Modeling Brand Extension as a Real Option: How Expectation, Competition and Financial Constraints Drive the Timing of Extensions

Lenny H. Pattikawa

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Email address corresponding author	pattikawa@few.eur.nl
Address	Erasmus Research Institute of Management (ERIM) RSM Erasmus University / Erasmus School of Economics Erasmus Universiteit Rotterdam P.O.Box 1738 3000 DR Rotterdam, The Netherlands Phone: + 31 10 408 1182 Fax: + 31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

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ABSTRACT AND KEYWORDS	
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Drs. Lenny H. Pattikawa
Phd Candidate ERIM (Erasmus Research Institute of Management)
Erasmus School of Economics and Business Economics
Erasmus University Rotterdam
P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
pattikawa@few.eur.nl,
Room H9-01, Tel: (+31) 10 4081321, Fax: (+31) 10 4089031

1. Introduction

Brand extensions have become an increasingly attractive growth strategy for many firms. This is due mostly to the increasing cost and high uncertainty involved in launching a new brand. Indeed, the cost of launching a product with a new brand name can be three times as high as that of launching a brand extension (Tauber 1988). No wonder that brand extensions accounts for as many as 95% of all new consumer product introductions (Aaker, 1991).

Although marketing literature provides various studies on brand extensions, the focus have been on the consumer research and the effect of brand extension on performance. Study on what drive firm to launch brand extension is still scarce. The existing research that studies the determinants of firm's decision to launch brand extensions focuses on conceptual approach and theoretical approach (Dias & Ryals 2002, Choi 1998, Amber & Styles 1997). In this paper, we aim to provide insights on brand extensions behaviors of pharmaceutical firms by using real option approach. Especially, we want to model firm's behavior in launching brand extension and argued that decisions to extend brand is consistent with real option framework. Borrowing concept from financial option, we show that firm's decision to extend a brand can be compared with the mechanism of call option. Firms that have launched a new brand and invest considerably amount on advertising not only enhance brand equity, but also create option in the form of the choice to launch an extension, which can be used to cope with unfavorable outcomes in the future.

In the next section we discuss the related literature in the marketing on brand extension. We also present some recent research on the application of real option in the economic and management literature. Section 3 presents our theoretical framework, where we explain how real option can be used to model firm behavior in brand extension. We also present our hypothesis based on real option literature. Section 4 describes how we model firm's decision to extend a brand. Section 5 explains data that we used and how we select our sample. Sections 6 present the results of our study. Section 7 summarizes our findings and discusses some implication for future research.

2. Related Literature

Marketing literature has provided a numerous study on brand extensions. However, the focus has been on the impact of brand extensions, both from consumer perspective as well as in term of financial performance. Earlier studies on extensions were typically conducted in laboratories with hypothetical brand extensions described to the participants of the experiment (Aaker & Keller, 1990; Keller & Aaker, 1992). For example, Aaker & Keller (1990) performed several experiments to show how consumers form attitudes toward brand extensions. They found that consumers associations of brands have positive relation with successful brand extensions. Later on, studies on brand extensions started to focus on financial performance. Swaminathan, Fox and Reddy (2001) investigated the impact of the introduction of a new brand extension on consumer choice in a behavioral context. They found that in the case of successful brand extension, the consumer trial has positive effect on market share of parent brand. Sullivan (1992) studied the impact of order of entry on the performance of brand extensions. This study shows that brand extensions can take advantage of the market share premia from their established brand names when entering late. Reddy, Holak, and Bhat (1994) studied the determinants of line extensions success for 34 cigarette brands. Their results indicate that parent brand strength and its symbolic value, early entry timing, a firm's size, marketing competencies and advertising contributes positively to the success of line extensions.

Despite the valuable contributions of the brand extensions research, research on the firms' motivation behind launching brand extensions is still in the early phase. Ambler & Styles (1997) is perhaps the first empirical studies on firms' motivation in launching brand extensions. They studied the managerial process that lead to the launch of successful brand extensions by using case study methodologies. They concluded that extension decisions are more about brand development than new product development. Choi (1998) presented a theoretical framework of brand extensions as an informational leverage. This paper shows that brand extension helps a multi-product monopolist to introduce a new experience good with less price distortion. Dias & Ryals (2002) is another conceptual paper on this issue, which used real option thinking to value brand extensions. This framework takes into account the firms' flexibility to extend or not to extend brand extensions. In spite of this interesting theoretical framework, there has not ant empirical study to test this framework.

