

Virtual Stock Markets for Business Forecasts

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Abstract

In situations of uncertainty firms find it hard to predict future outcomes of investments that depend on developments of external factors. Traditional projection methods often cannot provide reliable forecasts in case the knowledge of probable future states is highly dispersed among informants. Instead, we propose a market based forecasting model that reduces this deficiency by collecting information from spread sources and in addition offers a possibility to safeguard the respective investment. In analogy to the design of Political Stock Markets (Foresythe et al. 1992), this virtual stock exchange issues securities which prices reflect the market's probability estimates concerning the relevant future conditions. Furthermore, the proceeds of the stock issuance enable a securing of the investment by offering a hedging as well as a financing option. Thus, this concept of a virtual stock market comprises an essential decision tool for the public and private sector.

1. Introduction

Decisions on the realization of planned investments constitute an essential part of an entrepreneur's everyday life. Especially in the context of large-scale investments (see e. g. the billion € investments of several telecommunications carriers in the UMTS mobile communications technology in Europe) where the degree of amortization of expenditures by appropriate future flows of returns often determines the fate of a particular business unit or sometimes even of the entire enterprise, these management choices are of substantial relevance due to the inherent risk in case of wrong decisions. The key problem for impending mistakes in the planning of profitable investment projects, which the management is usually confronted with in advance of its decisions, is the high degree of amortization uncertainty about whether and in which extent an amortization will in fact take place. For companies operating in relatively young and dynamic and therefore neither technologically nor legally stabilized markets, this uncertainty with respect to success of planned investments is of a particularly high degree.¹ Thereby, it is mainly a result of the interplay of the following two factors:²

¹ Additional characteristics of these markets comprise a high rate of innovation and shrinking product life cycles so that the enterprises feel a strong amortization pressure besides their planning uncertainty.

² This result is analog to Williamson's Organizational Failure Framework. The uncertainty about a possible opportunistic behavior of the partner to a transaction becomes a relevant factor for the choice of institutional governance only in combination with transaction specific investments (Williamson 1975, 40).

- (1) the uncertainty about the future development of the world (*environmental uncertainty*), and
- (2) the *environmental specificity* of the respective investment project.

Ad (1): Due to the high rate of innovation in comparatively dynamic markets the selection of investment projects usually has to be done while facing an increasing uncertainty about the future development of the world. At the time of the investment decision, enterprises can only in exceptional cases forecast which of several future conditions will definitely prevail and which will not (Dietl 1993, 85). Instead, resulting from limited informational capabilities (Simon 1957; 1972; 1976) management rather has an incomplete conceptualization of the future. If the respective investment yielded a similar structure of returns in any of the possibly existing states of the world, this limited knowledge about the future would be of no concern to the decision makers. This, however, changes as soon as the second factor, i. e. the environmental specificity, comes into play.

Ad (2): An investment is called specific, if it is tailored to a special way of usage and loses productive value or becomes completely worthless if redeployed to alternative uses (Williamson 1991, 281). In the case of investments with a significant degree of environmental specificity, the amount of future returns, which is to be generated, and thus the amortization of expenditures crucially depend on the realization of a specific future scenario of the world. This dependence on a certain external development is due to the necessity to ex ante adjust the investment to a future state of the world without knowing at the time of the investment decision whether ex post this state will in fact occur. For an example think of a company planning to invest in facilities for the production of Blu-Ray DVDs but not knowing whether Blu-Ray or HD-DVD will become the dominant future DVD standard. If the relevant environmental scenario later comes about, the investment can be used as planned generating the calculated proceeds to amortize the upfront costs. If, however, the development of the world takes another course, alternative modes of application of the investment frequently do not exist. Under these conditions an amortization will be impossible. Therefore, especially in young as well as highly dynamic markets investment success sometimes becomes a discrete variable so that the degree of anticipated failure is very high in these kinds of markets.

