Assessing and Negotiating Commercial Contracts

Jan Vlachý*

This paper investigates the process of evaluating and negotiating commercial contracts using value-based models. First, contractual assets are defined and related to a comprehensive firm-theoretical background. Several simple valuation models for contracts are then derived and applied, using an option-theoretical background and particular case examples. Quantitative criteria are thus introduced, that can be used as a management toolkit to assist in negotiation, as well as for various corporate valuation purposes by e.g. auditors, appraisers or M&A specialists. Due perspective is given to various contractual asymmetries, which seem to be of considerable importance in the process of negotiation, and may have substantial valuation impacts.

Key words: *contractual assets, asset valuation, value-based analysis*
JEL Classification: *D81, G13, M21*

1. Introduction

Value-based methods for assessing tangible investments are a familiar tool for most decision-makers, they form a fundamental part of management education and they are extensively used for key constituents of the strategic management process, such as capital budgeting. The essential principles of the discounted cash-flow model have been public domain for at least one hundred years (Fisher, 1907).

Besides tangible assets, however, the value of a business may be strongly determined by intangibles. These generally constitute various rights and opportunities that can substantially boost, and sometimes

* **Jan VLACHÝ**, PhD, Visiting Lecturer, Czech Technical University, Prague, and City University of Seattle, jan@vlachy.cz.

diminish, the value of a company when compared to the balance of its assets and liabilities, and they may include considerably diverse items, ranging from licences and brands to in-house procedures, specific business skills and market share. Technically, this is one reason why many companies tend to trade at high multiples of their fair book value, either in public markets or through M&A transactions.

Theoretists of the firm have acknowledged this fact a long time ago, and they have undertaken numerous attempts to incorporate intangible factors in their explanations on how firms operate and why they exist in the first place. Pertinent examples include contributions which are essentially based on the value-creation concepts, pioneered by Penrose (1959), such as comparative advantage development and isolation proposed by Hodgeson (1988), protecting rent-generation assets from imitation (Barney, 1991), the key competence assumption (Prahalad and Hamel, 1990), or the concept and taxonomy of a firm's knowledge assets, developed by Kogut and Zander (1992).

In contrast, many researchers have focused on the notion that the nature and behavior of firms is essentially based on contracts and related phenomena, such as transaction costs and property rights (Coase, 1937, 1960). The contract-based model then led to break-through conclusions on the relationships within a firm (Jensen and Meckling, 1976), contract efficiency (Klein and Leffler, 1981), or the impacts of various forms of product integration (Grossman and Hart, 1986).

An integrated approach has also been pursued, albeit very recently, bringing together the knowledge-based and contract theories. Gorgá and Halberstam (2007) have structured the various types of knowledge available in a firm, linking them to particular mechanisms, which let firms assume their effective or legal ownership. This approach facilitates the explanation of various causalities, such as the dependence of a firm's organization on the structure of its knowledge assets, risks related to incomplete protection of knowledge, and knowledge allocation within a firm, linked, among other things, with transaction costs. The authors even consider the relationship between information asymmetry and the agency problem, concluding that it can be mitigated through a proper combination of particular knowledge-assets ownership, and stake-holding structure in a firm (we suggest that such an approach may fairly qualify as natural hedging).

One major limitation to the practical utilization of firm-theoretical models, however, stems from their inherent capability of explaining, rather than quantifying (Taylor and Oinas, 2006). It is thus virtually impossible to use them as a proper management tool when undertaking particular strategic decisions regarding mutually exclusive or rationed capital allocation (even though some commercially successful management heuristics use them for the sake of argument when lacking adequate quantitative credentials).

In view of these developments, it may seem surprising that there has been a considerable lag in the development of financial tools to support management decisions with regard to intangibles. Vlachý (2009) has attempted to define and describe the issue in terms of an integrated firm-theoretical model with direct couplings to existing valuation tools based on finance theory, in particular real options. Since their early implementations in the eighties, they have become instrumental in the analysis and valuation of various intangible assets, ranging from licences to market share. Myers (1984) has been the first one to point out the role of real options as a recourse in the schism between corporate strategy and finance theory, Luehrman (1998) seems to have been the first author to actually denominate corporate strategy as a portfolio of real options.

