RESEARCH SEMINAR IN INTERNATIONAL ECONOMICS

Department of Economics
The University of Michigan
Ann Arbor, Michigan 48109-1220

SEMINAR DISCUSSION PAPER NO. 232

IDENTIFYING THE COMPETITION

by

James Levinsohn
The University of
Michigan
and
Robert Feenstra
University of California, Davis

May, 1988

Abstract. We propose a utility consistent method of identifying the set of competititors that a product faces. We apply the method to the 1987 U.S. new automobile market.

Address. Professor James Levinsohn, Department of Economics, The University of Michigan, Ann Arbor, MI 48109-1220; Professor Robert Feenstra, Department of Economics, University of California, Davis, CA 95616.

Identifying the Competition

James Levinsohn
University of Michigan
and
Robert Feenstra
University of California, Davis

1. Introduction

A firm competes with other firms as each tries to sell its product(s) to the consumer. Much of economics is concerned with the degree of competition between these firms and how various policies interact with this competition. Surprisingly little attention has been focused on determining just which products compete with each other. Nonetheless, this question of "Who is the competition?" is an important one.

Consider the question in the context of a market with which most readers are familiar–the U.S. automobile market. Here we would ask which automobiles compete with one another. Economic policy implications abound. Does the purchase of American Motors by the Chrysler Corporation give Chrysler market power in a particular segment of the market? Would an oil import fee effect one firm relatively more adversely than other firms? When does the introduction of a new model by an existing firm significantly increase firm sales and when does such a new model merely reallocate current sales? Finally, will an import quota on Korean automobiles benefit domestic firms or are Japanese firms the primary beneficiaries? The answers to all of these questions hinge crucially on identifying the competition. Also, the issues presented in the above set of questions are not unique to the automobile industry. A similar set of issues and questions arise in many other industries.

This paper develops an empirical technique, informed by economic theory, which identifies the competition. [1] Section 2 develops the theory behind our new methodology. Section 3 discusses how one would empirically implement the theory. Section 4 provides an example of the technique. The methodology is used to identify the competitors of every 1987 model year automobile. In Section 5, potential problems with this new technique are discussed. We conclude with a brief discussion of possible applications of the methodology.

[1] We note that a purely statistical technique to identify competitors is cluster analysis, which is discussed in Dillon and Goldstein (1984) and applied in an economic context by Pepall (1987).

2. Theory

Whether firm A's product competes with firm B's product will depend upon the physical characteristics of the products and how consumers care about these characteristics. Let $\mathbf{x} = (x_1, x_2, .., x_n)$ be a vector of characteristics describing a product differentiated in n dimensions. R^n_+ then is the space in which products are differentiated. The set of products available to the consumer is a discrete set $\{x_m\}, m = 1, \ldots, M$.[2] $\Theta = (\theta_1, \theta_2, .., \theta_n)$ represents the vector of preference parameters for an individual. Different products have different $\mathbf{x}$'s and different individuals have different Θ's. An individual's utility is given by:

$$U(\mathbf{x}, \Theta) + y, \tag{1}$$

where y is the quantity consumed of a numeraire good. Prices of the differentiated products are denoted by P_m. Each consumer's maximization problem can then be stated as:

$$\max_{1 \leq m \leq M} \quad U(x_m, \Theta) - P_m. \tag{2}$$

It will be very convenient to introduce the idea of a consumer's most preferred, or ideal, product (as in Lancaster, 1979.) In determining the ideal product, we hypothetically assume that all points in R^n_+ are available as products. This means that we must also specify hypothetical prices for all $x \in R^n_+$. Prices of goods are related to the characteristics of the goods. Hence:

$$P = P(\mathbf{x}), \quad x \in R^n_+, \tag{3}$$

where we assume that $P(x_m) = P_m$.[3]

A consumer's most preferred product, denoted x^* is given by:

$$x^* = \arg\max_{x \geq 0} \quad \{U(x, \Theta) - P(x)\}. \tag{4}$$

The first order condition implied by (4) is given by:

$$U_x(x^*, \Theta) = P_x(x^*), \tag{5}$$

[2] The set $\{x_m\}$ should also include alternatives to purchasing the differentiated product, such as keeping a used version. In practice, we shall not include these alternatives as data.

[3] In other words, we are assuming that the price function (3) fits the price and characteristics data on the M models exactly. In practice, we expect that P_m will differ from $P(x_m)$ by some error, as discussed in section 5.

where subscripts denote partial derivatives.

