VALUING A PRIVATE EQUITY VENTURE INVESTMENT: THE CASE OF A B2B MARKETPLACE START-UP

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ABSTRACT

A great number of e-business investments is initiated by early stage companies – mostly financed by venture capital or private equity. Due to the sharp declination of stock prices of new economy companies in 2000 venture capitalists have realized that they have paid too high prices for their equity stakes. They have to admit that new economy market was driven by euphoria rather by fundamental values.

By such a crash, the applied valuation methods are questioned. Venture capitalists dealing with seed and start-up companies on their daily basis need realistic and sensible valuations in order to make profitable investment decisions. However, the valuation of those high growth companies is difficult and presents a big challenge. Most of those companies have negative earnings and no or only small revenues. In addition, comparable companies are rare or required information not accessible to the public which makes it difficult to apply multiple valuation.

Regarding the private equity market start-up venture consists of many options due to high flexibility and uncertainty of their future development. Also from an investor's perspective an investment in an early stage company may incorporate several options such as future follow-up investments, which will be carried out if the company proceeds successfully. Traditional valuation methods such as DCF are not able to capture and price such options, but with option theory it is possible to assign them a fair value.

As a consequence, the aim of this research paper is to apply and test a variation of the real option method on private equity investments. Based on the case approach a fictive B2B marketplace at the start-up financing round in the end of 2000 is discussed. On behalf of confidentiality agreements signed within the venture capital market it is not possible to access real world cases, which makes it compulsory to use a fictive case. The goal is to precisely define and calculate the individual steps of the real option approach in order to derive an accurate and correct valuation of the B2B marketplace at the given financing round.

This research paper makes three important contributions in this context: (1) it systemizes the application of real option models in the scope of private equity, (2) it demonstrates the feasibility of option theory for assessing private equity investments and (3) it shows a tendency concerning cost-benefit ratio if option theory is applied on private equity investments.

MOTIVATION

The application of option theory to problems in information technology and especially to e-business has been the subject of some research in the last years. Prior research (Benaroch 2000) especially targeted the demonstration of the power of real options through applying fundamental option pricing models, such as the Black-Scholes or the binomial models, on real world cases. As a result, option theory offers high potential for useful insights regarding the evaluation of irreversible investments under uncertainty and requiring flexibility.

A great number of e-business investments is initiated by early stage companies – mostly financed by venture capital or private equity. Due to the sharp declination of stock prices of new economy companies in 2000 venture capitalists have realized that they have paid too high prices for their equity stakes. They have to admit that new economy market was driven by euphoria rather by fundamental values.

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PRIVATE EQUITY INVESTMENTS

In order to secure corporate financing today's financial markets offer a variety of instruments and methods. Alongside the ability to use internal sources such as earnings, reserves, depreciation or corporate restructuring, most companies use external finance such as debt, venture capital or private equity.

Due to multiple, partly confusing and from a scientific perspective incorrect interpretations (Rudolph 2000) a clear definition of the term “private equity” is difficult. Usually the term “private equity” defines the market for equity capital that is not listed on a stock exchange; the American interpretation of private equity specifies venture capital as a segment of private equity capital (Rudolph 2000).

ANALYSIS OF VIRTUALTRADE

MOTIVATION

A real situation of a venture capital investment at the end of year 2000 is the basis of the case discussed in the scope of this paper. In order to ensure confidentiality, several names and other identifying information have been disguised, so that VirtualTrade represents a fictional company. For the consistent analysis of the case, all market information and data used was published prior to the end of 2000.

VIRTUALTRADE AT A GLANCE

VirtualTrade is a start-up venture planning to open a B2B marketplace. The company, located in Berlin, was founded by two Accenture consultants in spring 2000. VirtualTrade wants to offer online-auctions as well as individual procurement solutions for enterprises and virtual marketplaces. Besides the required software applications, they also offer several services in order to provide optimal support for their clients to undertake successful transitions. Their business activities will be focused on the electronic and computer industry, so that VirtualTrade can be considered as a vertical marketplace.

At the present stage the company has already developed the prototype of their auction software, which they used to carry out the first auction in December 2000. For VirtualTrade it is essential that their application is based on current network and software standards in order to ensure easy use, low maintenance as well as integration costs. Their clients will be able to choose among three different solution packages. Regarding individual requirements, customized solutions will be developed to provide optimal online auction facilities. VirtualTrade’s product diversification is considered as suitable to serve a wide range of customers facing different requirements and goals. Their aim is to offer customers a one-stop-shop where they can conduct their complete trade online.

