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An Economic Perspective on the Flexibility of IT-Systems

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ABSTRACT

Traditional capital budgeting models cannot appropriately capture the value of IT-systems. Real Option Pricing Theory provides a useful economic perspective on the valuation of IT-systems, although no comprehensive review of the state of the art of real option pricing models for IT-investments has been published to date. This paper provides an overview of the applicability of real option theory to IT-infrastructures investments. The suitability and the impact of real option pricing theory are analyzed and evaluated.

1. INTRODUCTION

The decision processes for investments in innovative technologies like IT-infrastructures are complicated. There is considerable risk, that IT-projects will not be completed on time, on budget, and will not produce the expected business benefits. Significant organizational change is required across multiple business units in a large IT-project. Hard cost saving benefits are often used to justify an initial IT investment, since the soft benefits of improved information technology like increased organizational flexibility, enhanced customer service, higher job satisfaction, better corporate image, etc. are extremely difficult to quantify. The problematic quantification of benefits leads to an asymmetric consideration of cost in the balance of the cost benefit analysis. As a result, IT-infrastructure projects often have negative economic valuation results despite of their strategic importance. Companies have to overcome the problem not to routinely reject truly important investments by using simplistic quantitative techniques (Kester, 1984). This is especially important for companies with independently operating business which act under the objective to maximize the company's equity in short-term. Organizations could loose important opportunities if they strictly rely on traditional criteria to assess innovative technology benefits. The need for a disciplined process for decision making is imperative.

This paper discusses the valuation of IT infrastructure investments according to the logic of real options. In section 2 we briefly review the basic principles of option theory as they apply to IT-projects. The section describes recent conceptual work on option typology relevant to IT-investments and establishes the foundation for the economic flexibilities presented in Section 3. Section 4 presents an economic perspective on the flexibilities for IT Investments. A summary is given in the last section.

2. OPTION THEORY – OPTION THINKING

The concept of real options has generated considerable interest within the literature in recent years. Several scientists stated the failure of the traditional NPV and demonstrate the use of option valuation methods in diverse decision problems as a new quantitative approach for valuating investments like Trigeorgis (2001), Sullivan et al (1997), Chalasani et al (1998), Dos Santos (1991), Kester (1984), Kambil et al (1993). Option researchers suggest using concepts from real options to properly structure the evaluation and management of investment opportunities and thereby capture the value of IT-infrastructure investments through flexibities. The amount of different approaches is built on three fundamental valuation methods for option pricing: analytical solutions, binomial trees and Monte Carlo simulations.

Analytical Solutions (Black-Scholes)

The Black-Scholes equation is an analytical solution for the option value. The Nobel-Prize winning solution requires only five inputs, four of which can be directly observed in the field of financial options. Since it was developed, the Black-Scholes equation is used widely. The basic approach of option pricing is derived from physics, specifically the Brownian motion in thermodynamics. The basic mathematical construct is an exponential function. The formulas describe the distribution of the present value of the project's expected revenues. There are different models, which assume that the option value follows either a geometric, binomial (Cox-Rubenstein 1979), normal (Taudes 1999) or lognormal (Black-Scholes 1973) distribution.

Binomial trees (Cox-Rubenstein-Ross)

One approach for valuating real options was introduced by John Cox and Stephan Ross in 1976 and later applied by these authors and Mark Rubenstein in the binomial option valuation model.

The assumption of risk neutrality simplifies calculations enormously. In the binomial option valuation model, the underlying asset moves up or down by a small amount in each short period. There are three advantages to the binomial option valuation model according to Amram (1999). First, many investment scenarios can be formulated as a sequence of options. Second, the approach is comfortable for many users because, it is consistent with the options valuations breakthrough and it retains the appearance of discounted cash flows analysis. Third, the flexibility of decisions is laid out in intuitively understandable visual images.

Monte Carlo Simulations

Monte Carlo Simulation was named after Monte Carlo, Monaco. The random behavior in games of chance is similar to how Monte Carlo simulation selects variable values at random to simulate a model. The simulation calculates numerous scenarios of a model by repeatedly picking values from the probability distribution for the uncertain variables and using those values for the event. Standard simulation methods, even though very powerful for solving European-type options, have traditionally been considered inadequate for solving American-type options as discussed in Herath and Park (2002). In recent research, Cortazar (2001) shows how to use simulation for American-type options and provides an exemplary application to a real option problem.

2.1 Characteristics of Option Valuation:

The real option approach assumes that the flexibility is analogous to the flexibility of exercise of financial instruments called options, and that the value of the flexibility is the value of the corresponding financial option (Fichman 2004). Independent of the applied methods, the following characteristics can be found in option valuation.

Volatility (uncertainty) is positively valuated

Options provide increasing value as the uncertainty of the investment grows. Greater volatility does not translate into greater losses, because losses are limited to the initial investment. The value of a