For many functional forms of (1), condition (5) may be inverted to solve for the unobservable taste parameters. [4] This implies a mapping between tastes and most preferred products given by:

$$\Theta = \Psi(x^*). \tag{6}$$

Now define,

$$S(x, x^*) \equiv U(x, \Psi(x^*)) - P(x). \tag{7}$$

Equation (7) defines a surplus function $S(x, x^*)$. This function gives the surplus associated with product x when the ideal product is x^*. Surplus is maximized at $x = x^*$. Likewise, as x becomes more different than x^* in any of the n dimensions in which the products are differentiated, surplus declines. [5] Equation (7) also defines iso-surplus contours conditional on a most preferred product, x^*. Surplus is constant along a contour and declines as contours become further from x^*. The shape of these contours will depend upon the functional forms chosen for (1) and (3).

Now the consumer's problem, (2), may be restated as:

$$\max_{1 \leq m \leq M} \quad S(\mathbf{x_m}, \mathbf{x}^*) = U(\mathbf{x}, \Psi(\mathbf{x}^*)) - P_m. \tag{8}$$

It is clear that (8) is simply a rewritten version of problem (2), in the sense that model m^* will solve both problems if $\Theta = \Psi(x^*)$.

We propose the following definition of competitors.

Definition: Products A and B are competitors if there exists $x^* \in R^n_+$ such that: $S(x_a, x^*) = S(x_b, x^*) \geq S(x_c, x^*) \;\; \forall$ models C.

This definition states that if A and B are competitors, then a consumer indifferent between A and B prefers those two models to all other models. There are, though, an infinite number of ideal varieties, x^*, that still leave $S(x_a, x^*) = S(x_b, x^*)$. We need only find one point x^* satisfying the above condition to call A and B competitors.

---

[4] From Gale and Nikaido (1965), a sufficient condition to globally invert (5) obtaining (6) is that the principal minors of $U_{x\Theta}$ be positive for all $x > 0$ and $\Theta > 0$. This will be satisfied by the functional form used in Section 3.

[5] To see this, consider the second-order approximation $S(x, x^*) \doteq S(x^*, x^*) + S_x(x^*, x^*)(x - x^*) + (1/2)(x - x^*)' S_{xx}(x^*, x^*)(x - x^*)$. From (5) and (7), we see that $S_x(x^*, x^*) = 0$ and $S_{xx}(x^*, x^*) = [U_{xx}(x^*, \Theta) - P_{xx}(x^*)]$, which is negative definite from the second order conditions for (4). It follows that $S(x, x^*) \doteq S(x^*, x^*) + (1/2)(x - x^*)'[U_{xx}(x^*, \Theta) - P_{xx}(x^*)](x - x^*)$, which declines as any component of x moves further away from x^*.

Figure 1 illustrates our definition. Points A, B, and C represent available products differentiated in characteristics x_1 and x_2. S_1 represents the surplus contour of an individual with an ideal product x^* who is indifferent between A and B (since A and B lie on the same iso-surplus contour.) S_2 represents the surplus contour of an individual with an ideal product x who is also indifferent between A and B. In Figure 1, models A and B are competitors since $S(x_a, x^*)[= S(x_b, x^*)] > S(x_c, x^*)$ as drawn. The fact that $S(x_a, x)[= S(x_b, x)] < S(x_c, x)$ means that a consumer with ideal product x would buy model C rather that A or B.

The above definition has several appealing qualities. These include: a) As in a Hotelling model, relations between competitors may be intransitive. Indeed, in Figure 1, A and C are competitors as are B and C, yet A and C are not; b) The definition is symmetric. If A is a competitor of B, B is necessarily a competitor of A; c) The definition is easily empirically implemented. This is the subject to which we now turn.

3. Implementing the Theory

The first step towards implementing the theory requires imposing functional forms on the utility function (1) and on the price function (3). While there is not a clearly right or wrong functional form for utility, some functional forms are better than others. One requirement is that the number of taste parameters Θ_i equal the number of characteristics x_i. In addition, it is desirable to be able to vary the concavity of the utility function in a parametric manner. These goals are achieved by using a constant elasticity of substitution functional form:

$$U(\mathbf{x}, \Theta) = \sum_{i=1}^{n} \frac{\theta_i}{\delta}(x_i^{\delta} - 1). \tag{9}$$

The elasticity of substitution between characteristics is $\sigma = \frac{1}{1-\delta}$ with $\delta \leq 1$. [6]

It will be important for empirical work that the price function (3) fit the data well. With this requirement in mind, empirical work often imposes (or tests) a log-linear functional form on the price function. Hence:

$$P(\mathbf{x}) = exp(\alpha + \beta'\mathbf{x}) \tag{10}$$

where α and $\beta = (\beta_1, \beta_2, ..., \beta_n) > 0$ are parameters.