After setting up their operation in Germany, VirtualTrade plans to open offices in USA, UK, France and Spain. Their strategic goal is gaining a 10 per cent market share of the German electronic and computer market in 2004 and 20 per cent in 2010. Therefore, VirtualTrade is looking for alliance partners in the technology, consulting and service integrator industry for leveraging their products. Co-operation partners and associations are contacted in addition. Nevertheless, VirtualTrade wants to stay neutral as an independent B2B marketplace. To start their operation, VirtualTrade is looking for an investor to finance the start-up phase. They prefer a participation of a venture capitalist, which is able to provide further capital for two additional financing rounds in the next two years. The venture capitalists should also be able to establish contacts to interesting alliance partners or valuable clients.

BUSINESS MODEL

VirtualTrade's business model is based on three standardized solution packages consisting of different applications and services, each addressing different needs and goals. All of their applications are web-based requiring only low integration costs.

- The first solution "Business Online" represents the start-up package to conduct online negotiation and to participate in auctions over a browser, which will not require any up-front investments. The auction tool will be flexible and includes multiple functions allowing an easy adaptation to changing customer demands. At the beginning VirtualTrade will support the client in registration, training, identifying suitable products and analyzing the market. The pricing will be transaction based as a percentage of the total purchasing volume.
- The "Sourcing Solution" enables the client to establish its own enterprise marketplace, which can be integrated into existing IT environments like ERP systems or intranets. The package is expanded by an administration tool enabling automatic contract and data transmission as well as a Request for Quotas (RFQ) module to conduct reverse auctions. In addition, auction design and integration services are offered.
- Finally the package "Marketplace Solution" represents the advanced solution with enhanced negotiation and auction functionalities in order to support a great number of transactions of a highly active marketplace. Thereby the "Sourcing Solution" is expanded by several modules and additional services, such as sales support to start these marketplaces.

The pricing of the "Sourcing-" and "Marketplace Solution" is license-based regarding the auction application. The services are offered separately and are invoiced on a per man-day basis similar to the consulting industry. It is expected that, within the first years of operation, mostly "Business Online" packages are sold, which will lead to a slightly fluctuating revenue stream as auctions vary during the year. As the number of license based contracts increases, the revenue stream will become more stable. But the revenues from services will continue fluctuating year through depending on the workload of the consultants.

TARGETED CUSTOMERS

Due to the fact that VirtualTrade has just started its operation, the company has only 16 customers. Based on their business plan, their targeted customer base consists of wholesale dealers, manufacturer and trading companies within the electronic and computer industry. It is estimated that there are approximately 2,000 wholesale dealer, 2,500 manufacturer and 26,000 trading companies mostly. small and medium-sized enterprises.

At the current stage, VirtualTrade is in contact with a couple of manufacturers, who are keenly interested in a tailored B2B solution. VirtualTrade aims gaining 2,300 clients at the end of 2004. Therefore they have to build a sales force, which has to be specialized on the industries in order to address their needs and goals. VirtualTrade will try is to diversify their customer base as widely as possible in order to avoid dependence on specific customers. But this is hard to achieve, especially for young B2B marketplaces, which need big players to bring in liquidity and jump-start these marketplaces. As theB2B marketplace is operating successfully, it will be discussed to expand the business to other industries and indirect materials. But at first, VirtualTrade's strategy will focus on the electronic and computer market.

COMPETITORS

The competition of B2B marketplaces is strong and increasing significantly. Compared with the USA, where this market is older and more developed, most of the marketplaces in Germany were founded in 2000. It is estimated that there were about 200 B2B marketplaces at the end of 2000 in Europe; most of them are not listed at stock exchanges. Regarding VirtualTrade, three groups of competitors can be identified. The first represents B2B marketplaces with similar business concepts and no indus-

try participation – they are so called direct competitors. The second classification covers e-commerce enabler which are software companies trying to penetrate the market by providing B2B solutions for their customers. The final group represents industry consortia that are B2B marketplaces initiated by leading companies within industry.

Overall, it has to be realized, that there are already a couple of B2B marketplaces operating. They have established valuable relations with large corporations and have been able to reach relatively high trading volumes. It will be hard for VirtualTrade to compete with these advantages and jump-start the marketplace. But the B2B market of the electronic and computer industry is expected to increase so dramatically in the future that there will be many opportunities for new marketplaces.