The current paper performs an empirical study on firms' behavior in brand extensions by using real option framework. Real options framework has gained popularity in recent years both in business and economics' applications. A recent economic paper, Bulan (2005) investigates whether real option models can explain the relationship between firm investment and uncertainty. This study shows that higher uncertainty reduced firm incentives for investing. One study from strategic management literature performed by McGrath and Nerkar (2004) investigate firm's R&D investment behavior in applying a second patent as the commitment to grow further in that area. They found that the impact of the first patent, firm's prior experiences, and intense of competition influence the propensity to apply for the second patent, hence show a commitment to invest further in that area. Another interesting study on the application of real option is performed by Quigg (1993), which examined the empirical predictions of real option pricing model. Her model has explanatory power for predicting transaction prices over and above the intrinsic value. In some, the application of real option has been studied wide-ranging. Our focus is to apply real option framework on firms' decision in the timing of brand extensions.

3. Theoretical Framework and Research Hypothesis

We start from the premise that a firm launching a brand extension can be compared with an agent exercising a call option in a financial market. In the financial terminology, having a financial option means having the right, but not the obligation, to either buy or to sell an underlying asset at a given price within a specified time. In the financial market, possession of an option protects the holder from the risk that the price of underlying assets changes in the future. A call option confers the right to buy a security at a fixed price. By analogy, an investment in real option bears the right, but not the obligation, for a firm to make further investment or to delay or even to stop such investments. Following Dias & Ryals (2002), we argue that launching a new brand and investing in brand equity can be compared with buying a call option. Launching a new brand involves a considerable amount of investment, including advertising cost to promote the new brand. Although this cost is irreversible, it creates possibilities for firms to extend the brand in the future, depending on the future circumstances. For example, a firm can decide to extend a successful brand as an offensive strategy against the closest competitor that launched a new brand in the market. Or, a firm might decide to launch an extension as the cost of capital increase. Following this line of reasoning , launching a brand extension is comparable with firm exercising a call option. Firm has the right to launch brand extension, but not the obligation.

In the economic literature, relationship between uncertainties and investment has been studied quiet intensively[1]. Applying to firm's investment decision, option gives firm flexibility in a dynamic and uncertain environment. This flexibility is valuable due to the irreversibility of investment and uncertain future (Bulan 2005). We assume that firms' motivation to exercise option by extending a brand is to cope with uncertainty regarding the future. Hence, the familiar situation regarding the work of financial option prevails: the greater the uncertainty in the future the more valuable the decision to exercise option in order to hedge against uncertainties.

[1] See for example: Caballero & Pyndick, 1996; Ghosal & Loungani 1996, 2000; Holland, Ott, & Riddiough, 2000

We define three sources of uncertainties: (1) uncertainty regarding the expectation on stock market volatility, both at the firm level and industry level, (2) uncertainty regarding firms' investment opportunities and (3) threat from competition.

Expectation Regarding Stock Market Movement

Bulan (2002) investigates the role of firms' expectation on stock market volatility in real option empirical applications. He found that both firm specific uncertainty, measured in firm stock price volatility, and industry specific uncertainty have negative effect on firm's investment. Applying to our case, we argue that the greater the uncertainty the more reluctant firms to invest in high risk projects such developing a new product or launching a new brand. Launching brand extension, on the other hand, provides a good alternative when the expectation about the future is highly uncertain. Investment on brand extension is relatively more cost efficient compared to launching a new brand. Hence, we argue that the higher the uncertainty, the more probable that firm exercise their option by launching brand extensions. Following Bulan (2005) we construct uncertainty as firms' expectation regarding stock market volatility. We decompose uncertainty into firm-specific uncertainty and industry-specific uncertainty.

Hypothesis 1: The higher the firm specific uncertainty is the higher firm's propensity to extend their brands.