Options can be perceived as being either opportunities or rights. The first view relates to the category of real options which Kogut and Kulatilaka (2001: 748) define as being: "… the investment in physical assets, human competence, and organizational capabilities that provide the opportunity to respond to future contingent events." Rights, on the other hand, constitute either financial options, i.e. traded securities, or embedded options, i.e. the rights vested in contracts.

Despite existing methodology and relatively widespread usage of real options, not to speak of the success story of financial options over the last thirty years, corporate valuation and business strategy have both largely ignored the value-based aspect of commercial contracts, which Vlachý (2009) categorizes as contractual assets. Consequently, this paper uses rudimentary modelling tools for embedded options to introduce a value-based approach to contract assessment and negotiation.

2. Defining Contractual Assets and their Value Characteristics

Under contractual assets, we understand any value, positive or negative, constituted by means of contracts, obliging a firm, or other parties in that firm's favour. Such contracts may be concluded either

- within the firm (e.g. with its employees), or
- outside the firm (e.g. with its suppliers or customers).

The form of the contracts may be either

- explicit (i.e. formally concluded between the counterparties), or
- implied (arising e.g. from pertaining legislation, industry standards, or custom).

Contractual rights or obligations can thus come into being from highly diverse sources and their analysis has to be based on a comprehensive review.

The value of a contract generally depends on two factors. These include

- the expected value of future settlement, and
- enforcement capability.

One may reasonably assume that rational parties tend not to close deals, which they would perceive as being disadvantageous at the moment of concluding the contract. Numerous contracts would thus be expected to have approximately null value at conclusion, in line with the theoretical equilibrium-valuation principle, commonly applied to financial instruments.

A positive or negative value might then arise over time, due to developments in the fair market value of the underlying asset (for the sake of convenience we shall continue to use this term, originating in financial economics, even though the subjects of commercial contracts may include categories like services, rentals or labour, where this designation may seem inapt). This is in line with both theoretical and empirical findings related to the valuation of forward transactions in financial markets (Hull, 2009).

In such a case, nonnegligible values are likely to be attained especially by contracts featuring long settlement maturities, jointly with high volatility of the underlying asset.

Commercial contracts may also feature various asymmetries, which may have considerable practical implications. In principle, these include

- structural asymmetries, and
- valuation asymmetries.

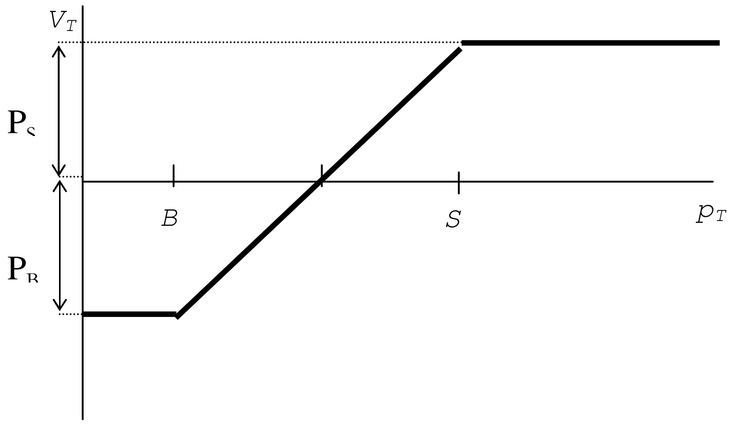
Several characteristical examples therefrom will be investigated in more detail when particular models get derived and introduced.

