

Chapter 5 Catastrophe Modeling and Estimating

5.1 Hypothesized Cusp Catastrophe Model

Although we have described the relationship between loyalty, switching cost and service quality using structural equation modeling in the previous chapter, most studies indicated that choice behavior can be regarded as a discontinuous catastrophe phenomenon and recognized the need to incorporate dynamic nonlinear modeling techniques to fully understand choice behavior processes. Cusp catastrophe modeling is one of such forms that are most pertinent to our present study. The choice behavior can be described by the loyalty variable and controlled by the switching cost and service quality. Of the seven different types of catastrophe modeling, cusp catastrophe is the most appropriate for exploring the choice behavior when there are two influencing factors.

A cusp catastrophe model in its simplest form includes a dependent variable and two independent variables. The two independent variables have different qualitative meanings. One of the independent variable is called normal factor and the other is called splitting factor. In this chapter, we discuss the nonlinear relationship between loyalty, switching cost and service quality according to the cusp catastrophe model.

Gilmore indicated that if there are recognized catastrophe flags in the research system, we can assume that the dynamic mechanism of this system is suitable for the catastrophe model, then choose the proper catastrophe model and determine a set of control factors and state factors to explain the dynamic behavior of the research system. According to the analysis framework of catastrophe model as illustrated in Figure 3.5, whether confirming the choice behavior first before using catastrophe theory has catastrophe flags. Figure 5.1 shows the hysteresis flags in our research system.

In June of 2003, 7-11.com suspended for two weeks its retailing delivery service of Pchome.com. During the temporary suspension of retailing delivery service, consumers of Pchome.com can only choose the service of CVS.com. As is illustrated in Figure 5.1, after 7-11.com resumed the retailing delivery service, the difference in orders between 7-11.com and CVS.com reduced by 10%. We can regard this phenomenon as the characteristic of catastrophe (hysteresis). Besides hysteresis, the market has only two service providers (7-11.com and CVS.com) that can be regarded as the bimodality flag.

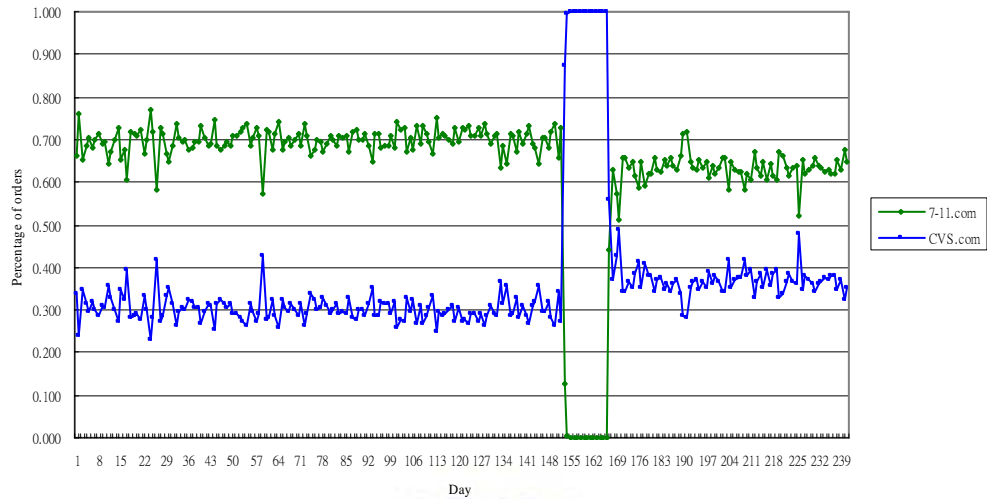


Figure 5.1 Catastrophe Characteristic of Research System

As shown in Figure 5.1, when there is a catastrophe flag of the choice behavior, in order to construct the cusp catastrophe model, which describes the choice behavior (loyalty), we must choose the proper control variables. According to the structural equation model (SEM) discussed in Chapter 4, the two most relevant variables influencing the loyalty of a pick-point are switching cost and service quality (see Figure 5.2). With these two variables, the loyalty dynamics may be conceptualized in terms of the cusp catastrophe model shown in Figure 5.3.

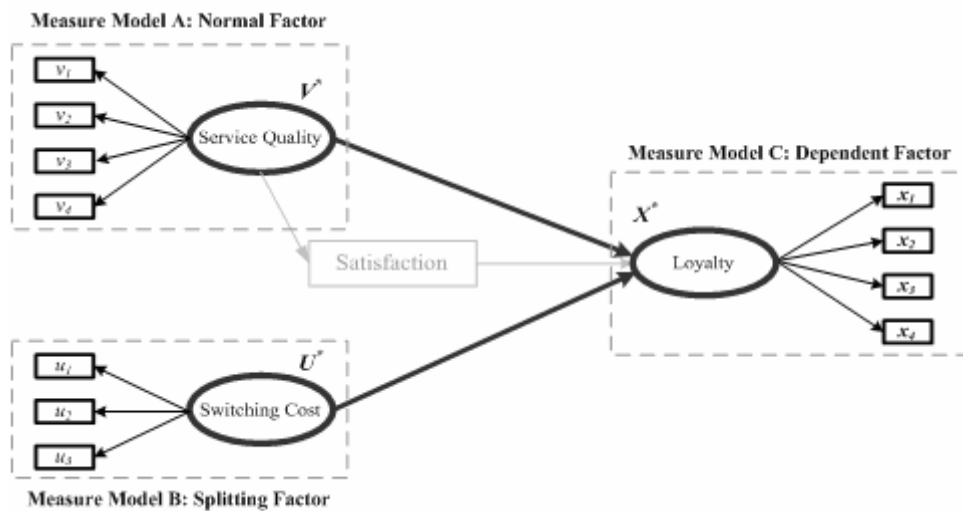


Figure 5.2 Control Factor and Dependent Factor in the Cusp Model

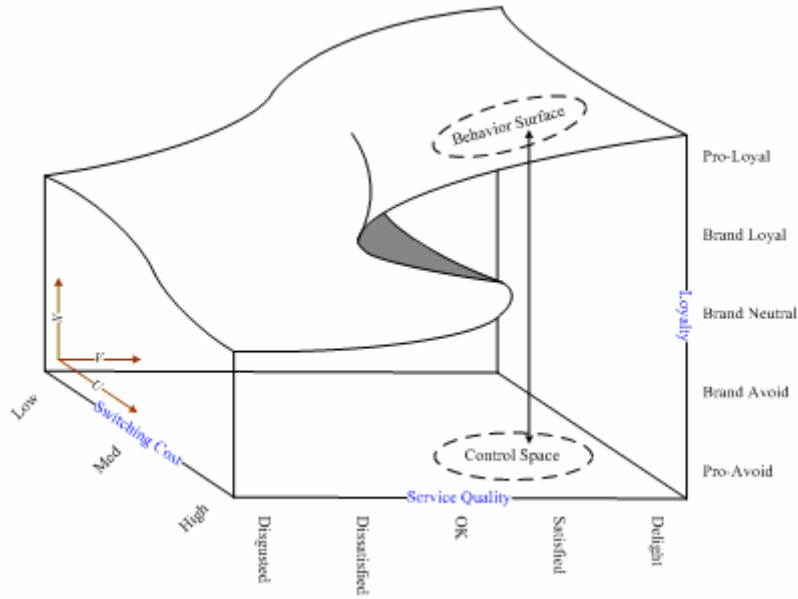


Figure 5.3 Hypothesized Cusp Catastrophe Model of Choice Behavior

In this hypothesized model, loyalty is the dependent variable z , service quality is a normal variable v , whereas the switching cost is a bifurcation variable u . Cusp catastrophe theory uses a continuous parameter to describe discrete morphology behavior. In a cusp catastrophe model framework, after the intensities of the normal factor and splitting factor are determined, model fitting and dynamical analysis are then performed. The analysis procedure of this chapter is shown in Figure 5.4.

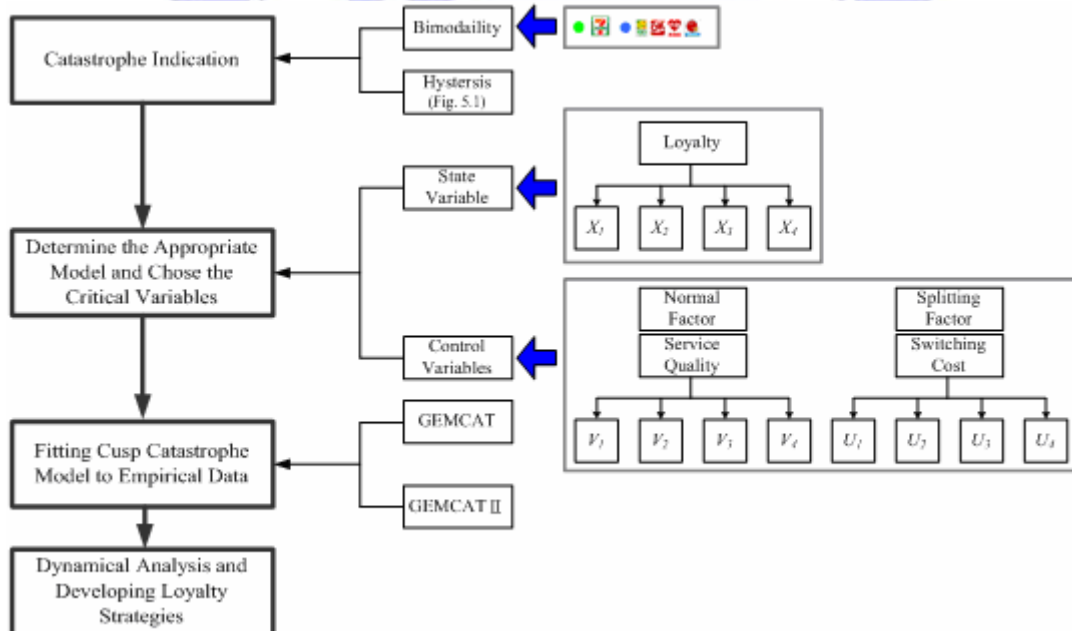


Figure 5.4 Analysis Procedure of Catastrophe Model of this Chapter

5.2 Operationalized of Variable and Data Set

Review of the literature of fitting the catastrophe model, a limitation of Cobb and Guastello's method is that it does not allow researchers to specify models in terms of specific combinations of multiple indicator variables. A solution to this problem was developed by Oliva *et al.* (1987). Their method, the General Multivariate Methodology for Estimating Catastrophe Models (GEMCAT), uses a scaling approach that allows for a priori variable specifications, which permit multivariate constructs in all variables. Hence, GEMCAT is more useful to researchers who need a confirmatory estimation approach for a given model (Alexander *et al.*, 1992). This approach forms the basis of GEMCAT II software (Lange, 1998), which adds a variety of statistical techniques and testing options to the original formulation.

The hypothesized cusp catastrophe model described earlier will be tested using the GEMCAT II software, which provides an extension of the latent variable approach described in Oliva *et al.* GEMCAT II allows individual indicator weights and offset values to be estimated, or, alternatively, they can be fixed by the researcher. Using a combination of the Downhill Simplex method and Powell's Conjugate Gradient approach, GEMCAT II estimates the various indicator weights by minimizing the total squared residual across observations.

