A Real Options Approach to Outsourcing Decisions under Uncertainty

THE FINANCIAL SERVICES INDUSTRY IS OPERATING IN HIGHLY VOLATILE MARKETS.

TO CONSIDER THE IMPACT OF UNCERTAIN MARKET ENVIRONMENTS ON IN- AND OUTSOURCING DECISIONS, WE INTRODUCE A REAL OPTIONS BASED DECISION SUPPORT MODEL. WE APPLY THE MODEL TO AN IT INFRASTRUCTURE OUTSOURCING DECISION AND DETERMINE - BASED ON COST SAVINGS RESULTING FROM OUTSOURCING AND OPTION VALUES ACCOUNTING FOR UNCERTAINTY - DIFFERENT "TRIGGER" OUTPUT VOLUMES WHICH INDICATE IF IN- OR OUTSOURCING IS PREFERABLE. FINALLY WE SHOW THAT THE MODEL CAN ALSO BE TRANSFERRED TO SOURCING DECISIONS OF TRANSACTION BASED BUSINESS PROCESSES LIKE CLEARING AND SETTLEMENT OF SECURITIES.

Introduction

The Financial Services Industry especially in Western Europe is recently going through a transition process of redefining its core business, cutting costs and consolidating their activities. Thereby outsourcing is one of the activities actively used by banks. Especially in processing intensive areas like IT infrastructure, clearing and settlement of securities, payments or credit back-office services outsourcing is a widely discussed issue, as scale economies are reached when being able to concentrate load on one specific activity. In the following, we show that there is a critical output volume based on a given price function from the service provider determining if in- or outsourcing is favorable. Additionally one-time investment costs for outsourcing and re-insourcing respectively as well as uncertainty about future output volume may have a significant impact on in- or outsourcing decisions.

Traditional approach to sourcing

The main reasons for outsourcing are cost savings and variabilization of costs. The cost structure of internally produced IT infrastructure or IT-enabled business processes is defined by significant fixed and marginal variable costs. The fixed costs result from expenditures for e.g. developing or buying applications and one-time investments in hardware. To be able to shift from fixed to variable costs via an outsourcing deal the price structure of the service provider has to consist of (1) a relatively small fixed price determining the floor for the service provider and (2) a variable price per transaction unit/output volume which is expected to also cover the gross of the service provider's fixed costs. Consequently, we can determine a critical output volume O* above which re-insourcing the IT infrastructure or business process becomes favorable for the bank again (see figure 1).

Based on externally available real-world data for an IT infrastructure outsourcing deal, we derived a cost and a price function. Both functions consist of a fixed and a variable component driven by mainframe computing power (measured in MIPS). We found that the critical output volume O* is 16.250 MIPS. As currently the bank observes about 10.000 MIPS, outsourcing is beneficial. But this initial analysis did not include two additional factors crucial for an outsourcing decision: (1) one-time costs evolving from outsourcing like implementing an interface to the service provider and (2) uncertainty about the future output volume.

A real options approach to sourcing

To consider these factors we developed a real options model which includes the current savings from outsourcing, the one-time investment outlay and an uncertainty surcharge which enables the bank to be highly confident that even if future output volume increases the decision to outsource stays favorable in the long run. The premise underlying the application of the real options approach (ROA) is the challenge of an uncertain future. The business strategy of a company

