum_i \Pr(X_{t-1} = S_i) \cdot \Pr(X_t = S_j | X_{t-1} = S_i), \tag{7}$$

or

$$q_j(t) = \sum_i q_i(t-1) \ P_{ji} \tag{8}$$

where $q_j(t)$ and $q_i(t-1)$ represent the unconditional marginal probabilities $\Pr(X_t = S_j)$ and $\Pr(X_{t-1} = S_i)$, respectively. Equation (8) is known as the Markov Model. P_{ji} is the constant transition probability associated with a change from S_i (or q_i) to S_j (or q_j). These transition probabilities are well defined if consumers buy only one brand of a product class at a time.

III. Markov Model for Analysing Automobile Market Shares

For an empirical estimation of P_{ji} from actually observed market share data for five different automobile size categories, equation (8) can be rewritten including an error term as follows:

$$Y_j(t) = \sum_{i=1}^{5} Y_i(t-1) P_{ji} + e_j(t) \quad \text{for } j = 1, 2, 3, 4, 5 \tag{9}$$

where $Y_j(t)$ is market share of size category (j) in time (t), $Y_i(t-1)$ is market share of the size category (i) in time ($t-1$). P_{ji} is the constant transition probability of having size category (j) in time t when size category

(j) was given in time $t-1$, and $e_j(t)$ is the disturbance term.

It is necessary to estimate the transition probability, P_{ji}, from sample proportion data $(Y_i(t-1), \quad Y_j(t))$. Telser (1962) used the conventional least squares estimator to estimate P_{ji}. It, however, does not guarantee that the estimated transition probabilities satisfy the mathematical properties of probability theory (i.e., equations 4-a and 4-b). Telser suggested a subjective adjustment procedure to correct the transition probability estimates falling outside of the zero-to-one interval. Based on Telser's work, Lee, Judge and Takayama (1965) and Theil and Rey (1966) suggested an inequality-restricted estimator based on a quadratic programming algorithm.

The objective function of the model is to minimize the sum of squared errors as follows:

$$\text{SSE} = \sum_{j=1}^{5} \left[Y_j(t) - \sum_{i=1}^{5} Y_i(t-1) \ P_{ji} \right]^2 \tag{10}$$

The objective function (10) is subject to the following constraints:

$$\sum_{i=1}^{5} P_{ji} = 1.0 \quad \text{for all } j \tag{11}$$

$$P_{ji} \geq 0.0 \tag{12}$$

Equation (10) is in quadratic form in terms of transition probabilities, P_{ji}. The estimated P_{ji} obtained from the quadratic programming model are shown in the following matrix:

$$P_{ji} = \begin{pmatrix} P_{11} & P_{12} \dots P_{1r} \\ P_{21} & P_{22} \dots P_{2r} \\ \vdots \\ P_{r1} & P_{r2} \dots P_{rr} \end{pmatrix}$$

where P_{ji} for $j=i$ represents the transition probability of having the same state in time t as a state given in time $t-1$. Values of the diagonal elements, therefore, are known as repeat purchase probabilities indicating consumer attachment to the particular category. Repeat purchases in this case result from consumer satisfaction with the car size category. P_{ji} for $i \neq j$ represents the

transition probability of having state j in time t when state i was given in time $t-1$. P_{ji} for $i \neq j$, therefore, is the probability of switching from state i to state j and is known as a switching probability. For example, P_{12} represents the transition probability of having state 1 in time t when state 2 was given in time $t-1$. A similar interpretation should be given to all off-diagonal elements of the transition probability matrix. However, interpretation on P_{21} is different from that of P_{12}. P_{21} represents the transition probabilities of having state 2 in time t when state 1 was given in time $t-1$. In terms of market share analysis, P_{12} represents the probability for switching from size category 2 to size category 1, while P_{21} represents the probability for switching from size category 1 to size category 2. In general, each row of the transition probability (P_{1i}, P_{2i}...or P_{ri} for $i=1, 2, ...r$) represent the probabilites for switching from all other size categories ($i=1, 2, ..., r$) to a particular size category ($j=1, ..., r$) while each column represents the probabilities for switching from a particular category ($j=1, 2, ...$or r) to all other categories.