GEMCAT II allows x , u , v in the cusp catastrophe model to represent "latent" variables consisting of arbitrary linear combinations of more elementary "indicator" variable. Our operationalizations of the dependent and independent indicator are measure is as follows:

1. Loyalty (X^*)

Δx_1 : relative loyalty by repurchase

Δx_2 : relative loyalty by personal partiality

Δx_3 : relative loyalty by verbal communications

Δx_4 : relative loyalty by the partialities of other services

2. Service Quality (V^*)

Δv_1 : relative service quality concerning the electronic map

Δv_2 : relative service quality concerning the e-tracking

Δv_3 : relative service quality concerning the service attitude

Δv_4 : relative service quality concerning the marketing program

3. Switching Cost (U^*)

u_1 : switching cost concerning the personal custom

u_2 : switching cost concerning the electronic map

u_3 : switching cost concerning the distance

A random sample of 2,500 responses generated from those who had experiences of picking up on-line ordered merchandises at convenience stores was selected from our database because of the restriction of GEMCAT II. In particular, the normal variable v is defined in terms of “relative service quality” (v_i with weight γ_i), and the splitting variable u uses the “switching cost” indicator (u_i with weight β_i), whereas the dependent variable x is defined in terms of relative loyalty (x_i with weight α_i). For instance, the latent variables in a cusp catastrophe model take the following general form:

$$X_t^* = \alpha_1 \Delta x_{1t} + \alpha_2 \Delta x_{2t} + \alpha_3 \Delta x_{3t} + \alpha_4 \Delta x_{4t} \quad , t = 1, 2, \dots, 2500 \quad (5.1)$$

$$V_t^* = \gamma_1 \Delta v_{1t} + \gamma_2 \Delta v_{2t} + \gamma_3 \Delta v_{3t} + \gamma_4 \Delta v_{4t} \quad , t = 1, 2, \dots, 12500 \quad (5.2)$$

$$U_t^* = \beta_1 u_{1t} + \beta_2 u_{2t} + \beta_3 u_{3t} \quad , t = 1, 2, \dots, 2500 \quad (5.3)$$

Before the GEMCAT procedure was performed by GEMCAT II, we preprocessed the data. Figures 5.5-5.7 and Tables 5.1-5.3¹ show the latent variable indicator measures and descriptive statistics.

Figure 5.8 presents the histogram of the pick-up point of choice behavior. Figures 5.9-5.19 show the operationalization of the dependent indicator (X^*) and independent indicators (V^* and U^*) after transformation.

¹ Our operationalizations of the dependent and independent indicator are measure is as follows

State variable : Loyalty : $z = f (z_1, z_2, z_3, z_4)$

Normal factor : Service quality : $x = f (v_1, v_2, v_3, v_4)$

Splitting factor : Switching cost : $y = f (u_1, u_2, u_3)$

Ex : $z_1 \rightarrow$ relative repurchase (repurchase for Cvs.com – repurchase for 7-ELEVN.com)

$v_1 \rightarrow$ relative service attitude (nice service attitude for Cvs.com – nice service attitude for 7-ELEVN.com)

$u_1 \rightarrow$ distance between another convenience store

Each index will be transformed into standardized value using the following equation: $x = \frac{x - \bar{x}}{\sigma}$

Ex : Repurchase (z_1) $\rightarrow \frac{\Delta x_i - \bar{\Delta x}}{\sigma}, i = 1, 2, \dots, 2500$

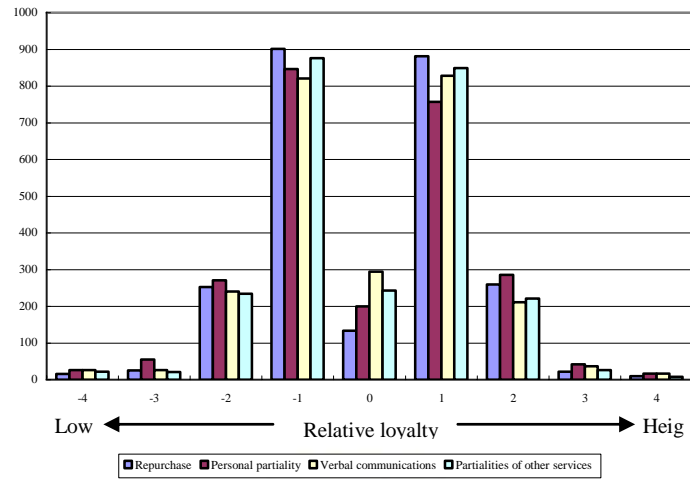


Figure 5.5 Latent Variable Indicator Measures and Descriptive Statistics (loyalty)

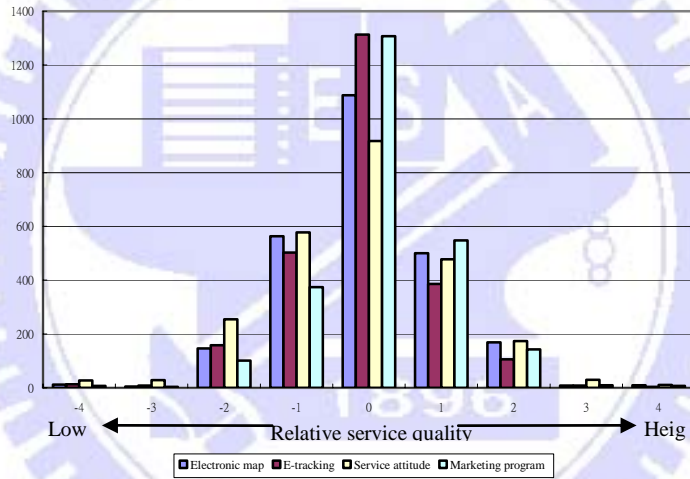


Figure 5.6 Latent Variable Indicator Measures and Descriptive Statistics (service quality)

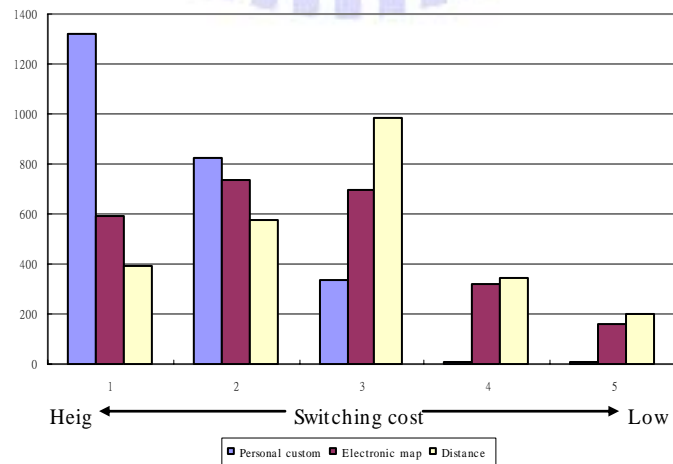


Figure 5.7 Latent Variable Indicator Measures and Descriptive Statistics (switching cost)

Table 5.1 Latent Variable Indicator Measures and Descriptive Statistics (loyalty)

Repurchase		Personal partiality		Verbal communications		Partialities of other services	
Standardized value	Frequency	Standardized value	Frequency	Standardized value	Frequency	Standardized value	Frequency
-2.9160	16	-2.6880	26	-2.8990	26	-2.9710	22
-2.1840	25	-2.0070	55	-2.1700	26	-2.2210	21
-1.4520	252	-1.3260	271	-1.4420	240	-1.4720	234
-0.7210	901	-0.6450	846	-0.7130	821	-0.7220	876
0.0114	134	0.0365	200	0.0157	294	0.0282	243
0.7434	881	0.7178	757	0.7444	828	0.7780	849
1.4753	259	1.3990	286	1.4730	211	1.5279	221
2.2073	22	2.0802	42	2.2017	37	2.2777	26
2.9392	10	2.7615	17	2.9303	17	3.0276	8

Table 5.2 Latent Variable Indicator Measures and Descriptive Statistics (service quality)

Electronic map		E-tracking		Service attitude		Marketing program	
Standardized value	Frequency	Standardized value	Frequency	Standardized value	Frequency	Standardized value	Frequency
-3.7877	12	-4.0280	13	-3.1107	27	-4.0778	27
-2.8383	5	-2.9943	8	-2.3071	29	-2.9439	44
-1.8900	146	-1.9605	159	-1.5034	255	-1.8101	181
-0.9412	563	-0.9267	503	-0.6998	578	-0.6762	536
0.0075	1088	0.1071	1313	0.1038	918	0.4576	1634
0.9564	500	1.1409	386	0.9074	478	1.5914	39
1.9054	169	2.1747	106	1.7111	174	2.7253	31
2.8540	8	3.2085	8	2.5147	30	3.8592	4
3.8028	9	4.2423	4	3.3184	11	4.9930	4

Table 5.3 Latent Variable Indicator Measures and Descriptive Statistics (switching cost)

Personal custom		Electronic map		Distance	
Standardized value	Frequency	Standardized value	Frequency	Standardized value	Frequency
-0.8328	1319	-1.2787	589	-1.5609	395
0.5052	828	-0.4207	733	-0.6693	577
1.8434	338	0.4372	700	0.2221	983
3.1816	8	1.2952	319	1.1137	346
4.5198	7	2.1531	159	2.0053	199

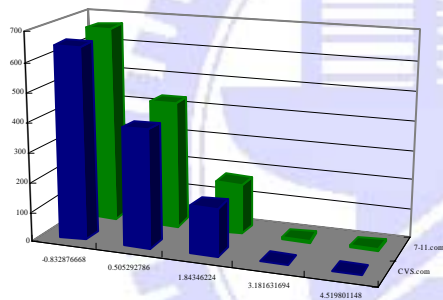


Figure 5.8 Histogram of the Pick-up Point of Choice Behavior

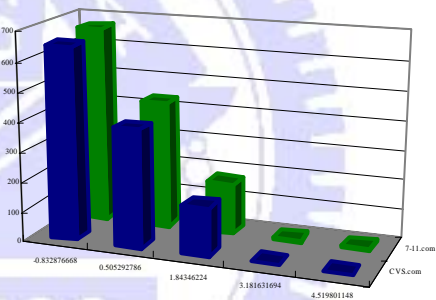


Figure 5.9 Histogram of Switching Cost Concerning the Personal Custom

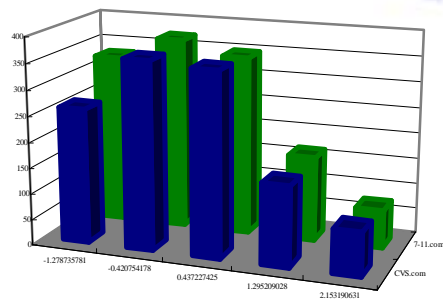


Figure 5.10 Histogram of Switching Cost Concerning the Electronic Map

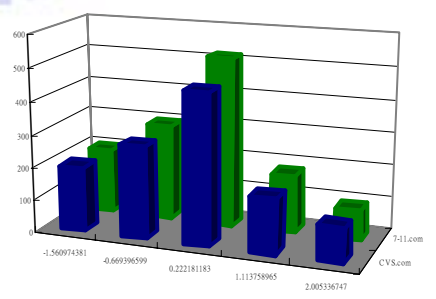


Figure 5.11 Histogram of Switching Cost Concerning the Distance

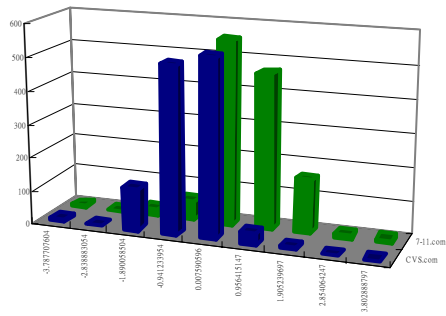


Figure 5.12 Histogram of Relative Service Quality Concerning the Electronic Map

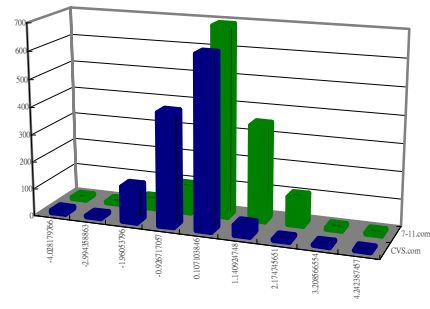


Figure 5.13 Histogram of Relative Service Quality Concerning the E-tracking

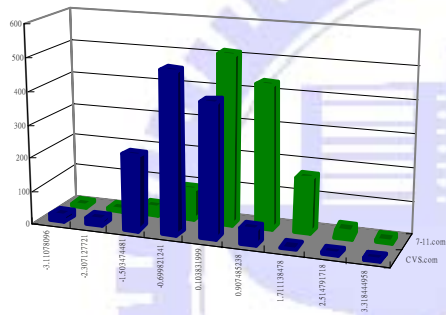


Figure 5.14 Histogram of Relative Service Quality Concerning the Service Attitude

