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E-BUSINESS VALUE AND INVESTMENT ANALYSIS

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INTRODUCTION

As we entered the 21st century, business conducted over the Internet (which to be referred as “E-business”), with its dynamic, rapidly growing, and highly competitive characteristics, promises new avenues for the creation of wealth. Established companies are setting up new online businesses, while new ventures are exploiting the opportunities provided by the Internet.

In comparison with traditional business, E-business is significantly more comfortable, companies can attract a broad customer base from around the world that is normally not available via traditional advertising vehicles and business processes can be completely automated to demand very little of company staff’s time.

Building E-business strategies and applications are perhaps the most important issues facing today’s business world. The Internet has indeed changed everything. Deploying benefits enabled by the Internet companies get the wide range of unique options of creating new business structures and technologies that can ensure success in a rapidly changing business world. Nowadays, companies are evaluated as much on their ability to adapt to the Internet as they are on their previous performance. This pressure has been created by a worldwide realization that the Internet will be leveraged in innumerable ways to enhance the way the business world works.

The Internet has created the challenge for every area of every company. The challenge is not simply to change one aspect of how a business operates; it is to change every aspect. Keeping pace with the Internet by evolving into an E-business is thus becoming critical. As companies are setting up E-business projects, they are facing a whole host of strategic, organizational, technical and increasingly global issues. Almost every company today is trying to find out how best to utilize the Internet throughout its value chain not only to improve operational efficiency but more importantly to create economic value.

The intent of E-business is to apply the benefits of Internet technologies to better manage a company's total value-chain with a focus on workflow, distributed workgroup computing and Internet-centric, knowledge-oriented operations at all levels. In its simplest sense, E-business is the use of Internet technologies to improve and transform key business processes. Most companies understand this and have begun the evolution from traditional business practices to E-business.

E-business can be viewed as a particular phase in the greater context of an ongoing computer/network "revolution" by which old business models and paradigms are obliterated and replaced by new ones. E-business involves the total digitization of value chains and business processes, and holds the promise of helping traditional organizations create new value and reach previously unattained heights of operational and financial excellence.

E-business has the potential of generating tremendous new wealth, mostly through entrepreneurial start-ups and corporate ventures. It is also transforming the rules of competition for established businesses in unprecedented ways. One would thus expect E-business to have attracted the attention of scholars in the fields of corporate finance and investments. Indeed, the advent of E-business presented a strong case for the confluence of researches in these fields. However, theoretical research on E-business investments is currently sparse. The literature to date has neither articulated the central issues related to this phenomenon, nor has it developed theory that captures the features of valuating E-business investments. As a result, it can be observed that valuation metrics aimed at measuring financial performance, such as financial variables in general and return on investment in particular, retained their traditional form and did not evolve parallel to specific features of E-business. Therefore, the validity and sustainability of assessment methods of E-business investments could and indeed have to be questioned.

During the past years, there has been a noticeable change in the decision makers' attitude towards E-business projects. There are more investments done not with the goal to save in costs, but with the goal to create new benefits. A part of these benefits can be measured or their amount estimated in numbers. Another part, however, cannot be measured in these terms at a first glance. This in fact is the main problem: how to estimate E-business investments when there are no tangible starting indicators?

The aim of this research is to establish the most proper method to value E-business investments. To fulfil this object it is important to analyze E-business value on its elements (relevant hypothesis and econometric model to be set up) to determine the significance of hidden components contained in E-business value. The method to be introduced has therefore to take account of all unique characteristics peculiar to E-business value.

This research paper is organized as follows. The first chapter explores theoretical issues of E-business investment analysis. First of all the author provides in depth insights into E-business value as it is essential to estimate the main factors of particular investment object to find out specific features of further investment analysis. Next the key characteristics of the E-business investment project to be argued upon to establish the link between E-business value and return on E-business investments. To proceed further to fundamental theory, the author takes crucial steps to analyze the neoclassical investment model (Tobin's Q model) to adjust this approach to value E-business investments. This particular part is extremely important in the light of investigation on the subject of the proper assessment method of E-business investments. The author therefore compares the fundamental model (based on net present value) and real option pricing theory. It is to be discussed on shortcomings and validity of fundamental method and how the new approach can overcome these significant flaws.

The second chapter develops relevant applications of previously investigated theoretical methods. Thus E-business value is to be analyzed by the means of econometric research and key drivers of E-business value derived upon the outcome of regression analysis. The author proposes a model that incorporates traditional and non-traditional variables to test the hypothesis on E-business value components. Then it is to be demonstrated how to value E-business project according to the fundamental investment approach. And finally the implementation of the real pricing option method is to be introduced and examined on the relevant example.

It is important to understand that before investment analysis it is crucial to value the investment object itself. The realization of key-drivers of E-business value enables more adequately value the return on investments, as E-business value contains significant portion of intangible assets which is difficult to account by traditional methods of

corporate finance. As a result, E-business projects are often underestimated and neglected by management.

This research paper provides the full investment analysis of E-business as it is viewed by the author: starting with E-business value modelling, moving through traditional investment methods and ending with the most suitable approach to value E-business investments.

1. FOUNDATIONS OF E-BUSINESS INVESTMENTS

1.1. Value creation and appropriation in E-business

Value has been one of the main interests among finance scholarship. Concretely, it has been interested in measuring companies performance, i.e. profitability, and in the development of adequate proxies for that purpose. On the other hand, strategists and economists have been also interested in value, but their research has been more concerned with the variables that affect companies' performance than with adequate mechanisms to measure it. Moreover, strategists in general suggest managers trying to affect the variables that influence companies' performance in order to outperform the market (Arthur 2000: 102). Therefore, unlike finance scholars, strategists are interested in finding what managers can do in order to increase their profitability, i.e. the value they appropriate, and, by extension, in finding what they can do in order to increase the value they create.

Empirical researches on strategy have not made an explicit separation between creation and appropriation of value, implicitly assuming it as a simultaneous process (Demeres 2001: 342). Even though this may be true, it might be desirable to differentiate between how E-business companies create and appropriate value for many reasons. First of all, it is not evident that E-business companies that create value would capture all or part of it. In almost perfect competitive markets, for example, most of the value created by E-business companies may be captured by consumers and companies might only expect normal returns (Truemann *et al.* 2000: 151). Secondly, while certain conditions external to E-business companies may improve their ability to create value, they can threaten companies' ability to appropriate it (*Ibid.*: 158). This is exactly the case with the advent of the Internet and related technologies. On the one hand, companies may develop innovative ways of doing business through the Internet and may create value by bringing to the market transactions that would not have been performed offline. On the

other hand, many benefits of the Internet (e.g. making information widely available, reducing the difficulty of purchasing etc.), threaten companies' ability to extract price premiums from buyers, making it hard for them to capture the benefits of the Internet as profits. Finally, maximal value appropriation, and not maximal value creation, may be the adequate objective of the company (Amir 1998: 59).

In order to distinguish between the concepts of creation and appropriation of value, it is essential to analyze how different players along a market chain create value. Value creation can be defined as the difference between the value of the product and the cost of the inputs used to make that product (*Ibid.*:61). As the value of the product depends upon buyers' perception, value creation is expressed as the difference between buyer's willingness to pay and suppliers' opportunity costs (Amit *et al.* 2001: 214-215). Consequently, value creation is an outcome of the efforts carried on by all the agents involved in business transactions. By contrast, value appropriation depends on each of the players involved in the production of a specific good or service, particularly in each player's bargaining power (Koller *et al.* 2000: 372). According to this interpretation, the players with high added value are the ones who may appropriate value since their bargaining power is high; on the contrary, the players with low added value will not capture any and may be substituted by others without threatening the value created in the market chain. By extension, if the bargaining power of a player changes, the ability to capture value changes as well (*Ibid.*: 379-380).

The value of E-business is created by all the agents involved in a particular "vertical market chain" is consistent with traditional strategic network theory which states that the locus of value creation may be the network rather than the company (Truemann *et al.* 2000: 142). This assertion may be more evident in cyberspace where companies' limits are more difficult to draw since many agents have to join together their interests and efforts in order to enable a particular transaction. This is the case of an online travel agency, which could be thought as a network that creates value for the final customer based on a joint effort of many agents (Amit *et al.* 2001: 209). For example, in order to help the traveller to find the best fares of a domestic flight, (and, therefore, creating value through efficiency) a start-up needs to have access to airfare databases, and may want to sign a contract with the owners of those databases (*Ibid.*: 211). Similarly, if the

virtual travel agency wants to create value through complementarities, it may need to sign contract with car rental companies. Clearly, taking advantage of the value creation potential of the Internet implies broadening companies' boundaries by signing alliances with parties needed to provide the service, which might not necessarily be the case for physical companies.

However, even though value creation in cyberspace is an outcome of the efforts of the agents that enable an online transaction, each agent looks for its own benefit as regards value appropriation. Since one of the effects of the Internet and related technologies in the overall business landscape is that it changes the bargaining power of the agents (Dewan *et al.* 2000: 265), it is particularly important to analyze online value appropriation because, as previously explained, when the bargaining power of a player changes, its ability to capture value changes as well. For example, as customers have more access to relevant information about prices, delivery and brands, they can search for and find the cheapest alternatives in the market, thus increasing their bargaining power in detriment of companies (Evans *et al.* 2001: 123). Similar reasoning can be applied to the agents that belong to the network that make a concrete Internet site. Using again the example of a virtual travel agency, the owner of the database that allow travellers to search for better fares may capture some of the value created in the network whereas the travel agency itself might hardly capture any if it acts solely as an aggregator of content and did not bring added-value to the network (Amit *et al.* 2001: 213-214).

Overall, it is arguable to study creation and appropriation of value as a simultaneous process for physical and virtual companies (E-business); in fact, one would call into question such methodology nowadays where companies' limits are more and more difficult to draw (Dehning *et al.* 2002: 17), where virtual markets are a particular example of this phenomenon.

What seems reasonable is to analyze value not only as divided among the many parties that form a network but also as created by parties as diverse as customers. Under this setting, it could be easily the case of some agents creating value and others appropriating it.

As E-business companies may be thought of as a collection of agents that work together to deliver a product to the final user, the role played by each of the components of the network is not trivial (Hagel *et al.* 2002: 143). For example, some agents that belong to the network that allow a virtual travel agency to enable online transactions might bring low added-value to the system and then, may run the risk of being substituted by anyone able to provide the same service without the travel agency running the risk of collapse; however, if a player with high added-value decides not to be part of the network, then, the whole virtual travel agency may collapse (Amit *et al.* 2001: 215). Consequently, the relationships between the agents that form an E-business company may be a good starting point to think about possibilities of examining value appropriation, and the unit of analysis used to investigate this issue, must allow researchers to deepen the characteristics of those relationships.

One way to analyze E-business value as a financial indicator is in terms of the theory of stock market efficiency (Hartman *et al.* 2000: 254). When the stock market is strongly efficient, the market value of a company is, at every instant, equal to its fundamental value, defined as the expected present discounted value of future payments to shareholders (*Ibid.*: 258). If abstract from adjustment costs, one can highlight the central role strong efficiency plays: it equates the company's market value to its enterprise value - that is, the replacement cost of its assets (*Ibid.*: 259). However, the most readily available measure of the enterprise value in company accounts data, the book value of tangible assets, is typically just a fraction of the market value (Hubbard 1998: 203) - and for E-business companies it's an even smaller fraction because they rely on intangible assets more than do old economy companies. Hence, the rest of the enterprise value must come from adjusting for the replacement cost of tangible assets and including intangible assets. When price inflation, economic depreciation, and technical progress are modest, the difference between the replacement cost and the book value of tangible assets is relatively small (Nakamura 1999: 35). This very statement implies that intangibles account for the remaining difference.

Unfortunately, it is difficult to gauge whether intangibles do, in fact, make up the difference because they are, by their very nature, difficult to measure. As a result, the accounting treatment of them by the Financial Accounting Standards Board (FASB) is

conservative - which means that companies must select methods of measurement that yield lower net income, lower assets, and lower shareholders' equity in earlier years (Baruch 2001: 117-118). Thus expenditures for R&D, advertising and the like are expensed even though they represent expected future profits (*Ibid.*: 119). The stock market forms expected values of these future profits but the assets generating them will never show up on the balance sheet. Consequently, it is argued by many researchers that the fundamental accounting measurement process of periodically matching costs with revenues is seriously distorted, adversely affecting E-business companies' financial information (Bond *et al.* 2000: 63-64).

The practical appeal of thinking in terms of strong efficiency is that the purported growth of **intangible capital that characterizes E-business** provides a ready explanation for the stock market expansion. Some researchers, for example - have even argued that the value of intangible assets can then be inferred from the gap between market capitalization and the measured value of tangible assets (Brynjolfsson *et al.* 2002: 137-138). The practical drawback, however, is that this makes the inferred valuation of intangible capital the critical determinant of market efficiency. At a basic level then the logic of this approach is circular: accounting principles for intangible assets are unsatisfactory and, as a result, it's difficult for market participants to value companies; but strong stock market efficiency is assumed in order to assign a value to intangibles.