IV. Data

Data used for this study are annual new passenger car sales, in Canada and the U.S., grouped by five size categories (i.e., sub-compact, compact, intermediate, full size and luxury) from 1970 to 1985 and annual new passenger sales by auto maker's country of origin in terms of North America, Japan and all others from 1964 to 1985. Canadian car sales data were obtained from Statistics Canada while the U.S. data were obtained from the Ward's Automotive Report. Used car sales data by size category was not readily available for the similar time periods therefore preventing examination of the used car market in this paper.

Market shares of each category of passenger cars for both Canadian and U.S. market were calculated from the data and were used in the quadratic programming model. To execute the quadratic programming model (equations

9, 10, 11 and 12) two files were generated[3]; one contained linear portions of the objective functions and constraints (linear file) formulated for the IBM MPS/360 or MPS/X. The other file contained nonlinear portions of objective functions (nonlinear file) based on the format specified by the subroutine MINOS (Murtagh and Sanders).

V. The Results and Analysis

Table 1 represents estimated transition probabilities for five different size categories of automobiles manufactured in North America. Results for the Canadian market indicate that repeat purchase probabilities are very high, particularly for the intermediate and luxury categories. That is to say, repeat purchase probabilities are 94.3% and 99.1% respectively. However, repeat

Table 1. Estimated Transition Probabilities (P_{ji}) for Different Sizes of Cars in the Canadian and U.S. Automobile Market

	Subcompact	Compact	Intermediate	Full	Luxury	Total
Canada						
Subcompact	0.852	0.148	0.000	0.000	0.000	1.000
Compact	0.030	0.770	0.145	0.055	0.000	1.000
Intermediate	0.008	0.049	0.943	0.000	0.000	1.000
Full	0.000	0.000	0.034	0.859	0.108	1.000
Luxury	0.000	0.000	0.000	0.009	0.991	1.000
Total	0.890	0.967	1.122	0.923	1.099	—
U.S.						
Subcompact	0.739	0.221	0.018	0.011	0.011	1.000
Compact	0.081	0.572	0.257	0.000	0.090	1.000
Intermediate	0.061	0.000	0.925	0.014	0.000	1.000
Full	0.000	0.046	0.000	0.874	0.080	1.000
Luxury	0.026	0.000	0.000	0.003	0.971	1.000
Total	0.907	0.839	1.200	0.902	1.152	—

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(3) For details, see Koo (1986).

probabilities for the sub-compact and compact cars are relatively lower (i.e., 85.2% and 77.0%). This indicates that consumer loyalty, in terms of purchasing decision-making, play an important role for intermediate and luxury cars, while it is somewhat less important with respect to compact and sub-compact size cars.

The probability of switching from sub-compact to either compact or to intermediate size cars are 3.0% and 0.8 respectively as shown by the first column of Table 1. The probability of switching from sub-compact to full size or to luxury cars is almost zero for both size categories. This is due to the fact that a consumer's budget is probably constrained to make it extremely difficult to jump from sub-compact cars with an average price of less than $8,000 Canadian to either full size or luxury cars with an average price well beyond $20,000 (Can.). The probability of switching in reverse order is also almost zero as shown in the luxury car column in Table 1. That is because consumers for the luxury cars are looking for comfort, safety, elegance and prestige factors, factors they may feel are absent in the sub-compact market segment, which has cars that are light weight, small, and economical in operation.