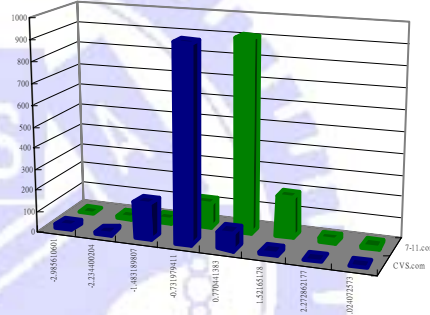


Figure 5.15 Histogram of Relative Service Quality Concerning the Marketing Program

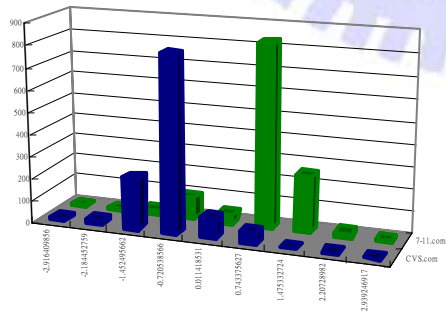


Figure 5.16 Histogram of Relative Loyalty by Repurchase

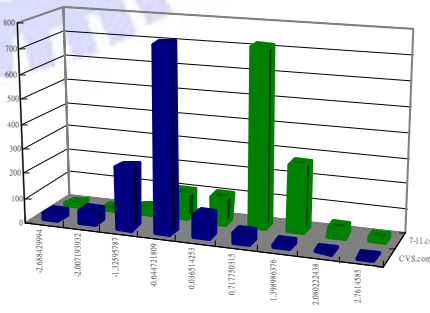


Figure 5.17 Histogram of Relative Loyalty by Personal Partiality

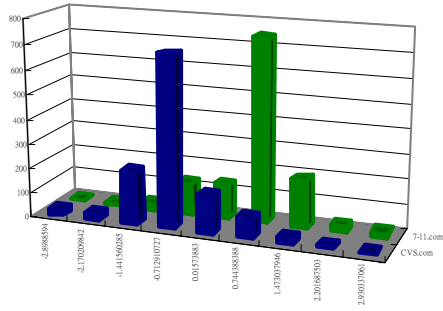


Figure 5.18 Histogram of Relative Loyalty by Verbal Communications

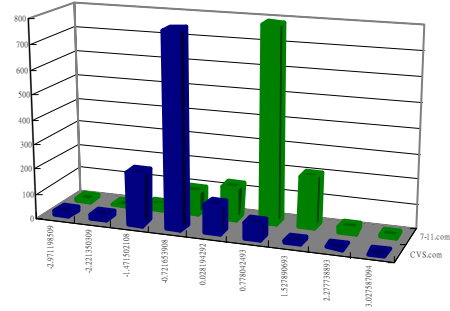


Figure 5.19 Histogram of Relative Loyalty by Partialities of other Services

5.3 Model Fit and Analysis Results

After transforming all variables to z -scores (i.e., $M=0$, $SD=1$), GENCAT II was employed to fit the hypothesized cusp catastrophe model. GEMCATII allows the individual indicator weights and offset values to be estimated, or, alternatively, they can be fixed by the researcher. Using a combination of Downhill Simplex method and Powell's Conjugate Gradient approach, GEMCAT estimates the various indicator weights by minimizing the total squared residual (Φ) across observations. Thus, for the case of the cusp model (Eq(4.2)):

$$\Phi = \min \sum_{n=1}^{2500} (Z^3 - X - ZY)^2 \quad (5.4)$$

Data were fitted using GEMCAT II version 1.3, yielding the average squared difference $\Phi/N = 0.000929$ between the actual and the predicted X^* , where N represents the number of cases. Substitution of these weights into Eq. (5.1)-Eq. (5.3) yields,

$$X^* = \Delta x_1 + 0.2754 \cdot \Delta x_2 + 0.2048 \cdot \Delta x_3 + 0.1993 \cdot \Delta x_4 \quad (5.5)$$

$$U^* = 0.081 \cdot u_1 + 0.2465 \cdot u_2 + 0.818 \cdot u_3 \quad (5.6)$$

$$V^* = 0.0675 \cdot \Delta v_1 + 0.0059 \cdot \Delta v_2 + 0.044 \cdot \Delta v_3 + 0.0029 \cdot \Delta v_4 \quad (5.7)$$

$$\text{Min}\Phi = \|e_i^2\| = \sum_{t=1}^{2500} [Z_t^{*3} - X_t^* - Y_t^* Z_t^*]^2 = 2.3232 \quad (5.8)$$

Figure 5.20 and Table 5.4 show the weights of the independent indicators of switching cost (U^*) and service quality (V^*).

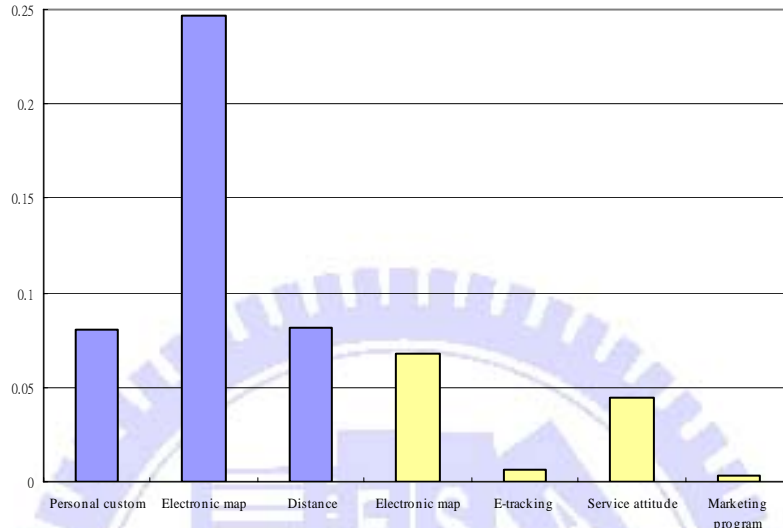


Figure 5.20 Frequency Distribution of the Weights of the Independent Indicators

Table 5.4 Weights of the Seven Indicator of the Control Variables

Indicator of the Control Variables	Weight	Rank*
Service Quality: V^*		
Δv_1 : relative service quality concerning the electronic map	0.0675	(1)
Δv_2 : relative service quality concerning the e-tracking	0.0059	(3)
Δv_3 : relative service quality concerning the service attitude	0.0440	(2)
Δv_4 : relative service quality concerning the marketing program	0.0029	(4)
Switching Cost: U^*		
u_1 : switching cost concerning the personal custom	0.0810	(3)
u_2 : switching cost concerning the reselecting a convenience store on the electronic map	0.2465	(1)
u_3 : switching cost concerning the distance	0.0818	(2)

* () express the ranked of weights

Figure 5.24 shows the relationships between control variables and dependent variable. Figure 5.25 explains the distribution situation in the control space of our

study samples, the x -axis shows the relative service quality of CVS.com and 7-11.com, while the y -axis expresses the switching cost. Frequency distribution of the latent dependent variable (X^*) and independent variables (U^* and V^*) are presented in Figs. 5.26-5.28. Further support for the cusp model is provided by Figure 5.23, which reveals that the dependent variable X shows clear signs of bimodality.