3. Value of the Right to Cancel Contract and Equilibrium

A typical case of structural asymmetry relates to the right or opportunity (i.e. option) held by the parties to divest of their respective contractual obligations when deemed to be disadvantageous. Such an option can be explicit, written in the contract, usually combined with some kind of penalty. It can also be implied, based on either pertaining legislation (such as the right of consumers to unilaterally change their mind within a statutory period), or lacking capability of the counterparty to enforce settlement.

For the sake of illustration, we shall assume that both parties, buyer and seller, hold a right to cancel contract to trade at the price F^* at the time of settlement T. The buyer may divest of his obligation by paying the seller a fixed amount (i.e. penalty) P_B. Similarly, the seller will be relieved upon paying P_S to the buyer. Contingent upon the fair market value of the underlying asset at the time of settlement p_T, the buyer's value of the contract is shown under Figure 1 (the seller's value would be reversed).

Figure 1. The value of a purchase contract at settlement, assuming mutual cancellation rights



source: Author

In case that $p_T \in <F^* - P_B; F^* + P_S>$, the transaction will take place as expected. If $p_T \neq F^*$, however, one of the parties is due to make a profit and the other party will suffer a loss. In case $p_T > F^* + P_C$, the buyer is expected to curtail his loss by paying the penalty P_B. On the other hand, the seller will mitigate his risk by paying P_S when $p_T < F^*$ $- P_B$.

Using the terminology of financial economics, this payoff structure describes a combination (usually called zero-cost collar), which includes a forward purchase of the underlying asset at the settlement price F^*, writing a call option at the strike price S, and holding a put option at the strike price B. Assuming that no advance fee (i.e. premium) is paid by any party as a condition for signing, which would be highly unusual for commercial contracts, the present, as well as future value of the combined rights has to equal zero, as described by (1) and (2)

$$V_F(F^*) - V_C(S) + V_P(B) = 0 \quad (1)$$

$$F_F(F^*) - F_C(S) + F_P(B) = 0 \quad (2)$$

where

$V_F(F^*)$ … value of a forward contract (no cancel. rights) with settlement price F^*,

$V_C(S)$ … value of a call option with strike price S,

$V_P(B)$ … value of a put option with strike price B,

$F_F(F^*)$ … future value of a forw. contract (no cancel. rights) with settlement price F^*,

$F_C(S)$ … future value of a call option with strike price S,

$F_P(B)$ … future value of a put option with strike price B.

Assessment of the future value of the forward contract is trivial (3), assuming that there exists a fair (equilibrium) market forward value for the underlying asset F.

$$F_F(F^*) = F - F^* \quad (3)$$

The valuation of the options, however, depends on particular stochastic assumptions regarding the future development of the market value of the underlying assets. Under circumstances, one reasonable premise may be based on the geometric Brownian motion, stated as (4)

$$dF\ /\ F = \mu\ dt + \sigma\ dz \qquad (4)$$

where

F … equilibrium forward price (no cancel. rights),

t … time,

μ … expected drift of the equilibrium forward price,

σ… standard deviation (volatility) of the changes of the equilibrium forward price,

z … Wiener (normal random distribution) process.

There are numerous methods for estimating the key parameter of volatility, described in more detail in real-options literature such as Mun (2002), or Copeland and Antikarov (2003). Anyway, for benchmarking purposes only, we may note the typically observed annual volatilities for freely floating foreign exchange of ca 10%, diversified equity and real-estate indices of ca 20%, and various commodities of ca 30% to 40%. Individual stocks and investment projects containing specific risk can feature volatilities within a broad range from 20% to well over 100%, depending on a number of factors, such as industry, region, size, market share, etc.

Based on assumption (3), a closed-form formula for the valuation of the call (5) and put (6) option can be derived based directly on the Black (1976) formula for valuing futures options.

$$F_C(S) = [F\,\mathrm{N}(d_{C1}) - S\,\mathrm{N}(d_{C2})] \qquad (5)$$

$$F_P(B) = [-F\,\mathrm{N}(-d_{P1}) + B\,\mathrm{N}(-d_{P2})] \qquad (6)$$

where

$$d_{C1} = [\ln(F/S)+\sigma^2 T/2]\ /\ (\sigma\sqrt{T}),\ d_{C2} = [\ln(F/S)-\sigma^2 T/2]\ /\ (\sigma\sqrt{T}),$$

$$d_{P1} = [\ln(F/B)+\sigma^2 T/2]\ /\ (\sigma\sqrt{T}),\ d_{P2} = [\ln(F/B)-\sigma^2 T/2]\ /\ (\sigma\sqrt{T}),$$

N(.) … cummulative distribution function of the standard normal distribution.