Hypothesis 2: The higher the industry specific uncertainty is the higher firm's propensity to extend their brands.

Financial Constrains

Financial constraints are critical factors in firms' investment decisions (Fazarri, Hubbard & Petersen, 1988). Firms that have abundant financial resources are more inclined to take up riskier project such as developing a new product of launching a new brand. On the contrary, firms that lack financial resources to undertake investments tend to take a more low-cost and less risky investment, such as launching brand extensions. We categorize two financial resources; (1) leverage and (2) sales. We argue that investment opportunities have negative relation with launch rate of extension.

Hypothesis 3: The higher the level of leverage, the lower the launch rate of brand extensions in the next period.

Hypothesis 4: The higher the sales performance, the lower the launch rate of brand extensions in the next period.

Competition

Competition forms one of the most important factors of uncertainties. In the strategic real option literature, McGrath and Nerkar (2004) found that competition in a certain patent area has a positive association with the likelihood of applying a second patent. In other words, competition threat stimulate firms to exercise option by investing further in the patented innovations. Applying to our case, we argue that the more intense the competition, the more pressure for firms to keep up with their competitors, and therefore the more motivation for firms to expand their brand names in the market, in order to protect their market share.

Hypothesis 5: The higher the competition pressure is the more likely that firm extends their brands.

Number of New Brands

We include number of new brands in our analysis and argue that the more firms launch new brands the more likely that they launch extensions in the next period.
Hypothesis 6: The higher the number of new brands launched, the higher the extension rate in the next period.

4. Modeling Multiple Brand Extensions

As we have dependent variable measured in time, survival analysis is the common method to apply. The traditional survival analysis assumes, however, that event times are independent. In our dataset we have most of the time multiple extensions per brand. Considering each extension as an independent random variable can yield misleading results. Not only that standard errors are incorrect, but doing this we implicitly restrict the influence of covariates to be the same across extensions when in fact there might be varying effects from one extension to the next (Box-Steffenmeier & Zorn 2000). To deal with multiple extensions, we correct the covariance matrix by using robust variance estimate (Wei, Lin & Weissfeld 1989). This *variance corrected approach* consists of three widely used variants; *independent increments model* (Andersen & Gill, 1982), *marginal model* (Wei, Lin & Weissfeld, 1989) and *conditional model* (Prentice, Williamd, and Peterson 1981). These models are different in the way they define the risk set at each extension (Cleves, Gould, Gutierrez 2004). To note, risk set is the collection of brands which are at risk at a certain point in time and this risk set defines which brand may be extended at a particular time (Box-Steffenmeier & Zorn 2002).

In Andersen & Gill model (1982), henceforth AG model, extensions are assumed to follow a nonhomogeneous Poisson distribution, i.e. multiple extensions for any particular brand are assumed to be conditionally independent. AG model assumes that the risk set at time *t* for extension *k* [2] is the same for all brands under the observation at time *t*. Following this approach, the data records, for each brand, a separate record for each of extension plus a final record containing the time in years from the last extension until the end of observation, which is in our dataset is on 31 December 2005, or a withdrawal of brand, whichever comes first. If a brand has never been extended, there was only one record, namely the one that includes the number of years since the brand is launched.

Marginal model is based on the idea of marginal risk set. In this model, the data is treated as a competing risk dataset, as if the extensions were unordered. Each extension has its own stratum and each extension appears in all strata (Cleves 1999). The dataset for marginal model required, for each brand, a separate record for each extension for the maximum overall number of extensions (the most frequent extended brand in our dataset is 14 times), plus a final record containing the time in years from the last brand launch until 31 December 2005, or a withdrawal, whichever comes first. Thus, extensions are ordered from 1 to 15

In the conditional model, the data is set up just like in AG model, except the analysis is stratified by order of extension. Furthermore, this model imposes a sequential ordering of extensions: a brand can only be at risk for its *k*-th extension if it already underwent *k*-1 extensions in the past. Conditional model has two variations (Cleves 1999). In the former, time to each extension is measured from entry of parent brand, the so-called conditional elapse time (CET) model. In the second variation, the time to each extension is measured from the previous extension, the so called Conditional Inter event Time (CIT) model.