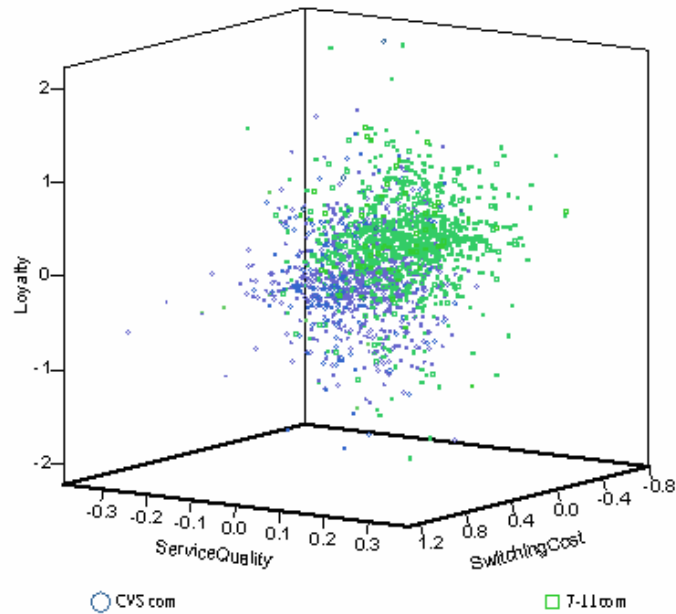


Figure 5.21 Relationships between Control Variables and Dependent Variable

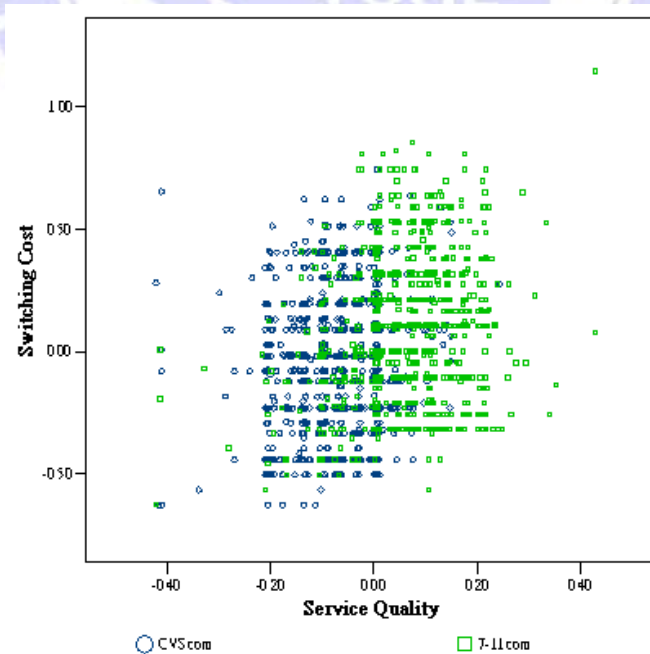


Figure 5.22 Latent Splitting Variable U^* by the Normal Variable V^*

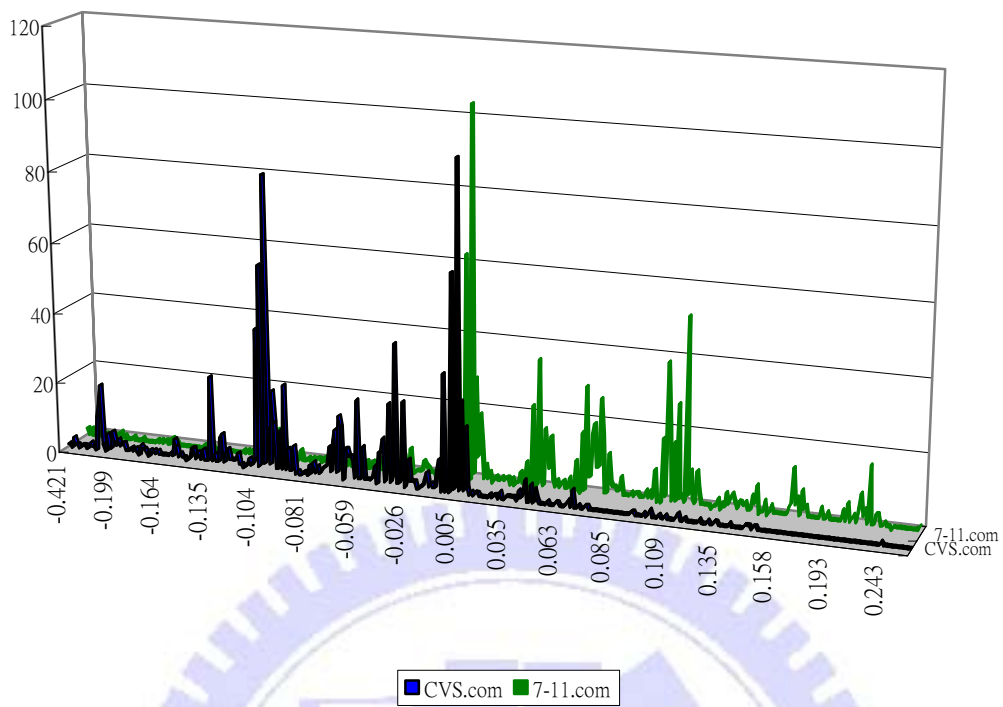


Figure 5.23 Frequency Distribution of the Latent Dependent Variable V^*

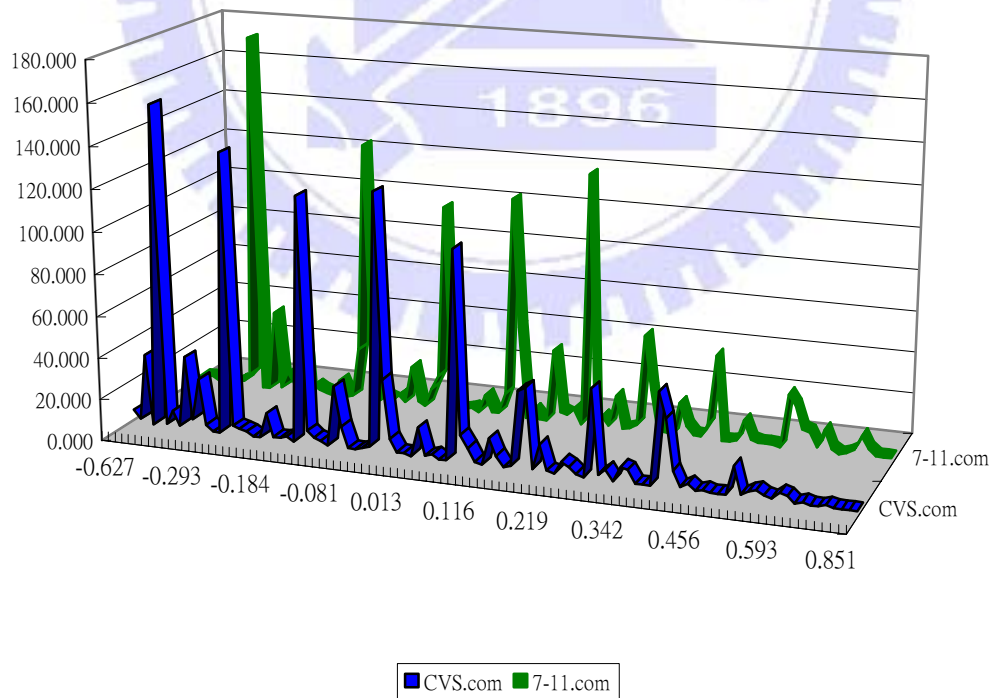


Figure 5.24 Frequency Distribution of the Latent Independent Variable U^*

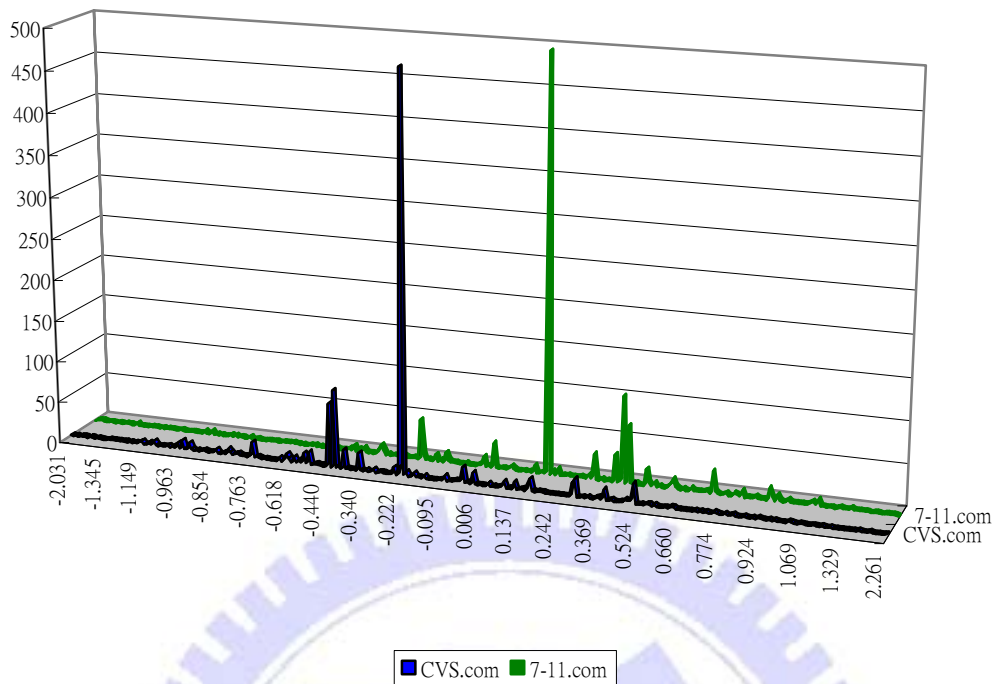


Figure 5.25 Frequency Distribution of the Latent Dependent Variable X^*

Hessian discriminate can judge systematic stability. Let's reconsider the cusp catastrophe model; the corresponding gradient dynamic system is given by Eq. (5.9).

$$\frac{\partial F}{\partial x} = -x^3 + ux + v = 0 \quad (5.9)$$

Hence, the behavior manifold is the graph of Eq. (5.10).

$$M_F : \{(u, v, x) \mid -x^3 + ux + v = 0\} \quad (5.10)$$

The catastrophe set is by Eq. (5.11).

$$K = \{(u, v) : 3x^2 - u = 0\} \quad (5.11)$$

To sketch K in the (u, v) plane, we go on step further. In parameter space C , the relation between u and v given on K can be calculated from the fact that (u, v) satisfies the formulas in Eq. (5.10) and Eq.(5.11):

$$x^3 - v - ux = 0, \quad 3x^2 = u$$

Hence,

$$v = x^3 - ux = x^3 - 3x^3 = -2x^3$$

$$\Rightarrow v^2 = 4x^6 = 4(x^2)^3 = 4(u/3)^3$$

We conclude that

$$k = \{(u, v) : 27v^2 = 4u^3\} \quad (5.12)$$

The Hessian discriminate is expressed with the symbol “ K ”. This allows us to examine how the potential function looks in various regions of parameter space as well as in the set K itself, as Figure 5.26 shows. When the Hessian discriminate is greater than zero, the system only has a steady equalization point; if Hessian discriminate is smaller than zero, the system will have two steady equalization points and an unstable equalization point. According to the difference in service quality, switching cost and Hessian discriminate (K), Figure 5.22 can be divided into two parts, as shown in Figure 5.26 (a) and Figure 5.26 (c).

In Figure 5.26 (b), the x -axis is the relative loyalty of our research sample when the Hessian discriminate is greater than zero. The y -axis is the frequency of loyalty of the sample. We find that some customers are loyal to 7-11.com while some customers are loyal to CVS.com (see Figure 5.26 (b)). When the Hessian discriminate is smaller than zero as seen in Figure 5.26 (c), most samples show that customers are loyal to CVS.com.

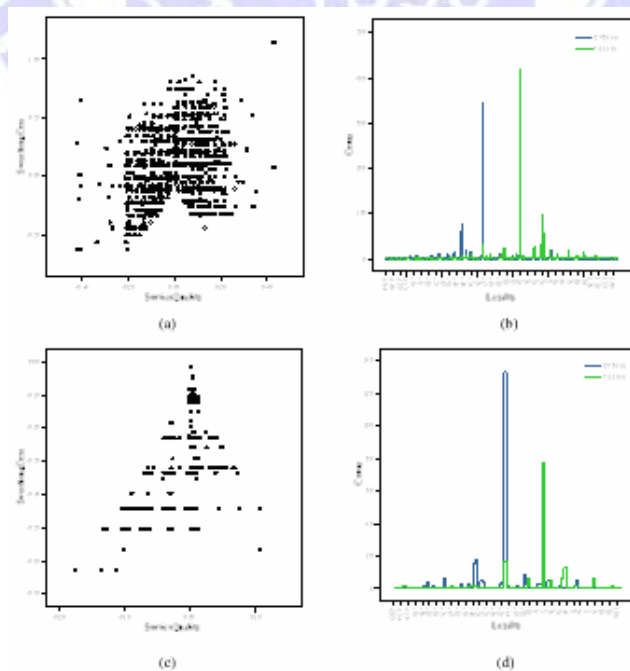


Figure 5.26 Plot of Service Quality versus Switching Cost by Different K

5.4 Model Dynamic Analysis

In the previous section, we have demonstrated the efficacy of GEMCAT II for testing catastrophe models; next, a computer program code with Visual Basic was performed on a personal computer as shown in Figure 5.27. The program developed by this dissertation includes three functions: the first function is exploring the cusp catastrophe theory by the visual interface, the second function is showing the five characteristics of the cusp catastrophe model, and the third function is dynamic analysis of the cusp catastrophe model by changing the control variable.

Figures 5.28 and 5.29 show different associations of the potential function of the cusp model in various regions of control variables of u_i and v_i . Ranked the weights of all control parameters of u_i (switching cost) as shown in Figure 5.28, “reselection electronic map” is the main index of the splitting factor, and in all of the control parameters of v_i (service quality), “relative service quality concerning the electronic map” is the main index of the normal factor.