Substituting from (3), (5), (6) into (2), and making a few simple formal adjustments, leads to the equilibrium condition (7).

$$F\,[\mathrm{N}(d_{P1}) - \mathrm{N}(d_{C1})] + B\,\mathrm{N}(-d_{P2}) + S\,\mathrm{N}(d_{C2})] - F^* = 0 \qquad (7)$$

For practical purposes, it may be useful to define variables $\square_{S}$ (the seller's penalty as a percentage of the contractual price F^*), $\square_{P}$ (the buyer's penalty, similarly defined), and $\square$ (ratio between the contractual price and the equilibrium forward price with no cancellation rights. Their substitution into (7) provides an equivalent equilibrium condition (8).

$$\phi = \frac{\mathrm{N}(d_{p1}) - \mathrm{N}(d_{c1})}{[1-(1+\pi_S)\mathrm{N}(d_{c2}) - (1-\pi_B)\mathrm{N}(-d_{p2})]} \qquad (8)$$

where

$d_{C1} = [-\ln(\phi\,(1+\pi_S) + \sigma^2 T/2] \,/\, (\sigma\sqrt{T})$, $d_{C2} = [-\ln(\phi\,(1+\pi_S) - \sigma^2 T/2] \,/\, (\sigma\sqrt{T})$,

$d_{P1} = [-\ln(\phi\,(1-\pi_B) + \sigma^2 T/2] \,/\, (\sigma\sqrt{T})$, $d_{P2} = [-\ln(\phi\,(1-\pi_B) - \sigma^2 T/2] \,/\, (\sigma\sqrt{T})$,

$\pi_S = P_S \,/\, F^* = \dfrac{S}{F^*} - 1$,

$\pi_B = P_B \,/\, F^* = 1 - \dfrac{B}{F^*}$,

$\phi \;= F^* / F$.

This condition can then be applied either to particular decision-making, or as an economic model serving to improve our understanding of the rational negotiating process.

For example, we may consider an annual contract (T = 1) for the purchase of an underlying asset with an estimated volatility σ = 60%. When negotiating, the buyer requires a cancellation right with a penalty not exceeding 20% of the purchase price (i.e. $\pi_B \leq 20\%$). This can be acceptable to the seller, but only if the selling price gets adjusted in his favour (i.e. ϕ > 100%), or he himself obtains sufficienty favourable cancellation terms (i.e. low π_S).

For any given T and σ, the problem has an infinite number of solutions, representing various equilibrium combinations of $\{\phi, \pi_B, \pi_S\}$. In practice, it is thus necessary to choose two of these parameters, and calculate the remaining one by numerical iteration. Table 1 illustrates the characteristic of their relationship.

Table 1. Equilibrium combinations of ϕ and π_S for T = 1, σ = 60% and π_B = 20% (%)

ϕ	34	50	60	70	75	80	84	90	95	100	105	110	116
π_S	1	4	7	11	14	17	20	26	31	39	50	65	100

source: Author

It is obvious that a higher penalty π_S (i.e. more difficult cancellation by the seller) will lead to a higher price F^*, and vice-versa.

The objective values of cancellation rights are not symmetric for both parties. The table shows that equal penalties of $\pi_B = \pi_S$ = 20% would lead to a fair price well below the market (ϕ = 84%), while at the market price (ϕ = 100%), the seller should pay double the penalty of the buyer (π_B = 20%, π_S = 39%).