When the stock market is not strongly efficient the company's market value can differ from its fundamental value. This formulation sidesteps the question whether intangibles account for the missing value of companies, only to point up another one that is just as thorny. If the stock market fails to properly value intangibles, then what do market prices represent? One perspective is that the stock market is efficient in the sense that prices reflect all information contained in past prices (called weak efficiency), or that they reflect not only past prices but all other publicly available information (called semistrong efficiency) (Frank *et al.* 2001: 178). These weaker concepts of market efficiency are not necessarily inconsistent with deviations of prices from fundamentals that are caused, for example, by bubbles (*Ibid.*: 182). Another perspective eschews

efficiency in favour of behavioural or psychological models of price determination (Hand *et al.* 2000: 44).

Another way to think about E-business value as a financial indicator is empirical. Tobin's average Q - which is defined, in its simplest form, as the ratio of the stock market value of the company to the replacement cost of its assets - provides the empirical link (Blundell *et al.* 2000: 237). Under conditions familiar from the Q theory of investment, average Q equals unity when the stock market is strongly efficient and taxes, while debt and adjustment costs are ignored (*Ibid.*: 239). This means that the market value of the company is just equal to the replacement costs of its tangible and intangible assets. Since intangible capital is difficult to value, in practice average Q is computed using tangible capital. This is why average Q can exceed unity and why it must increase as intangible assets become a larger fraction of total assets (Chirinko 1999: 126).

Since the unusual rise in the values of E-business from 1999 to early 2000, some researches claim that conventional financial metrics such as earning and book values have no value-relevance for these companies because many E-business stocks have been selling at high prices relative to their operating performance (Banker *et al.* 2000: 82). Consistent with this assertion, recent empirical literature provide evidence that web traffic (as one of possible intangible assets) metrics are useful in explaining the essence of E-business value (Hand *et al.* 2001: 75).

In one of the earlier studies examining the value relevance of web traffic information of E-business, it has been provided evidence that Internet usage measures including both unique visitors and page views in general have a significant incremental explanatory power for stock prices over the financial data (*Ibid.*: 71). It has been also found that the web traffic measure defined as number of unique users divided by the total estimated population viewing the web is positive and significantly associated with stock prices of E-business companies (*Ibid.*: 72-73). By the same token, a group of scientists examined the value-relevance of web traffic measures both before and after the dramatic downturn of Internet stocks in March - April 2000 (Freeman *et al.* 2002: 76). Using a factor analysis, they found evidence that web performance measures are value-relevant to the share prices of E-business companies each of 1999 and 2000. Interesting enough, their

results show that web traffic performance factors remain value-relevant in 2000, which contradicts the widespread claim that web traffic data are no longer useful after the market downturn (*Ibid.*: 77-78).

1.2. E-business investments as value-added driver

Estimating the value of an E-business investment project is a particularly challenging task, because there are many factors that affect the payoffs and costs of the project. E-business projects usually involve the acquisition or development of multiple assets of different nature. Some of these assets are related to the E-business infrastructure *per se* (e.g. hardware components) while others involve the application software that support specific business processes (Harmon *et al.* 2000: 117). A particular asset might have no or little value unless other assets are present or it may have a value due to the support it provides to other components (*Ibid.*: 120). For instance, a programming language is generally not valuable unless it is used to develop or interpret an application program, e.g. for E-business network. Also, purchasing a software package might imply upgrading the server that is also used to run other application and this would have some side benefits even if the activity of implementing the software package is interrupted after the project has started. Even when the benefits of a particular asset can be isolated from other decisions taken with respect to the E-business infrastructure, the benefits and costs of an E-business project have a **high degree of uncertainty** because their realization is affected by multiple organizational elements (Hausman 1999: 59). In addition, there are multiple alternatives for developing E-business project that imply different project phases and cost schemes (Hofmann *et al.* 2001: 181).

Although E-business projects share many common attributes with conventional e.g. software engineering development projects, it is identified three distinctive differences between E-business projects and other projects (Korper *et al.* 2000: 99-101):

1. **Invisibility.** There is no physical object to work with; the heart of the E-business Web site consists of program codes. Observation of behaviour is the only way to visualize the system. In an E-business trading system, output may not be apparent and is subject to changes due to various conditions. The system response can therefore be difficult to predict in most cases.

2. Complexity. Software products often contain more complexity than engineering works; the structure of an E-business Web site can be complex with many links between various parts of the site.
3. Flexibility. Any piece of software is made to adapt to change of its associated components, hardware, organizational structure, etc. An E-business project must therefore be developed in such a flexible way that it can adapt to any change in the operating environment. The implication is that an E-business project is likely to encounter constant change and these changes may lead to major consequences.

The business value derived from E-business investments has been a subject of intense debate over the past years. Value of E-business investments is generated through productivity, profitability and consumer effects (Srinivasan 2000: 155-156):

1. Impacts on productivity are analyzed by considering that the organization has a method for transforming various inputs into outputs. This method is traditionally represented by a production function that is monotonically increasing. Each additional unit of an input contributes to an increment in the output level until an equilibrium point in which the net marginal product of any input is zero. An increase in productivity due to E-business occurs when an E-business investment allows an organization to use fewer inputs for producing the same level of output.
2. Effects on profitability are associated with the ability of a company to capture the value of E-business to create competitive advantage. A company might create additional economic value by applying its unique competencies in the management of E-business to differentiate itself from its competitors.
3. Impacts on consumer value are derived from the surplus that consumers obtain from paying a market price that is less than the one they would be willing to pay to obtain a particular output of the company. When E-business investment contributes to reduce the price of a product or service, the surplus of existing customers is increased, and new surplus is created for those additional consumers that are willing to pay the lower price.

Investment valuation is the first step companies have to go through to determine the benefits of setting up the E-business.

A number of theoretical frameworks can aid conceptualization regarding the E-business investment analysis. For example, one group of researches shows how companies can discover the potential value of E-business investment by looking at the maximum benefits the E-business can generate and comparing them with the benefits obtained without using it (Smith *et al.* 2002: 87). The other group proposes that this potential value is created by generic value flows applied to the specific characteristics of the technology implementation environment (Strassmann *at al.* 1999: 117). Value flows describe sources of value that are generally observed for a specific E-business projects successfully implemented and used as expected (*Ibid.*: 121). However, these perfect implementation and adoption conditions cannot be found in every company. Instead, existing organizational processes or culture, the current level of technological infrastructure and standards adoption in the industry, and the actions of competitors all create value barriers that limit the value flows, resulting in company and industry-specific technology potential value (Walmann 1999: 83-84). E-business investment evaluation should therefore involve analyzing how these generic value sources apply to the specific organizational and industry context of the company that makes the E-business investment decision, what the value barriers are and how they can be overcome.

How can companies identify the general value flows that will occur for their E-business investments? Existing theoretical and empirical studies suggest that these value flows occur primarily from two sources (Keating *et al.* 2002: 35). First, process-level value flows can be observed, consisting of increased process efficiency that reflected in cost savings and improved product quality (*Ibid.*: 37). Second, market-level value flows also occur based on the extent to which the business model offers sustainable competitive advantage (*Ibid.*: 38). In some cases, another market-level value flow is generated by positive network externalities that increase the value of the E-business investment for all of the company's technology adopters, as more adopters join the network (Rajgopal *et al.* 2002: 138).

A new approach to analyzing the value of E-business investments, real option pricing (ROV) method, has become increasingly popular during the past few years (McGrath *et al.* 2003: 36). The option value of E-business investment relates to the flexibility for

future projects enabled by the current technology investment (Copeland *et al.* 2003: 75). In other words, companies create, through the current investment, the option (a right, but not an obligation) to make future investments as they gain valuable experience with the technology and improved knowledge of the industry and competitive environment (*Ibid.*: 79). E-business technologies are generally characterized by uncertainties that arise as these technologies are adopted in the marketplace, industry standards evolve and industry competition intensifies. Therefore, they are very well suited for real option pricing analysis.

Given that investment valuation bears significant costs as well, some companies are willing to skip the valuation step and move directly to implementation based on industry-wide estimates (Ittner *et al.* 1998: 8). This is probably the biggest mistake companies can make in implementing E-business project. Only companies that take this step seriously and thoroughly analyze their organization and industry structure for the new technology achieve successful implementations. Companies have to spend time analyzing the range of value sources for a specific investment decision, as well as the value barriers that impact them.

The investment valuation should prompt an investigation of the advantages and disadvantages offered by a specific industry setting, as well as by existing organizational routines and resources that can limit potential value otherwise available to other companies (*Ibid.*: 12). Taking into account all these issues, the investment evaluation stage can help identify real value and moderate overly optimistic estimates. In some cases, it is also possible that the investment decision will be delayed until market and organizational conditions allow the benefits to be realized.

Justification of investments in E-business is one of the many challenging issues facing managers today. Many tangible and intangible factors have to be assessed and weighted. Although qualitative factors play an important role in E-business investments, the evaluation of quantifiable costs and benefits should at least be a part of any valuation (Reilli *et al.* 1999: 317-318).

1.3. Theoretical approach to E-business investment modelling

The author uses the neoclassical model of investment as the basis for further investigation. First the author sets up the model and presents the empirical investment equation that relates Tobin's Q and the demand for fixed capital when there is a single capital good. Next it will be shown how this empirical model can be modified to incorporate the key feature of the E-business - that there are two different types of capital (tangible and intangible), only one of which can be easily measured.

In each period, the company chooses investment in each type of capital good: $I_t = (I_{1t}, \dots, I_{Nt})$, where j indexes the N different types of capital goods and t indexes time. This is equivalent to choosing a sequence of capital stocks $K_t = (K_{1t}, \dots, K_{Nt})$, given K_{t-1} , to maximize V_t , the cum-dividend value of the company, defined as (Chirinko 1999: 109):

$$(1) \quad V_t = E_t \left\{ \sum_{s=t}^{\infty} \beta_s^t \Pi(K_s, I_s, \varepsilon_s) \right\},$$

where E_t - expectations operator conditional on the set of information available at the beginning of period t ,

β_s^t - discount rate net revenue in period s back to time t ,

Π - revenue function net of factor payments,

ε_s - productivity shock.

Assume that Π is linear homogeneous in (K_s, I_s) and that the capital goods are the only quasi-fixed factors - or, equivalently, that variable factors have been maximized out of Π . For convenience in presenting the model, assume that there are no taxes and the company issues no debt.

The company maximizes equation (1) subject to the series of constraints (*Ibid.*: 110):

$$(2) \quad K_{j,t+s} = (1 - \delta_j)K_{j,t+s-1} + I_{j,t+s} \quad s \geq 0,$$

where δ_j is the rate of economic depreciation for capital good j .

In this formulation, investment is subject to adjustment costs but becomes productive immediately. Furthermore, current profits are assumed to be known, so that both prices and the productivity shock in period t are known to the company when choosing I_{jt} .

Other formulations - such as one where there is a production and/or a decision lag - are possible but the author chooses this, the most parsimonious specification.

Let the multipliers associated with the constraints in equation (2) be $\lambda_{j,t+s}$. Then the first-order conditions for maximizing equation (1) subject to equation (2) are:

$$(3) \quad -\left(\frac{\partial \Pi_t}{\partial I_{jt}}\right) = \lambda_{jt} \quad \forall j = 1, \dots, N$$

and

$$(4) \quad \lambda_{jt} = \left(\frac{\partial \Pi_t}{\partial K_{jt}}\right) + (1 - \delta_j) \beta_{t+1}^t E_t[\lambda_{j,t+1}] = E_t \left[\sum_{s=0}^{\infty} \beta_s^t (1 - \delta_j)^s \left(\frac{\partial \Pi_{t+s}}{\partial K_{j,t+s}}\right) \right],$$

where the equation (3) is the basis for estimating the Euler equation of investment, and (4) is the basis for Abel and Blanchard's forecasting approach.

To derive an empirical investment equation based on Tobin's Q for a single homogeneous capital good, the author proceeds in two steps. First it is essential to express marginal q in terms of observable variables and then use it in the first order condition for investment in equation (3).

Combining equations (3) and (4), assuming that $N = 1$ and using the linear homogeneity of $\Pi(K_t, I_t, \varepsilon_t)$:

$$(5) \quad \lambda_t (1 - \delta) K_{t-1} = \Pi_t + \beta_{t+1}^t E_t[\lambda_{t+1} (1 - \delta) K_t] = E_t \left[\sum_{s=0}^{\infty} \beta_{t+s}^t \Pi_{t+s} \right] = V_t$$

Thus:

$$(6) \quad \lambda_t = \frac{V_t}{(1 - \delta) K_{t-1}}$$

and

$$(7) \quad q_t = \frac{\lambda_t}{p_t} = \frac{V_t}{p_t (1 - \delta) K_{t-1}},$$

where p_t is the price of capital goods, and q_t is marginal q .

Assume that the net revenue function, Π , is composed of a production function, F , and an adjustment function, G , that are additively separable:

$$(8) \quad \Pi(K_t, I_t, \varepsilon_t) = g_t [F(K_t) - G(K_t, I_t, \varepsilon_t)] - p_t I_t,$$

where g_t is the price of output.