INDUSTRY

The growing B2B trade worldwide, which is due to changing purchasing habits of the industry participants, as well as the changing technology supporting B2B trade have led to significant changes in the procurement behavior. Market forecasts of B2B commerce vary significantly. At the current stage, the European market for B2B e-commerce is less developed than the US market and represents only a minor proportion of total global transactions. But analysts such as Gartner expect the European share to increase who estimate that the European market will represent 32% of the global B2B e-commerce by the end of 2004. For 2004, Gartner forecasts the European B2B e-commerce market to reach $ 1,400 € bn (UBSWartburg 2000).

Along the market perspective for the B2B industry, the computer and electronic industry is considered as one of the most suitable industry for B2B marketplaces in the short- as well as in the long-term. Companies within this industry have a high technology readiness. The market is quite fragmented and the overall market size is big. In addition, the products are standardized and fungible.

SWOT ANALYSIS

A strategic analysis of VirtualTrade regarding its strengths, weaknesses, opportunities and threats (SWOT) leads to the following results; thereby typical start-issues will not be considered, such as possible administrational and operational problems as well as recruitment and product development risks.

- Strengths
  VirtualTrade's business model is well diversified to serve a broad customer base. By offering three different B2B e-commerce solutions, VirtualTrade addresses major customer needs. Moreover they are flexible to provide customized solutions for individual requirements. The B2B commerce applications are combined with several consulting services in order to ensure successful integration and smooth operation. Customers who are not willing to make high investments at their early stage of B2B commerce can trade at B2B marketplaces by using the transaction based fee model. As transaction volume increases, customers can take advantage of the advanced B2B commerce solutions. By applying such a business model, VirtualTrade will be well positioned in the market for B2B marketplaces.
  VirtualTrade's business concept will benefit significantly from the great experience of their founders and employees. For early stage companies, human resources – the company's most valuable asset – are essential. The two founders gained massive knowledge about e-commerce solutions in several projects at their former employer. They are experts of today's e-commerce strategies and developments and know the circumstances of several companies, their requirements and goals. Besides the development of e-commerce solutions, they also gained rich experience about solution integration. Their employees have lots of experience in the field of software devel-

opment and are up-to-date on today's e-commerce standards such as XML.
VirtualTrade is a third party marketplace, which is not backed by any industry or company interests. They are neutral and operate independent from the goals of market participants. This marketplace concept provides high loyalty and means competitive advantage over industry-based consortia.

- Weaknesses
  VirtualTrade has just launched its marketplace and has only a small customer base. However they have developed same promising relations with mid-size manufacturers. The small number of customers is a big disadvantage, because the acquisition of customers requires a lot of time and high efforts. Relatively old B2B marketplaces, which achieved early liquidity, are more likely to be successful in this market, so that they can build on a first-mover advantage.
  At the current stage, VirtualTrade does not make any mentionable revenues or positive earnings. The company is not able to initiate big investments or acquisitions. Established and better capitalized companies with a proven track record have more strategic options than start-up companies. Due to promising forecasts, many companies are encouraged to enter this market by using their capital power.

- Opportunities
  The outlook for B2B marketplaces is promising. The European market for B2B marketplaces has just recently started to develop and is expected to reach € 3,900bn of trading volume in 2010 (UBSWartburg 2000) providing enough possibilities for a whole bunch of companies. Especially the electronic and computer market is considered as one of the best suitable markets for B2B marketplaces, since the participants adopt new technologies quickly and the market consists of standardized products. Additionally, the size of the B2B electronic and computer market is quite large making the application of B2B marketplaces reasonable.
  VirtualTrade is able to enter strategic alliances with technology, consulting and service integrators and is pursuing this goal at present. These partnerships will increase the usage and therefore the distribution of their solutions, which will result in higher trading volumes. Moreover, VirtualTrade is as well contacting associations in order to gain access to industry communities being interested in marketplace solutions.
  After the first B2B marketplaces for the electronic and computer industry have been launched, the expansion towards other industries or product categories can be conducted easily. VirtualTrade's technology can be reused along specific industry elated features. But the acquisition of customers may create several difficulties and efforts. VirtualTrade can also start its operation in other geographical areas. All in all, VirtualTrade will have several valuable opportunities for expansion, after their first marketplace project runs smoothly.