The last column can serve as a proxy for the case when the cancellation right is unilateral ($\pi_S \to 100\%$ becomes clearly prohibitive, similarly, there exists a solution for $\pi_S \to 100\%$).

Vlachý and Vlachý (2008) analyze some other characteristics of this model, such as the possibility to optimize in case any of the theoretically acceptable solutions carries a distinct preference, e.g. for marketing, legal or tax reasons.

4. Getting Past the Equilibrium Condition

The previous analysis has assumed an equlibrium, characterized by conditions (1) and (2). This would be fitting for the point of time when the contract is being negotiated, with both parties making equal assessments of rights' value, and freely deciding whether to deal under particular terms or not. In practice, any of these reasons can effectively result in a breach of the equilibrium condition. Market development may change the value of outstanding contracts, there may exist a valuation asymmetry, or implied contracts may commit the firm in a particular manner.

Instead of (8), one must then use a proper valuation formula or procedure, assessing the total value of rights embedded in the contract. To achieve this, a present-value calculation is required, using an appropriate discount rate.

Under the assumption of complete markets (this criterion essentially requires not only trading underlying assets in efficient markets, but also their risks), the discount rate can be derived implicitly using a set of market prices. This is reasonably realistic in developed markets, which trade a range of derivatives. As shown by Hull (2009), with some instruments (stocks) it is then appropriate to use the risk-free rate (resulting in the Black-Scholes model), with others (stock indices, currencies), one takes into account the asset's dividend yield (Merton's generalized Black-Scholes model, Garman-Kohlhagen model). Finally, as described in more detail by Williams and Wright (1991), the convenience yield is of essence for commodities, including e.g. shipping and warehouse capacity (which can apply to commercial contracts as well).

Of course, with most commercial contracts, complete markets would be a highly unrealistic assumption. We shall thus simply express the time value of the pertaining contracts using a generic continuously compounded discount rate *r*. In practice, a qualified estimate will usually suffice, as the results tend to be quite insensitive to this parameter, in particular when compared to volatility.

Equations (9), (10) and (11) can then be applied

$$V_F(F^*) = e^{-rT} F_F(F^*) \quad (9)$$

$$V_C(S) = e^{-rT} F_C(S) \quad (10)$$

$$V_P(B) = e^{-rT} F_P(B) \quad (11)$$

and the total value of the contract V can be assessed using formula (12).

$$V = V_F(F^*) - V_C(S) + V_P(B) \quad (12)$$

Substituting from (3), (5) and (6) into (9), (10) and (11), and thence into (12), the valuation formula (13) ensues.

$$V = e^{-rT}\{F[\mathrm{N}(d_{p1}) - \mathrm{N}(d_{c1})] - F^*[1-(1+\pi_S)\mathrm{N}(d_{c2}) - (1-\pi_B)\mathrm{N}(-d_{p2})]\} \quad (13)$$

where

d_{C1} = [ln(F/(F^*(1+π_S)))+ $\sigma^2 T/2$] / ($\sigma\sqrt{T}$), d_{C2} = [ln(F/(F^*(1+π_S))– $\sigma^2 T/2$] / ($\sigma\sqrt{T}$),

d_{P1} = [ln(F/(F^*(1-π_B)))+ $\sigma^2 T/2$] / ($\sigma\sqrt{T}$),d_{P2} = [ln(F/(F^*(1-π_B)))– $\sigma^2 T/2$] / ($\sigma\sqrt{T}$).

It is also possible to assess the contract when absolute values of the costs P_B and P_S are known, instead of the relative variables π_B and π_S. The valuation formula would then take the form (14).

$$V = e^{-rT}\{F[\mathrm{N}(d_{p1}) - \mathrm{N}(d_{c1})] + F^*[\mathrm{N}(d_{c2}) - \mathrm{N}(d_{p2})] + P_S\mathrm{N}(d_{c2}) - P_B\mathrm{N}(-d_{p2})\} \quad (14)$$

where

$d_{C1} = [\ln(F/(F^*+P_S))+\sigma^2T/2] / (\sigma\sqrt{T})$, $d_{C2} = [\ln(F/(F^*+P_S))-\sigma^2T/2] / (\sigma\sqrt{T})$,

$d_{P1} = [\ln(F/(F^*-P_B))+\sigma^2T/2] / (\sigma\sqrt{T})$, $d_{P2} = [\ln(F/(F^*-P_B))-\sigma^2T/2] / (\sigma\sqrt{T})$.