Given these functional forms, the mapping (6) between tastes and most preferred products becomes:

[6] As $\delta \rightarrow 0$, the utility function becomes $U(x, \Theta) = \sum_{i=1}^{n} \theta_i ln x_i$.

$$\theta_i = (x_i^*)^{1-\delta} \beta_i \exp(\beta' \mathbf{x}^* + \alpha). \tag{11}$$

The surplus function is:

$$S(\mathbf{x}, \mathbf{x}^*) = \exp(\beta' x^* + \alpha) \sum_{i=1}^{n} \frac{\beta_i}{\delta} (x_i^*)^{1-\delta} (x_i^\delta - 1) - \exp(\beta' x + \alpha) \tag{12}$$

The iso-surplus contours implicitly defined by (12) resemble ellipsoids but are not symmetric. Rather, they are slightly egg-shaped.

The next task is to implement the definition of competitors using the surplus function (12). Given two potential competitors, products A and B, the first step is to identify the consumers with preferences Θ, and hence a most preferred product x^*, such that $S(x_a, x^*) = S(x_b, x^*)$. As discussed in the previous section, there are an infinite number of points x^* such that $S(x_a, x^*) = S(x_b, x^*)$, and in principle we need to check each of them to see whether Definition 1 holds. In practice, we shall simplify the task by only considering points x^* such that $x^* = \Omega x_a + (1 - \Omega) x_b$ with $0 \leq \Omega \leq 1$. That is, we restrict attention to ideal products x^* which lie on a line segment between x_a and x_b. In many cases, such as illustrated in Figure 1, this approach will correctly identify whether A and B are competitors. However, since we have restricted the search for x^*, it is certainly possible that we will *omit* some models as competitors, as illustrated in Figure 2.

Figure 2 is similar to Figure 1, except that the position of model C has changed. Ideal product x^* satisfies $S(x_a, x^*) = S(x_b, x^*)$ and $x^* = \Omega x_a + (1 - \Omega) x_b$. Since $S(x_a, x^*)[= S(x_b, x^*)] < S(x_c, s^*)$, we would reject models A and B as competitors by only considering x^* lying on a line segment between x_a and x_b. However, we also see that $S(x_a, x)[= S(x_b, x)] > S(x_c, x)$, so models A and B are competitors by Definition 1. Summing up, our method can reject models as competitors when they really are, but it clearly can never accept models as competitors when they are not. In section 5, we discuss how serious this limitation may be.

With many models A, B, C, D, ... available, we calculate x^* on a line segment between eacg two models with equal surplus obtained from the two. We then check whether greater surplus is obtained from any other model. Is so, then the two models are (possibly incorrectly) rejected as competitors; if not, the two models are accepted as competitors. The results from this calculation are reported next.

4. An Example

In this section, we identify the competitors to the 136 models which made up the 1987 new car market in the United States. [7] The automobile market provides an especially nice test of our methodology. It is a market with which most readers are familiar, hence the plausibility of our results is readily examined. It is also a market with many differentiated products and plentiful data.

We first choose the dimensions in which products are differentiated. Data were available on 13 characteristics of every model. [8] We choose the relevant characteristics by applying nested hypothesis testing to the OLS estimation of the price function (10). The estimated price function is:

$$\begin{aligned} LOGPRICE = &-.685 + .000119\ WT + .121\ CARB1 + .0030\ TORQ + .156\ PS1 + \\ &(.519) \quad (.000059) \qquad (.051) \qquad (.0007) \qquad (.053) \\ &.407\ AIR1 + .252\ FOR1 + 53.8\ INVHT \qquad R^2 = .794 \qquad 136\ obs. \\ &(.053) \qquad (.045) \qquad (25.6) \end{aligned} \tag{13}$$

Of the 13 differentiating characteristics on which data were available, nested hypothesis testing resulted in a characteristics space differentiated in seven dimensions. These are weight of the vehicle (WT), engine torque (TORQ), the inverse of the height of the vehicle (INVHT), whether the auto had fuel injection (CARB1), air conditioning (AIR1), and power steering (PS1) as standard equipment, and whether the auto was foreign (FOR1). [9] All variables refer to the base model of a product.

Use of binary variables in the context of identifying competition deserves special note. We view the variables PS1 and AIR1 as proxies for increasing degrees of luxury. Similarly, the FOR1 may proxy for perceived quality or longevity. In these contexts, a most preferred product may well have a value for these variables that is between the all-or-nothing choice imposed by available products.