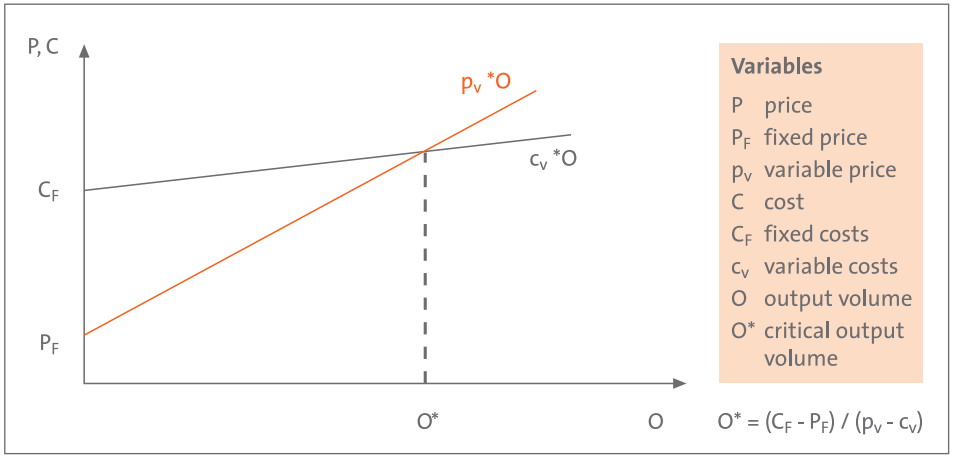

Figure 1: Critical output volume for in- and outsourcing decisions

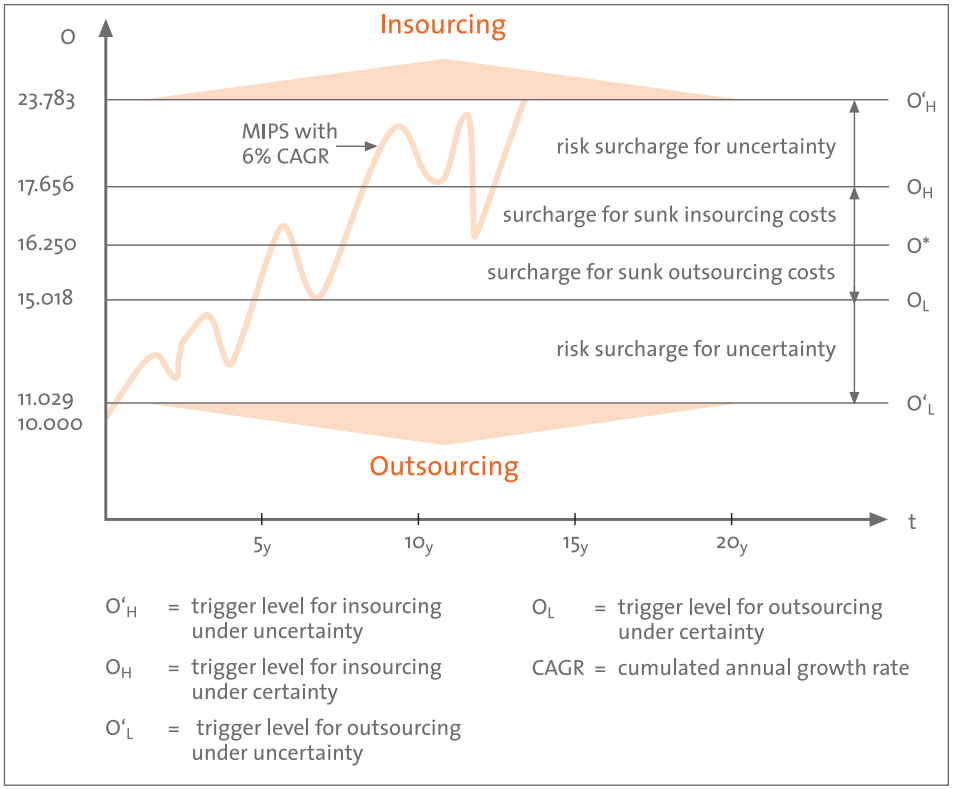

Figure 2: In- and outsourcing considering uncertainty and sunk investment costs

resembles a series of options rather than a single projected cash flow. Options imply uncertainty and these alternatives can be valued by applying option pricing theory on real investments.

The idea of options pricing is that an option provides the holder with the right but not the obligation to sell or buy a specified quantity of an underlying asset at a fixed price, called strike price. A short introduction to the methodology of option pricing is given in the Appendix. Managerial flexibility in real investments may evolve from the right to wait with an investment until uncertainty is reduced or the option to expand an investment in production facilities if product demand increases. In our model, the real options approach is used to determine the value that arrives from having the managerial flexibility to switch between internal production and outsourcing. Therefore a bank which is internally producing IT infrastructure will outsource if the cost savings from outsourcing plus the option value to abandon outsourcing is equal the option value to insource (which is the current value that insourcing becomes valuable again in the future) plus one-time costs for outsourcing et vice versa (for a detailed description of the real options model see the paper Lammers / Lucke 2004). Solving this model we came to the results depicted in figure 2.

Considering uncertainty and one-time investment costs, it can be seen that the outsourcing decision of the bank is still correct, as the current computing capacity of 10.000 MIPS is below the outsourcing trigger O'_L=11.029 MIPS. If the output volume over time increases above the insourcing trigger O'_H=23.783 MIPS and the service provider is not adopting the price structure of the outsourcing deal, then re-insourcing would be favorable again. Under the assumption that the variable MIPS increases with a cumulated annual growth rate of 6%, the insourcing trigger would be reached after about 15 years.

Therefore the general model enables to determine an uncertainty surcharge in volatile areas to support that outsourcing or internal production is lastingly favorable. Thus the model is not only applicable for IT outsourcing decisions but also for transaction based business processes like clearing and settlement where the transaction volume is partly correlated to the movement of the capital markets. In certain areas like payments, where output volume is relatively stable, managerial flexibility under uncertainty obviously has no significant value. In these cases the in- or outsourcing decisions can be determined based on comparing the cost and price structure and considering sunk costs evolving from outsourcing and re-insourcing respectively. The sourcing triggers under certainty for insourcing (O_H=17.656) and outsourcing (O_L=15.018) in figure 2 therefore represent the output volumes which enables the bank to recapture the sunk investments costs from an in- or outsourcing decision.