The equation (8) can be used to reexpress the first order condition for investment in equation (3) in terms of the adjustment cost function, marginal q , and the relative price of capital:

$$(9) \quad \frac{\partial G_t}{\partial I_t} = (q_t - I) \frac{p_t}{g_t}$$

Assuming that the adjustment cost function is quadratic in investment and symmetric about some “normal” investment rate a (Blundell *et al.* 2000: 269):

$$(10) \quad G(I_t, K_t, \varepsilon_t) = \frac{b}{2} \left[\left(\frac{I_t}{K_t} \right) - a - \varepsilon_t \right]^2 K_t,$$

where a and b are the technical coefficients of the adjustment cost technology.

Thus:

$$(11) \quad \frac{I_t}{K_t} = a + \frac{I}{b} (q_t - I) \frac{p_t}{g_t} + \varepsilon_t,$$

where p_t and g_t are the price of the investment good and the price of output, respectively.

Marginal q is unobservable so this equation cannot be estimated directly. To derive an empirical investment equation (7) and (11) to be combined:

$$(12) \quad \left(\frac{I}{K} \right)_{it} = a + \frac{I}{b} (q_{it} - I) \frac{p_{it}}{g_{it}} + \varepsilon_{it} = a + \frac{I}{b} \left(\frac{V_{it}}{p_{it} (I - \delta) K_{i,t-1}} - I \right) \frac{p_{it}}{g_{it}} + \varepsilon_{it} = \\ = a + \frac{I}{b} Q_{it} + \varepsilon_{it}$$

The goal of the econometric procedure is to estimate these structural parameters. The productivity shock in equation (12) affects I_{it} since ε_{it} is known when I_{it} is chosen. It also affects Π_{it} and is therefore correlated with V_{it} .

The key idea behind the uniqueness of the E-business is that capital is composed of a tangible and an intangible component. The tangible part is what is easiest to measure - property, plant, and equipment - while the intangible part is more difficult to measure

since it depends on how advertising, R&D and the like create assets for the company. For practical reasons this intangible component has been ignored in most studies of investment.

Now consider the case of two capital goods subject to additively separable adjustment costs. Denoting investment and the stock of tangible capital by I_1 and K_1 , and investment and the stock of intangible capital by I_2 and K_2 , an equation for investment in tangible capital is to be derived. Assume that intangible capital and its price are an exogenously fixed proportion of tangible capital and its price:

$$(13) \quad K_1 = \frac{I}{c_i} K_2 \quad 0 < c_i < \infty;$$

$$(14) \quad p_1 = \frac{I}{d_i} p_2 \quad 0 < d_i < \infty.$$

Combining equations (3) and (4) assuming that $N = 2$ and using the linear homogeneity of $\Pi(K_t, I_t, \varepsilon_t)$:

$$(15) \quad \sum_{j=1}^2 \lambda_{jt} (1 - \delta_j) K_{j,t-1} = \Pi_t + \beta_{t+1}^t E_t \left[\sum_{j=1}^2 \lambda_{j,t+1} (1 - \delta_j) K_{jt} \right] = \\ = E_t \left[\sum_{s=0}^{\infty} \beta_{t+s}^t \Pi_{t+s} \right] = V_t$$

Thus marginal q for the first type of capital can be expressed as follows (similar for q_{2t}):

$$(16) \quad q_{1t} = \frac{\lambda_{1t}}{p_{1t}} = \frac{V_t}{p_{1t} (1 - \delta_1) K_{1t}} + \frac{I}{p_{1t}} \left(\frac{\partial \Pi_t}{\partial I_{2t}} \right) \left(\frac{1 - \delta_2}{1 - \delta_1} \right) \left(\frac{K_{2t}}{K_{1t}} \right)$$

Assume that the adjustment cost function is additively separable in tangible and intangible capital one can derive an empirical investment equation based on Tobin's Q. If it is not additively separable, then such an equation can be derived but it cannot be econometrically identified. In this case, the assumption is not unappealing since the cost of installing fixed capital is unlikely to have an effect on the adjustment costs of advertising, R&D and the like. The author chooses the two capital good analogue of the adjustment cost function introduced in equation (10) where additive separability has been imposed:

$$(17) \quad G(I_t, K_t, \varepsilon_t) = \frac{b_1}{2} \left[\left(\frac{I_{1t}}{K_{1t}} \right) - a_1 - \varepsilon_t \right]^2 K_{1t} + \frac{b_2}{2} \left[\left(\frac{I_{2t}}{K_{2t}} \right) - a_2 \right]^2 K_{2t},$$

where tangible and intangible variables are indicated by the subscripts 1 and 2, respectively.

Then it is easy to obtain the following empirical investment equation:

$$(18) \quad \frac{I_{1t}}{K_{1t}} = a_1 + \frac{I}{b_1} \left(\frac{V_t}{p_{1t}(1-\delta_1)K_{1,t-1}} - 1 \right) \frac{p_{1t}}{g_t} - \frac{b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{I_{2t}}{K_{1t}} \right) + \\ + \frac{a_2 b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{K_{2t}}{K_{1t}} \right) - \frac{I}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{p_{2t}}{p_{1t}} \right) \left(\frac{K_{2t}}{K_{1t}} \right) + \varepsilon_t$$

Using assumptions (13) and (14), it is possible to rewrite equation (18) in the following way:

$$(19) \quad \frac{I_{1t}}{K_{1t}} = a_1 + \frac{I}{b_1} \left(\frac{V_t}{p_{1t}(1-\delta_1)K_{1,t-1}} - 1 \right) \frac{p_{1t}}{g_t} - \frac{b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{I_2}{K_1} \right) + \frac{a_2 b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) c_t - \\ - \frac{I}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) c_t d_t + \varepsilon_t$$

Since the parameters and depreciation rates are nonstochastic it is possible to redefine the terms that are multiplied by c_t and d_t as e_t . Doing so yields:

$$(20) \quad \left(\frac{I_1}{K_1} \right)_{it} = a_1 + \frac{I}{b_1} \left(\frac{V_{it}}{p_{1i,t}(1-\delta_1)K_{1i,t-1}} - 1 \right) \frac{p_{1i,t}}{g_{it}} - \frac{b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{I_2}{K_1} \right)_{it} + \\ + \frac{a_2 b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{K_2}{K_1} \right)_{it} - \frac{I}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{p_2}{p_1} \right)_{it} \left(\frac{K_2}{K_1} \right)_{it} + \varepsilon_{it}$$

This equation cannot be estimated without data on the stock of intangible capital (K_2), which as argued is difficult, if not impossible, to measure. However, it can be noticed that so long as the ratio of intangible capital to tangible capital (K_2/K_1) is stable over time for a given company, and the ratio of the price of intangible capital to the price of tangible capital (p_2/p_1) is similarly stable, then the last two terms in equation (20) will be well approximated by a company-specific effect (e_i). While these assumptions are certainly restrictive, they are not ruled out by the model with two types of capital, and

they allow to proceed in the absence of data on the stock of intangibles. Maintaining these assumptions, one can obtain an estimable equation for E-business investments as:

$$(21) \left(\frac{I_1}{K_1} \right)_{it} = a_1 + \frac{1}{b_1} \left(\frac{V_{it}}{p_{li,t}(1-\delta_1)K_{li,t-1}} - 1 \right) \frac{p_{li,t}}{g_{it}} - \frac{b_2}{b_1} \left(\frac{1-\delta_2}{1-\delta_1} \right) \left(\frac{I_2}{K_1} \right)_{it} + e_i + \varepsilon_{it}$$

This equation differs in a number of important ways from the standard set-up in Tobin's Q equation (12). Notice that the tangible investment-capital ratio - not the total investment capital ratio which as being argued is unobservable - is related to Tobin's Q and the ratio of intangible investment to tangible capital. The coefficient on this latter ratio is a function of the adjustment cost parameters and depreciation rates for tangible and intangible capital. This shows that the basic Tobin' Q model that ignores intangible capital is misspecified unless b_2 is zero or $\delta_2 = 1$, or the covariance between Tobin's Q and intangible investment is zero. Based on *a priori* reasoning these conditions are unlikely to be satisfied: intangible capital surely has at least some adjustment costs and does not depreciate completely in each period; and presumably intangible investment is undertaken because it affects the average return to capital and hence V_t . The negative coefficient on I_2/K_1 is easy to interpret. For companies making intangible investments

$\frac{V_{it}}{p_{li,t}(1-\delta_1)K_{li,t-1}}$ will tend to be high. But, in part, this is just a signal to the company to invest in intangibles rather than tangible capital. So in modelling tangible investment specifically it is essential to correct the high value of $\frac{V_{it}}{p_{li,t}(1-\delta_1)K_{li,t-1}}$, which is what the negative coefficient on the I_2/K_1 term achieves.

1.4. Real option pricing vs. fundamental approach

The real-options approach applies financial options theory to real investments, such as E-business investments. A financial option gives the owner the right, but not the obligation, to buy or sell a security at a given price. Analogously, companies that make strategic investments to E-business have the right, but not the obligation, to exploit these opportunities in the future (real option) (Copeland *et al.* 2003: 82).

Real options take a number of forms, including the following (*Ibid.*: 97-102):

1. If an initial investment works out well, then management can exercise the **option to expand** its commitment to the strategy. For example, a company that enters E-business market may build a distribution center that can be expanded easily if market demand materializes.
2. If commercial prospects are uncertain, a company may have an incentive to wait to invest until the market develops sufficiently, rather than investing immediately and executing its **option to delay**. For example, a company having in possession a patent on some specific IT applications can wait to initiate the project till the market is ready to accept new technology.
3. Management may begin with a relatively small trial investment and create an **option to abandon** the project if results are unsatisfactory. E-business research and development spending is a good example. A company's future investment in E-business development often depends on specific IT applications developed in the R&D department. The option to abandon research projects is valuable because the company can make investments in stages rather than all up-front.

Each of these options - expand, delay, and abandon - owes its value to the flexibility it gives the company. Flexibility adds value in two ways. First, management can defer an investment. Because of the time value of money, managers are better off paying the investment cost later rather than sooner (Elton *et al.* 1995: 376). Second, the value of the project can change before the option expires. If the value goes up, the company is better off; otherwise it is no worse off because in this case the company does not have to invest in the project (*Ibid.*: 379).

Real options theory has generated increased research interest in the strategy field in recent years, and this interest is natural in view of the high degree of uncertainty that companies often confront in making strategic investment decisions. The appeal of real options theory also rests on its distinctive ability to capture managers' flexibility in adapting their future actions in response to evolving market or technological conditions (Copeland *et al.* 2003: 112). While such flexibility has long been recognized and appreciated by managers in an intuitive way, until the publication of Black and Scholes' seminal work on the pricing of financial options and Myers' pioneering idea of viewing

companies' discretionary future investment opportunities as real options, there had been a lack of formal models of such flexibility (McGrath *et al.* 2003: 35).

Over the years, strategy research on real options has used the theory both as a model for financial valuation and as a heuristic for managerial decision-making (*Ibid.*: 37). Many corporate investments have been argued to have option-like features, and a large number of studies have conceptualized or evaluated such investment projects using the real options perspective. For example, Kogut proposes that companies can form joint ventures as real options to expand under uncertain market or technological conditions (*Ibid.*: 38). McGrath argues that technology positioning projects embody valuable real options because of the sequential nature of staging investments and the high degree of uncertainty usually surrounding these projects (*Ibid.*: 47). Trigeorgis offers a taxonomy of real options that maps different categories of investments into the space of different types of options (*Ibid.*: 39-40).

Many internal and external corporate development projects such as investing in new technologies, entering into joint ventures, and so forth potentially create future investment opportunities in addition to generating benefits from their current uses (Truemann *et al.* 2001: 308). As one example, investing in E-business may not only bring in cash flows from the initial investment, but can also create valuable growth opportunities should the market develop in a favourable fashion. Therefore, managers must regard such initial investment as the first link in a longer chain of subsequent investment decisions or as a part of a larger cluster of projects. This type of "time series" investments presents particular managerial and valuation difficulties because it is not amenable to traditional valuation and capital budgeting techniques (Wiell *et al.* 2002: 275). Indeed, previous research in the strategy and finance literatures has indicated that applying these traditional techniques can lead to problems such as under-investment, myopic decisions, and even the possible erosion of a company's competitiveness (*Ibid.*: 276).

The most common financial justification method used, offered by the capital budgeting theory, is the Net Present Value method (*NPV*). The *NPV* method has received a lot of criticism from many authors. Major problems concern the ability of the method to value intangible benefits and costs, the estimation of future cash flows, the possibility to

properly value management flexibility, and the determination of the appropriate discount rate (Dehning *et al.* 2002: 26).