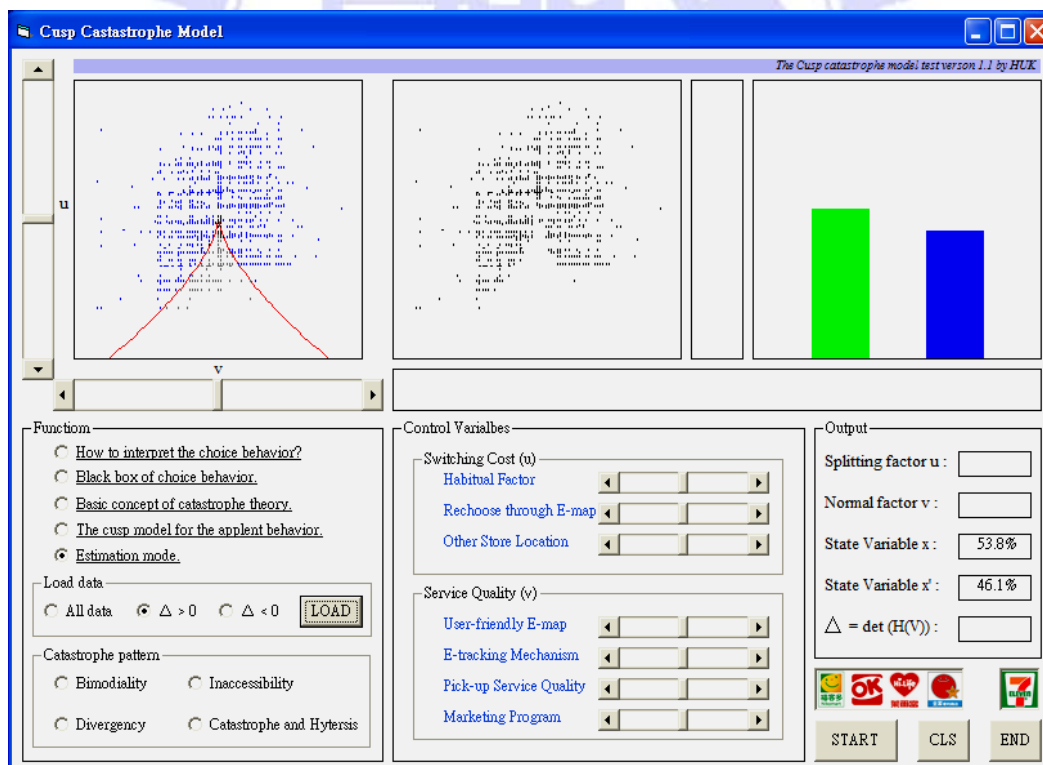


Figure 5.27 Cusp Catastrophe Model Dynamic Analysis by Visual Basic

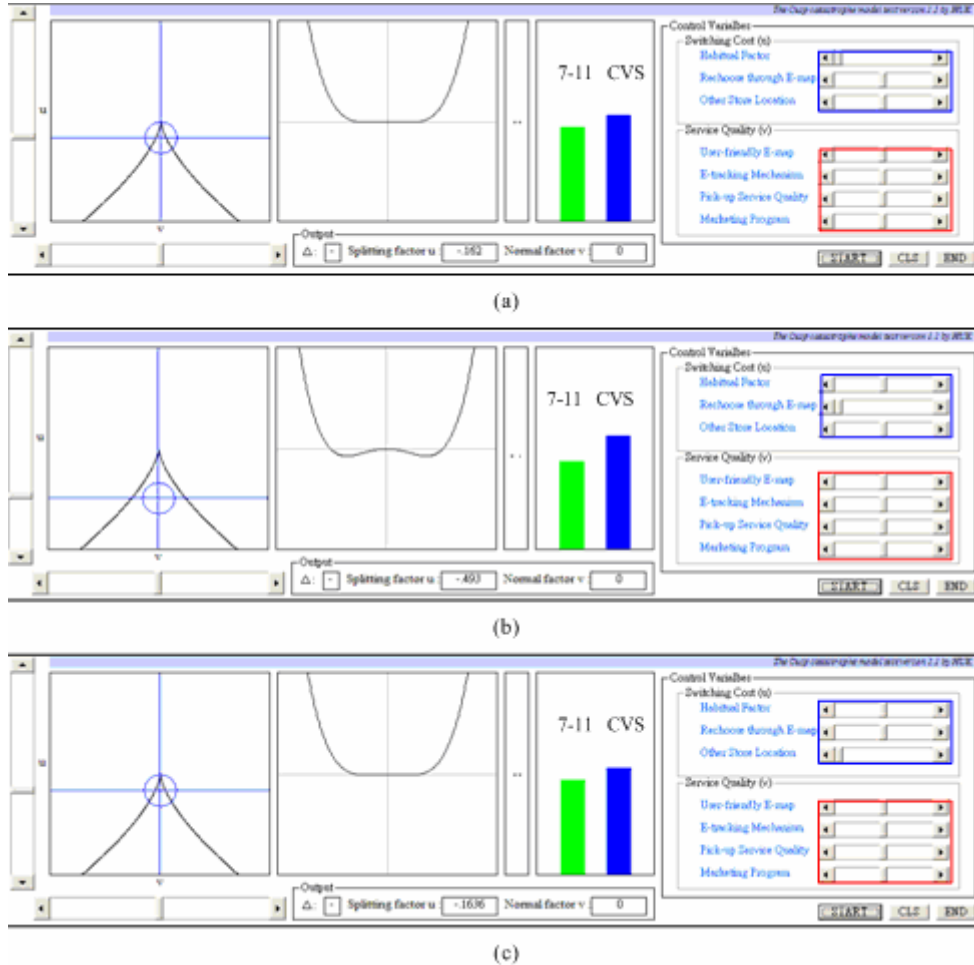
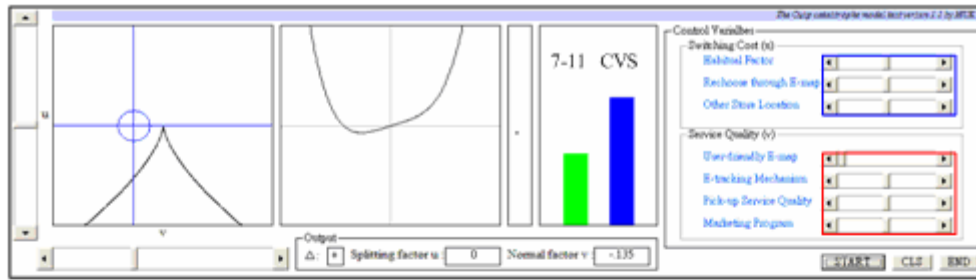


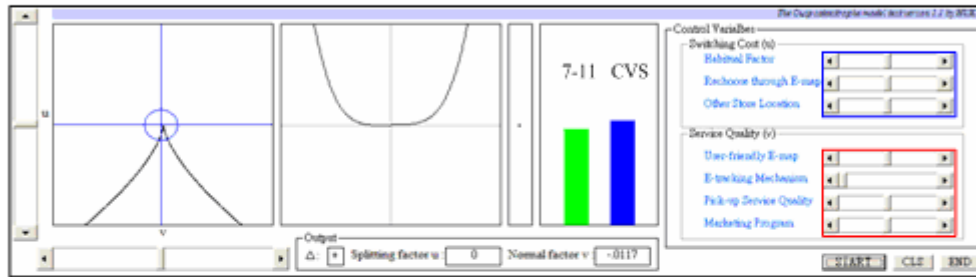
Figure 5.28 Types of potential function of cusp model in various regions of u_i

The catastrophe theory indicates that different control variables set shows different states of the dependent variable. We select four different sets of control variables when $U^* > 0$ to explore the phenomenon as shown in Figs. 5.30 and 5.31.

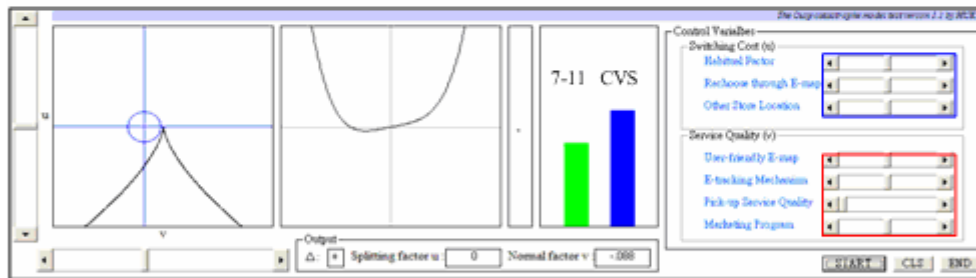
Figure 5.30 shows the control space separated from different sets of control variables (splitting variable U^* and the normal variable V^*) and the Hessian discriminate. Block A means control variables $U^* < 0$ and $V^* < 0$ (switching cost is high and service quality of CVS.com is also high) but the Hessian discriminate > 0 as shown in Figure 5.30 (Block A). Block B means control variable $U^* < 0$ and $V^* < 0$ (switching cost is high and service quality of CVS.com is also high) but the Hessian discriminate < 0 . Block C means control variable $U^* < 0$ and $V^* > 0$ (switching cost is high but service quality of CVS.com is low) but the Hessian discriminate < 0 . Block d means control variable $U^* < 0$ and $V^* > 0$ (switching cost is high but service quality of CVS.com is low) but the Hessian discriminate > 0 .



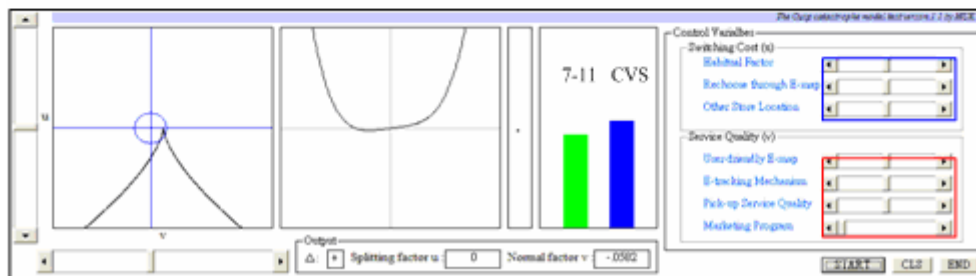
(a)



(b)



(c)



(d)

Figure 5.29 Types of potential function of cusp model in various regions of v_i

In Figure 5.30, we are interested in the control variable set when switching cost is high because high switching cost will cause nonlinear behavior. Contrast to Figure 5.30, Figure 5.31 shows different distribution of behavior types. In Figure 5.31, the x -axis is the relative loyalty of our research sample when switching cost is smaller than zero and is described by different service quality, and the y -axis is the frequency of loyalty of the sample