Using examples, we shall now illustrate several possible approaches to such a valuation, as well as its practical implications.

4.1 Changing Value of Contracts

The basic case relates to a contract, which has been negotiated under equilibrium and, over time, its value has changed.

Imagine a contract, originally one-year, which has been conceived six months ago, when the volatility of the underlying asset has been estimated to be $\sigma = 60\%$, under the terms $\pi_B = 20\%$, $\pi_S = 39\%$ $\phi = 100\%$ and $F^* = \$1$ million (Table 1 indicates that this would have been an equilibrium).

Six months having passed, we now have $T = 0{,}5$, and the market value of the underlying asset with delivery on the contract's settlement date has fallen to $F = \$0{,}9$ million. We have also adjusted our volatility estimate to $\sigma = 50\%$, using the discount rate $r = 5\%$. The terms of the contract remain unchanged.

Using formula (13) with current values, we find that $V = -\$44{,}000$. From the point of view of the buyer, the contract thus has a negative value, corresponding to approximately 4% of the contracted price. Unless there are any valuation asymmetries between the counterparties, the contract has an exactly opposite (i.e. positive) value for the seller.

It may also be interesting to note that the value of the contract, in absolute terms, is substantially lower than the total market price movement, which would be expected to benefit the seller ($F - F^* = -$ \$100,000). This is due to the cancellation rights which mitigate the contract's risk.

It is obvious that the initial equilibrium has no relevance whatsoever for a contract's valuation and the same procedure can thus be used regardless.

4.2 Valuation Asymmetry

A valuation asymmetry relates to the parties' different assumptions concerning the values of pertaining rights. The following example illustrates its potential impact on negotiation.

A contract is being negotiated regarding an underlying asset whose market price F with delivery at time T is publicly unknown. There are also different expectations concerning its risk characteristic σ. While the buyer bases his decisions on ${}^{B}F$ = \$10 million, ${}^{B}\sigma = 40\%$, the seller assumes ${}^{S}F$ = \$11 million, ${}^{S}\sigma = 60\%$. The contract duration should be two years ($T = 2$), both parties are entitled to equal cancellation terms $\pi_B = \pi_S = 20\%$, and are using the same discount rate $r = 5\%$.

At first glance, it might seem that the parties can never close a deal, because the seller values the subject of the contract much more than the buyer does (${}^{S}F > {}^{B}F$). Nevertheless, a brief assessment of their respective negotiating positions using formula (13), with the conditions ${}^{B}V > 0$ and ${}^{S}V < 0$, proves otherwise.

The seller would namely be prepared to deal at any price ${}^{S}F^* >$ \$7.73 million, while the buyer would be comfortable with any ${}^{B}F^* <$ \$8.58million. This offers plenty of scope for negotiation within the range $F^* \in$ (\$7.73 million, \$8.58million).

Generally, valuation asymmetries imply different contract values for counterparties, and they are instrumental for explaining why trading actually takes place (this is not obvious when using the theoretical equilibrium assumption). Namely, asymmetries can lead to either ${}^{B}V > {}^{S}V$ (as in the previous example) when both parties benefit from the transaction, or to ${}^{B}V < {}^{S}V$ when they have to search for another, more suitable, counterparty.

In practice, valuation asymmetries may also be due to different costs of carry and, in particular, convenience yields. This phenomenon can be utilized to explain why trading is not purely a matter of chance, due to "accidental" misvaluations of assets or their risks. As a matter of fact, markets for goods and services tend to be segmented between the sellers (e.g. producers or proprietary owners) of a particular asset, and their users (e.g. industrial purchasers, wholesalers, retailers, consumers). The users can be characterized by generally higher convenience yields (and, in some cases, lower costs of carry) for the asset.