Generally, the *NPV* method uses a series of discrete cash flows per period, usually per year. The investment outlay is assumed to occur at the beginning of the first year, the subsequent cash flows are assumed to be received or paid at the end of each period. This is a simplification as e.g. revenue will be collected throughout the year. Using one estimate per period also raises the question of how high this estimate should be. As future cash flows cannot usually be predicted with a hundred percent certainty, some probability distribution applies. However, as is the case in many economic decisions, objective probabilities are impossible to generate (Elton *et al.* 1995: 71). The decision makers have to rely on subjective probabilities, which are the personal estimates of those involved in the decision making process (*Ibid.*: 82). Often a distinction is made between an optimistic, a pessimistic and a neutral prediction per cash flow, each of the predictions is granted a probability to occur (the sum of all probabilities per cash flow being equal to 100 %) (Frank 2001: 22). A possible appropriate estimate of the periodical cash flow will be the expected value (the statistical mean) of the distribution function. It should be noted that “the statistical mean” is not equal to the cash flow with the highest probability, which is often used as an estimate (of course, in the case of a normal distribution, the statistical mean will be equal to the cash flow with the highest probability of occurrence) (*Ibid.*: 27).

Second, the discount rate is problematic. Besides choosing the right basis for calculating the “time value of money”, its relation to the project risk is a problem. In order to accommodate for project risk a “risk adjusted discount rate” is often used, which is the summation of a risk-less market rate (e.g. returns on bonds) and some risk premium (Dehning *et al.* 2002: 37). Applying a single risk premium assumes a particular risk profile for the whole project. Different stages in the project lifetime and different cash flows may be connected to different risk profiles (*Ibid.*: 39).

A third important problem poses the concept of management flexibility. Managers have flexibility to adapt their response to unexpected market developments resulting from change, uncertainty, and competitive interactions (Elton *et al.* 1995: 79). As a project evolves in time, new information may become available and uncertainty about market

conditions and cash flows is gradually resolved. Management may therefore have flexibility to alter its initial operating strategy in order to capitalize on favourable future opportunities, or to react so as to mitigate losses (*Ibid.*: 81-82). Hence, managers are actively involved in the investment, contrary to the assumption of passive management for the traditional *NPV* approach. Traditional valuation techniques therefore do not take into account this management flexibility, and as a result often underestimate the value of investments (Elton *et al.* 1995: 87).

Real options enable one to calculate the expected value of actively managed projects. The *NPV* of the project with real options is said to be “expanded” by the option value of management flexibility and intangible assets. The real options approach is best seen as an improvement to conventional discounted net present value determination; it does not invalidate the procedure but amends the way it is applied. In fact it rationalizes what many evaluators are already doing on intuitive grounds (Copeland *et al.* 2003: 315-316):

- ❖ attach importance to the timing of decisions;
- ❖ assess the intangible outcome of investments;
- ❖ identify downside risks and upside opportunities associated with the project;
- ❖ identify, evaluate, and optimize future decisions that may affect exposition to downside or upside fluctuations.

Once these dimensions of the project are introduced, projects become proactive instruments that modify the way uncertainty and intangible assets affect results in the decision maker’s favour. Proper evaluation of costs and benefits always was crucial in conventional net present value evaluation. In the real options approach, costs and benefit evaluation becomes more difficult. Options created by the project now enter as benefits; options used up by the project enter as costs (McGrath *et al.* 2003: 48-49). In both cases these options must be valued and in most cases such evaluation involves finding the optimal way to decide whether and when the option must be created or used up.

2. VALUATION OF E-BUSINESS INVESTMENTS

2.1. E-business value modelling

As discussed earlier, prior studies collectively provide reasonable evidence that web traffic metrics in general are relevant to the valuation of E-business companies. They also suggest that the value relevance of web traffic information is sensitive to business models employed by E-business companies (Hand 2001: 75). These results imply the need for a better understanding of the E-business models and for the development of other proxies for this particular economic sector.

The further study focuses on identifying and testing value relevance of new non-financial measures that are assumed to be particularly relevant to E-business. E-business companies earn revenues in much the same way as the more traditional, i.e. "bricks and mortar" stores do, through sales. Their Web sites are characterized by high upfront expenditures in technology, sales, general and administrative and advertising. Getting browsers to these Web sites is essential. Getting them to make purchases, however, is the key value driver of revenues. Therefore, the most influential intangible measures for these companies would be how many visitors respond to their advertisement/promotions (click through rate) and how many visitors complete a purchase once at their Web sites.

Coupled with the inconsistent empirical findings of value relevance of non-financial variables to heterogeneous groups of E-business companies, above discussions suggest that a critical mass of visitors in the first place is an important economic indicator for an E-business in building customer relationship in the cyber market place. In this light the greater member base creates "network effects" (Harmon *et al.* 2000: 205). As the number of visitors grows, more and more users find the Web site attractive because of their ability to interact with other users and information sharing generated by members.

Greater member base enhances opportunities for E-business to market a range of products and services to those members (Harmon *et al.* 2000: 206).

This research paper introduces two value drivers of E-business: usage rate (*UR*) that can be viewed as the ratio of a particular company's registered users to total visitors and buy rate (*BR*) that is the ratio of the number of actual buyers to total visitors. Put differently, usage rate indicates how many visitors decided to use a company's services offered on-line (Extranet, mailing lists etc) and buy rate measures how many visitors actually end up purchasing products or services that companies sell. Therefore, *BR* is directly related to the revenue of E-business companies; naturally it is expected that *BR* is closely associated with the equity market value of E-business. From the above discussion, the following **hypothesis** to be formulated: the buy rate (as an intangible characteristic) of E-business is on average positively associated with the company value.

Several data sources are employed in order to select the sample for this research. Sample companies (238 companies on 31.12.2002) come from E-business sector of New York Stock Exchange, their relative financial data available on Yahoo financial Web site (Yahoo! Finance 2003) and non-financials is obtained on the Internet statistics Web site (Clicz Network 2003). The time-frame for this analysis is 1997-2002.

To test the hypothesis, the author relies on the well-known residual income model proposed by Ohlson (1995: 164) in which equity values are a function of both economic fundamentals (i.e., accounting information) and information not yet reflected in accounting system. Ohlson (1995: 167-168) develops the following market valuation model, assuming clean surplus accounting:

$$(22) \quad P_t = BV_t + \sum_{i=1}^{\infty} \frac{E(RE_{t+i})}{(1+r)^i},$$

where P_t – the market value of equity at time t ,

BV_t – the book value of equity at time t ,

RE_{t+i} – residual earnings for period $t + i$,

r – the company's required rate of return on its equity capital.

Using the time-series behaviour of residual earnings that RE satisfies the stochastic process, Ohlson (1995: 170) demonstrates that RE follows an autoregressive process and expresses a company value as follows:

$$(23) \quad P_t = BV_t + \alpha_1 RE_t + \alpha_2 v_t,$$

where α_1, α_2 - regression coefficients,

v_t - intangible factor at time t .

Equation (23) implies that the market value of equity equals the sum of the book value, the current profitability as measured by residual earnings and intangible parameter that modifies the prediction of future profitability. This parameter should be thought of as summarizing value of relevant data that have yet to have an impact on the financial statements (Ohlson 1995: 172). In other words, it captures all non-accounting information used in the prediction of future residual earnings.

As in prior researches that relate the value of E-business to its non-financial metrics, the author employs equation (23) to allow for including both financial and intangible measures of performance. The initial models comprised both fundamental (i.e. company functioning characterizing parameters) and intangible characteristics of E-business. Thereafter by the means of model optimizing techniques the model has been considerably reduced to the following linear relation:

$$(24) \quad P_{it} = a + a_1 BR_{it} + a_2 UR_{it} + a_3 NI_{it} + a_4 BV_{it} + u_{it},$$

where P_{it} - the market value of equity for company i at time t ,

BR_{it} - the number of purchasers divided by total unique visitors for company i at time t ,

UR_{it} - the number of registered users divided by total unique visitors for company i at time t ,

NI_{it} - net income for company i at time t ,

BV_{it} - the book value of equity for company i at time t ,

a, a_1, \dots, a_4 - parameters of regression model,

u_{it} - error (stochastic variable).

All financial variables are deflated by the number of shares outstanding at time t to mitigate potential estimation problems with heteroscedasticity. To make sure that

heteroscedasticity is not the case, the author exploits the White's test as a controlling tool. The White's test output affirms that conditional variances of u_{it} are equal (i.e. homoscedasticity), since nR^2 (5.62) < critical χ^2 (6.57) value, where the probability is 95% and degrees of freedom equal 14.

The author uses market value of equity at the end of the month t as the dependent variable. It is expected that BR and UR should be incorporated in the valuation equation, after controlling for information in contemporaneous accounting book value (BV) and earnings (NI).

Next, net income is to be decomposed into its components. The assumption of unbiased accounting of Ohlson (1995: 173-174) model implies that the decomposition would allow the model to empirically mitigate potential problems arising from biased accounting that is of particular prevalence in intangible-intensive E-business. Consistent with this assertion, prior research demonstrates that the income components do not have identical relationships with the market value of the equity (Hand 2001: 72). Hence the following decomposed regression model is to be run:

$$(25) \quad P_{it} = a + a_1BR_{it} + a_2UR_{it} + a_3GP_{it} + a_4SM_{it} + a_5RD_{it} + a_6OTEX_{it} + a_7BV_{it} + u_{it},$$

where GP_{it} - gross profits for company i at time t ,

SM_{it} - sales and marketing expenses for company i at time t ,

RD_{it} - R&D costs for company i at time t ,

$OTEX_{it}$ - other expenses for company i at time t .

Since prior literature suggests that the market may view expenditures on marketing and product development and R&D expenses as investments in intangible assets as well (*Ibid.*: 73), net income is to be decomposed into four components: gross profits, sales and marketing expenses, research and development costs, and other expenses. The author hypothesizes that gross profits (GP), sales and marketing expenses (SM) and R&D expenses (RD) are positively valued by the market in its determination of E-business companies' value.

The results of the White's test suggest that the decomposed model has no heteroscedasticity, since nR^2 (18.98) < critical χ^2 (22.46) value, where the probability is 95% and degrees of freedom equal 35.

For the test of value drivers of E-business, most of the prior studies employ a pooled time-series and cross-sectional approach to gain power with a small number of observations (*Ibid.*: 73-74). Pooling data cross-sectionally and intertemporally assumes that the regression model's parameters are equal across companies and are stable over time (*Ibid.*: 76-77). While such an approach is computationally simple and significantly increases the degree of freedom, the assumption of a sample-wide relation fails to incorporate any form of heterogeneity among sample companies. Ideally, it is important to allow regression coefficients to vary across companies by using an independent company-specific approach. However, this approach is not suitable for this research mainly because there is a serious lack of degrees-of-freedom necessary for its deliberate implementation. In an attempt to reconcile a trade-off between desire to model individual difference and the necessity to preserve a high degree-of-freedom, the author uses a panel regression approach, i.e. a fixed-effects model. On one hand, this model combines data over both time and across companies as in the simple pooled time-series and cross-sectional ordinary least squares regression approach (Campbell *et al.* 1997: 403). On the other hand, it assumes that the residual consists of two types of fixed effects: a time effect, which is assumed to be constant for all companies in a given period, and a company effect, which is assumed to be constant for a given company over time (*Ibid.*: 405).

Next, a pooled time-series and cross-sectional approach creates other concerns in terms of the efficiency of the parameters' estimates. The coefficients on financial data may be time varying, particularly in a period like spring 2000 when the market values of E-business companies declined dramatically. More importantly, since this research focuses on a homogeneous group of companies in a single industry, some factors (included in error terms) which are non-observable and/or omitted from the regression model may affect all the sample companies at the same time, giving rise to a non-zero contemporaneous covariance between the disturbances of different companies. To address this potential problem, the author uses a seemingly unrelated regressions (*SUR*) approach with a fixed-effects model.

Tables 1 and 2 provide descriptive statistics for the relevant dependent and independent variables used in the study. For sample E-business, 12.38% of unique visitors registered

as the users of the sample company's Web services. And 8.01% of the visitors have purchased products listed in the cyber market places of the sample company.

Table 1. The main characteristics of reduced model of E-business value

| Model variable | Mean | Standard deviation | Median |
|----------------|-------|--------------------|--------|
| <i>P</i> | 23.31 | 21.11 | 14.27 |
| <i>BR</i> | 8.01 | 4.13 | 7.29 |
| <i>UR</i> | 12.38 | 7.34 | 5.54 |
| <i>NI</i> | 0.03 | 0.12 | 0.01 |
| <i>BV</i> | 8.12 | 15.28 | 4.21 |

Source: Computed by author in SPSS software

Table 2. The main characteristics of decomposed model of E-business value

| Model variable | Mean | Standard deviation | Median |
|----------------|-------|--------------------|--------|
| <i>P</i> | 21.27 | 27.15 | 13.24 |
| <i>BR</i> | 8.23 | 4.58 | 8.46 |
| <i>UR</i> | 12.89 | 7.98 | 6.02 |
| <i>GP</i> | 0.04 | 0.03 | 0.02 |
| <i>SM</i> | 0.12 | 0.10 | 0.10 |
| <i>RD</i> | 0.07 | 0.04 | 0.05 |
| <i>OTEX</i> | 0.41 | 0.32 | 0.39 |
| <i>BV</i> | 4.12 | 3.88 | 3.67 |

Source: Computed by author in SPSS software

On average, the sample companies report a net income of \$ 0.03 per share. Average gross profits are positive as expected. These profit measures are consistent with those reported in the prior literature. The mean book value of the sample companies is \$ 8.12 in comparison to the \$ 23.31 of the market price.