Characteristics such as horsepower and mile per gallon of gasoline, items many consumers may deem important, were not statistically significant [10] in the price function. This is because these

[7] When a model is produced by two divisions of the same corporation and the models only differ cosmetically, such as the Ford Escort and the Mercury Lynx, only one of the models is used in the sample.

[8] Please refer to the Data Appendix for a complete description of the data set.

[9] The dummy variables CARB1, PS1, and AIR1 took the value of 2 if the feature was standard equipment and 1 if not. FOR1 took the value of 2 if the auto was produced abroad and 1 if domestically produced. (Models which were produced both in the U.S. and abroad are considered foreign models.) This differs from the usual 0-1 convention, but is necessary since some dummy variables are raised to negative powers in calculating the surplus function. This departure from convention only changes the constant in the regression and has no effect on the results.

[10] "Statistically significant" refers to an estimate being statistically significantly different from zero.

characteristics are spanned by linear combinations of included variables such as weight, inverse of height, and torque. Including the statistically insignificant characteristics in the price function (13) would have posed two problems. First, inclusion would have induced multicollinearity. This is a relatively minor problem as estimates are still unbiased, and we only use the parameter estimates, not their estimated standard errors, in the surplus function. [11] More importantly, each characteristic included in the price function represents a dimension in which one much search for potential competitors. With too many characteristics, the search becomes computationally burdensome.

Estimated coefficients in the price function are used to parameterize the surplus function (12). The only unidentified parameter in the surplus function is δ which is related to the elasticity of substitution between characteristics. We are unable to econometrically identify δ with our data. Rather, we set δ equal to a variety of plausible values and test the robustness of our results. [12] Setting $\delta = -3$ for the base case scenario, competitors to every 1987 automobile model were identified using the procedure described above. The results are given in Table 1. Table 1 tells one, for example, that model 2, the Acura Legend, has as competitors models 4 – the Alfa Romeo Milano, 8 – the Sterling, 40 – the Nissan Maxima, and 69 – the Volvo 740. The number or competitors to a model varies from one (the Chevrolet Corvette) to sixteen (the Renault Medallion). With few exceptions, the results accord well with intuition.

Two types of sensitivity analysis were performed to check the robustness of the results in Table 1. First, δ was set equal to -.01 and then to -1.0. Each time, the analysis was repeated. Second, the order in which hypotheses are tested when conducting nested hypothesis testing may affect the outcome of the tests. Recognizing this, we used engine horsepower in the price function instead of using the variable torque, and repeated the analysis. [13] Robustness of the results depends on the question being posed. In general, if a model has four competitors, about 3 of these will remain competitors when δ is varied or when the characteristics space is redefined. Hence, if one wishes only to determine if model X is a competitor of model Y, answers may change with specification changes. If, on the other hand, one wants to know the group of competitors a product faces, results are quite robust.

---

[11] Were multicollinearity too severe, though, the design matrix might be so ill-conditioned that inversion difficulties arise. In addition, negative estimated values for β_i can lead the surplus function (12) to violate the properties in footnote 5.

[12] This procedure was used in a different context by Feenstra (1988). Note that lower (negative) values for δ lead to utility and surplus functions which are more concave.

[13] The results of these sensitivity analyses are available upon request.

5. Caveats

We believe the methodology discussed in this paper is a valuable tool and can be profitable applied to many economic problems. However, our analysis has a number of limitations, and in this section we give an economic interpretation for two such limitations.

First, when calculating surplus in (12) we have subtracted the predicted price from the hedonic regression (13) rather than the actual price. This means that we are treating the error term from the hedonic regression as reflecting only unmeasured characteristics of a model, which yield utility exactly equal to the dollar error. It follows that surplus is properly calculated as utility from measured characteristics minus the predicted price, as in (12).

An alternative approach we considered was to treat the error in the hedonic regression as reflecting pure price markups, with no unmeasured characteristics. In this case, actual rather than predicted prices are used in (12). However, this approach fails in practice, because we find that certain models with actual prices much greater than predicted prices are never purchased. That is, a grid search over Θ shows that every consumer would avoid the high prices of certain models, and choose another model with similar characteristics. In future research, it would be desirable to assume that the errors in (13) reflect some combination of unmeasured characteristics and pure price markups.