4.3 Transaction Costs

Valuation and negotiation of contracts can also be strongly influenced by the existence of transaction costs, which can be perceived as "friction", constraining the expected reactions by counterparties. This effect will be shown in the last example, which touches on the fundamentals of game theory.

We consider a contract where $T = 1$, the market forward price $F = 1$ million, both parties assume $\sigma = 60\%$ and $r = 5\%$. Total costs borne by the seller on cancelling the contract would amount to $P_S =$ \$800,000. All of these expenses do not constitute a potential income for the buyer, however, as they include transaction costs (such as may relate to adjustments in procedures and logistics, bookings with third parties etc.) The buyer only receives a pre-agreed penalty ${}^{\circ}P_S =$ \$300,000.

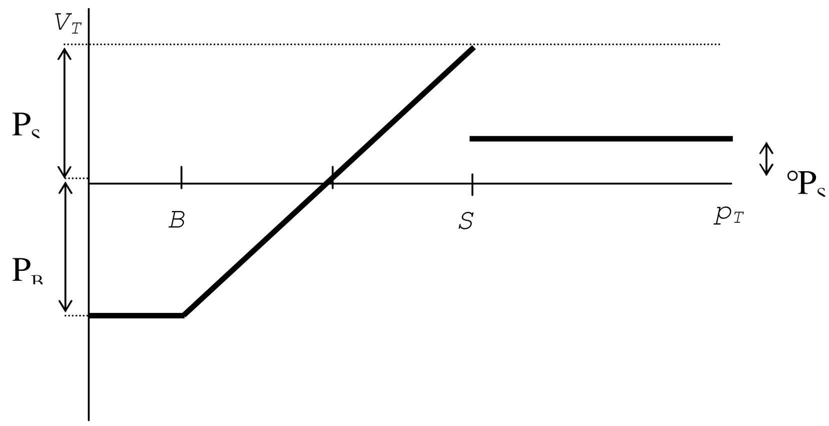
A cancellation penalty P_B = \$200,000 is stipulated for the buyer (who would bear no further transaction costs). The buyer is not aware of the total transaction costs for the seller, he thus assumes $°P_S$ = \$300,000, and using formula (14) would offer a price not exceeding $^{B}F^{*}$ = \$937,000.

On the other hand, the seller takes into account his total transaction costs P_S = \$800,000, and using (14) calculates his minimal required price $^{B}F^{*}$ = \$1.15 million, i.e. substantially higher than the buyer is willing to accept. Once again, here is a case of asymmetry with each party assigning a different value to their rights, and it will be very hard to come to a mutually acceptable agreement.

Let us now assume, however, that the buyer is fully aware of the total transaction costs of the seller P_S. In such a case he is in a position to improve on his offer.

The reasoning supporting this conclusion can be split into two parts. First, it is possible to determine the terms, under which the seller would actually cancel the contract. Getting back to Figure 1, it is possible to estimate the parameter $S = F^{*} + P_S$. There would be a change in the contract's assessment by the buyer, however. Namely, with the seller cancelling contract contingent on $p_t > S$, he does not earn the full amount P_S, but only its part $°P_S$, as illustrated under Figure 2.