In order to make qualified decisions with respect to the selection of investment projects, the management has to limit this amortization uncertainty. Besides others, one strategy which might be pursued is to collect additional information on the probability of occurrence of the future states of the world and to use this data to derive forecasts on the success of potential investments (Helten/Bittl/Liebwein 2000, 170). The later decision can be based on these projections. By doing so, the degree of environmental uncertainty is reduced as the decision maker broadens its level of information. However, one question remains: *What type(s) of information gathering mechanisms should reasonably be applied in order to obtain high quality forecasts of the future?* To answer this research question, in the next section we are going to describe traditional methods used to limit environmental uncertainty. There, we will also present the shortcomings of these instruments in providing reliable forecasts of investment success, especially in cases where the knowledge of probable future states is highly dispersed among informants. Due to these shortcomings of the conventional mechanisms, in section 3 we therefore propose a market based forecasting model that reduces several of the deficiencies mentioned beforehand and that in addition offers the possibility to safeguard the respective investment. The paper closes with a summary of the main findings as well as some fruitful avenues for future research.

2. Conventional Methods for Reducing Amortization Uncertainty

Usually, three different instruments or mechanisms are used to limit investment uncertainty and to reduce the information gap about forthcoming trends: *(Market) research institutes* are often asked to judge external trends in order to assess risks and opportunities of an investment. This is due to the understanding that the necessary knowledge about the success of an investment is spread in the market. For this reason the market research institutes interview e. g. experts regarding future market trends or technology developments. This information can be used to make well-founded decisions about the investment. But interviews are time-consuming and such kind of field research is very expensive (Foresythe et al. 1995, 772). As a second solution, the success of an investment is *calculated in-house*. Subjective evaluation and personnel assessment of risks and opportunities substitute expensive external analyses (Hansmann 1995, 272 f.; Mödritscher/Pichler 1997, 40). With the help of indicators respectively conclusions based on analogies to former investments in comparable settings management tries to derive estimates of success for planned projects. Therefore, employees with expert

status in the area of interest and high competency are interviewed. *Delaying an investment* is a third alternative to reduce the risk of selecting an inefficient project (Pindyck 1991). With each day of waiting the company hopes to increase its own information basis about the uncertain environment.

To emphasize the weaknesses regarding the forecast quality of the first two conventional alternatives it is helpful to focus on the actors' knowledge basis in two ideal-type market situations (Rese 2000, 23-26).