Next examine the Pearson correlations among variables used in the empirical analysis (Tables 3, 4) to find out significance of relations of the models' variables.

Table 3. Pearson correlations of reduced E-business model variables

| | <i>P</i> | <i>BR</i> | <i>UR</i> | <i>NI</i> |
|-----------|------------------|------------------|------------------|------------------|
| <i>BR</i> | 0.769 (0.002) | 1 | | |
| <i>UR</i> | 0.722 (0.058) | 0.618 (0.000) | 1 | |
| <i>NI</i> | 0.334 (0.171) | 0.221 (0.039) | 0.125 (0.847) | 1 |
| <i>BV</i> | 0.297 (0.292) | 0.264 (0.374) | 0.399 (0.104) | 0.324 (0.081) |

Source: Computed by author in SPSS software (values in parentheses denote p-values)

Table 4. Pearson correlations of decomposed E-business model variables

| | <i>P</i> | <i>BR</i> | <i>UR</i> | <i>GP</i> | <i>SM</i> | <i>RD</i> | <i>OTEX</i> |
|-------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|-------------------|
| <i>BR</i> | 0.778 (0.009) | 1 | | | | | |
| <i>UR</i> | 0.731 (0.017) | 0.627 (0.002) | 1 | | | | |
| <i>GP</i> | 0.115 (0.475) | 0.020 (0.122) | 0.147 (0.000) | 1 | | | |
| <i>SM</i> | -0.078 (0.005) | 0.007 (0.741) | 0.080 (0.231) | 0.022 (0.338) | 1 | | |
| <i>RD</i> | -0.101 (0.321) | 0.135 (0.543) | 0.144 (0.659) | 0.111 (0.495) | 0.598 (0.224) | 1 | |
| <i>OTEX</i> | -0.262 (0.074) | -0.094 (0.665) | -0.056 (0.453) | -0.115 (0.501) | 0.499 (0.190) | 0.476 (0.015) | 1 |
| <i>BV</i> | 0.131 (0.625) | 0.388 (0.049) | 0.397 (0.224) | 0.209 (0.002) | 0.187 (0.598) | 0.112 (0.000) | -0.173 (0.232) |

Source: Computed by author in SPSS software (values in parentheses denote p-values)

As expected, *BR* and *UR* are strongly positively correlated with the market value. Financial variables exhibit predicted signs with mixed significance levels.

The results of the panel regression with the *SUR* approach are reported in Tables 5, 6, where adjusted coefficients of determination $\text{adj. } R^2$ are equal 0.815 and 0.823 respectively that implies the trustworthy of set-up models.

Table 5. Output of regression analysis of reduced model of E-business

| Variable | <i>BR</i> | <i>UR</i> | <i>NI</i> | <i>BV</i> |
|-----------|-----------|-----------|-----------|-----------|
| Parameter | a_1 | a_2 | a_3 | a_4 |
| Estimates | 2.393 | 1.988 | 11.202 | 5.021 |
| t-value | 3.112 | 3.923 | 4.345 | 13.270 |
| p-value | 0.000 | 0.023 | 0.002 | 0.127 |

Source: Computed by author in SPSS software

Table 6. Output of regression analysis of decomposed model of E-business

| Variable | <i>BR</i> | <i>UR</i> | <i>GP</i> | <i>SM</i> | <i>RD</i> | <i>OTEX</i> | <i>BV</i> |
|-----------|-----------|-----------|-----------|-----------|-----------|-------------|-----------|
| Parameter | a_1 | a_2 | a_3 | a_4 | a_5 | a_6 | a_7 |
| Estimate | 2.446 | 2.107 | 9.122 | -15.002 | -4.334 | -4.437 | 5.568 |
| t-value | 3.739 | 3.980 | 0.895 | -1.543 | -1.235 | -1.898 | 9.275 |
| p-value | 0.001 | 0.018 | 0.526 | 0.039 | 0.287 | 0.113 | 0.025 |

Source: Computed by author in SPSS software

In Table 5 in which the reduced model is used, the coefficients of all independent variables exhibit predicted signs. As hypothesized, the buy rate (*BR*) has a positively significant association with the market value at less than the 1% level. This result supports the hypothesis that the buy rate of a company is on average positively associated with the company's value. Equally important, the coefficient on the ratio of registered users to the unique visitors (*UR*) is also significant at less than the 1% level. Thus, the market reacts favourably to the increase in the purchase rates of companies as well as the increase in the usage of companies' Web services.

With respect to the financial data, both net income (*NI*) and book value of the equity (*BV*) show predicted positive signs and are statistically significant. Contrary to the results of most prior literature, net income (*NI*) is strongly positively value relevant to the sample of E-business companies. This result, however, is not surprising. It is rather consistent with the notion that E-business companies run their business in much the same way as traditional "bricks and mortar" companies do (Keating *et al.* 2002: 47). The core difference is significant value of intangible parameters that characterise network processes of E-business companies.

When net income is decomposed into its components, the tenor of results for non-financial information remains the same. As reported in Table 6, both *BR* and *UR* are positive and statistically significant at less than the 1% level. Gross profit (*GP*) and Book value (*BV*) are also statistically significant and show predicted positive signs. None of other earnings components (*SM*, *RD* and *OTEX*) is significantly associated with market prices in a positive direction. These results are consistent with a conjecture that the market is no longer willing to implicitly capitalize these expenditures in valuing E-business value as the market has experienced the shakeout in the spring of 2000 (*Ibid.*: 48).

Overall, the results suggest that the market treats intangible assets as a part of strategic investments by management. As the analysis shows intangible parameters are significant and influence considerably the value of a company, thus these parameters should be included in the further investment valuation, otherwise E-business projects may be underestimated and never realized.

2.2. Fundamental approach to E-business investment analysis

The total E-business investments made by a company can be thought of as a portfolio, similar to a financial portfolio of stocks and options. Each E-business investment will have a different risk and return on investment (*ROI*) and, because capital is limited, selecting the optimal portfolio is a challenging management decision for any company. The methodology for choosing and managing an optimal portfolio is called portfolio management. This process often includes the use of scorecards so that executive managers can rate projects on multiple dimensions and ultimately rank projects in relative order of importance to the company (Elton *et al.* 1995: 192). A typical scorecard will include several categories that help quantify the value of a project to the business and the risk of the project. It needs to be mentioned, that *ROI* is typically only one category on the scorecard and that several other factors may have equal or greater importance.

The overall process of calculating return on investment for E-business project is straightforward. The first step is to calculate the base case revenue and costs expected in the future if the business continues as it is now. The next step is to measure the net cash flows with the new proposed project; this includes total revenue, potential cost savings, and all costs of the project. Finally, the base case cash flows are subtracted from the projected cash flows with the new project. The results of these subtractions are called the incremental cash flows for the project (*Ibid.*: 211). The internal rate of return (*IRR*) is then calculated from these incremental cash flows. An equivalent approach is to calculate the additional benefits of the project directly to obtain the incremental cash flows. For complex business models, however, separating out the additional benefits when there are multiple variables can be more difficult than calculating the total cash flows with the new project and then subtracting the base case (*Ibid.*: 217).

As postulated in corporate finance theory, if the *IRR* calculated from the incremental cash flows is greater than the project discount rate, i.e. weighted average cost of capital (*WACC*), the project should be considered for funding - this is equivalent to a positive *NPV* project.

The challenge is to accurately incorporate the business drivers in the base case and all of the project costs, potential cost savings, and potential revenue benefits in the new project's cash flows. In order to put the calculation process in context, and to discuss some of the important details, it is useful to walk through an example.

Let now discuss a case example of investment analysis applied to a Web site E-business project. The Web site in this example is a Web site with a product catalogue, and customers can buy products and transact orders using the Internet. The Web site front end acts as a customer interface and, for a large company, is typically connected internally to the company's back-end IT systems, such as an enterprise resource planning (*ERP*) system, and other enterprise systems, such as customer relationship management (*CRM*) software. The particular example discussed in this section is for a midsize electronics manufacturing company with global sales and operations. The example has been simplified to illustrate the main features of investment analysis, and all numbers depict hypothesized case. The cost and revenue numbers in this example are therefore for illustrative purposes only.

The objective of this case example is to illustrate the general process and the important mechanics for calculating return on investments (i.e. tangible effect) rather than the exact costs and benefits of a Web site project.

The first step in setting up any investment analysis is to understand the base business case. That is, what are the primary costs and revenues expected if the company continues operations and does not implement a new E-business solution? Answering this question should focus on the major costs and revenue drivers that the new technology project is expected to impact. The process of understanding the existing business is called business discovery (Elton *et al.* 1995: 282). A best practice of business discovery is to understand the cost and revenue drivers in a particular business process and then benchmark against competitors in the industry (*Ibid.*: 287). For example, if the average transaction cost for order processing in a company is \$ 35 per order, and the industry average is \$ 10 per order, there is clearly an opportunity for improvement.

If E-business or other information technology is used by competitors to achieve cost or revenue improvements, benchmarking data provide estimates of the improvements that might be expected if a similar solution were applied to existing processes within a company. Understanding the key business drivers, and which factors can improve business performance, is essential and can have important bottom-line implications. For the case example discussed assume that the business discovery yielded a set of assumptions that are summarized in Table 7.

Table 7. E-business project set-up

| | Case Data | Value |
|----------------------------|--|--------------|
| General Assumptions | Weighted average cost of capital (WACC) | 12% |
| | Tax rate | 35% |
| | Customers in year 0 | 1,700 |
| | Transactions in year 1 | 141,000 |
| | Average order size in year 1 | \$ 258 |
| | Cost of goods sold as % of the sales price | 70% |
| | Average order size annual growth rate | 3% |
| Base Case | Number of transactions annual growth rate | 3% |
| | Average processing cost per order (base) | \$ 30 |
| E-business Project | Initial implementation cost | \$ 5M |
| | Ongoing maintenance and marketing each year | \$ 1M |
| | Increase in total transactions in year 1 | 20,000 |
| | Number of transactions annual growth rate after year 1 | 10% |
| | Average processing cost of a Web transaction | \$ 3 |
| | Average processing cost per order | \$ 16.50 |
| | % total transactions with the Web site in year 1 | 50% |

Source: Set up by author

Specifically, the revenue and cost drivers are assumed to be the sales transactions to 1,700 customers and the transaction costs for processing these orders, respectively. The average sales revenue per order is \$ 258, the average cost of goods sold (*COGS*) is 70% of each order, and the transaction cost using phone and fax averages \$ 30 per transaction. In the next year (year 1) the company anticipates 141,000 total transactions through existing channels and without a Web site. Multiplying the average revenue per order by the number of transactions, and subtracting *COGS* and transaction cost, one can calculate the net income in year 1. If the tax rate is 35%, the net year 1 free cash flow is expected to be \$ 4.3 M. Cash flows projected into additional future years can be estimated by multiplying the year 1 numbers by anticipated annual growth rate factors. One must make assumptions based upon the expected increase in sales and costs for the

next few years. As part of the business discovery, these assumptions may be based on data for the company's performance in the past. For simplicity in the present example it is assumed that the company is in a mature industry and anticipates 3% growth in the total number of transactions, assuming the Web site initiative is not implemented. The base case three-year future (also called pro forma) cash flows derived from these assumptions are given in Table 8.

Table 8. Pro-forma of base case

| | Year 1 | Year 2 | Year 3 |
|----------------------------|---------------|---------------|---------------|
| Customers | 1,751 | 1,804 | 1,858 |
| Number of transactions | 141,000 | 145,230 | 152,492 |
| Average order size | 258 | 265 | 273 |
| Revenue (\$) | 36,308 | 38,519 | 41,658 |
| Cost of goods sold (\$) | 25,415 | 26,963 | 29,161 |
| Order processing cost (\$) | 4,230 | 4,357 | 4,575 |
| Earnings before taxes (\$) | 6,662 | 7,199 | 7,923 |
| Taxes (35%) | 2,332 | 2,520 | 2,773 |
| Net income (\$) | 4,330 | 4,679 | 5,150 |
| Free cash flow (\$) | 4,330 | 4,679 | 5,150 |

Source: Calculated by author

Note that this base case is simplified for this example and in practice may be much more complicated. For example, the revenue may come from multiple market segments with different transaction costs, and the number of transactions may be very large.

The Web site case example has two primary business objectives:

- ❖ enable self-service order entry by customers, thus reducing costs,
- ❖ enable access into a broader market for customers, potentially increasing revenues.