Second, because most preferred products lie on lines drawn between available products, the methodology may omit some models as competitors. In particular, it is unable to account for the preferences of consumers whose ideal product lies outside the convex hull of all available products. [14] This is unlikely to be a problem in a market with many available models and minimal entry barriers facing new products. Were there a high density of consumers in a part of characteristics space outside the convex hull of available models, such a market niche would likely be a profitable one. Given the actual absence of available models, we conclude that there are not likely to be many consumers whose preferences lie outside the convex hull of available products. While this caveat, then, does not apply to the automobile market with its myriad products, it may well apply to the super-computer market.

[14] In figure 2, the convex hull of available products is the triangle with vertexes at A, B, and C. Our method fails to identify A and B as competitors because the ideal product x lies outside the convex hull.

6. Potential Applications

Product differentiation has recently been a much researched topic in the International Trade and the Industrial Organization literatures. Almost all of this research has been theoretical. A wide range of these issues may be empirically investigated using the methodology described above. Levinsohn (1988) estimated an ad-hoc demand system in which identification of competitors was used to impose cross price elasticity zero restrictions. Work on estimating a utility consistent demand system for differentiated products is in progress by the authors.

Anti-trust analysis is often directed at ascertaining whether firm mergers will give rise to market power in a particular segment of the market. The answer often depends on how the market is defined. The method of identifying the competition is a natural tool for the job. Similarly, one could easily investigate the dynamic competitive effects of government policies such as taxes, subsidies, bail-outs, tariffs, and quotas by analyzing how competitors change over time in response to the policies.

The methodology also has natural marketing applications. Given the characteristics of a potential entrant, it is straightforward to determine with which products the potential entrant would compete.

These are but a few examples. The methodology presented in this paper is a first attempt at devising a much needed empirical tool. We hope the methodology will facilitate empirical work in International Trade, Industrial Organization, and Public Economics. We also hope others are stimulated to improve on the methodology itself.

Data Appendix

The data used is from the 1987 *Automotive News Market Data Book.* The entire data set is available on floppy disk from the authors on request. Collected variables (and their units of measurement) are Overall Length (inches), Overall Width (inches), Overall Height (inches), Curb Weight (lbs.), Engine Displacement (cubic inches), Carburation (2 in fuel injected, 1 otherwise), Net Horsepower, Net Torque (foot pounds), Power Steering (1 if not standard, 2 if standard), Power Brakes (1 if not standard, 2 if standard), Air Conditioning (1 if not standard, 2 if standard), Foreign (1 if domestic, 2 if foreign), and List Price (dollars).

The source code of the FORTRAN 77 program which implemented the identification of competitors is also available from the authors on request.

References

Crain Communications (1987) *1987 Automotive News Market Data Book.* Detroit: Crain.

Dillon, W. and M. Goldstein (1984) *Multivariate Analysis: Methods and Applications.* New York: Wiley Series in Probability and Mathematical Statistics.

Feenstra, R. (1988) "Gains from Trade in Differentiated Products: Japanese Compact Trucks," in *Empirical Methods for International Trade*, ed. Robert Feenstra. Cambridge, MA: MIT Press.

Gale, D. and H. Nikaido (1965) "The Jacobian Matrix and Global Univalence in Mappings," *Mathematische Annalen*, **159**, 81-93.

Hotelling, H. (1921) "Stability in Competition," *Economic Journal*, **39**, 41-57.

Lancaster, K (1979) *Variety, Equity, and Efficiency.* New York: Columbia University Press.

Levinsohn, J (1988) "Empirics of Taxes on Differentiated Products: The Case of Tariffs in the U.S. Automobile Industry," in *Trade Policy Issues and Empirical Analysis*, ed. Robert Baldwin. Chicago, IL: University of Chicago Press.

Pepall, L. (1987) "A Clustering Analysis of the Effects of Import Penetration on Product Variety," mimeo, Tufts University.