We model the hazard of extension as a function of five lagged covariates - lagged sales, lagged leverage, lagged competition, and lagged of number of new brands launched – and two covariates measuring firms' expectation in the stock market, both at the firm level and at the industry level, measured in the current period.

[2] *k* is the order of extension; *k*=1 refers to the brand's first extension; *k*=2 refers to the second, etc.

$$ln \quad r(t) = \lambda_0(t) + \beta_1 S_{it-1} + \beta_2 C_{it-1} + \beta_3 DE_{t-1} + \beta_4 NB_{t-1} + \beta_5 \hat{\gamma}_{it}\hat{\sigma}_{it} + \beta_6 \hat{\sigma}_{\varepsilon it} + \eta_{it} \qquad (1)$$

$r(t)$ = the hazard rate of extension

$\lambda(t)$ = baseline hazard rate

S_{it-1} = sales of firm i at period $t-1$

C_{it-1} = number of new brands launched by firm i competitors at period $t-1$

NB_{it-1} = number of new brands launched by firm i at period t-1

DE_{it-1} = debt to equity ratio of firm i at period $t-1$

$\hat{\gamma}_{it}\hat{\sigma}_{it}$ = industry volatility at time t

$\hat{\sigma}it$ = firm i volatility at time t

The dependent variable is the hazard rate of brand extension, that is, the rate at which brands are extended at a given instant in time. The hazard rate is measured as the logarithm of time until brand extension is launched. The decision to exercise the option to extend is assumed to be made at the beginning of the year *t*. Sales (S), Competitions (S), Leverage (DE), and number of firm's new brand (NB) are measured as the value at the end of year *t*-1, and hence are predetermined repressors.

Unlike any other covariates, we do not use the lagged variables for firm- and industry-uncertainty. This is to count for the forward looking feature of stock market movement. Under rational expectation assumption, we can use realized values of volatility to proxy for expected volatility (Bulan 2005). Hence, firm- and industry uncertainty represent rational expectations of the variability in the firm's profits over year *t*. Appendix 1 provides in more details how we construct our covariates

As we do not have any a priori beliefs regarding how the risk set is defined, we estimate the above equation by using all four models described above; AG model, marginal model, CET and CIT model. As comparison, we begin with a model that only considers the first extension, i.e. henceforth First model. This model only includes the time until each brand first extension and implicitly assumes that the first extension is representative of all extensions. This is, however, a questionable assumption because it wastes possibly relevant information (Cleves 1999).

We tested all models to determine whether they met the proportional hazard assumption. This is actually a specification test to check whether the hazard ratio is proportional over time. The result is a chi-square value which indicates deviation from the proportional hazard assumption. In the preliminary analysis we cannot reject the null hypothesis of specification test based on Schoenfeld residuals (Schoenfeld 1982), especially for financial resources variable. Hence, we cannot reject the hypothesis that these variables are time-varying covariates.

We modify our model to take this fact into account by specifying a simple function of analysis time that interacts with these variables. Namely, we argue that the effect of those covariates are constant up to analysis time *t*, and afterwards it increase by a fixed magnitude. Mathematically, suppose that the effect of cash flow is β_1 up to analysis time t=20 and thereafter $\beta_1 + \beta_2$. For this purpose, we specify a dummy variable equal to one if the condition is true (t>20) and zero otherwise. This decision is based by specifying a step function (t=5, t=10, t=20) and we let the magnitudes of the steps be determined by the data (Cleves et al, 2004). Thereafter we estimate the models and tests whether the estimates coefficients of these step functions are significant.

We found that only the longest time (t=20) for sales variable is significant. Therefore, we include interaction between sales and time in our model. By doing this, we assume that the effects of sales is constant up to 20 years after the parent launch for the first four models, i.e. First-, AG-, Marginal- and CET model. While for the last model, CIT model, we assume that the effects of sales are constant up to 20 years after the last launch, which can be a launch of parent brand or a launch of brand extension. After 20 years, the effect will increase or decrease by a fixed amount.