- Threats
  The competition of B2B marketplaces is hard and is expected to increase. VirtualTrade has to compete against established e-commerce providers, who can benefit from their huge customer bases and take advantage of their track record representing an important competitive advantage over VirtualTrade. Besides some German companies, many American companies have already entered or will enter the European market. The development of a dominating player within the European market during a short time is not realistic, due to the high growth within the market and the high number of participants. For VirtualTrade taking a stake of their customer base will be hard. Moreover many start-up companies have been founded in 2000, which will launch their marketplaces soon. As the market continuous to develop, competition will increase dramatically, which will result in high margin pressures, may force some companies to close down operations

and will lead to a consolidation.

VirtualTrade might not be able to reach the critical mass of marketplace participants. For a marketplace a high number of sellers and buyers is substantial in order to enable matching of supply and demand at fair market prices. Liquidity is the key element of a marketplace operating successfully, adding value to the customer and therefore justifying its existence. Since exchanges are low-margin endeavors, they require enormous trading volumes to make it a viable business. Therefore it is important for the generation of revenues and profitable operation of VirtualTrade to reach high trading volumes.

REAL OPTION BASED ASSESSMENT OF VIRTUALTRADE

OVERVIEW

In order to value a company like VirtualTrade, it is not reasonable to consider the current performance. The company has great potentials and most of their value will be generated by future developments. Therefore many investors and analysts use DCF approaches in order to value the company reasonable. But from an investor's perspective such an investment incorporates also several options, which cannot be valued with traditional approaches. In order to capture the high uncertainty and flexibility included in these ventures the real option approach is used (Schäfer 2001). Besides several operating options, which might be included in the business, the following real option analysis focuses on strategic options. Therefore, the perspective of private equity respectively venture capital investors is adopted in order to evaluate the investment opportunity.

REAL OPTIONS SCENARIO

The real option analysis adopts the perspective of venture capital investors. Thereby the investment in the company is considered from an entire perspective rather than form a specific equity stake owned by a venture capitalist. The perspective is therefore similar to one of equity research analysts who value publicly listed companies instead of privately held companies.

At the current stage, VirtualTrade is looking for an investor to provide them with the required start-up financing. Based on their business plan, which is considered as realistic, VirtualTrade will require two additional financing rounds. The first will be needed at the beginning of 2002 and the second one will be needed at the beginning of 2003. Regarding the start-up financing, VirtualTrade contacts a venture capital investor who now has the possibility to invest in the business and who is currently analyzing the investment opportunity. Within a week the venture capitalists has to decide whether he will invest in this venture or not. During this period, the investment opportunity will be reserved only for the contacted venture capitalists. If the venture capitalist rejects the investments opportunity, he will not be able to participate in later stage financing rounds. It is assumed that any investor having invested at the start-up stage will be the only one to participate in later financing stages. This implies, if the contacted venture capitalist invests in this business at the start-up stage, he will be the only investor who has the opportunity to provide the first and second round financing. This means that only one investor is able to invest and that no dilution in later financing rounds is possible.

Assuming that the venture capitalist has invested in the business and the first financing round at the beginning of the year 2002 is approaching, the venture capitalist has to decide whether to invest in this business again or not. It is assumed that the amount of required capital for the first financing round is known before, based on the reasonable business plan that it can be considered as fixed. The

decision of the venture capitalists will significantly depend on VirtualTrade's value, which will be determined for future performances as presented. If the perspectives of the business are promising and the company is expected to achieve their goal, the venture capitalists will invest again. But if the market environment has changed or VirtualTrade has not managed to achieve their targeted goals, he will not be willing to invest in the company again.

The second financing round will be similar to the first one. It is assumed that VirtualTrade will not need any additional financing after the second round. If the business model succeeds, the company will have reached full operation and will be able to generate positive earnings. This would boost the company value, which can be turned into cash by the venture capitalists in a successful exit such as an IPO or trade sale. Thereby it is assumed, that the company will be owned by the venture capitalist completely and that no management participation exists. This assumption is not very realistic, but here it is used to make the case simpler. The complete context of the investment opportunities is depicted in figure 1.