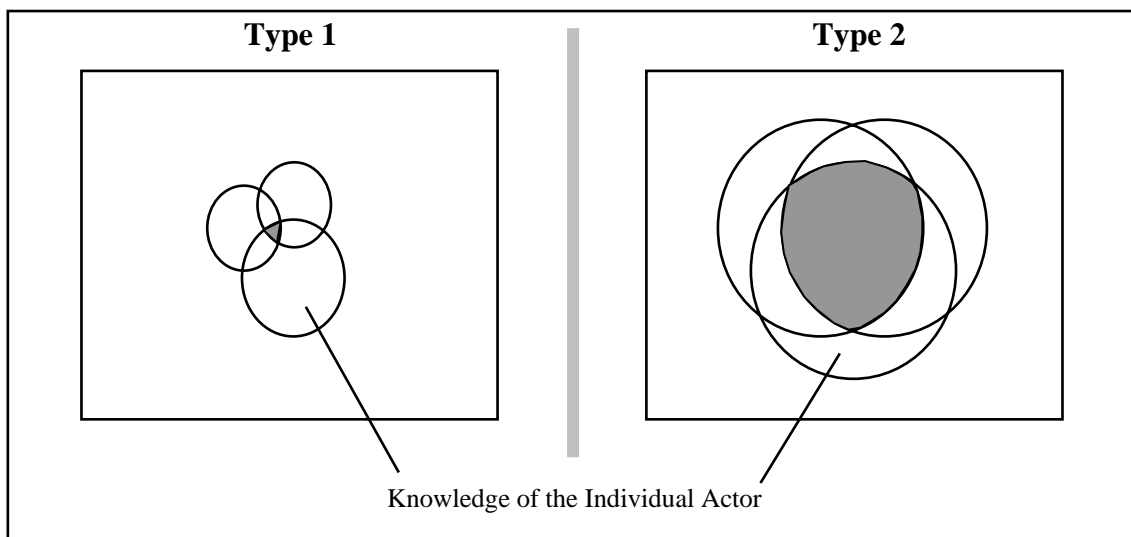


Figure 1: Level of knowledge in two ideal-type market situations

Each actor in markets of type 1 possesses a limited level of knowledge. Additionally, the individual knowledge background differentiates significantly between the agents, which is indicated in figure 1 by the narrow intersection of the three small circles. Also, the knowledge is highly dispersed among the agents. This is often typical for young and dynamic environments which are characterized by numerous innovations and short market cycles. Due to high rate of business activities information about new innovations are constantly spread into the market implying that each actor's knowledge about a specific product or technology could become obsolete very fast. The result is the described limitation of the player's knowledge. The situation differs substantially in markets of type 2. Each market participant possesses an extensive information background that overlaps to a large extent indicated by the shaded area of the "knowledge circles". Such a situation is a result of only a moderate level of innovation. It is a characteristic of

markets with comparatively fewer dynamics which implies that the existing knowledge is rarely devaluated.

Given these facts, it is necessary to criticize the contribution of internal return on investment forecasts to the decision process of companies in young and highly dynamic situation-1-markets. Mechanisms conventionally used such as time series analysis and the method of deriving conclusions by analogy to similar situations try to identify regularities based on former trends to deduce conclusions about the realisation of future developments (Bock/Dietl 1996, 185). This method appears to be successful only in markets of type 2 in which sufficient data and experience due to a low rate of innovation exist. Such empirical data does not prevail in type 1 markets. However, this procedure bears a high risk as economic agents cannot identify all relevant factors influencing the success of former investments due to their limited information capabilities (Berlemann 2000, 55; Simon 1957; 1972; 1976).

Although market research institutes often address market participants with specific expert knowledge for deriving prognoses, the possibility exists that persons having relatively little information of relevance are included in the sample. Experts with a more extensive knowledge repertoire – this is symbolized by the larger circle on the left hand side of figure 1 – yet not known by the research institute are ignored. Especially in type 1 markets such a procedure might be problematic. Additional disadvantages exist with respect to the participants' motivation regarding a truthful provision of data (Pfungsten 1987; Berlemann 2000, 61). Even if the interviewees possess relevant information, they do not have positive incentives for answering truthfully. This is due to the fact that the actors frequently receive only a fixed payment for their efforts endured. Besides, these studies regularly guarantee the anonymity of the participants so that reputation mechanism cannot effectively impede shirking by the agents. A third drawback of conventional market research is the short half-life period of such reports which generally can only represent a snapshot of a company's external environment. This results in forecasts with only limited validity. However, the inclusion of new up-to-date data is of particular importance for enterprises that try to further cultivate an already developed technology and therefore plan a series of follow-up investments (Dixit/Pindyck 1995). Necessary repetitions of a study then guzzle an enormous sum of money.

As frequently suggested by theory (Dixit/Pindyck 1995), the third method of delaying planned investments might also entail severe disadvantages. As an example think of a supplier who battles with several other competitors over establishing a dominant technological standard within an industry. By delaying planned investments to broaden the level of knowledge about the future he/she risks losing a possible first mover advantage in building up an installed basis for his/her technology which in the end might endanger the whole company (Farrell/Saloner 1987, 13 f.).³

3. The Concept of a Virtual Stock Market

In order to forecast the outcome of a certain state of the world which in turn determines the success of a specific investment made by a firm, shares are traded at a virtual stock exchange that exactly resemble this future state of the world and act as underlying asset. In order for an investor to be able to assign a value to this type of stock it is necessary to have specific knowledge about the underlying future condition in terms of its probability of occurrence. The compensation for investing in such shares will be an initially guaranteed payoff amount per share in case the underlying future state of the world takes place. On the other hand, if the underlying external development does not occur, the stock will be worthless and an investor will not receive any reimbursement. Particularly investors with relevant knowledge about this specific future state of the world have the opportunity to prosper at this virtual stock market and are specifically qualified to trade stocks at this marketplace (Berlemann/Schmidt 2001, 15). Therefore, a self selection process among investors takes place (Milgrom/Roberts 1992; Reips 1997) since this specific knowledge about the future state necessary for valuing the stock offers participating experts great prospects for profit, In contrast investors without this knowledge are subject to a higher risk of loss. For example, in case of a firm in the technological sector wishing to invest specifically into the development of a certain technology dependent upon a future state of the world potential investors would be customers, suppliers, competitors as well as analysts of investment banks, interest groups, even government officials and members of a regulatory board that own specific expertise about this future development. These technological experts have an obvious self-interest in pursuing and evaluating this type of knowledge and their expertise makes them potential investors for this specific security. Investors without this fundamental knowledge will