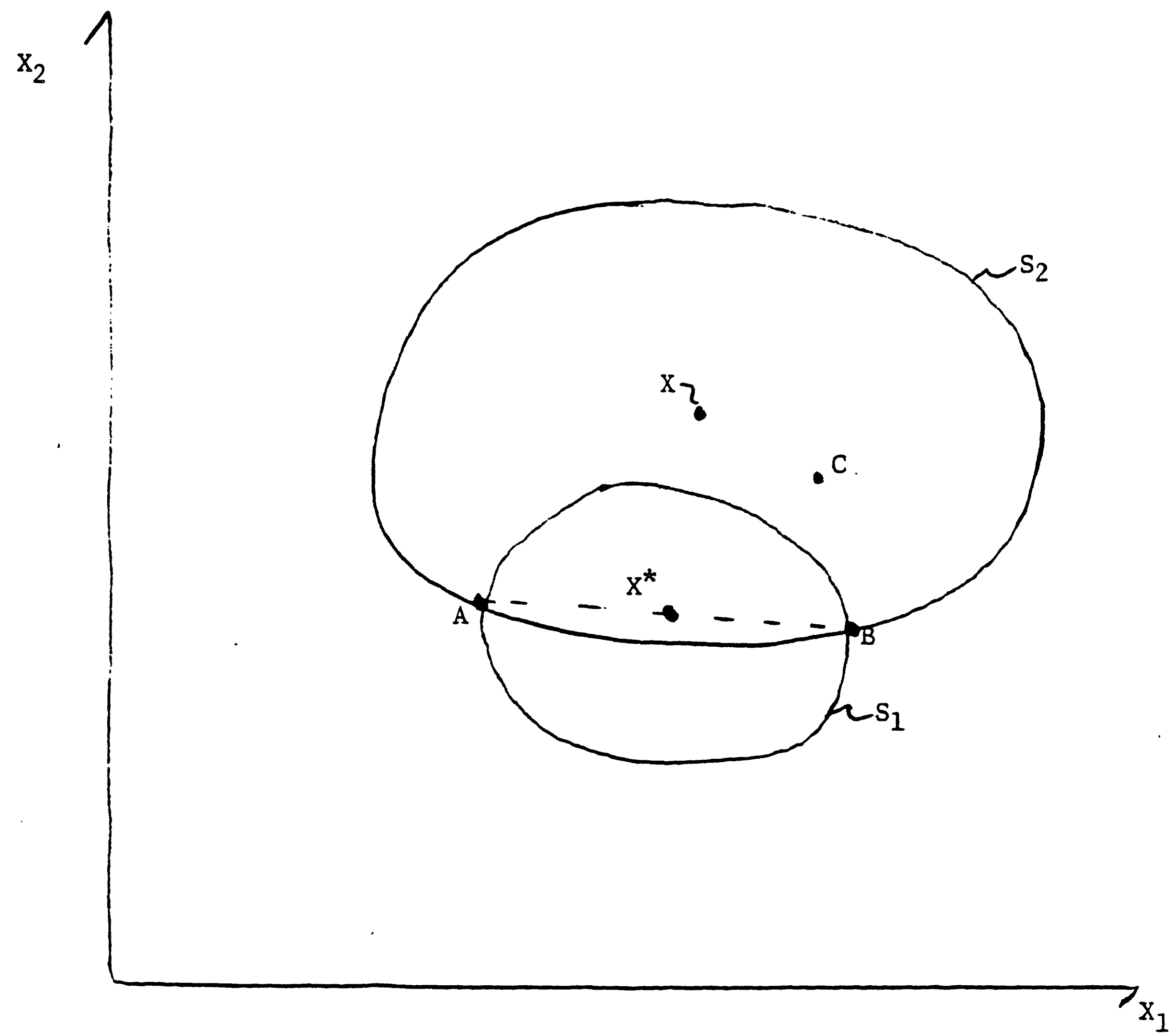

FIGURE 1

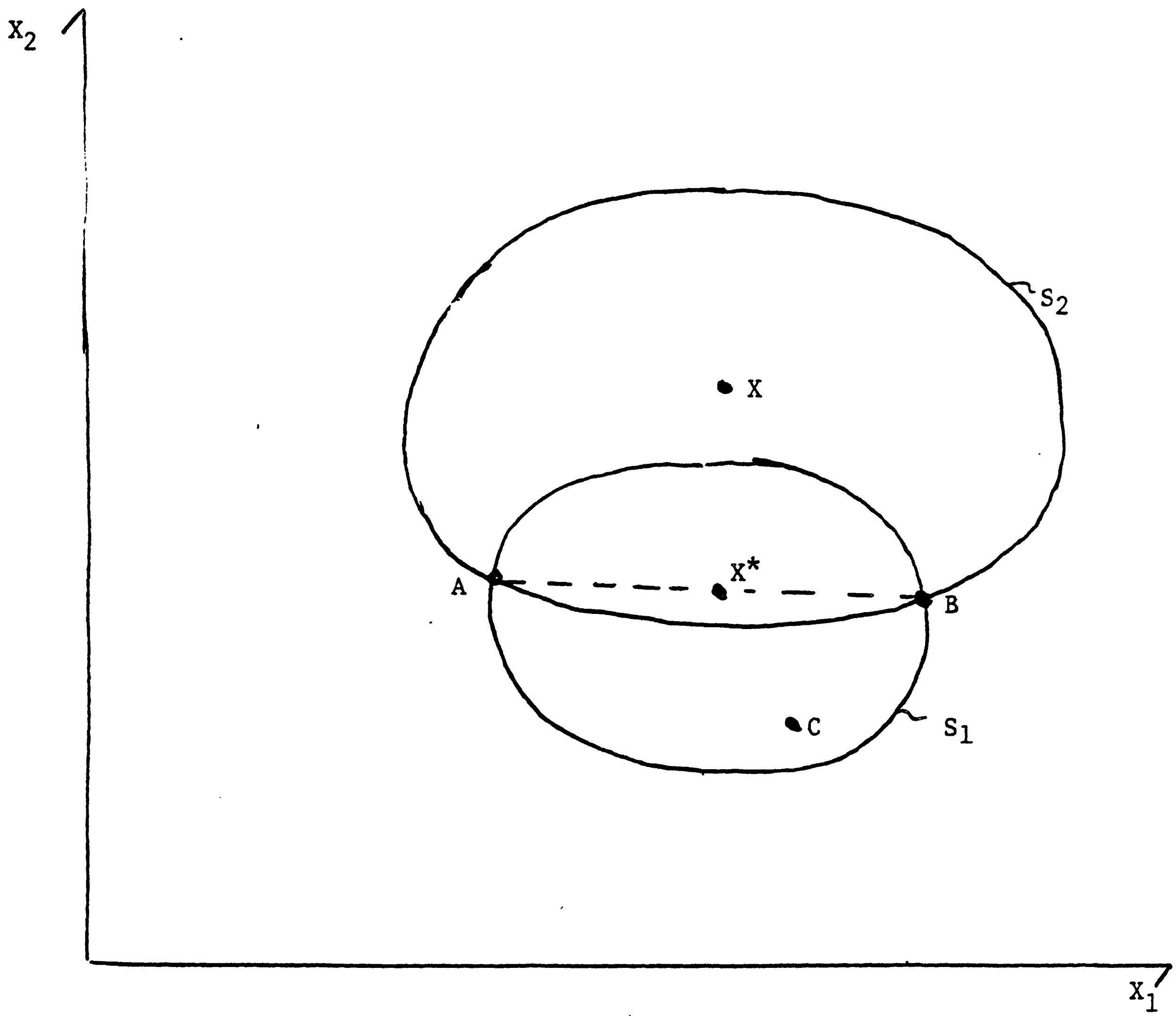

FIGURE 2

Table 1

Base Case Results

Model Number	Model Name	Model Numbers of Competitors										
1	Integra	5	21	34	38	39	41	53	66	67	91	116
2	Legend	4	8	40	69							
3	Spider	19	26	27	41	54	59	128				
4	Milano	2	10	24	28	42						
5	Audi4000	1	6	19	38	39	41	57	59	66	81	
6	AudiCoupe	5	36	59	63							
7	Audi5000	48	49	63								
8	Sterling	2	60									
9	Bertonex19	17	38	54	58	135						
10	BMW325	4	15	30	70	79						
11	BMW528	29	40	60	70							
12	BMW735	29	61	83	86	111	112	113				
13	Sprint	18	50	55								
14	Spectrum	16	17	25	55	56						
15	Conquest	10	27	43	59	77	92	131				
16	Colt	14	32	55								
17	CRXsi	9	14	31	64	116	135					
18	CivicDx	13	50	55	71	87						
19	PreludeSi	3	5	35	41	58	59	66				
20	Civic Sed.	22	51	87	115							
21	Accord	1	34	39	47	66	114	124				
22	Excel	18	20	33	56	115						
23	IMark	25	32	55								
24	Impulse	4	28	36	44							
25	Mazda323	14	23	51	56	62	65	114				
26	Mazda626	3	39	47	52	53	66	67	73	88	101	129
27	Rx7	3	15	57	59	128						
28	MB190E	4	24	36	69							
29	MB300E	11	12	30	61	70	80	84	86	122		
30	XR4ti	10	29	37	46	61	70	110				
31	Tracer	17	52	56	62	116	135					
32	Mirage	16	23	51								
33	Precis	22	56	115								
34	Tredia	21	1	35	41	66						
35	Cordia	19	34	38	58							
36	Galant	6	24	28	44	45	63	69				
37	Starion	30	42	46	61							
38	Pulsar	5	9	35	1	54	58	116				
39	Stanza	5	21	26	1	41	47	57	66	91	103	109
40	Maxima	2	11	60	70							
41	200SX	3	5	19	34	39	1	57	59			
42	300ZX	4	37	60	61							
43	Peugeot505	15	47	48	57	89	90	96	109	119	133	
44	Porsche924	24	36	45								
45	Porsche944	36	44									
46	Porsche911	30	37	79	86	110						