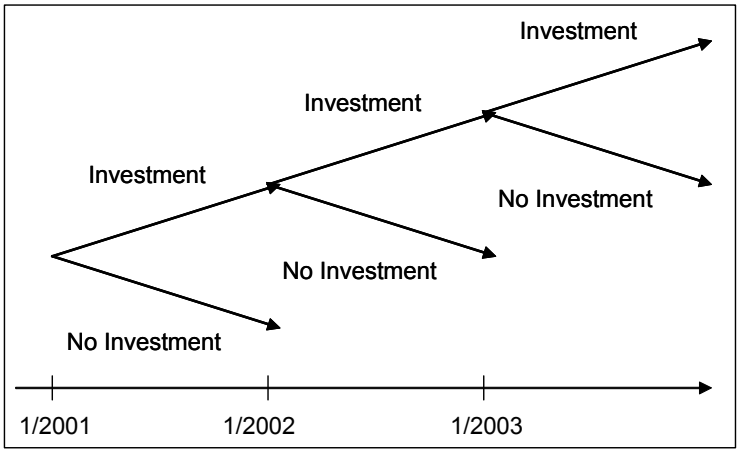

Figure 1: Real option scenario.

By expressing the context in option theory terminology, the investment in VirtualTrade can be considered as a purchase of a two sequential compounded call option. The different investment stages represent additional compounded call options. Due to the fact that exercise will only be possible at the final exercise date, these options are European call options. The underlying is represented by the potential company value of VirtualTrade at full operation. The financing rounds represent the costs of making the investment and therefore the exercise prices. The volatility of the underlying asset is determined by the market risk of the business concept and originates from the volatility of the demand and margins(Willner 1995).

APPLIED METHODOLOGY

The scenario incorporates a compounded call option, which is compounded on another compounded call option; thereby all options are European style. Based on these characteristics it is possible to use a variety of real option methods, which are able to value this scenario reasonably. Due to the fact that the scenario consists of European style options it possible to apply the Black/Scholes equation. Nevertheless, this real option analysis uses the binomial approach developed by Cox, Ross and Rubinstein (Cox 1977). The binomial model is able to price American as well as European style options and has the advantage that the real option calculation is more transparent and easy to follow. Besides this, the approach provides the possibility to visualize the applied decision strategy in different situations. The leaking accuracy of the binomial approach is reduced by quarterly intervals. In addition, a sensitivity analysis is conducted to quantify the influence of the input parameters on the option value.

PARAMETER ESTIMATION AND CALCULATION

After specifying the real option model it is necessary to precisely define the requirements for the input parameters. In the paper the derivation of the volatility will be exemplarily shown. Regarding the determination of the volatility, it has to be realized that the applied valuation approach requires only one parameter of uncertainty.

Regarding this case, a Monte Carlo simulation estimates the volatility of the underlying asset. As underlying asset – the company value of VirtualTrade – has been calculated by a DCF analysis, it is possible to extend this spread sheet by using a simulation program. At first, it is necessary to identify the variables driving the volatility. In doing so, the different sources of uncertainty have to be kept separately. Consequently, the stochastic properties – e.g. distribution, mean and standard deviation – of the variables driving volatility have to be determined and entered into the spread sheet. Finally the forecast cell, which presents the rate of return, has to be determined. After running a high number of iterations, the standard deviation of this output field results. It represents the "consolidated" volatility, which combines the defined and modeled uncertainties used in this real option analysis. In order to convert the different simulated company values into rates of return, the annual rate of return generated within one specific period has to be calculated. The Monte Carlo simulation was conducted by running 5000 iterations; thereby 5000 sets of random values for the defined variables have been selected. Within a new simulation, there might be a slightly different outcome due to the random selection of numbers.

Statistics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Mean
Mean	20.5%	20.8%	20.7%	20.6%	20.6%	20.6%	20.6%	20.6%	20.6%	20.5%	20.6%
Median	-1.3%	-1.2%	-2.0%	-2.1%	-2.1%	-2.7%	-2.6%	-3.0%	-3.0%	-3.4%	-2.3%
Standard Deviation	83.6%	85.4%	86.1%	86.8%	87.5%	88.0%	88.8%	89.5%	90.1%	90.7%	87.6%
Variance	69.8%	72.9%	74.1%	75.4%	76.5%	77.5%	78.8%	80.1%	81.1%	82.4%	76.9%

Figure 2: Annual rates of return.