³ First mover advantages and a fast installation of a sufficient customer base are substantial prerequisites to become the winner of a standard war (Shapiro/Varian 1999, 16).

refrain from this virtual stock exchange since their risk of losing their investment is comparably high. The major target of the virtual stock exchange is thus to merge as many investors with expert knowledge about the stock's underlying state of the world as possible in order to aggregate their individual expertise into the stock quote and provide a sound forecast.

Investors transfer their knowledge about the probability of occurrence of the stock's underlying state of the world to the marketplace through their orders to purchase and sell shares. For example, if the stock guarantees its bearer the amount of 1,00 € in case the underlying asset occurs an investor will be willing to pay up to 0,90 € if he/she estimates the probability of occurrence at 90 %. On the other hand, at stock quotes of 0,91 € and above the same investor will be willing to sell the stocks again (for comparison see the calculation at Foresythe et al. 1992, 1144). The redemption structure of the stock is of substantial importance in order to be able to provide a reasonably high quality forecast about the future. Investors should only consider their individual probability estimation in their stock quotes and not any risks or other external factors. Therefore, the underlying future state of the world needs to be separable and has to be formulated in a way that the decision if the future condition is fulfilled or not can be made without doubt. An unbiased third party needs to be selected to make this decision without being subject to any interference and influence. This way there will not be any doubt if the corresponding stock needs to be redeemed or not.

The course of events at such a virtual stock market presents itself as follows: In a first step the market's probability estimation regarding the future state of the world is provided in a bookbuilding phase which supports the firm to evaluate the probability of success of the investment. In this pre-market phase of the initial public offering the price of the stock is derived and the volume of the share-offering can be calculated. The purpose of this phase is to collect the experts' individual probability estimation regarding to the occurrence of the underlying state of the world which reveal public and especially private information through the investors' purchase orders. The average price of all aggregated orders reflects the available information at the stock market. The firm is able to utilize this price as the first forecast about the success of its specific investment. If the average stock price of the bookbuilding phase signals a sufficient probability of occurrence of the underlying future state of the world and therefore a high probability of

success the firm will offer the stock and will finance the specific investment with the proceeds of the share issuance. For this, the probability derived from the average stock price needs to exceed the amount of the investment expenditure divided by the expected return. Though, if the stock price is too low signaling great uncertainty about the future the stock will not be offered to the investors and the firm will not invest specifically as initially planned. Even if the stock price signals a successful investment, the firm will also terminate the stock offering in case the demand for the stock is too low not covering the sum of the specific investment. Due to the target of the investors to incur profits the virtual stock exchange provides incentives for the experts to only reveal their true knowledge reflected in the offered stock quotes. These investors will therefore not offer an amount per share that exceeds the individually estimated fundamental value of the stock. On the other hand, if the offered price per share is too low the investors have to bear the risk of not receiving any shares at the initial public offering. Consequently, the bookbuilding-phase provides incentives for investors to reveal their true probability estimation of the underlying state of the world.

If the firm decides to execute the initial public offering and therefore to invest specifically the cost can be covered by the proceeds of the stock issuance since these funds are available to the firm prior to the investment expenditure. This additional financing function of the virtual stock exchange is very valuable since funding could be difficult to achieve by traditional means since the risk of default is high due to the specificity of the investment in combination with an uncertain environment. In case the stock's underlying state of the world does occur at a future point of time the specific investment will be successful and the firm is able to pay off the investors with the revenues achieved. The remaining part of the revenue stream can be kept as profit. The specific investment will not be successful if the predicted state of the world does not occur. In this case the firm has no obligation to pay off the investors. This market mechanism safeguards the firm against the loss of financial resources despite the high risk of a specific investment and an uncertain environment. The revenue stream of the initial public offering can therefore be characterized as a liability that only needs to be redeemed if the predicted state of the world occurs. The cost for safeguarding the investment is the difference in amount between the opening price at share issuance to the market and the initial guaranteed redemption price in case the underlying state occurs.