In addition to these business goals, the Web site has strategic value, because in the electronic components manufacturing industry a Web site is becoming a requirement for conducting business. The costs of a project are often the easiest component of the investment analysis to quantify. These costs may include items such as hardware, software, license fees, programmers' time, professional services (consulting), project management, hosting fees, outsourced contractors, and ongoing operating expenses. Managers strive to keep the total cost of ownership of new products and systems at a minimum. Minimizing total cost of ownership is related to the build vs. buy decision for

the E-business project. This is because custom-built applications can have high total cost of ownership over their useful life. A useful rule of thumb is that if less than 10% custom modification to a packaged enterprise application is necessary then it is generally cheaper to buy than build (Frank 2001: 121). Greater than 10% custom modification puts the cost of building vs. buying about even, because new version releases of the packaged software will require continual custom modifications (*Ibid.*: 124). Web site technology was novel in the mid 1990s, but a couple of years latter, several vendors were offering stable solutions. Hence, for this case example the best approach is most likely to integrate commercial off-the-shelf packaged applications with the company's existing enterprise software systems.

The major costs will most likely be integration with existing systems and infrastructure to support high availability (24/7 operation with little or no down time) across multiple geographic markets. The cost of outsourcing the system, versus keeping it in house, may also be considered. Cost estimates can be obtained from similar projects that have been completed in the past. For the purpose of this example the project cost is assumed to be \$ 5M, with ongoing costs of \$ 1M in each year. The ongoing costs include maintenance, upgrades, license fees, and professional services. To help facilitate the second business goal the Web site initiative must include a marketing campaign in target markets. For simplicity in this example, these marketing costs are assumed to be included in the ongoing costs of the project. In practice the marketing plan would contain detailed costing and would most likely be broken out into a separate line item in the cash flow statement.

The primary anticipated benefits, or outputs, of the Web site initiative are reduced transaction costs and increased revenue generation. The cost savings occur because phone and fax orders for this company average \$ 30 per order, and electronic processing is anticipated to cost \$ 3 per order. The revenue generation benefit is expected to come from the Web site's ability to have a global reach, so that with targeted marketing more customers can access the company's products without increasing the size of the sales force. Other benefits of this initiative include fewer errors in processing transactions, reduced time to process orders, improved information on customers, and improved

customer satisfaction, because customers can place orders 24/7 and have access to up-to-date product data.

Accurately quantifying all of the benefits of an E-business is the most challenging part of investment analysis. In practice one can often quantify the major hard cost savings. Revenue growth is more difficult to estimate and must come from market research, industry data, and past experience. It is often not possible to quantify soft benefits (i.e. **intangible effect**) such as customer satisfaction and strategic advantage. The analysis therefore typically includes cost savings and revenue generation that can be estimated, and unquantifiable soft benefits are not included. This means that the *ROI* calculated will potentially be less than the realized *ROI* including soft benefits. One must then subjectively consider the project's soft benefits and how important they are to the company. To put it clear, the investment analysis is only as good as the assumptions that go into the analysis.

The details of the financial analysis calculation including the Web site are described as follows. For the case example, the average transaction cost is the easiest benefit to quantify and is straightforward to calculate. For all of the transactions processed, 50% of the customers are assumed to use the Web site and 50% are assumed to use fax and phone methods of ordering. The average total transaction cost is the weighted average of the number of transactions expected using the new Web site system (assumed to be 50% of total transactions) multiplied by the transaction cost of \$ 3 for each electronic transaction and \$ 30 for each phone and fax order: $0.5 * (\$ 3 + \$ 30) = \$ 16.50$ per order. With a larger fraction of customers using the E-business system, the average transaction cost per order decreases significantly from \$ 30. For this case example, assume that with the new Web site market penetration will increase and that there will be an initial increase in the number of total transactions in year 1 as the global customer base is enabled to do online transactions. With the year 1 14% increase in transactions, and a 10% yearly growth in the total number of transactions driven by the marketing campaign in years 2 and 3, the effective growth in gross revenues is 13.3% per year. Because it costs only \$ 3 to process an order using the Internet, in addition to revenue growth there is also a substantial cost savings of \$ 2M due to the reduced average transaction cost to process an order. Table 9 incorporates the revenue and cost savings

of the new Web site initiative into a pro forma cash flow statement. The upfront and ongoing costs of the new initiative are also included. The revenue generation is incorporated in the increased number of transactions, and the cost savings are encapsulated in the total order processing cost line of the cash flow statement Table 9. For the calculation of net income subtract out the depreciation of the project, assuming a three-year straight line schedule Straight line is a conservative compromise, because it weights the expense equally in each year, whereas accelerated depreciation weights the capital expense more in the first few years than in the last. Once the system is operational, ongoing costs such as maintenance and professional service support can be expensed when they occur.

Table 9. Pro-forma of E-business project case

| | Year 1 | Year 2 | Year 3 |
|-----------------------------------|---------------|---------------|---------------|
| Customers | 2,081 | 2,299 | 2,454 |
| Number of transactions | 161,000 | 177,100 | 194,810 |
| Average order size (\$) | 258 | 265 | 273 |
| Revenue (\$) | 41,458 | 46,971 | 53,219 |
| Cost of goods sold (\$ thousands) | 29,020 | 32,880 | 37,253 |
| Total order processing cost (\$) | 2,657 | 2,922 | 3,214 |
| Gross profit (\$) | 9,781 | 11,169 | 12,751 |
| Project ongoing maintenance (\$) | (1,000) | (1,000) | (1,000) |
| Depreciation expense (\$) | (1,667) | (1,667) | (1,667) |
| Earnings before taxes (\$) | 7,114 | 8,503 | 10,085 |
| Taxes (35%) | 2,490 | 2,976 | 3,530 |
| Net income (\$) | 4,624 | 5,527 | 6,555 |
| Free cash flow (\$) | 6,291 | 7,193 | 8,222 |

Source: Calculated by author

Off balance sheet and lease financing options are usually not incorporated into the cash flow statements for the investment analysis with a new project. For capital budgeting, the base case and the case with the new project should be objectively compared, independent of how the project is financed. Leasing and off balance sheet financing can artificially improve the *ROI*, because the cost of the project is spread over time by the lease payments. A more conservative estimate is to assume the costs of the project are incurred up front, or at the same time as the costs are anticipated to actually occur. Once the project is accepted for funding the best method of financing should be chosen.

To calculate the free cash flow with the new project, the last step is to add back the depreciation expense to the net income after tax. The depreciation expense was included in the calculation of net income in order to correctly include the tax advantage of this expense. However, for the final free cash flows the total depreciation is added back to the net income, because depreciation is not a “real” expense that actually impacts the cash flows, other than for tax reasons.

Once the pro forma base case and new-project free cash flows have been calculated, the calculation of *IRR* is straightforward. The base case cash flows are subtracted from the cash flows with the new E-business project; these are the incremental cash flows. The incremental cash flows are the net positive or negative cash in each time period that occurs in addition to the base case. The *IRR* is calculated from these incremental cash flows.

$$(26) \quad NPV = \sum_{i=1}^3 \frac{FCF_i^2 - FCF_i^1}{(1+WACC)^i} - I_0 = \frac{1,961}{1.12} + \frac{2,514}{1.12^2} + \frac{3,072}{1.12^3} - 5000 = 941.6 ,$$

where *NPV* – net present value of E-business project,

FCF^1 – base case free cash flow,

FCF^2 – cash flow after implementing E-business project,

WACC – weighted average capital cost,

I_0 – E-business project initial investment.

To calculate *IRR*, the following equation is to be solved:

$$(27) \quad NPV = \sum_{i=1}^3 \frac{FCF_i^2 - FCF_i^1}{(1+IRR)^i} - I_0 = 0 \Rightarrow \frac{1,961}{1+IRR} + \frac{2,514}{(1+IRR)^2} + \frac{3,072}{(1+IRR)^3} - 5000 = 0$$

$$IRR = 0.219 = 21.9\%$$

Assuming the assumptions are correct, the *IRR* being greater than the company’s *WACC* suggests that this is a project the company should consider funding. However, *IRR* calculated in this example does not include additional benefits such as: fewer errors in processing transactions, reduced time to process orders, improved information on customers, and improved customer satisfaction because customers can place orders 24/7 and have access to up-to-date product data. One can attempt to quantify these benefits and include them in the model; however, soft benefits such as improved customer

satisfaction and better information are extremely difficult to accurately quantify. The approach most often used is to realize that the calculated *IRR* does not include these benefits, and hence the actual *IRR* of the project should be somewhat higher. In addition, the case example does not include the strategic value of the initiative. Specifically, the Web site may be a “table stake” - an investment that is required to stay in business in a particular industry (Freeman *et al.* 2002: 76).

Hence, even if the *IRR* is less than the hurdle rate (i.e. *WACC*) for the company, management have to consider investing in the E-business project, or risk losing market share to competitors who have the technology.

To illustrate E-business project dilemma (i.e. *IRR* vs. *WACC*), the author conducts sensitivity analysis (Table 10), by means of which management is able to decide what is the proper *IRR/WACC* ratio for the company.

Table 10. Sensitive analysis of E-business project

| Revenue (\$) | Cost savings (\$) | | | | | | |
|--------------|-------------------|--------|--------|--------|--------|--------|--------|
| | 1,700 | 1,800 | 2,000 | 2,200 | 2,400 | 2,600 | 2,800 |
| 39,250 | -26.3% | -25.8% | -24.7% | -23.7% | -22.6% | -21.5% | -20.3% |
| 39,500 | -20.3% | -19.7% | -18.7% | -17.6% | -16.4% | -15.3% | -14.1% |
| 39,750 | -14.6% | -14.0% | -12.9% | -11.8% | -10.7% | -9.5% | -8.3% |
| 40,000 | -9.2% | -8.6% | -7.5% | -6.3% | -5.2% | -4.0% | -2.7% |
| 40,250 | -4.0% | -3.4% | -2.3% | -1.1% | 0.1% | 1.3% | 2.6% |
| 40,500 | 1.0% | 1.6% | 2.8% | 4.0% | 5.2% | 6.4% | 7.7% |
| 40,750 | 5.8% | 6.4% | 7.6% | 8.9% | 10.1% | 11.4% | 12.7% |
| 41,000 | 10.5% | 11.1% | 12.4% | 13.6% | 14.9% | 16.2% | 17.5% |
| 41,250 | 15.1% | 15.7% | 17.0% | 18.3% | 19.5% | 20.8% | 22.2% |
| 41,500 | 19.6% | 20.2% | 21.5% | 22.8% | 24.1% | 25.4% | 26.8% |
| 41,750 | 24.0% | 24.6% | 25.9% | 27.2% | 28.6% | 29.9% | 31.2% |
| 42,000 | 28.3% | 29.0% | 30.3% | 31.6% | 32.9% | 34.3% | 35.7% |
| 42,250 | 32.6% | 33.2% | 34.5% | 35.9% | 37.2% | 38.6% | 40.0% |
| 42,500 | 36.8% | 37.4% | 38.8% | 40.1% | 41.5% | 42.9% | 44.3% |

Source: Calculated by author

The grey cells correspond to cost saving and revenue generation amounts that would not be acceptable (*IRR* < *WACC*). The boundary, where the cells change from grey to white, is the minimum cost saving and revenue generation necessary so that the *IRR* approximately equals *WACC* (*NPV* = 0). This table can be used as a tool to review the ranges of *IRR* in the context of the best, worst, and average cases expected for each

input parameter. The sensitive analysis is therefore extremely useful method for management to get reasonable insight (due to intangible effect) into *IRR* variation (e.g. $IRR + \% \text{ variation} \geq WACC$) for E-business project acceptance.

2.3. Real option pricing approach to E-business investments

This part deals with a topic widely recognized as important in strategy and related disciplines, namely the investment analysis (in this case E-business) when the environment is uncertain and intangible benefits are prevailing.

There are two types of options that can influence the return on the E-business project. The first is the option to delay investing in a project. When a company has the exclusive rights to a project, even one with a negative net present value, it can hold back on investing until the project becomes an attractive one, and choose not to invest if this never happens. Consequently, the value of the rights to invest in this type of investment will often exceed the discounted cash flow value of the investment, and can be estimated using an option pricing model.

The second type of option is the option to expand into a new product, market or business as a consequence of an initial investment. In this case, the value of the option to expand can be estimated based upon the expected volatility in the cash flows from expansion and the cost of the expansion. In some cases, the option to expand can have sufficient value to allow companies to invest in project that have negative net present value. In fact, this argument has been used by some analysts as a justification for paying premiums over discounted cash flow values for the stocks of E-business companies.

The third option type (i.e. option to abandon) is not so vital from the practical point of view, because the company cancelling the particular E-business project, do not loose much capital, as the computer hardware and software can be usually used for the alternative E-business projects and other ongoing business processes.

Option to delay

Assume that a company has, or are interested in acquiring the exclusive rights to market a new product that will make it easier for people to access their E-mail via voice

commands by phone. If the company do acquire the rights to the product, it is estimated that it will cost \$ 500 million up-front to set up the infrastructure needed to provide the service. Based upon current projections, the company believe that the service will generate only \$ 100 million in after-tax cash flows each year. In addition, the company expect to operate without serious competition for the next 5 years, because the product is really unique and patented.