Probabilities for switching from all other size categories to sub-compact cars are shown in the the first row of Table 1. The repeat probability for the sub-compact cars is 85.2% while probabilities for switching from compact, intermediate, full size and luxury to sub-compact are 15.0%, 0.000%, 0.000% and 0.000% respectively[4]. Probabilities for switching from intermediate to compact is 15.0% while to full size cars is only 3.4%. Probabilities for switching from sub-compact, compact, full size and luxury to intermediate size are 0.8%, 5.0%, 0.000% and 0.000%, respectively. This clearly illustrates that the probability of switching from a larger size car to a category one size smaller is higher than the probability of the reverse. For example, probability

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(4) It should be noted that a probability of 0.000% refers to close to zero probability rather than literally zero in probability.

to move from compact to sub-compact is about 15.0% while to intermediate size is only about 5.0%. Similarly, probability to move from intermediate to compact is about 15.0% while to full size is only about 3.4%. These results, shown in Table 1, of course, reflect the automotive market of the past 20 years in all of North America where both consumer purchasing behaviour and industry reponse has shown a trend toward smaller vehicles with greater fuel efficiency.

Generally speaking, the results for the U.S. market are quite similar to that of the Canadian market. Repeat purchase probabilities for intermediate and luxury cars are higher than 90.0% for both categories. However, the repeat purchase probabilities at 73.9% and 57.2% are smaller for sub-compact and compact size markets in the U.S.. These indicate that consumer loyalty to car size in the lower end of the market is not as important as that in the intermediate, full size and luxury car markets. The U.S. automotive market also reveals that consumer purchasing behaviour over time trends toward down-sized cars. This is shown by the probabilities to switch from the compact and intermediate car category to a category one size smaller are 22.0% and 26.0% respectively, while the probabilities of the opposite are almost zero.

A comparison of the vertical and cross sums of the transition prob-abilities shown in Table 1 indicates the trend to a particular size category from other categories[5]. Note that the cross sum of the transition probabilities is equal to 1.0. When the vertical sum of a particular size category is greater than 1.0, the trend of moving from other size categories to this category is stronger than that of moving from this size category to all others. Since the vertical sums are somewhat higher than 1.0 for the intermediate size vehicle class, this indicates that the intermediate size has gained market share while sub-compact has lost market share in Canada. In the U.S. market, the vertical sum of transition

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(5) Note that the sum of the coefficients in the P_{ji} matrix across the rows equals total purchases of the size category during period $t-1$. The column sum of the P_{ji} matrix equals total purchases of the size category with the given column during period t.

probabilities indicates that compact size cars have been losing market share to the intermediate size, the traditional American family car. In other words, intermediate size and, to some extent, full size cars are widely used by the middle class income category in North America.

The vertical sums of transition probabilities are slightly larger than 1.0 for luxury category and are only slightly smaller than 1.0 for compact and full size categories in Canada, indicating that the market share for these size categories remained largely unchanged. However, in the U.S. market, the vertical sum for the compact car is much less than 1.0, indicating a losing market share situation over these years.

It should be emphasized at this point that the North American automotive market is characterized as a segmented market by strong product differen-tiation[6], by consumers' income class and by other socioeconomic characteristics of consumers'[7]. Because of this segmentation, the possibilities of switching for the consumer from one size category to another exist only in a rather narrow range. That is to say, switching from sub-compact to either full-size or luxury cars seldom takes place. Families of modest income would not normally buy a luxury car of beyond $ 25,000 (Can) price tag. The converse is also true.

Table 2 shows estimated transition probabilities in the Canadian auto market by origin in terms of place of manufacture [North America, Japan and all others (which refers predominantly from the Western Europes up to 1983 and Korea since 1983)]. The results indicate that consumer loyalty to North

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(6) A strategy of product differentiation is an effort by the firm to mold its entire market around one specific product with minor variations rather than offering completely different products for the various sub-markets. The key point is that in a developed economy where technological breakthroughs have made possible minimum efficient production runs, and where discretionary buying power is sufficiently high to produce shopping comparisons.

(7) The other socioeconomic characteristics of consumers' which could influence market segmen-tation are such variables as occupation, family life cycle, education of the head of the hou-sehold, social class and personality. In response to these, auto manufacturers segment its market into several distinct sub-markets and then designates products which match the needs of these smaller markets.