After the initial public offering the stocks can be traded without restrictions in a secondary market at the virtual stock exchange by old and also new investors comparable to a regular stock exchange. This way investors are able to adjust their stock portfolio by adding more shares or selling them if new knowledge about the underlying issue arises affecting the value of the stock. New information will therefore be expressed in the stock price immediately. Next to regular orders the investors should also have the possibility to perform short sales to be able to sell shares without owning them. In general, short sales are an ideal instrument for an investor if the estimated fundamental value of the share is lower than the market price. Stocks that are not owned by the investor are sold at the market with the obligation to repurchase them at a later point in time to close the open position again. This transaction proves to be lucrative if the shares can be sold short at a high market price and repurchased at a lower market price in the future in order to profit from the price difference. The possibility to sell short is a prerequisite for successful forecasts at the virtual stock exchange since only then the market price can collect all information available at the market from all experts. The virtual stock exchange can continuously provide a high quality probability estimation regarding the underlying future state of the world in a timely manner.

A continuous forecast about the future state is especially valuable if the specifically invested firm plans a series of investments which are interlinked and are therefore also dependent on the occurrence of the underlying future state of the world. For example, the first investment could be a specific R&D expenditure required for the new technology of the Blu-Ray DVDs and the second expenditure which follows at a later point in time could be the training of employees about this new technology. Forecasts based on the stock quote of the initial public offering are no longer sufficient for the evaluation of these future investments any more. The firm needs continuous and up-to-date probability estimations for its specific investments whose success is dependent upon the relevant future state of the world. The virtual stock exchange provides these probability estimates by reflecting all information in the stock prices daily. This way the firm is able to maintain the option of realization and utilization of further investments. The course of events at a virtual stock exchange is summarized in figure 2.