Although the time function is only crudely defined in this way, in the context of what we are testing, the cost should be minimal (Cleves et al 2004). By allowing financial covariates to interact with a simple function of time, we can still maintain the proportionality assumption and hence we can be sure that our model is adequate for our purpose[3]. We also include the interaction between sales and leverage as including this variable improves the original model. Our final model is as follows.

$$\begin{aligned} ln \quad r(t) = \lambda_0(t) + S_{it-1}(\beta_1 + \beta_7 I_{it}) + \beta_2 C_{it-1} + \beta_3 DE_{t-1} + \beta_4 NB_{t-1} + \beta_5 \hat{\gamma}_{it}\hat{\sigma}_{it} \\ + \beta_6 \hat{\sigma}_{\varepsilon it} + \beta_8 (DE_{it-1} x S_{it-1}) + \eta_{ti} \qquad (2) \end{aligned}$$

where all other variables are defines as in the equation (1) and

I_{it} = dummy of time function with value 1 if (t>20) and 0 otherwise**.**

[3] Note that by using this procedure, we found that Marginal model is the only model that still has trouble with proportionality test. See also table 1 for the test statistics.

For all models, we allow firms to have different baseline hazards, hence we performed stratified analysis by firms in all regressions. By doing this, we want to control for the fact that rate of extensions are not the same for all brands. Indeed, models that allow baseline to be different perform better than ones that assume the same baseline hazard for all firms[4].

5. Data and Sample Selection

Pharmaceutical industry is characterized by a high degree of modified brands, which makes it suitable for our study. According NIHCM rapport, the majority (65%) of drugs that were approved in 1989-2000 were extended products, i.e. drugs that contained (active) ingredients that were already marketed before (NIHCM 2002). Highly innovative products, drugs that brand new (active) ingredients and also provide significant clinical improvement, are rare.

We use three main databases: CDER, Compustat and Kenneth French database. The information on brand extension, including the dates of launch, is obtained from CDER database. To identify brand extension, we follow Kotler's definition, which defines brand extension as "any effort to extend a successful brand name by launching new or modified product" (Kotler 1991). Applying to our dataset, we define an extension as launching a product with the same or similar name. Product that launched with a name that has never been used before or there has been no similar name before is defined as a new brand. For each brand in our dataset, both new and extended, we know the date of approval. We assume that this is also the day of launch. The variable competition is also obtained from this database, as this database also contains for each drug launched, the firm that responsible for the launch. Competition is defined as the number of new brands launched by 20 big pharmaceutical firms. Financial and accounting data is obtained from COMPUSTAT. This includes leverage, sales, and firm's return (see also appendix 1 for more details description on variables used in our analysis). Daily industry index is obtained from Kenneth French database.

The final dataset consists of 13 pharmaceutical firms. The selection is based on the fact that we use (1) firms that regularly launch branded drugs and (2) can be followed continuously on what and when they launch branded drugs. Note that several major pharmaceutical industries are not included in our dataset because they have major merger and acquisition that makes it difficult to determine which products they launched in the observation period. CDER database only list the most recent firm that are responsible for the drugs, which is not necessary the one that launch them. For example, Glaxo Holding and SmithKline merged in 2001 and both brought their own portfolio. After this merge, all drugs under these merged

[4] We compare these two groups model by looking at the log likelihood (Roberston et al 2005).

firms are listed on one name only : Glaxo SmithKline. This makes it impossible to trace which firms launch which drugs in the period before the merger.

The observation period ranges from 1973-2005, following availability of data on advertising which is not available before 1971 in COMPUSTAT. We use all brands that firms in our sample have ever launched, on the condition that these brands are not withdrawn from the market before 1 January 1972. We only include extensions that happen after 1 January 1972, regardless the order of extension. For example, Premarin, a brand name drug launched by Wyeth, is first launched in 1942, and underwent its first extension in 1956 and the second one in 1978. We do not include the first extension, but we include the second one. Note that in AG-, Marginal, and CET models, the clock starts ticking when the brand is first time launched. So for brand Premarin, it started on 1942. For CIT model, the clock is reset after each extension. In our example, the clock is reset to zero again after the first extension in 1956. The observation is defined censored when (i) brand is not yet extended at 31-12-2005 or (ii) brand is withdrawn from the market before 31-12-2005, whichever comes first.