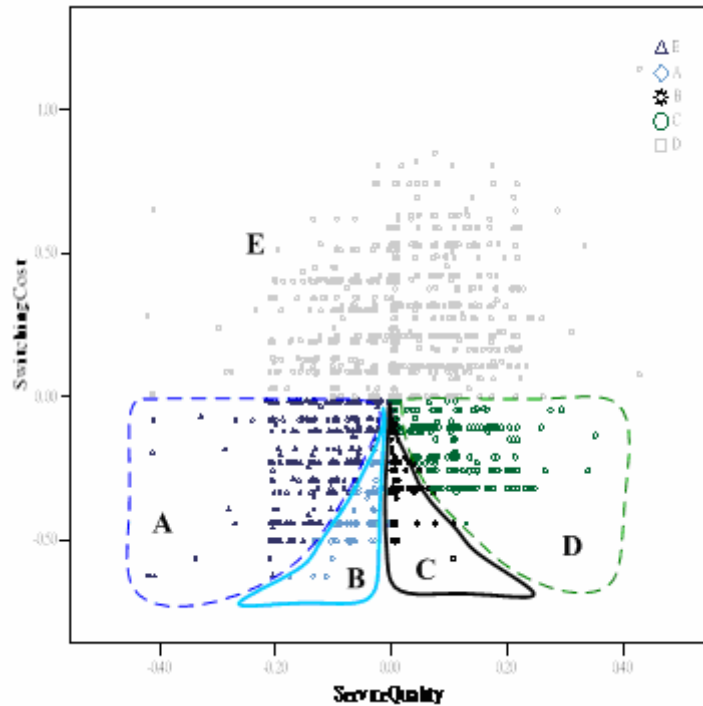


Figure 5.30 Control Space Separate from Different Control Set

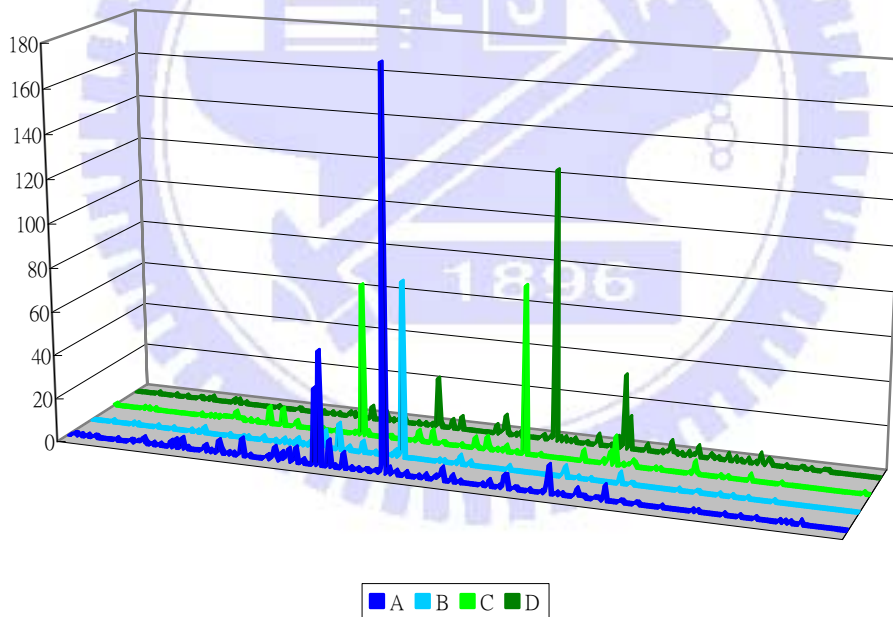


Figure 5.31 Distributions of Different Behavior Types

Consider the distribution of behavior type in Fig 5.31, when service quality of CVS.com is high, most samples show that customers are loyal to CVS.com (see Figure 5.31 (behavior types A and B); when service quality of CVS.com is low and the Hessian discriminate is greater than zero, customers are loyal to 7-11.com. An interesting phenomena is distribution of behavior type C when switching cost is high and service quality of CVS.com is low but the Hessian discriminate is smaller than

zero, some samples indicate that they are loyal to 7-11.com while some customers are loyal to CVS.com. The finding supports once again the characteristic of bimodality.

Next, we will discuss the nonlinear behavior of our behavior model developed by the cusp catastrophe model using software developed of this thesis. Figure 5.32 presents our mapping of the control variables onto the catastrophe surface structure. The projection of the fold curve into parameter space C yields the catastrophe set K . The b_4 and b_3 are trajectories in C that determine corresponding trajectories B_4 and B_3 of equilibrium behavior. Consider the surface shown in Figure 5.32, there are some points of the plane that map to three points, and some that map to two points (those on the border of the shaded region) or one point.

System dynamics occur on the surface of the model in Figure 5.32. Changes in position result form changes in U (switching cost) and V (service quality), causing changes in X (loyalty). If U 's magnitude is small, then smooth change occurs in X (loyalty), directly proportional to change in X (loyalty), as depicted by Path D as shown in Figure 5.32. Small difference in the initial starting positions (e.g., Points A_1 and A_2) can result in vastly different values for X (loyalty) as the magnitude of the U (switching cost) variable increases beyond the point where the pleat starts. This can be seen in Figure 5.32, where A_1 is driven downward, and A_2 is driven upward. At high values of U (switching cost), large changes in V (service quality) will produce relatively small changes in X . At some point, however, a sudden discontinuous shift in X (loyalty) will occur that reverses system behavior from its previous state. This is shown by examining the travel from Point B_4 to B_3 as depicted by Path C in Figure 5.32. Note that once the shift has happened, reversing the values of V will not cause a substantial downward change in X (loyalty). There must be a significant reversal in U (switching cost) before a shift down to point B_4 will occur. These lags in response are aggravated or mitigated by the size of the U (switching cost) variable. Within the cusp area, the dependent variable can take on two possible values for a given (V, U) pair. This characteristic allows the modeling of lag effects (hystereses).

The area bounded by the cusp is the region within which such anomalous behavior take place. This is represented by Points A-D in Figure 5.33, keeping in mind that this is a projection of the surface onto the independent variable plane.

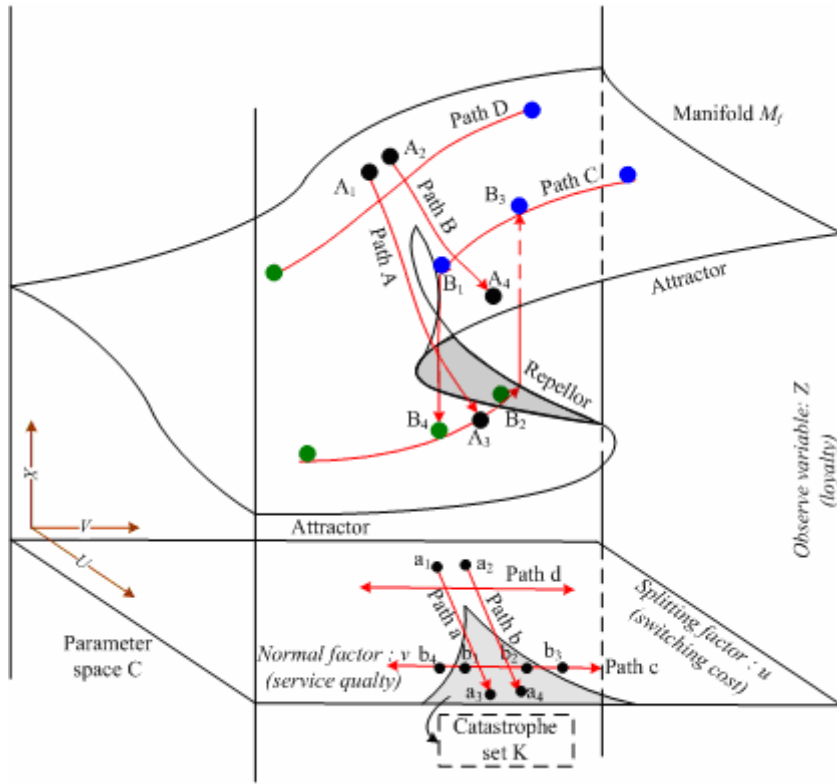


Figure 5.32 Behavior Manifold of the Cusp Catastrophe Model

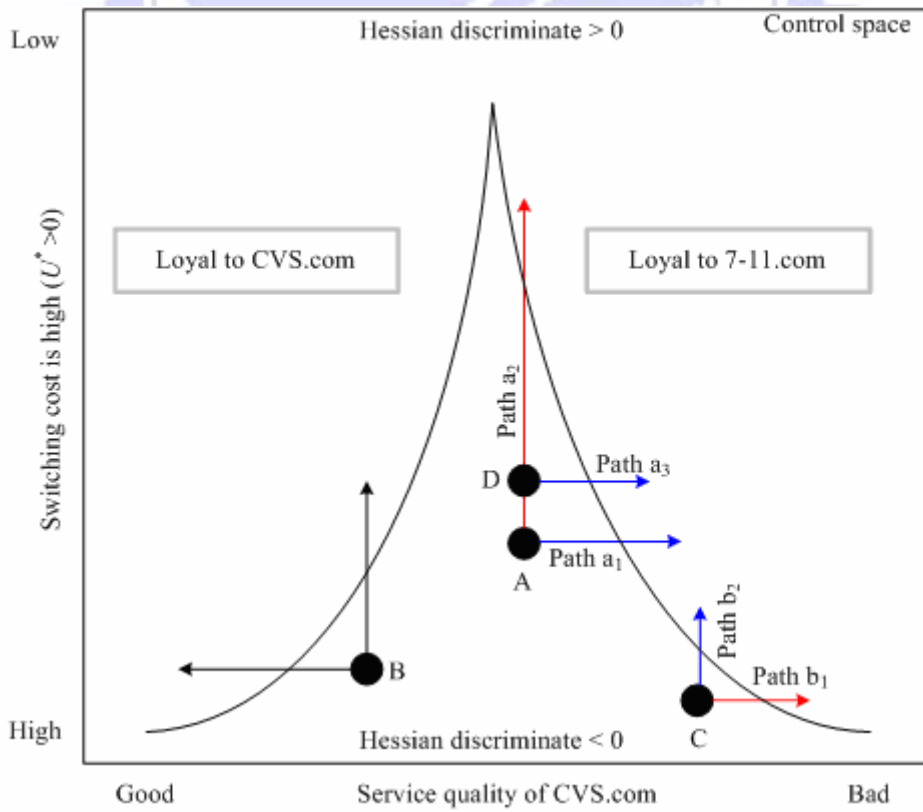
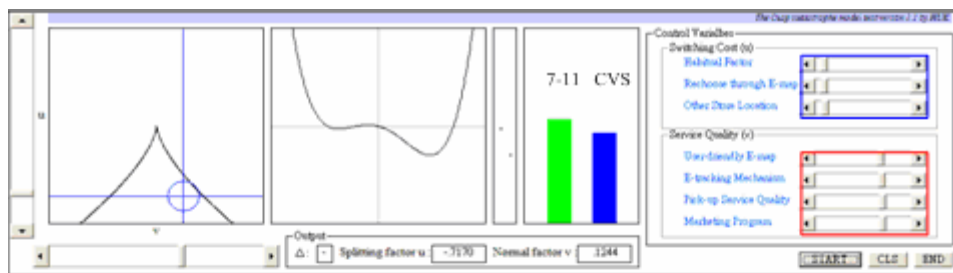
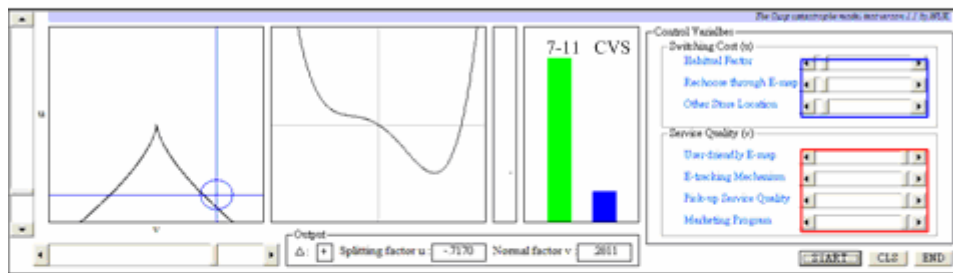


Figure 5.33 Locus on Shift Projected on the Control Variable Space

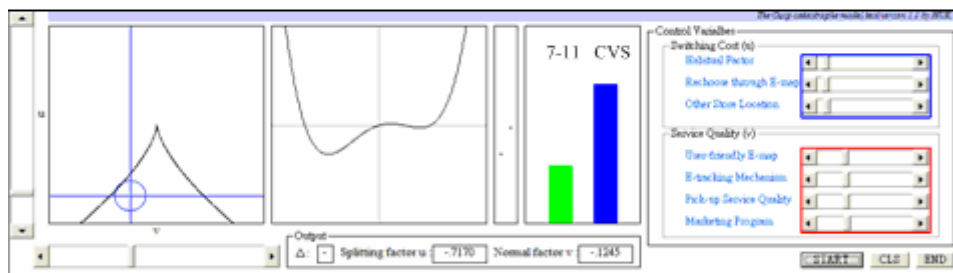
Returning to Figure 5.33, one sees that location within the cusp leads to different implications regarding behavior. From the point of view of 7-11.com, if a consumer is dissatisfied with CVS.com, which has a high switching cost, improving service quality (path a_1) is inefficient compared with trying to reduce the intensity of switching cost (path a_2) as indicated by Point A. The horizontal distance to the cusp's right edge is farther than its vertical distance. This assumes that switching cost can in some sense be managed. For another consumer who is dissatisfied with CVS.com, which has a high switching cost at Point C, the reverse is true, and markers are better off improving service quality than trying to manage consumer's switching cost. Figures 5.34 and 5.35 show the dynamic analysis above presents by our software.