Table 1 (continued)

47	Medallion	5	21	26	39	43	57	66	75	76	96	103	108	109	118	119
48	Saab900	7	43	57	63											
49	Saab9000	7	68	69												
50	Justy	13	18	71												
51	SubHatch	20	25	32	56											
52	SuburuGL	26	31	1	53	62	66	67	88	116	129					
53	SuburuDL	26	52	1	64	116										
54	SuburuXT	3	9	38	64	116										
55	Tercel	13	14	16	18	23										
56	Corolla	14	25	33	51	114										
57	Camry	5	27	39	41	43	47	48	59	96	102	108	109			
58	MR2	5	9	19	35	38	54									
59	Celica	3	5	6	15	19	27	41	57	89	102					
60	Cressida	8	11	40	42	61										
61	Supra	12	29	30	37	42	60	86	123							
62	Fox	25	31	52	65	67	114	116	135							
63	Quantum	6	7	36	48											
64	Scirocco	17	53	54	116											
65	Golf	25	62	66	67	106	114									
66	GTI	5	19	21	26	39	47	52	65	1	67	91	107	136		
67	Jetta	26	52	62	65	66	1	73	88	114	116	117				
68	Volvo240	49	69													
69	Volvo740	2	28	36	49	68	131									
70	Volvo760	10	11	29	30	40										
71	Yugo	18	50													
72	Eagle	82	92	93	105	132										
73	Skyhawk	26	67	91	117											
74	Somerset	75	118													
75	Skylark	47	74	76	96	102	108	118	130							
76	Century	47	75	96	119	133										
77	Regal	15	89	124	132											
78	LeSabre	29	79	81	92	93	110	121	131							
79	Electra	10	46	78	81	89	110	130								
80	Riviera	29	84	110	123											
81	Cimarron	5	78	79	89	91	102	103	108	135						
82	DeVille	72	85	127	134											
83	Brougham	12	86	111	113	127										
84	Eldorado	29	80	122	123											
85	Seville	82	122													
86	Allante	12	29	46	61	83	110	111	123	127						
87	Chevette	18	20	115	135											
88	Cavalier	26	52	67	91	98	99	106	117	129	135	136				
89	Camaro	43	59	68	69	77	79	81	92	102	130	131	133			
90	Celebrity	43	47	119	133											
91	Corsica	39	66	73	81	88	1	107	129	136						
92	MonteCarlo	15	72	78	93	131										
93	Caprice	72	92	105	121	134										
94	Corvette	111														
95	LeBaron	81	100	126												
96	NewYorker	43	47	57	75	76	108	109	119							
97	FifthAve	105														

Table 1 (continued)

98	Omni	88	99	101	106	114	115	117	129		
99	Charger	77	88	98	114	124					
100	Shadow	47	81	95	118	125					
101	Aries	26	98	107	128	129					
102	Daytona	57	59	75	81	89	108	128			
103	Lancer	39	47	81	104	108	109	119			
104	600	47	81	103	126						
105	Diplomat	72	82	83	86	93	97	127			
106	Escort	65	88	98	115	117	135				
107	Tempo	66	81	91	101	125	129	136			
108	Mustang	47	57	75	81	96	102	103			
109	Taurus	39	43	47	57	96	103	119			
110	TBird	29	30	46	78	79	80	86	121		
111	LTD	12	83	86	94	113	127				
112	Continental	12	113								
113	TownCar	12	83	111	112						
114	Sentra	21	25	56	62	65	98	99			
115	Nova	20	22	87	98	106	135				
116	FX16	17	31	38	52	53	54	64	1	136	
117	Firenza	67	73	88	91	98	106				
118	Calais	47	74	75	100	125					
119	Ciera	43	47	76	90	96	103	109			
120	Supreme	132									
121	Delta88	29	78	93	110	134					
122	Olds98	29	84	85	134						
123	Toronado	61	80	84	86						
124	Turismo	21	77	88	99	114	129				
125	Sundance	47	66	81	100	107	118				
126	Caravelle	95	104								
127	GranFury	72	82	83	86	93	105				
128	Fiero	3	27	101	102	129					
129	Sunbird	26	52	88	91	98	101	107	124	128	136
130	GrandAm	75	79	89	133						
131	Firebird	15	69	78	81	89	92				
132	GrandPrix	15	72	77	120						
133	6000	43	47	76	89	90	130				
134	Bonneville	29	82	93	121	122					
135	Alliance	9	17	31	81	87	88	106	115		
136	GTA	66	88	91	107	116	129				