After merging all databases we get a final sample of 428 parent brands and 632 extensions. Depends on the how the risk time is defined, we have 1246 to 8959 observations in our regressions. The earliest extension observed in our data is launched in 1973 and the last extension is in 2005.

6. Results

[Insert Figure 1 here]
[Insert Figure 2 here]

Figure 1 and figure 2 present nonparametric estimates of hazard function. Figure 1 shows hazard function for all extensions from all firms in our dataset; while figure 2 presents hazard function separated by order of extensions. In both figures time to each extension is measured from the entry of the parent brand. We remove four outliers concerning four extensions that were launch after 50 years of the parent entry. Including these observations lead to an extreme rise at the right tail of hazard curve.

The nonparametric hazard function increases rapidly in the first four year after the entry of the parent brand, regardless the order of extensions. Afterwards, it decreases steadily and level off approximately 30 years after the launch of the parent brand. We can see that the hazard rate is not constant. Looking at figure 2, we can see that the higher the order of extension the higher the speed of extensions. In other words, given that a brand is already extended before, it is more likely that it will be extended in the future. Indirectly, this might explain the phenomenon that a successful brand is frequently extended. A log rank test shows that there is a significant difference of survivor functions among different order of extensions (p<0.000).

Table 1 presents the results of regression estimates of the five models. The first column presents the results that use first extension only; followed by AG model, marginal model, CET and CIT model. A log likelihood value is given for each model. The model is considered to describe the data well when this value is near to zero. This value can indicate the best fitting model when we want to compare models using the same data (Robertson et al 2005). In term of log likelihood value, conditional models seem to be the best models as their log likelihood values are nearest to zero compare to AG model or marginal model.

[Insert Table 1 here]

In all models, we find negative effects of sales on the rate of brand extensions. The same applies for leverage variable. These negative effects are even greater when these variables interact with each other. Both lack of sales performance and small amount of leverage increase firms' motivation to extend brands. This is consistent with our hypothesis that lacks of financial resources stimulates firms to launch brand extension, which provide a cost effective alternative that launching a new brand. For sales variables, the effects are also increased for brands that has spent quite some time in the market, as the interaction variables between sales and time are negative and significant. It seems that when, for example, there is a decrease in sales performance, the launch rate increases, and the increase are higher for groups of old brand.

Confirming our hypothesis, we found a positive effect of competition on the launch rate of brand extensions. All of the coefficients of competition are significant and relatively similar across all models. Note that we construct competition as the number of new brands launched by the big competitors. This suggest that new brand launched by dominant firms stimulate other firms to speed up the launch of brand extensions.

Looking at the uncertainty effects, we find mixed findings. On the one hand, firm's specific volatility, measured in stock prices volatility, has a positive significant effect on the launch rate in all models. On the other hand, uncertainty at the industry level seems to discourage launch of brand extensions, which does not conform our hypothesis. As an explanation, we argue that uncertainty at the industry level influence all firms in our sample, hence firms tend to feel threatened less compared to uncertainty at the firm level, such as stock price volatility. As the situation is more uncertain at the industry level, the less likely firms are eager to invest, including launching and developing brand extensions.

As expected, the number of new brands launched in the last period increase the probability of brand extensions in the current period. This suggests that if firms aim to use brand extensions as strategic or tactical movement, they also have to invest sufficient enough in launching new brands.

7. Conclusions

Brand extensions are widespread practices as it offers a more cost efficient alternative above launching a new brand. This is especially true in the drugs industry when the cost of developing and launching a new product is tremendously high. We consider brand extensions as an opportunistic behavior to cope with uncertainty, competition, and lack of financial resources. We address this conjectures within a real option framework that allows us to make a parallel comparison between firm's launching brand extension with an agent exercising a call option in a financial market.

We have demonstrated the use of several different models to explain the launch rate of brand extensions. The central assumption of our models is that firms are driven by uncertainties concerning firm's value, competition, and financial resources and use brand extensions to maintain their position in the market. Our results support this assumption. Our results show that firms extend brands in response to increase in competition pressure, uncertainty concerning their stock prices, and decrease in financial resources. Certainly, the assumption that brand extensions are merely a routine in the pharmaceutical industry does not seem plausible.