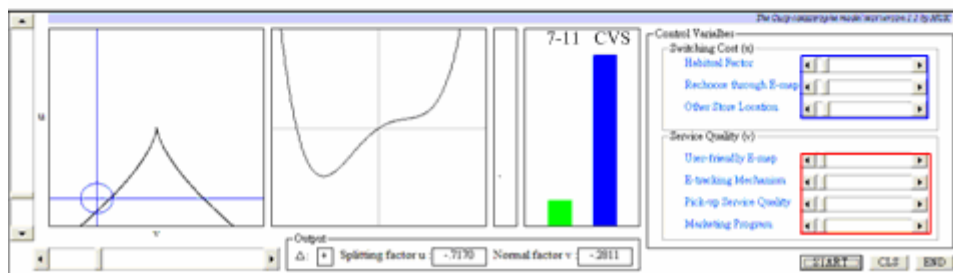
(a)



(b)



(c)



(d)

Figure 5.34 Dynamic Analyses by Changing Control Variable V^*

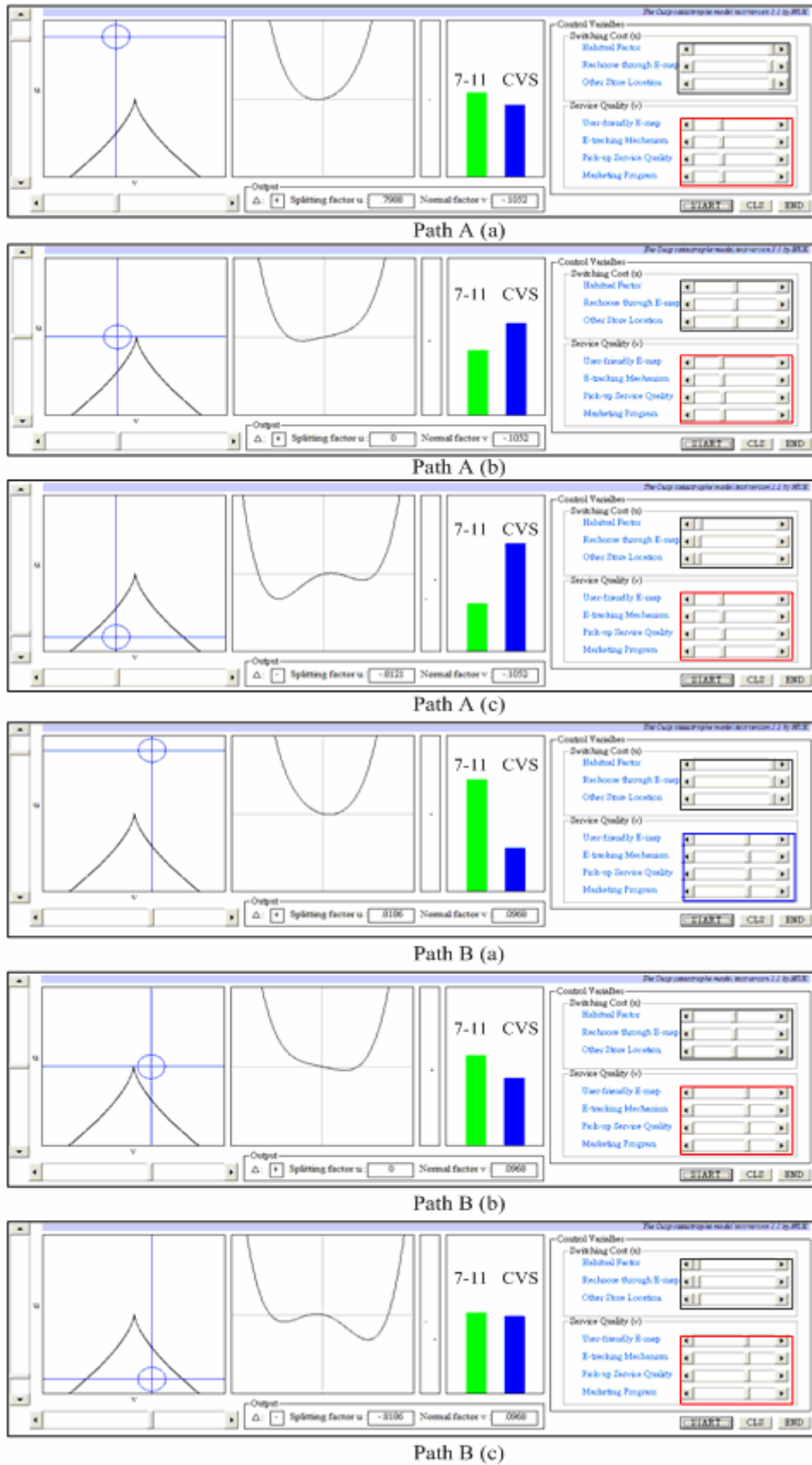


Figure 5.35 Dynamic Analyses by Changing Control Variable U^*

5.5 Developing Loyalty Strategies and Case Study

Moving from the more tactical issues discussed in the illustration to more strategic issues pertaining to service strategy in general, our research indicates that, depending on switching cost, the relation between service quality and loyalty can be nonlinear, at least for some facets of service. This finding has important implications for loyalty strategies and decisions on how to deploy a limited budget across different opportunities to enhance service, given that competitors are making similar decisions. The cusp catastrophe model have five important features, we develop our four different types of loyalty strategies via the catastrophe characteristic and the hysteresis characteristic in this section as shown in Figure 5.36.

We take CVS.com as an example and develop loyalty strategies via the cusp catastrophe model. Clustering analysis to identify convertible consumers is the first step of developing loyalty strategy. As shown in Figure 5.36, it is difficult for any strategies to change a consumer if he or she is very satisfied with 7-11.com or switching cost is very high. Idea-convertible consumers must have medium switching cost and there should be difference in service quality between 7-11.com and CVS.com (see Figure 5.36).

According to our analysis above, switching cost and service quality are the two main factors influencing loyalty. That is, when perceived switching costs are low, dissatisfied consumers should be more likely to defect than satisfied customers because perceived switching benefits outweigh perceived switching costs. Simply speaking, when perceived switching costs are high, customers may remain in spite of their dissatisfaction owing to the perceived switching benefits. Thus, the relationship between customer satisfaction and loyalty is stronger for customers with high switching costs than for those with low switching costs.

Service quality and switching cost are the control variables in our cusp catastrophe model; we will discuss these factors briefly here. Switching cost is the customer's perception of loss in terms of time, money, and psychological costs when switching. Many studies argued that it is defined as perceived risks when switching service providers, the potential losses are of financial, performance-related, social, psychological, and safety-related nature. When a customer changes a service provider, there exists some uncertain perceived risks that a new supplier might not perform the core service at a level equal to, or better than, the current supplier. Clearly, switching costs seem to be an important element when deciding whether to switch a service provider or not. Because the indicator u_3 (switching cost concerning the distance) has the greatest impact on loyalty among the different indicators of switching cost, one of

these loyalty strategies will be related to indicator u_3 .

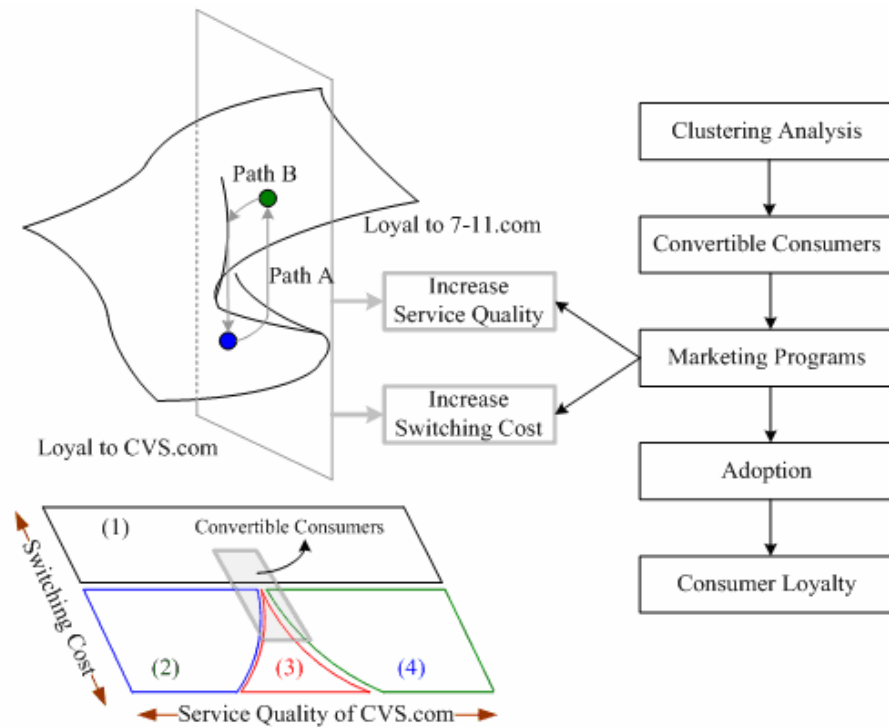


Figure 5.36 Developing Loyalty Strategy via Catastrophe Model

From the short-term point of view, indicator v_4 (marketing program) is the most important factor among the four indicators of service quality of the control variables u_i . Sales promotions can encourage consumers to either buy larger quantities of the promoted product or buy that product at an earlier time. By definition, the objective of sales promotions is to offer a direct incentive that affects consumers to accelerate their purchase.

The cusp catastrophe model has two important features: catastrophe and hysteresis, we use these characteristics to develop three different types of strategies. Table 5.5 shows the details of the three strategies.