Table 2. Estimated Transition Probabilities (P_{ji}) for Passenger Cars by
Origin for Different Time Periods, Canada

		Domestic	Japan	Other Imports	Total
1964~1974	Domestic	0.992	0.000	0.008	1.000
	Japan	0.000	1.000	0.000	1.000
	Other	0.000	0.184	0.816	1.000
	Total	0.992	1.184	0.824	—
1974~1985	Domestic	0.997	0.000	0.023	1.000
	Japan	0.000	0.936	0.064	1.000
	Other	0.039	0.195	0.766	1.000
	Total	1.036	1.031	0.853	—
1964~1985	Domestic	0.985	0.000	0.015	1.000
	Japan	0.000	0.966	0.033	1.000
	Other	0.015	0.080	0.905	1.000
	Total	1.000	1.106	0.950	—

American manufactured cars is very high over this time period. Consumer
loyalty to North American made vehicles may even have increased in the
recent years particularly after front wheel drive small cars with 4 cylinder
engines were introduced. The probability of moving from a North American
manufactured to foreign manufactured car is very small—about 4.0% in the
period 1974~85[8]. The repeat purchase probability for the Japanese cars was
nearly 100.0% between 1964~74. At that time the volume of Japanese cars
sold in Canada was seldom as much as 100,000 units, and this accounted for
less than 10.0% of the total market before the early 1970s. Thus, Japanese

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(8) This result confirms findings from the Consumers' Association of Canada. The 1985 Vehicle
Durability Survey conducted by the Association reveals that a tremendous increase in the res-
pondents' loyalty to the manufacturers of their current vehicles. The greatest increase in loyalty
was acheived by the North American manufacturers, with 73.8 percent of the owners of these
vehicle responding that they would purchase their next vehicles from the manufacturer of the
one currently owned. This is an increase of 66 percent over last year. According to the Asso-
ciation, Japanese manufacturers appear to be largely retaining their consumer loyalty as mea-
sured by consumers' repeat purchase indications. However, the American manufacturers have
gained substantially in this area in the past year and their consumer repeat purchase indications
are now 73.8%.

car buyers were not widespread across the crossection of Canadian consumers.
Buyers may have been affiliated with Japan in some way or another, or the
price was so good that buyers in the lower end of the market could not pass
them up. Between 1974~1985, however, the volume of Janpanese car sales
went up to about 200,000 units with a market share of 23.0% in 1981. With
this volume and market share, consumer loyalty was somewhat reduced—
indicated by about 94.0% repeat probability. The probability to move from
Japanese cars to other foreign manufactured cars was about 20.0% in that
period. This is probably because Japanese cars were more substitutable with
European made cars in terms of its characteristics—sporty body design, small
and economical to operate.

The repeat purchase probability for other foreign cars is lowest compared
to alternative source of cars and, in the past decade, it has been lower than
in the earlier decade probably because Japanese made cars have been greatly
improved in quality and design. For example, the Japanese exterior designs
are now more like European sporty designs, are mainly small sizes and are

**Table 3. Estimated Transition Probabilities (P_{ji}) for Passenger Car by Origin
for Different Time Periods, U.S.**

		Domestic	Japan	Other Imports	Total
1964~1974	Domestic	0.989	0.000	0.011	1.000
	Japan	0.005	0.976	0.019	1.000
	Other	0.000	0.128	0.872	1.000
	Total	0.994	1.104	0.902	—
1974~1985	Domestic	0.984	0.000	0.016	1.000
	Japan	0.000	0.999	0.001	1.000
	Other	0.034	0.092	0.873	1.000
	Total	1.018	1.091	0.890	—
1964~1985	Domestic	0.987	0.000	0.013	1.000
	Japan	0.000	0.999	0.000	1.000
	Other	0.013	0.000	0.987	1.000
	Total	1.000	0.999	1.000	—

very economical in operation. Therefore, European car is more substitutable with Japanese than that of North American design.

Table 3 reveals the estimated transition probabilities by origin of car manufactured with respect to the U.S. market. The results are quite similar to that of the Canadian market. Repeat probabilities are high, in general, for all three sources–North America, Japan and other origins. However, repeat probability for Japanese made cars between 1974~1985 is slightly higher than that of the earlier period. Consumer loyalty for Japanese-made cars has steadily increased over time, whereas consumer loyalty for the North American car is somewhat lower than earlier.