We contribute to brand extensions by opening up a research agenda on modeling firm's behavior in brand extensions. We are convinced that there is still a lot of works to be done in this area. It is not yet very clear how exactly, for example, time interacts with firm's financial resources in affecting the launch rate. Furthermore, it is also a challenge to investigate whether our findings can be generalized to other industries, especially consumer fast goods that relied heavily on brand image.

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Appendix 1: Constructions of Covariates

This appendix provides the variables use in the empirical estimation. Except for competition and industry index, data is obtained from COMPUSTAT. All values are measured in nominal terms and time *t* variables refer to the value at the end of fiscal year.

Sales (S): Net sales

Leverage (D/E): firm's leverage where D refers to the book value of long term debt plus current liabilities and E is the common equity (market value) plus the preferred equity (liquidating value).

Competition (C) : number of new product launched by 20 biggest pharmaceutical firms (source CDER database).

New brands (NB): number of firms' new brands.

Volatility Variables[5]

Daily returns for firms and industry are used to generate annual volatility. Total uncertainty is decomposed into industry and firm specific components by estimating a single index model.

$$r_{i\tau} = \alpha_{i\tau} + \gamma_{i\tau} r_{I\tau} + \varepsilon_{i\tau} \quad (3)$$

where returns are assumed to have standards i.i.d in each year. $\tau = 1,2, \ldots, t_i$. t_i is the number of trading days in year t, $r_{i\tau}$ is the daily return on firm *i*'s equity, $r_{I\tau}$ is the daily industry index return, $\varepsilon_{i\tau}$ is a white noise error term with variance $\sigma_{\varepsilon it}$. We estimate equation (3) by using an ordinary least square. We use the estimate of standard deviation of the residuals as measure of firm specific uncertainty, which is calculates as follows.

$$\hat{\sigma}_{\varepsilon it} = \sqrt{\frac{1}{t_i}\sum_{\tau=1}^{t_i} \hat{\varepsilon}_{i\tau}^2}$$

This measure captures the volatility of firm's return that is orthogonal to the industry movement.

γ_{it} is the industry coefficient for firm *i* in year *t*, as indicated by equation (3). We measure industry volatility as $\hat{\gamma}_{it}\hat{\sigma}_{It}$, where the first term refers to the estimated industry coefficient and the latter is defined as follows:

$$\hat{\sigma}_{It} = \sqrt{\frac{1}{t_i}\sum_{\tau=1}^{t_i} (r_{It} - \bar{r}_{It})^2}$$

Appendix 2: Figures and Tables

[5] The following constructs are closely adapted from Bulan 2005

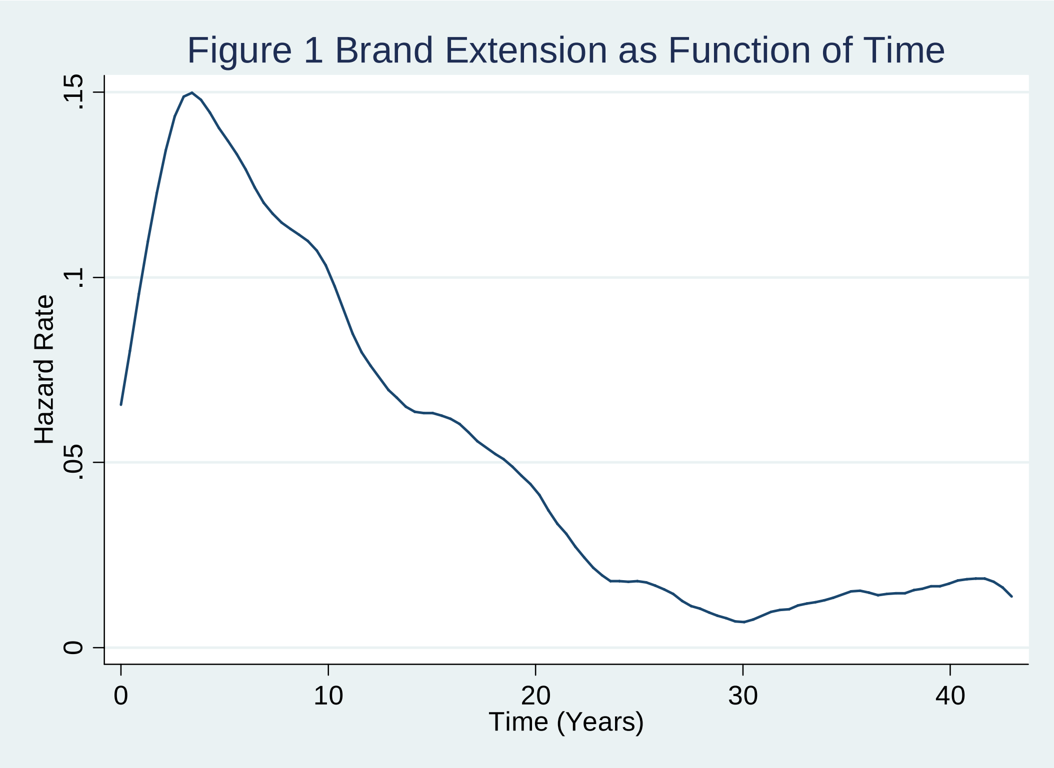
Figure 1 Brand Extension as Function of Time
Hazard Rate
0
.05
.1
.15
0
10
20
30
40
Time (Years)


