



The Application of Real Options in E-Business System Investment

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Abstract

This paper studies the performance of real options applied in the e-Business system investment. We propose a model to address managerial flexibility in introducing the e-Business system into a traditional business and seek an optimum time point for investment. Based on the assumptions of the base demand, the derived demand occurring on the new e-Business system can be characterized by nonstationary stochastic processes. The model solutions can be acquired by solving a dynamic programming taking into account the discounted cash-flow. The sensitivity analysis is also provided through model evaluation and numerical illustration.

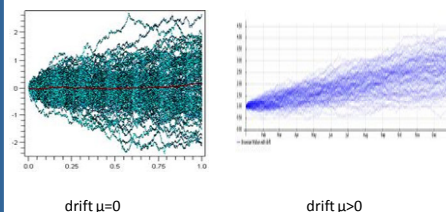


Figure 2. Visual Brownian Motion

2. e-Demand y_t (occurring on E-business system after investment)

To derive e-Demand:
Positive/negative network externalities
Promotion effects
Positive/negative word-of-mouth
Cascading effects

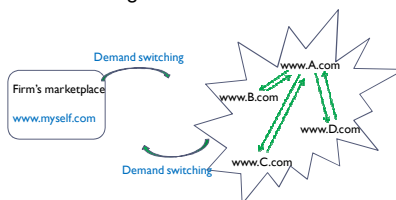


Figure 3. The impact of demand switching parameter

3. Demand evolution (e-imitators $N(t)$)

$$\frac{dN(t)}{dt} = q[(1 - k_1 - k_2)x(t) - N(t)]$$

$$y(t) = k_1x(t) + N(t), \quad t \geq t_m$$

4. Model design with deferral option

$$\Phi_t(y_t) = \max\{\pi_t(y_t, B), (1 + \rho)^{-\Delta t} E[\Phi_{t+\Delta t}(y_{t+\Delta t})]\}$$

where B is the amount of investment at t

3. Sensitivity analysis

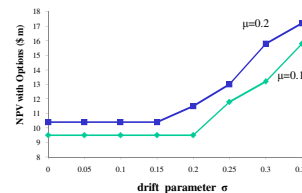


Figure 4. NPV with Option as a function of diffusion parameter

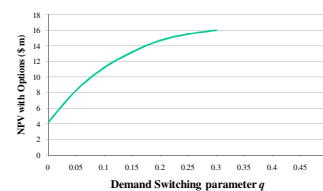


Figure 5. The impact of demand switching parameter

Motivation

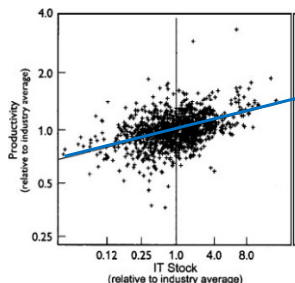


Figure 1. Productivity as a function of IT investment (total firm IT related expenditures) for a sample of 1,300 individual firms. (Jeffery, M. 2004)

Questions:

1. How could bring more values?
2. Given the wide variance illustrated in Figure 1, Do or not do? When to do?
3. How to address the uncertainty in e-Business investment?

Model

1. Base demand x_t (in retail stores without e-Business)

$$dx_t = \mu x_t dt + \sigma x_t dW$$

A geometric Brownian motion (Ito process)

Managerial Insights

1. The type of companies providing different types of products and/or services influences the decision of e-Business system investment and investment time point as well.

E.g., High technology retailer vs fresh food retailer. They have different regions of parameters k_1, q .

2. The firm size (revenue) also affects the decision (μ).
3. How much (in percent of revenue) does the company spend on marketing and sales for traditional retail? (s)

How much does the company invest on building customer-relationship on e-Business system? (B)

4. In such dynamic environment, the retailers might reconsider their decision as the time elapses.

Results

1. Model parameters

According to the reports from US Census Bureau and previous reports, we have $\mu=0.1, \sigma=0.3, q=0.15, k_1=k_2=0.3, s=0.1, \rho=0.06$, time horizon $T=5y$, # of run=500

2. NPV and time to exercise options

NPV = \$9.4 m (invest now)
NPV = \$13.2 m (invest later)

Time (y)	Frequency	Percent
1	8	1.60%
2	76	15.23%
3	339	67.94%
4	62	12.42%
5	14	2.81%

Table 1. Sample distribution of time to exercise option

Conclusion

This research develops an approach to explore the e-Business investment problem and seek the optimum time point for investment. It builds a bridge between e-Business system investment and real options. More work would be done to improve the accuracy in modeling the uncertainty of demand.