Table 5.5 Difference of Loyalty Strategies

Strategy	Details
Strategy A	A consumer choosing the CVS.com as a pick-up point will get 200 point of exchange premium.
Strategy B	Some useful hints on the webpage to CVS.com.
Strategy C	The e-retailing supplies the quick ordering system to CVS.com

Data for testing the effect of different strategies are collected from Payeasy.com² (<http://www.payeasy.com.tw>). Figure 5.37 presents the web application Strategy A of Payeasy.com, the strategy means when consumer chooses the CVS.com as a pick-up point; he or she will get 200 points of exchange premium per order. As seen Figure 5.38, some useful hints on the webpage to CVS.com are applications (Strategy B). In this case as shown in Figure 5.38, Payeasy.com proposes that online shopper chooses CVS.com for delivery issue during the promotion. Application of Strategy C is shown in Figs. 5.39 and 5.40. Payeasy.com only supplies the quick ordering system to CVS.com. For a consumer who is loyal to CVS.com, reselecting a convenience store on the electronic map is not necessary when reordering at Payeasy.com because of Strategy C.



Figure 5.37 Application of Strategy A

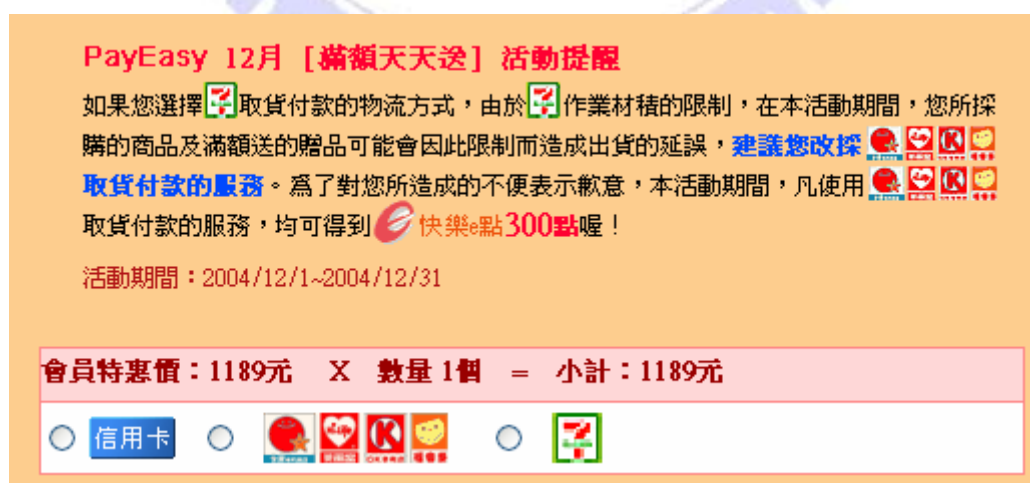


Figure 5.38 Application of Strategy B

² Most members of this website are female; the website has more than 1,500,000 members and more than 400,000 orders per month.

Step3. 進行 取貨付款結帳：選擇CVS取貨門市 → 完成CVS門市確認

感謝您使用「CVS取貨付款」方式索取/購買本商品
... 您目前有禮券0元 / 您目前有快樂e點數246點

商品名稱	單價	點數	數量	禮券	現金小計	點數小計
百合茉莉純花滋養面膜(我要一入)	299元	0點	1個	0元	299元	0點
					本次購物金額總計	299元
					本次購物貨運或商品被領取後，您將獲得快樂e點總計	45點

取貨資料明細

取貨人姓名：

取貨人行動電話：

聯絡信箱： **注意事項**
為確保您的交易訂單及其他重要通知確實收到，建議使用收信狀況穩定的信箱或公司E-mail；
●pc-home 等免費E-mail信箱，時有不穩定且無法收取E-Mail之情形，建議您勿填寫。

贈品寄送郵遞區號：

贈品寄送地址：

以上個人資料若有修改，我願意一併異動個人資料，日後將以此資料為連絡方式

發票抬頭：

統一編號： 二聯式 三聯式，統一編號

[快速結帳] 前次交易門市如下：

門市店名：

門市地址：

Figure 5.39 Application of Strategy C (CVS.com)

Step3. 進行 取貨付款結帳：選擇7-11取貨門市 → 完成7-11門市確認

感謝您使用「7-11取貨付款」方式索取/購買本商品
... 您目前有禮券0元 / 您目前有快樂e點數246點

商品名稱	單價	點數	數量	禮券	現金小計	點數小計
百合茉莉純花滋養面膜(我要一入)	299元	0點	1個	0元	299元	0點
					本次購物金額總計	299元
					本次購物貨運或商品被領取後，您將獲得快樂e點總計	15點

取貨資料明細

取貨人姓名：

取貨人行動電話：

聯絡信箱： **注意事項**
為確保您的交易訂單及其他重要通知確實收到，建議使用收信狀況穩定的信箱或公司E-mail；
●pc-home 等免費E-mail信箱，時有不穩定且無法收取E-Mail之情形，建議您勿填寫。

贈品寄送郵遞區號：

贈品寄送地址：

以上個人資料若有修改，我願意一併異動個人資料，日後將以此資料為連絡方式

發票抬頭：

統一編號： 二聯式 三聯式，統一編號

Figure 5.40 Application of Strategy C (7-11.com)

In Figure 5.36, Path A implies the catastrophe characteristic and Path B implies the hysteresis characteristic. There are two goals of the strategies: one is to attract the rival's consumers to choose the retailing delivery service of CVS.com (make

catastrophe phenomenon occur), and the other is to try to keep the existing consumers (make hysteresis phenomenon occur).

We collect the order materials of Payeasy.com (2004.10-2005.2). Figure 5.41 shows the performance for different loyalty strategies of our research case. Using marketing program A, CVS.com accounts for 56% to 58% of the retailing delivery market occupation rate of Payeasy.com (see Figure 5.41). When using marketing program B, the difference in orders between 7-11.com and CVS.com is reduced by 45%; at this time, the market proportion of CVS.com is 72.5%. An interesting phenomenon occurred in January of 2005 when Payeasy.com stops all marketing programs, and the market proportion of CVS.com is 53.4%. There is almost no difference between marketing program A and no marketing program. In February of 2005, the market proportion of CVS.com rises to 56.5% because of marketing program A.

Figure 5.41 shows the two catastrophe flags; one is bimodality and the other is hysteresis. Marketing program B begins in December of 2004, and gets very good results, showing that consumers will deflect. In this case, the feature (catastrophe) of the cusp catastrophe model appears due to Strategy B. When using Strategy B, the difference in orders between 7-11.com and CVS.com is reduced by 53.4% when the catastrophe feature occurs. When all marketing activities stop, we can find that CVS.com still maintains a lead due to the hysteresis phenomenon occurring via Strategy C. We will discuss the impact of different strategies using the cusp catastrophe model in the following.

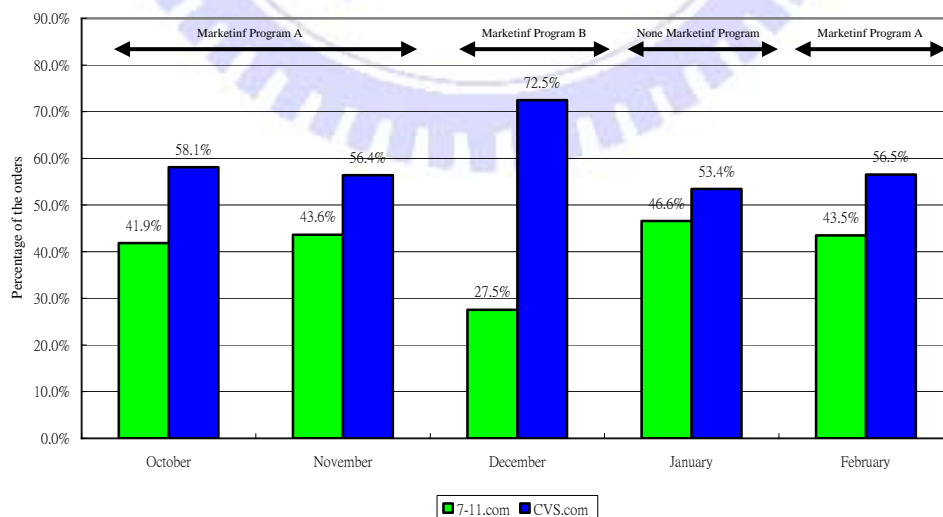


Figure 5.41 Empirical analysis³

³ Payeasy.com only supplies the quick ordering system (strategy C) to CVS.com.

As shown in Figure 5.42, according to different parameter associations, the control space can be divided into three different cases. Case 1 describes smooth continuous movement in behavior, given small changes in the independent variables. Case 2 implies that there are two likely equilibrium states and one unlikely state. These two equilibrium states represent the two standards between which consumers are switching, such that there is no halfway or mid-ground position. Case 3 describes the locus of points where sudden switches occur between equilibrium states. Note that there are two different thresholds; one is for change from loyalty to CVS.com to loyalty to 7-11.com, and the other is for change from loyalty to 7-11.com to loyalty to CVS.com. Small changes in the independent variables will result in the market staying at the current standard unless one of these points is crossed. When this happens, a sudden shift in equilibrium states occurs and consumers switch to the other standard.

Group A comprises consumers loyal to 7-11.com and Group B comprises those loyal to CVS.com. The effect of Strategy A and Strategy B is improving the service quality of CVS.com using marketing program. Different effects of Strategy A and Strategy B is shown in Figure 5.42 [a] and Figure 5.42 [b]. Some consumers will change their loyalty from 7-11.com to CVS.com because of marketing programs A and B (see Figure 5.42; Path A explains the catastrophe characteristic). Strategy C will increase the switching cost effectively for those who are loyal to CVS.com (see Figure 5.42 Path B). There are no marketing programs in January of 2005 (the service quality of CVS.com is relatively low). Path C describes the occurrence of hysteresis characteristic because of high switching cost as shown in Figure 5.42.

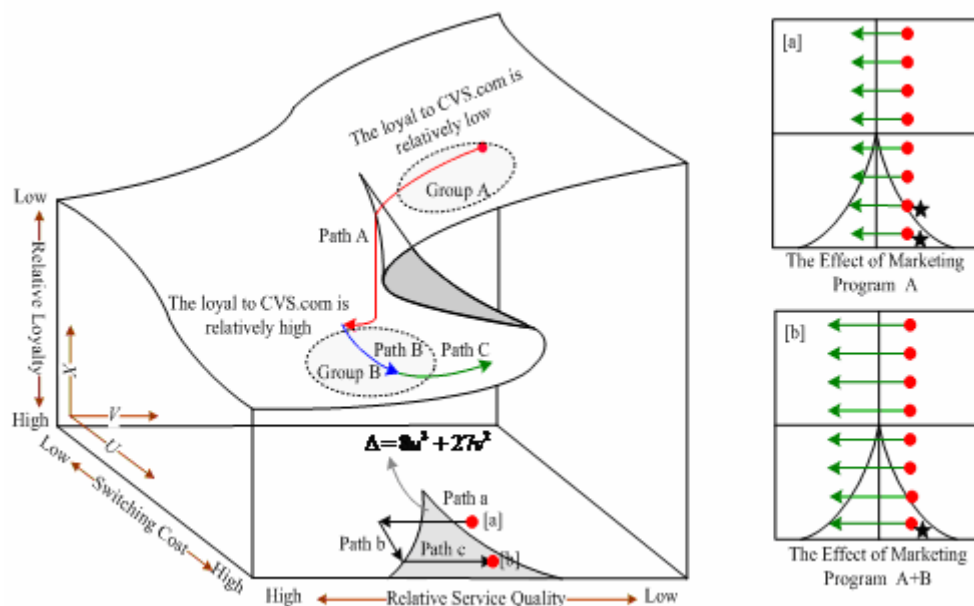


Figure 5.42 Representation of the Switching Behavior between Different Strategies