Figure 2 Extension Rate by Order of Extension
Hazard Rate
0
.1
.2
.3
.4
.5
0
10
20
30
40
Time (Years)
1 st extension
2nd & 3rd extension
4th-14th extension

Table 1 Variance Corrected Models for Brand Extension

Covariates	Cox Regression Time to First Event (First)	Andersen-Gill (AG)	Wei et al. (Marginal)	Conditional Elapsed Time (CET)	Conditional Intervent Time (CIT)
Sales $_{t-1}$	-0.767***	-0.491***	-1.162***	-0.636***	0.581***
	(0.143)	(0.184)	(0.179)	(0.112)	(0.094)
Leverage $_{t-1}$	-0.501***	-0.533***	-0.987***	-0.500***	-0.533***
	(0.137)	(0.103)	(0.155)	(0.100)	(0.099)
Sales $_{t-1}$ x Leverage $_{t-1}$	-1.234***	-1.061***	-1.558***	-0.933***	-0.764***
	(0.288)	(0.215)	(0.292)	(0.191)	(0.188)
Firm's Volatility (σ) $_{t-1}$	0.340**	0.632***	0.493***	0.596***	0.588***
	(0.156)	(0.206)	(0.203)	(0.142)	(0.140)
Industry's Volatility ($\gamma\sigma$) $_{t-1}$	-0.145	-0.491***	-0.348*	-0.503***	-0.540***
	(0.121)	(0.184)	(0.186)	(0.134)	(0.127)
Competition $_{t-1}$	0.164**	0.158**	0.132**	0.203***	0.176***
	(0.077)	(0.065)	(0.067)	(0.052)	(0.050)
# New Brands $_{t-1}$	0.137	0.136**	0.111	0.166***	0.166***
	(0.088)	(0.065)	(0.077)	(0.057)	(0.057)
Sales $_{t-1}$ x Time Function	-5.617***	-4.288***	-5.072***	-6.926***	-5.834***
	(1.952)	(0.823)	(1.140)	(1.615)	(1.249)
Log likelihood value	-549	-1989	-1829	-942	-1271
N observations	472	1246	8959	1246	1199
N brands	370	428	428	428	428
N extensions	190	628	628	628	632
N Time at risks	4,987	8,402	122,936	8402	8442
Schoenfeld PH test (χ^2)	5.25	9.72	14.98***	7.21	7.17

Cell entries are estimated coefficients computed with Breslow method for resolving ties; standard errors are in parentheses. Models in the last three columns have robust standard errors (adjusted by clustering within brand) and allow the baseline hazard rates to differ by the order of extensions. *p<0.05 **p<0.05 ***p<0.01
CIT does not have the same number of observations as with CET due to splitsing procedure in Stata (the time origin is different between CIT & CET).

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