The net present value of this project can be computed by taking the present value of the expected cash flows over the next 5 years. Assuming a discount rate of 15% (based on the riskiness of this project), it is possible to obtain the following net present value for the project:

$$(28) \quad NPV \text{ of project} = - 500 \text{ mil} + \$ 100 \text{ mil (PV of annuity, 15\%, 5 years)} = - 500 \text{ mil} + \$ 335 \text{ mil} = - \$ 165 \text{ mil}$$

This project has a negative net present value. The biggest source of uncertainty on this project is the number of people who will be interested in this product. While the current market tests indicate that the project will capture a relatively small number of business travellers, the test also indicates a possibility that the potential market could get much larger over time. In fact, a simulation of the project's cash flows yields a standard deviation of the 42% in the present value of the cash flows, with an expected value of \$ 335 million.

The value of the option can be estimated based on Black-Scholes' equation as follows (Schwartz *et al.* 2001: 86):

$$(29) \quad \text{Value of call} = S e^{-yt} N(d_1) - K e^{-rt} N(d_2),$$

$$d_1 = \frac{\ln(S/K) + t(r - y + 0,5\delta^2)}{\delta\sqrt{t}}, \quad d_2 = d_1 - \delta\sqrt{t},$$

where S - current value of the underlying asset,

K - strike price of the option,

t - expiration time of the option,

r - riskless interest rate corresponding to the expiration time of the option,

$N(d_1), N(d_2)$ - cumulative normal distribution functions of d_1 and d_2 respectively,

y – dividend yield,

δ^2 - variance in the value of the underlying asset.

To value the exclusive rights to this project, first define the inputs to the option pricing model:

1. Value of the underlying asset = PV of cash flows from project = \$ 335 million
2. Strike price = initial investment needed to introduce the product = \$ 500 million
3. Variance in underlying asset's value = $0.42^2 = 0.1764$
4. Time to expiration = period of exclusive rights to product = 5 years
5. Dividend yield = $1/\text{time to expiration of the patent} = 1/5 = 0.20$
6. Assume that the 5-year riskless rate is 5%

$$(30) \text{ Value of call} = 335 * \exp^{(-0.2)(5)} * 0.225 - 500 * \exp^{(-0.05)(5)} * 0.0451 = \$ 10.18 \text{ (mil)}$$

The right to this product, which has a negative net present value if introduced today, is \$ 10.18 million. Note though that the likelihood that this project will become viable before expiration is low (4.5% - 22.5%) as measured by $N(d_1)$ and $N(d_2)$.

The option to delay a project is valuable if and only if the following conditions are met (Dixit *et al.* 1999: 126):

1. The company has exclusive rights to the project for a fixed period. If it does not have exclusive rights in a competitive sector, the project will be taken by a competing company as soon as it becomes a value-creating project. In other words, the option will be exercised by someone else as soon as $S > K$.
2. There have to be factors that will cause the present value of the cash flows from taking the project (e.g. intangible effect) to vary across time. If there is no variance in the present value of the cash flows, there can be no value to the option.

While it is quite clear that the option to delay is embedded in many projects, there are several problems associated with the use of option pricing models to value these options (Schwartz *et al.* 2001: 116-118):

1. The underlying asset in this option, which is the project, is not traded, making it difficult to estimate its value and variance. The value can be estimated from the expected cash flows and the discount rate for the project, albeit with error. The

variance is more difficult to estimate, however, since it is attempted to estimate a variance in project value over time.

2. The behaviour of prices over time may not conform to the price path assumed by the option pricing models. In particular, the assumption that value follows a diffusion process, and that the variance in value remains unchanged over time, may be difficult to justify in the context of a project. For instance, a sudden technological change may dramatically change the value of a project, either positively or negatively.
3. There may be no specific period for which the company has rights to the project. The company's rights may be not clearly defined, both in terms of exclusivity and time.

Several important implications emerge from the analysis of the option to delay a project as an option, especially in the context of E-business companies. First, a project may have a negative net present value based upon expected cash flows currently, but the rights to that project may still be valuable because of the option characteristics.

Second, a project may have a positive net present value but still not be accepted right away because the company may gain by waiting and accepting the project in a future period, for the same reasons that investors do not always exercise an option just because it is in the money. This is more likely to happen if the company has the rights to the project for a long time, and the variance in project inflows is high. To illustrate, assume that a company has the patent rights to produce a new type of disk drive for computer systems and that building a new plant will yield a positive net present value right now. If the technology for manufacturing the disk drive is in flux, however, the company may delay taking the project in the hopes that the improved technology will increase the expected cash flows and consequently the value of the project. It has to weigh this off against the cost of delaying taking the project, which will be the cash flows that will be forsaken by not taking the project.

Third, factors that can make a project less attractive in a static analysis can actually make the rights to the project more valuable. As an example, consider the effect of uncertainty about how long the company will be able to operate without competition and earn excess returns. In a static analysis, increasing this uncertainty increases the

riskiness of the project and may make it less attractive. When the project is viewed as an option, an increase in the uncertainty may actually make the option more valuable, not less.

Option to expand

In some cases, companies invest in projects because doing so allows them either to invest in other projects or to enter other markets in the future. In such cases, it can be argued that the initial projects are options allowing the company to invest in other projects, and the company should therefore be willing to pay a price for such options. A company may accept a negative net present value on the initial project because of the possibility of high positive net present values on future projects.

Assume that Amazon is considering creating an Estonian/Russian version of its web site and expanding into the Estonian and Russian markets. It is estimated that the cost of creating this site will be \$ 500 million, and that the present value of the expected cash flows from the investment will be only \$ 300 million. In other words, this venture considered on a stand-alone basis has a negative net present value of \$ 200 million.

Assume, however, that by investing in this site and expanding into Estonia and especially into Russia today, Amazon acquires the option to expand into the much larger potential market (i.e. CIS countries) anytime over the next 10 years. The cost of expansion will be \$ 1 billion, and it will be undertaken only if the present value of the expected cash flows exceeds this value. At the moment, the present value of the expected cash flows from the expansion is believed to be only \$ 850 million; thus, the expansion would not make economic sense today. Amazon still does not know much about these markets, and there is considerable uncertainty about this estimate of present value. The variance in this estimate, estimated based upon the variance of publicly traded Internet ventures in Russia, is 0.20. The value of the option to expand can now be estimated, by defining the inputs to the option pricing model as follows:

1. Value of the underlying asset = PV of cash flows from expansion into new markets, if done now = \$ 850 million
2. Strike price = cost of expansion into new markets = \$ 1,000 million
3. Variance in underlying asset's value = 0.20

4. Time to expiration = period for which expansion option applies = 10 years
5. Assume that the ten-year riskless rate is 6%

The value of the option can be estimated as follows (note $y = 0$):

$$(31) \quad \text{Value of call} = 850 * 0.8453 - 1,000 * \exp^{(-0.06)(10)} * 0.3454 = \$ 528.94 \text{ mil}$$

This value can be added on to the net present value of the original project under consideration:

$$(32) \quad \text{NPV of investment with expansion option} = \text{NPV of Estonian/Russian venture} + \\ + \text{Value of call} = (- \$ 500 \text{ mil} + \$ 300 \text{ mil}) + \$ 528.94 \text{ mil} = \$ 328.94 \text{ mil}$$

Amazon.com should therefore invest in the Estonian/Russian venture even though it has a negative net present value, because the option to expand into new markets that emerges from it has such high value.

The practical considerations associated with estimating the value of the option to expand are similar to those associated with valuing the option to delay. In most cases, companies with options to expand have no specific time horizon by which they have to make an expansion decision, making these open-ended options, or, at best, options with uncertain lives. Even in those cases where a life can be estimated for the option, neither the size nor the potential market for the product may be known, and estimating either can be problematic. To illustrate, consider the Amazon example discussed above. At the end of 10 years, it is assumed that Amazon has to decide whether or not to expand into new markets (i.e. the former CIS countries). It is entirely possible that this time frame is not specified at the time the initial investment is made. Furthermore, it is assumed that both the cost and the present value of expansion are known initially. In reality, the company may not have good estimates for either before opening the first store, since it does not have much information on the underlying market.

In general, the option to expand is clearly more valuable for more volatile businesses with higher returns on projects (e.g. E-business projects), than in stable businesses with lower returns (such as housing, utilities or automobile production).

The option to expand a project adds value to the current project if and only if the following conditions are met (Dixit *et al.* 1999: 211):

1. The current project has to be taken in order for the expansion to be viable later on. In other words, if the company can take the expanded version of the project later without taking the current project, it is not appropriate to credit the current project with the value of this option.
2. There have to be factors that will cause the present value of the cash flows from expansion to vary across time. If there is no variance in the present value of the cash flows, there can be no value to the option.

When real options are used to justify a decision, the justification has to be in more than qualitative terms. In other words, managers who argue for taking E-business project with poor returns or paying a premium on an acquisition on the basis of real options should be required to value these real options and show, in fact, that the economic benefits exceed the costs. There will be two arguments made against this requirement. The first is that real options cannot be easily valued, since the inputs are difficult to obtain and often noisy. The second is that the inputs to option pricing models can be easily manipulated to back up whatever the conclusion might be. While both arguments have some basis, an estimate with error is better than no estimate at all, and the process of quantitatively trying to estimate the value of a real option is, in fact, the first step to understanding what drives it value.

Not all investments have options embedded in them, and not all options, even if they do exist, have value. To assess whether E-business investments create valuable options that need to be analyzed and valued, three key question-sets need to be answered affirmatively:

1. Is the first investment a prerequisite for the later investment/expansion? If not, how necessary is the first investment for the later investment/expansion? Consider the earlier analysis of the patent. A company cannot generate patents without investing in research or paying another company for the patents. Clearly, the initial investment here (spending on R&D or acquiring the patent from someone else) is required for the company to have the second investment. Now, consider the Amazon investment in its Estonian/Russian venture and the option to expand into new markets later. The initial store investment allows Amazon to build an Estonian/Russian web site and learn more about these markets, but it does not give them any exclusive rights to

expand into the larger market. Unlike the patent illustration, the initial investment is not a prerequisite for the second, though management might view it as such. The connection gets even weaker when to look at one company acquiring another to have the option to be able to enter a large market. Acquiring an Internet service provider to have a foothold in the Internet retailing market would be an example of such a transaction.

2. Does the company have an exclusive right to the later investment/expansion? If not, does the initial investment provide the company with significant competitive advantages on subsequent investments? The value of the option ultimately derives not from the cash flows generated by then second and subsequent investments, but from the excess returns generated by these cash flows. The greater the potential for excess returns on the second investment, the greater the value of the option in the first investment. The potential for excess returns is closely tied to how much of a competitive advantage the first investment provides the company when it takes subsequent investments. At one extreme, again, consider investing in research and development to acquire a patent. The patent gives the company that owns it the exclusive rights to produce that product, and if the market potential is large, the right to the excess returns from the project. At the other extreme, the company might get no competitive advantages on subsequent investments, in which case, it is questionable as to whether there can be any excess returns on these investments. In reality, most investments will fall in the continuum between these two extremes, with greater competitive advantages being associated with higher excess returns and larger option values.
3. How sustainable are the competitive advantages? In a competitive market place, excess returns attract competitors, and competition drives out excess returns. The more sustainable the competitive advantages possessed by a company, the greater will be the value of the options embedded in the initial investment. The sustainability of competitive advantages is a function of two forces. The first is the nature of the competition; other things remaining equal, competitive advantages fade much more quickly in sectors where there are aggressive competitors. The second is the nature of the competitive advantage. If the resource controlled by the company is finite and scarce (as is the case with natural resource reserves and vacant

land), the competitive advantage is likely to be sustainable for longer periods. Alternatively, if the competitive advantage comes from being the first mover in a market or technological expertise, it will come under assault far sooner. The most direct way of reflecting this in the value of the option is in its life; the life of the option can be set to the period of competitive advantage and only the excess returns earned over this period counts towards the value of the option.

These are important test-questions, and one can see that using a real option argument to justify E-business project investments is a serious procedure, which must be correctly undertaken in the following fashion:

- ❖ defining particular intangibles peculiar to the E-business project;
- ❖ deciding if these intangibles involve valuable options;
- ❖ assessing particular options of the E-business project.

If these steps are accordingly fulfilled, then the real option valuation is the most proper way to value E-business dynamic investments, because it is the only available method which enables to account uncertainty effect and intangibles as a specifically important share of E-business.

CONCLUSION

Companies have found they can expand their markets relatively inexpensively using the Internet. This does not mean that it is cheap to set up E-business, but when compared to establishing a brick-and-mortar facility, the Internet can be much more efficient as a business network. E-business companies can reach worldwide markets and, in some cases, do not have to maintain a large inventory of components or finished products. Many E-businesses have moved to just-in-time processes, which start with customer orders, and have then applied automation to every phase of manufacturing, from ordering supplies, assembly, shipping and customer support. Establishing successful E-business environments requires significant capital and support organizations to ensure customer needs are met every day. The ultimate goal is to leverage E-business investments into something that fundamentally changes the company's ability to compete and succeed. This is the reason why E-business investment analysis is so crucial.