Summarizing the findings, a model was developed for IT infrastructure as well as transaction based business processes to support in- and outsourcing decisions considering (1) the cost and price structures of the bank and the service provider respectively, (2) sunk costs from out- or insourcing decisions and (3) uncertainty, which is in the described case future output volume like computing capacity or number of processed transactions.

The real options approach is enjoying increasing attention. Recently, the value of applying ROA has been shown by Benaroch &

Kauffman (2000) who demonstrate how traditional approaches would have generated wrong IT investment recommendations in an electronic banking network. Besides the potential to better cope with the uncertainties of corporate reality and to end with a caveat of Nobel Laureat Robert Merton (1998), one has to be cautious when applying any valuation model and when "their mathematics become too interesting".

Literature:

Benaroch, Michel/Kauffman, Robert J. (2000): Justifying Electronic Banking Network Expansion using Real Options Analysis, in: MIS Quarterly 24, pp. 197-225.

Lammers, Markus/Lucke, Claus (2004): Sourcing Decisions under Uncertainty: A Real Options Approach for In- and Outsourcing of IT-enabled Business Processes in the Banking Industry. (Working Paper-submitted for publication), Frankfurt a. M.

Merton, Robert C. (1998): Applications of option pricing theory: twenty-five years later, in: The American Economic Review 88, pp. 323-349.

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Appendix: A short introduction to using option pricing theory in investment decisions

To introduce option pricing we will value two types of options, a call option and a put option. These two kinds of options are also included in real investment decisions as will be shown later. The holder of a call option has the right but not the obligation to buy a stock for a given price while the holder of put option has the right to sell the underlying stock for a given amount of money.

Valuing a call option

Let us assume that we have the option to buy a RWE stock for 100 Euro. The time to expiration is 1 year, i.e. the holder is only allowed to exercise the option within the following year. We will assume for simplification that the RWE stock will at the end of the year move up to 125 Euro or move down to 80 Euro with each 50% probability. The risk-free rate of return rf is assumed to be 2.5%, which is needed to discount the future value of the option to the present value. The holder of the option will obviously use the right to buy the stock, if the price of the stock at the end of the year is above 100 Euro. Therefore the possible payoffs to the option are:

Stock Price:	125 Euro (p_1 = 0,5)	80 Euro (p_2 = 0,5)
Payoff of call option (after one year):	25 Euro	0 Euro

Concluding the expected value of the call option (in Euro) – being the right to decide if buying the stock or not - can be determined as follows:

Expected return= [(probability of rise x 25)+(1-probability of rise x 0)]/(1+rf)=[(0,5 x 25)+(0,5 x 0)]/1,025=12,19

Therefore the option shows the current value of the flexibility to buy or not to buy the stock for a given level of uncertainty.

Valuing a put option

In the following we will show, that the same process allows for determining the value of a put option. We assume that the put option has the same characteristics than the call option, except that the put option gives the right to sell the RWE stock for an exercise price of 100 Euro. Then the possible payoffs of the put option would be:

Stock Price:	125 Euro (p_1 = 0,5)	80 Euro (p_2 = 0,5)
Payoffs of put option (after one year):	0 Euro	20 Euro

Concluding the expected value of the put option (in Euro) can be determined as follows:

Expected return= [(probability of decline x 0)+(1-probability of decline x 20)]/(1+rf)=[(0,5 x 20)+(0,5 x 0)]/1,025=9,75

Application of option pricing theory for real options

The same system can also be used in real investments, e.g. the company can decide when to make an investment or may be able to expand the investment at a later stage when the demand for the produced product increases. Furthermore the investor may decide to abandon a project and to sell the underlying assets. The option to invest is similar to a call option. The investor has the right but not the obligation to buy the future cash flows of an investment by paying the investment costs. On the other side the put option is like an option to abandon an investment project. The investor has the right but not the obligation to sell the underlying assets for the current value and will exercise this option if the value of the current assets is above the net present value of the projects future cash flows. These kinds of options which are embedded in an investment project can be valued to include the possibility to react on future uncertainty into the net present value of the project. In the following table it can be seen that the influencing factors needed to value a financial option have an equivalent in real investments thus enabling to value options embedded in real investments.

Call option on a stock	Real option on an investment
Current value of stock (=market expectation of the present value of a companies' future cash flows)	Expected present value of future cash flows of the investment
Exercise price	Investment cost
Time to expiration	Time until the investment project has to start
Stock value uncertainty	Project value uncertainty
Risk-free rate of return	Risk-free rate of return