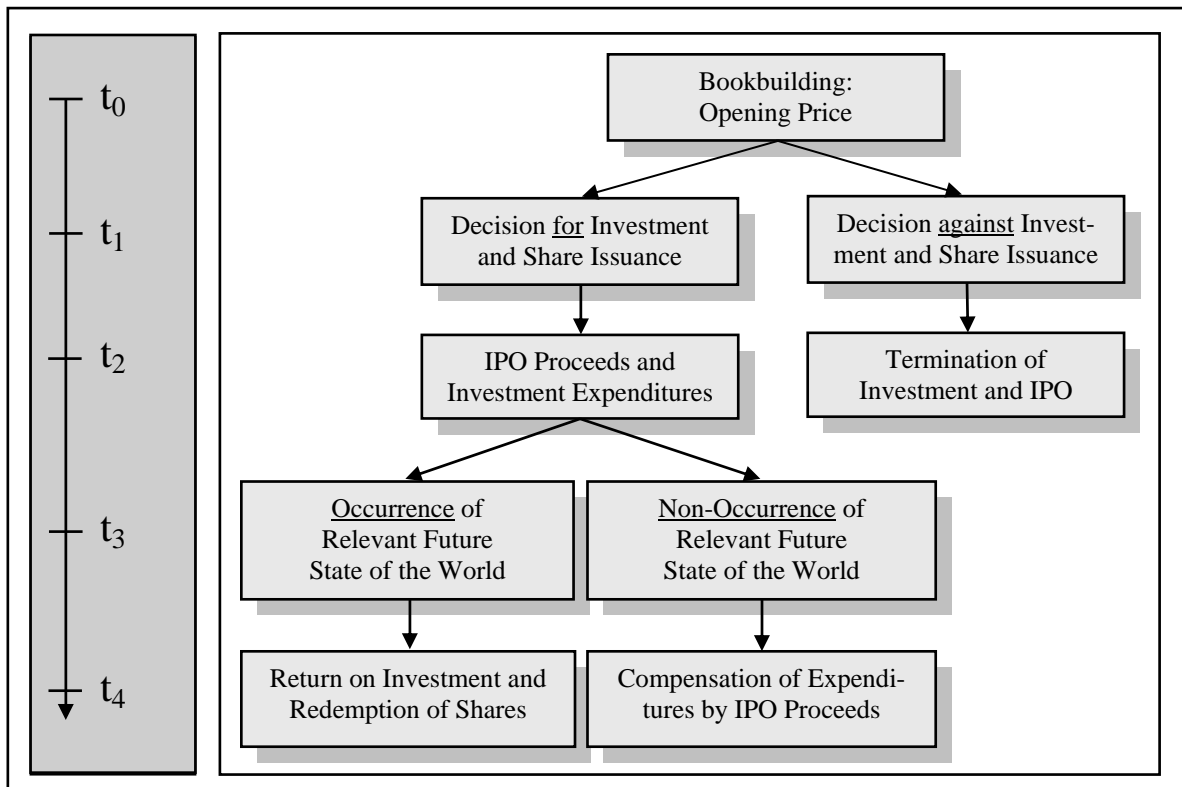


Figure 2: Course of events at a virtual stock market

In summary, the advantages of the virtual stock exchange are threefold: First, the proceeds of the share issuance provide the funds for the investment without reducing the flexibility as well as the independence of the firm. Neither collateral needs to be pledged as security as in the case of debenture capital nor will a third party gain influential rights due to equity financing. Furthermore, the specific investment can be hedged against the threat of non-amortization. The issued shares only need to be redeemed in case the relevant future state of the world does occur. In this case the investment proves to be profitable. In contrast, if this future state will not occur the investment will fail to amortize but is safeguarded against loss since the shares do not need to be redeemed. Traditionally, this type of hedge can only be obtained by insurance companies which charge a high premium for such a risky investment. However, it is questionable if an insurance company would even be willing to safeguard against such a loss due to the specificity and therefore lack of information needed to itself estimate the insurance risk resulting in an infinite regress. Last, the virtual stock exchange, which can be used in addition to the method of calculating the risks of an investment in-house, provides a reasonable high quality forecast while eliminating the disadvantage of conventional methods of reducing amortization uncertainty. Due to the opportunity to profit from

trading shares at the virtual stock exchange a self-selection process takes place addressing actors with dispersed knowledge about the relevant future state of the world. Investors without this specific information have to fear to lose their investment since they need to expect insiders with expert status to incur profits at their expense. Less informed investors will therefore avoid the virtual stock market leaving the grounds for experts with relevant knowledge. These well-informed investors have an incentive to always reflect their true knowledge in the stock price due to the pay-off structure of the shares. This also leads to continuous forecasts eliminating the disadvantage of outdated information often provided by research institutes.

4. Conclusion

In our paper we have shown that the amortization uncertainty might be viewed as a key problem for the selection of profitable investment projects, especially for companies that are operating in young and relatively dynamic market environments. This uncertainty is due to the companies' necessity to ex ante adjust their investments to a specific future state of the world (e. g. a special technological standard) without knowing at the time of the investment decision whether this external development will in fact occur or not. For the management it becomes essential to limit the surrounding amortization uncertainty in order to avoid selection mistakes either resulting in severe losses or even endangering the whole enterprise. The traditional methods used as instruments for reducing uncertainty as has been presented all have their special disadvantages and drawbacks that might result in inferior forecasting respectively decision outcomes. Therefore, we have proposed the concept of a market-based forecasting mechanism that enables the management to collect information about the probability of success of its potential investments by the trading of specially designed securities. At the same time, it provides the possibility of securing expenditures against missing returns. The field of application of such a virtual stock market for business forecasting is thereby very large (for a detailed presentation of possible fields of application see Dietl et al. 2004; Dietl et al. 2005). As an interesting area for future research in this context we regard the institutional design of such a virtual stock market to secure that the positive effects for the quality of derived forecasts are not compensated by opportunistic, i. e. cheating investors in these markets.

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