As depicted in figure 2, the mean of the annual rate of return is above the WACC (calculated with 13.56%). Moreover, the means are stable throughout the year. But the interesting parameter of this simulation is the standard deviation, which is 83.6% in 2004. In order to determine volatility, which can be used in the real option analysis, it is assumed that the volatility of the underlying asset is similar to the mean of the standard deviations (87.6%). Volatilities calculated for US biotech start-up at the end of 2000 were between 65% and 90% of standard deviation. Although these parameters cannot be compared directly, due to different industry characteristics, they indicate that the simulated volatility of 87.6% is realistic. For the calculation process the following input variables are used (see figure 3):

Volatility	87.6%		
Exercise Price	1st Exercise Price: 12.5 €m	2nd Exercise Price: 16.5 €m	3rd Exercise Price: 11.0 €m
Underlying	284.5 €m discounted company value in 2004)		
Time to Maturity	2 years (splitted in quarters)		
Dividends	No dividends assumed		
Risk-free Interest Rate	4.75% (equals to the coupon rate of two-years German government bond)		

Figure 3: Value of Input variables.

The calculation of the real options is conducted by the binomial approach developed by Cox-Ross-Rubinstein-model. The calculation starts with the construction of the event tree. Based on the event tree, option values at the final notes are determined and discounted back. In this case, additional options have to be considered at time 4 and at the beginning.

The values of an up- and down-movement are calculated to be 1.5496 resp. 0.6453. Starting from the first subinterval, the event tree can be constructed. The value of € 246.3m (see figure 4) represents the final value of the real options. Within this analysis, it can be realized that only in one node (time 8) an option is not exercised.

Input Parameters

1. Annual risk-free rate, rf	4,75%
2. Current value of the underlying, V0	284,50 €m
3. Life of the options, T	2 years
4. Annual standard deviation, σ	0,876
5. Number of subintervals per year, n	4
6. Exercise Prise, X1, Call	12,50 €m
7. Exercise Prise, X2, Call	16,50 €m
8. Exercise price, X3, Call	11,00 €m

Calculated Parameters

1. Length of subinterval, Δt (1 year/n)	0,2500
2. Risk free rate / subinterval, R (erf Δt)	1,0119
3. Up movement per step	1,5496
4. Down movement per step	0,6453
5. Risk neutral prob. (up)	0,4054
6. Risk neutral prob. (down)	0,5946

Event tree

0	1	2	3	4	5	6	7	8
284,50	440,86	683,16	1.058,63	1.640,46	2.542,07	3.939,20	6.104,21	9.459,11
	183,60	284,50	440,86	683,16	1.058,63	1.640,46	2.542,07	3.939,20
		118,48	183,60	284,50	440,86	683,16	1.058,63	1.640,46
			76,46	118,48	183,60	284,50	440,86	683,16
				49,34	76,46	118,48	183,60	284,50
					31,84	49,34	76,46	118,48
						20,55	31,84	49,34
							13,26	20,55
								8,56

Option value tree (Option C)

0	1	2	3	4	5	6	7	8
274,53	430,74	672,92	1048,27	1629,97	2531,45	3928,46	6093,34	9448,11
	173,53	274,26	430,50	672,67	1048,02	1629,72	2531,20	3928,20
		108,34	173,23	274,01	430,25	672,42	1047,76	1629,46
			66,26	107,99	172,98	273,76	429,99	672,16
				39,14	65,84	107,74	172,73	273,50
					21,72	38,60	65,59	107,48
						10,65	20,97	38,34
							3,83	9,55
								0,00

Option value tree (Option B)

0	1	2	3	4
258,80	414,82	656,81	1031,96	1613,47
	157,61	258,14	414,19	656,17
		92,22	156,92	257,51
			49,96	91,49
				22,64

Option value tree (Option A)

0
246,30

Figure 4: Real option calculation.

FINAL RESULTS

The calculated option value of € 246.3m represents the company value of VirtualTrade. Thereby the investment stacks as well as the flexibility about the investment decisions have been priced into this value. In order to value start-up companies, the applied model can be used instead of other valuation techniques, such as DCF or multiplies. They are not able to value the flexibility about the investment decisions, which depend significantly on the development of the company and the environmental changes within this industry. Nevertheless, it has to be realized that in determining the required input parameters, this approach also uses traditional valuation models. Thus the selected approach builds on traditional valuation models, but in addition provides the advantage of valuing flexibility.

In this case the company value calculated by the real option approach is only slightly higher than the company value calculated with the DCF approach. The company value generated from the DCF analysis is € 244.5m (see figure 5) at the beginning of 2001, which is just € 1.8m below the value of the real option analysis.