This research takes essential steps toward determining significance of E-business investments and the key drivers of E-business value. The author attempts to fill the theoretical gap by seeking methods to identify the sources of value creation in E-business and apply the findings to E-business investment analysis.

It has been argued that the traditional financial information of E-business companies is of limited value to investors. Clearly, this aspect has motivated to seek for non-financial valuation measures peculiar to these companies. In an attempt to address this issue, the author identifies and tests intangible components of E-business value, e.g. "buy rate" that is assumed to be particularly relevant to the valuation of E-business, because it represents the direct performance of these companies in the electronic market place. The outcome of regression model proves the hypothesis on importance of intangible

parameters in E-business value. Thus intangibles have to be accounted in E-business investment analysis.

In order to assess the optimal level of E-business investments, the author theoretically develops the E-business investment model based on Tobin's Q theory. The model includes tangible and intangible components, which is especially important while analyzing E-business investments, as intangibles noticeably influence E-business value. Comparing the E-business investment model and the traditional Tobin's Q approach, it is clear that the latest underestimates the optimal level of investments if intangibles are accounted for as a significant portion of valuation.

According to standards of theory of corporate finance, an investment project is to be undergone *ROI* analysis. The goal of *ROI* analysis is to determine the profitability of particular project. If the internal rate of return of the project exceeds the weighted average cost of capital, the project can be considered as profitable. However, the share of intangible components in E-business project is neglected in *ROI* analysis. As a result, it can occur that potentially profitable project with ultimate strategic meaning is never accepted. Thus it is important to set the appropriate variation of *IRR* to enable the management to consider E-business projects with negative present value. This particular assignment can be fulfilled by means of sensitivity analysis, which is the proper tool to determine the variation of the rate of return while other parameters (e.g. revenue and cost savings) are to be altered.

The further research established that *ROI* analysis has practical drawbacks: the model assumes parameters to be fixed while the project time span, cash flows are treated as nothing can happen to deviated them, further decisions on project management are ignored. The main problem concerns the ability of the method to adequately assess intangibles, which is resulted in failure of decision making process. The author demonstrates how to overcome these significant problems, introducing the alternative approach to value E-business investments, i.e. real option pricing model. E-business investments can be treated as real options, where the value of the investment is determined by the future range of opportunities the technology represents. To make sure that the intangibles can be numerically assessed and E-business investment decision correctly made, the application of real option pricing model has been analyzed upon two

option types peculiar to E-business projects: option to delay and option to expand. As the result the proper framework of real option approach is set up to adequately estimate the value of specific options in E-business projects.

The major result is that network advantages constitute important intangible assets that go unrecognized in the financial statements. Conventional valuation metrics do not enable to measure the intangible effect, hence distorting the validity of decisions made on particular projects. This issue has motivated the author to undertake the deep research on theoretical foundations of investment theory. As the outcome of the analysis, the author shows how to evaluate intangibles in theory and practice.

To conclude – E-business in all its myriad forms is here to stay – it offers the possibility to expand company's market in a way that simply was not previously possible – many of the dangers (and they are real) are capable of being significantly mitigated and controlled. It is up to each company how it is able to get along under the conditions of electronic market. To facilitate the decision making process on E-business strategic investments, this research offers the most crucial solutions on E-business value and investment analysis.

Together with the bachelor's thesis "E-business: entrepreneurship and financial analysis" the author embraces the whole range of most essential issues in the field of corporate finance and investments, i.e. particular approaches to value E-business (defining and measuring value of a company) and assessment of return on E-business investments (evaluating business projects).

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RESÜMEE

E-ÄRI VÄÄRTUSE JA INVESTEERINGUTE ANALÜÜS

Igor Sinkevitš

Maailma majandus on muutumas ning muutused on sedavõrd suured, et uuenenud keskkonda on hakatud nimetama uueks majanduseks. Informatsiooni vahetamisel ja töötlemisel on toimunud oluline kvalitatiivne hüpe, mis on aluseks uuelaadsele äritegevusele, s.o. E-ärile.

Uued tehnoloogiad ja ärikeskkonna muutumine on võtmesõnad, mis mõjutavad äritegemise viisi. Kõik see on kokku võetav mõistega E-äri, mis tähendab uute tehnoloogiate rakendamist ettevõtete väärtusahela sees ja vahel ning ettevõtte ja tema klientide vahel.

Valdav osa Internetist saadav kasu ettevõttele seostub sellega, et äriprotsessid muutuvad oluliselt efektiivsemaks ja kliendisuhe ettevõtetega aktiveerub. Interneti ärirakendusi kasutades saab ettevõtte hakata raha säästma, muutes efektiivsemaks kulukaid protsesse. Ärikeskkond võrgus kõrvaldab hulga logistilisi tõkkeid ning loob ettevõtetele senini kättesaamatuid arenguperspektiive. Äriprotsesside väljaviimine ettevõttest annab võimaluse fokuseerida tähelepanu vahetult põhieesmärgile, samas vabanevad ressursid, mida saab suunata põhiprotsessi tõhustamisele. Enamasti toovad sellised strateegiad kaasa efektiivsuse tõusu ja vähendavad äririski, mis on eriti oluline tiheda konkurentsi tingimustes. Interneti puhul on tegemist paindliku ja kõrge selekteerimisvõimega kanaliga, mis pakub piiramatu infomahtu. Ükski teine kanal ei paku kohest interakteerumisvõimalust sama kanali kaudu.

Tehnoloogiliselt kiiresti arenevas maailmas on ärijuhtide ülesandeks selliste otsuste vastuvõtmine, mis parimal viisil vastavad ettevõtte eesmärkidele või uutele väljakutsetele. Infotehnoloogia, mis mõni aeg tagasi teenis peamiselt kulude kokkuhoiu,

tööaja säästu või muid operatiivse iseloomuga eesmärke, on nüüdseks muutunud paljude ettevõtete strateegiliseks instrumendiks. Nii nagu mistahes muude kapitalikulude planeerimisel, on ka E-äri investeeringute otsustamisel eesmärgiks optimaalse alternatiivi objektiivne valik.

E-äri projekti analüüs on muutunud viimasel ajal eriti aktuaalseks, kuna nähes, et paljud E-äri sektori ettevõtted on kokku puutunud raskete majanduslike probleemidega, hakkavad nüüd ettevõtted, kes soovivad Internetiturule pääseda, teostama sügavat E-äri projekti analüüsi hindamaks otstarbekust tegeleda E-äri.

E-äri projektide puhul tuleb lisaks mõõdetavatele kriteeriumidele vaatluse alla võtta ka immateriaalsed väärtused. Autor on oma töös osutanud probleemile, et üldtunnustatud investeeringute hindamise meetodid, mida kirjeldab ärihanduse teooria, ei võimalda objektiivselt hinnata selliseid projekte, kus lisaks monetaarsetele väärtustele on tähtsal kohal ka immateriaalsed väärtused; sellised mille kaalukuse hindamisel kasutatakse subjektiivseid arvamusi ja kus puuduvad standardsed mõõteskaalad.

Magistritöö hõlmab kogu investeeringute hindamisprotsessi nii nagu autor seda ette kujutab. Esiteks analüüsitakse E-äri väärtust. Enne asumist investeerimisprojekti vahetu hindamise juurde, tuleb eelkõige kindlaks määrata investeerimisobjekti väärtus, mis võib omakorda koosneda varjatud komponentidest. Varjatud komponentide mitteamestamise korral projekti vastuvõtmise otsus võib aga osutada negatiivne, ehkki potentsiaalselt on projekt ettevõttele tulutoov.

Teiseks püütakse hinnata E-äri investeeringute optimaalset taset, arvestades E-äri väärtuse omapära. Kasutades Tobini Q teooriat, tuletatakse teoreetilist mudelit E-äri investeeringute hindamiseks, kusjuures mudel arvestab nii materiaalseid kui ka immateriaalseid komponente. Võrreldes saadud mudelit klassikalise Tobini Q mudeliga, järeldatakse, et immateriaalsete komponentide olemasolul klassikaline mudel oluliselt moonutab optimaalset investeeringute suurust.

E-äri väärtuse hindamiseks püstitatakse vastavat hüpoteesi, mille järgi immateriaalsed näitajad (nt. Interneti võrgu kaudu ostjate ja külaliste suhe) avaldavad tunduvat mõju E-äri väärtusele. Hüpoteesi testimiseks koostatakse E-äri väärtuse mudelit, kusjuures

eksogeenseteks muutujateks on nii fundamentaalsed kui ka immateriaalsed karakteristikud ja endogeenne muutuja on ettevõtte väärtus. Järgnevalt viiakse läbi regressioonanalüüsi (*SUR* analüüs), kusjuures vaatluse all on 238 New York'i Väärtpaberibörsil noteeritud E-äri tegelevat ettevõtet. Teostatud analüüsi tulemusena selgub, et immateriaalsed komponendid on statistiliselt olulised ja mängivad tähtsat rolli E-äri väärtuses. E-äri tegelevate ettevõtete peamiseks väärtust kujundavateks teguriteks on seega just immateriaalsed komponendid ja suutlikkus neid edaspidi turul realiseerida. Järelikult investeerimisanalüüs peab arvestama ka E-äri immateriaalseid väärtusi.

Praktikas investeerimisprojekti hindamiseks viiakse läbi *ROI* analüüsi, mille eesmärgiks on leida projekti tasuvus. Kui viimane on suurem ettevõtte keskmisest kapitalihinnast, siis vastavat projekti võib pidada aktsepteeritavaks. E-äri projekti korral on aga immateriaalsete komponentide osakaal nii tähtis, et võib juhtuda, et pikaajalises perspektiivis tulus projekt saab allahinnatud ja kunagi ei realiseeru. Seega tuleb paika panna projekti tasuvuse vahemik, et isegi juhul, kui keskmine kapitalihind on suurem E-äri projekti tasuvusest, oleks projekt ikka veel aktsepteeritav. Projekti tasuvuse vahemiku suurust on ettevõtte juhtkonna otsustada ja selle kindlakstegemiseks võib rakendada nn. sensitiivset analüüsi. Sensitiivne analüüs on sellisel juhul eriti hea meetod projekti tasuvuse varieerumise uurimiseks erinevate stsenaariumide korral nt. tulu ja kulu kokkuhoiu muutumisel.

Ent *ROI* analüüsil on mitmed olulised puudused: mudel ei võta arvesse parameetrite (nt. diskonteerimismäära) võimalikku muutust ajas, eeldatakse rahavoogude paikapidavust ja samas ignoreeritakse vahepealseid otsuseid projekti ümbervaatomise kohta (nt. lisafinantseerimine, üleminek alternatiivsele projektile vms). Peamiseks takistuseks *ROI* analüüsi rakendamisel E-äri investeeringute hindamiseks on eelkõige immateriaalsete väärtuste mitteamistamine, ehkki nende mõju projekti tasuvusele võib olla piisavalt ulatuslik. Autor demonstreerib alternatiivset lähenemist investeeringute hindamiseks, s.o. reaaloopioonide hindamismeetod, mille rakendamisel ületatakse *ROI* analüüsi puudusi. Projekti hindamisel võetakse arvesse asjaolu, et juhtkonnal on võimalik projekti kestel projekti mahtu suurendada, projekt enneaegselt lõpetada, tänu millele projektile on võimalik ette võtta järgmisi/teisi projekte ning juhtkonnal on ka muid

võimalusi ehk optioone projekti juhtimisel, mida standardne *ROI* analüüs ei arvesta. Reaaloopsioonide lähenemist rakendatakse kahe E-äri investeeringutele spetsiifilise näite abil (s.o. optioon projekti käivitamise edasilükkamiseks ja optioon projekti lõpetamiseks), mille väljundiks on projekti immateriaalsete väärtuste konkreetne hinnang. Samuti töötatakse välja hindamisraamistik, mis võimaldab samm-sammult hinnata E-äri investeeringuid reaaloopsioonide lähenemise vahendusel.

Autor usub, et E-äri lahendused aitavad ettevõtetel saavutada oma strateegilised eesmärgid: nt. suurendada käive, viia klienditeenindus kõrgemale tasemele, siseneda uutele turgudele, vähendada tegevuskulud, arendada suhted äripartneritega vms. Ärivõimalused on tõesti suured ja avatud, kuid iga ettevõtte juhtkond peab ikkagi täpselt mõistma E-äri väärtuse omapära ja oskama adekvaatselt hinnata E-äri investeeringuid. Ärijuhid vajavad sellist metoodikat, mille abil E-äri investeeringute otsustusprotsessi väljundiks oleks objektiivselt põhjendatud, ettevõtte eesmärkidele parimal moel vastav lahendus. Käesolev magistr töö võimaldab saada pädeva ettekujutuse E-äri väärtuse ja investeeringute kõige olulisematest äriahenduslikest aspektidest ja saab olema heaks juhendiks antud teema edaspidiseks arenguks.