Finally, implications for export potentials of Korean auto makers are as follows:

First of all, market penetration should be aimed primarily at subcompact and compact car size markets where consumer loyalty is less important. These market segments are characterized as a relatively price competitive market which represents about 50.0% of the entire Canadian new car market of 1.1 million units annual sales in 1985. Hyundai Motor Co. has already successfully penetrated Canadian market with the market share of 7% (i.e., about 80,000 units) in 1985. They are likely to reach a market share of 10.0% by the end of 1986. In the U.S. market, however, the combined sub-compact and compact car markets account for somewhat less than 50.0% of the entire U.S. new car market where 11.0 million cars were sold in 1985. If Korean auto makers penetrate 10.0% of the lower end of the U.S. market (i.e., subcompact and compact), in the near future it would amount to about 500,000 units. This figure would be less than a quarter of the Japanese car sales in the U.S. (i.e., 2.2 million units in 1985). Secondly, it should be noted that these markets, sub-compact cars, are vulnerable to fierce price competition, particularly from the future newly industrialized nations. To retain their market share after penetration, Korean manufacturers marketing strategies should be developed in the following area:

(a) optimize advertising technique to differentiate Korean made cars from other competitors,

(b) provide a competent after sale service system with a large network of service centers,

(c) demonstrate technological leadership in engine and body design vis-a-vis competitors.

VI. Summary and Conclusions

Transition probabilities associated with market share broken down by five designated automobile size categories and by manufacturing country of origin respectively have been estimated using a Markov Model. The estimation technique used was the inequality-restricted estimatior based on a quadratic programming algorithm. The estimator was executed using a nonlinear software package MINOS developed by Murtagh and Sanders.

The estimated transition probabilities indicate that in the Canadian market, the repeat purchase probability is particularly high for intermediate and luxury categories of automobilies while repeat purchase probabilities are relatively low for sub-compact and compact cars. Similarly, in the U.S. market, the estimated repeat purchase probabilities are very high for the intermediate and luxury cars while they are lower for the sub-compact and compact cars. This indicates a greater likelihood of easy penetration in the lower end of the market: sub-compact and compact car markets in both Canada and the U.S. where consumers loyalty (as indicated by the repeat purchase probabilities) is less important. A high price elasticity of demand (to such an extent that price is the single most important decision variable) characterizes these segments of the automobile market where majority of the buyers are the first time car purchasers.

It should be noted that total market size of the new passenger car sales in Canada and U.S. are approximately 1.1 million and 11.0 million units, respectively, in 1985. Out of the 1.1 million unit Canadian market, the sub-

compact and compact markets combined accounts for approximately 50.0%. In the U.S. market, however, out of 11.0 million unit sales, subcompact and compact combined sales account for somewhat less than 50.0%. These two combined markets' annual sales represent approximately 6 million units. If newcomers could acheive about a 10.0% market penetration in these areas, it would amount to as much as 600,000 units per annum.

Price is one of the important reasons, *inter alia*, why Hyundai Company's sub-compact model, Pony, was so successful in penetrating the Canadian sub-compact car market where strong consumer loyalty is absent. However, one should recognize that this segment of the market is quite vulnerable in the long-run to market competition, usually from the newly industrialized countries where low wages play a significant role in establishing a comparative advantage in international trade.

Finally, it should be recognized that the transition probabilities estimated in this paper are constant over the entire sample period. There are many cases, however, in which the transition probabilities are not constant over the sample period.[9] Further study should be focused on estimation of variable transition probabilities which could be functions of time or certain explanatory variables.

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(9) Although transition probabilities are obtainable in principle from data in the form of Table 1, such estimates would not necessarily enhance our ability to predict the demand for various size categories. One reason is that the transition probabilities are functions of prices and cannot be expected to remain constant over time if relative prices vary over time.

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