Discounted company value in 2004	€ 284.5m
– Discounted value of investments	– € 12.5m
	– € 16.5m
	– € 11.0m
Company value based on DCF	€ 244.5m

Figure 5: Present company value based on DCF.

In order to identify the important value driver of the real option valuation, a sensitivity analysis has been conducted assuming that the input variables are normal distributed and the standard deviation of each parameter is 10 per cent of the mean. The result of the analysis (see figure 6) shows the level of correlation, which measures the influence of the input parameters on the option value.

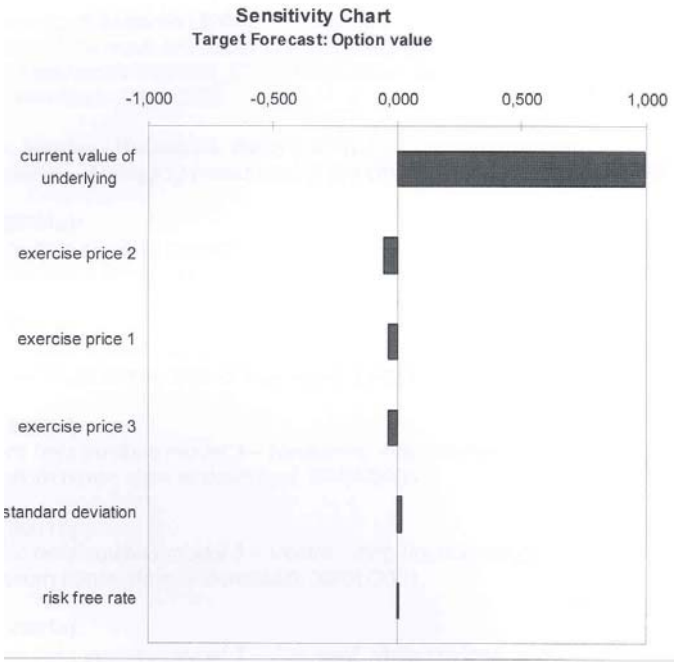

Figure 6: Sensitivity analysis.

Regarding the underlying, the level of correlation is nearly 1 (perfectly positive correlated), which implies that the increase in the underlying results in a similar increase in the option value. A negative correlation implies that the increase in one parameter results in the decrease of another, which can be recognized regarding the exercise prices. From this analysis it can be realized that the underlying is the dominant value driver. The exercise prices, which are relatively small compared to the value of the underlying, have only a minor impact on the option value. Finally the influence of the standard deviation on the option value is slightly positively correlated implying that this variable has only a small impact on the option value.

CONCLUSION AND OUTLOOK

The aim of this paper has been to apply and test the application of real option valuation in private equity investments. Therefore a case approach has been chosen which uses the case of VirtualTrade, a fictitious company derived from a real world investment. After the definition of the private equity market and the presentation of the real option methodology, VirtualTrade has been analyzed. Regarding the real option analysis, several parameters have been estimated in order to conduct the calculation of the company value.

The results of this real option analysis show that in this case the additional value generated by the flexibility is small in comparison with traditional models. The application of the results of the sensitivity analysis (see figure 6) leads to the hypothesis that the option of follow-up investments included in venture capital investments incorporates only a small value. If this hypothesis can be verified by empirical research, traditional approaches will be sufficient for venture capitalists to calculate the value of start-up investments. But one must be aware that this case uses several assumptions which do not exist in the real world, especially assumptions regarding the investment conditions. In practice, investment contracts are complex and incorporate many conditions. In order to diversify the risk, usually several venture capitalists invest in one start-up. This implies that the follow up investments are not reserved to one investor only.

Alongside the obstacles and limitations of this approach, venture capital investments have a high uncertainty and incorporate much flexibility. During the preparation of this paper several companies have been contacted. Thereby it could be recognized that none of them has ever used the real option approach for valuing an investment, although an interest in new valuation techniques for anti-dilution clauses and other contractual conditions exists. They represent options for the investors and usually they are not estimated on a theoretical base. In order to have an anchor for negotiations about these contractual options it is desirable to value them correctly. Therefore an equity stake perspective is required which considers the individual options of an investor. Thereby also interactions with other investors can be considered requiring the application of game theory for correct modulation. Finally, such approaches can also be used to improve the investment strategy of venture capitalists and other private equity investors.

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