Figure 2. The value of a purchase contract at settlement, assuming seller's transaction costs



source: Author

In other words, the buyer must substract from the value of the contract according to (13) or (14) the value of an abstract right, providing an income of $P_S - °P_S$, contingent on $p_t > S$. This is formally stated by (15).

$$V = V_F(F^*) - V_C(S) + V_P(B) - V_{BINC}\,(S;\, P_S - °P_S) \qquad (15)$$

The item $V_{BINC}\,(S;\, P_S - °P_S)$ represents the value of a binary option, derived by Reiner and Rubinstein (1991), which, in this case, can be calculated using formula (16)

$$V_{BINC}\,(S;\, P_S - °P_S) = e^{-rT}\,(P_S - °P_S)\;N(\,d_{C2}) \qquad (16)$$

where

$$d_{C2} = [\ln(F/S) - \sigma^2 T/2]\;/\;(\sigma\sqrt{T}\,).$$

Substituting for S, and eventually also for P_S a $°P_S$, brings formulae (17) or (18), suitable for substitution directly into (15).

$$V_{BINC}\,(S;\, P_S - °P_S) = e^{-rT}\,(P_S - °P_S)\;N(d_{C2}) \qquad (17)$$

$$V_{BINC}\,(S;\, P_S - °P_S) = e^{-rT}\,(\pi_S - °\pi_S)\;F^*\;N(d_{C2}) \qquad (18)$$

where

$$d_{C2} = [\ln(F/(F^{*}+P_S)) - \sigma^2 T/2] / (\sigma\sqrt{T}),$$

or

$$d_{C2} = [\ln(F/(F^{*}(1+\pi_S))) - \sigma^2 T/2] / (\sigma\sqrt{T}).$$

Formula (15) can then be applied by the buyer, again using numerical iteration, to derive the various combinations of terms that he would still deem acceptable (i.e. lead to $V > 0$), or for the valuation of a particular contract.

In the present example he uses P_S = \$800,000 and $°P_S$ = \$300,000, readily concluding that he is in a position to offer a price up to ${}^{B}F^{*}$ = \$1.024 million. This is substantially more than the original ${}^{B}F^{*}$ = \$0.94 million.

Naturally, practical applications may include further valuation asymmetries, both parties may bear transaction costs, etc.

5. Concluding Remarks

The models and their solutions introduced in this paper have been based on relatively straightforward assumptions, and structured in a way that conforms to a simple purchase or sale of an asset. However, an analogous approach can be used in cases when the contract relates to rental, shipping, storage or labour relationships, for example, rather than tangible assets.

Analyses of more complex structures, or problems that do not fit analytically convenient statistical assumptions, such as stochastic processes based on the normal distribution, may be more inclined towards using numerical assessment methods, such as binomial trees or statistical simulations, which are both well-established tools in operations research and options analysis.

Anyway, even rudimentary models with handy closed-form solutions have been shown to be quite powerful, both as a management-support tools for tasks comprising both valuation and negotiation, as well as an economic utility improving our understanding of the dynamic properties of contractual assets and their value drivers.

References

Barney, J.B. (1991), "Firm Resources and Sustained Competitive Advantage", Journal of Management, 17(1): 99-120.

Black, F. (1976), ”The Pricing of Commodity Contracts", Journal of Financial Economics, 3(1/2): 167-179.

Coase, R.H. (1937), ”The Nature of the Firm", Economica, 4(16): 386-405.

Coase, R.H. (1960), ”The Problem of Social Cost", Journal of Law and Economics, 3(1): 1-44.

Copeland, T.and Antikarov, V. (2003), ”Real Options: A Practitioners' Guide", Texere.

Fisher, I. (1907), ”The Rate of Interest: Its Nature, Determination and Relation to Economic Phenomena", Macmillan.

Gorga, É. and Halberstam, M. (2007), ”Knowledge Inputs, Legal Institutions and Firm Structure: Towards a Knowledge Based Theory of the Firm", Northwestern University Law Review, 101(3): 1123-1206.

Grossman, S.J. and Hart, O.D. (1986), ”The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", Journal of Political Economy, 94(6): 691-719.

Hodgson, G. (1988), ” Economics and Institutions: A Manifesto for Modern Institutional Economics", Polity Press.

Hull, J.C. (2009), ”Options, Futures and Other Derivatives”, 7th ed., Prentice Hall.

Jensen, M. and Meckling, W. (1976), ”Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure”, Journal of Financial Economics, 3(4): 305-360.

Klein, B. and Leffler, K.B. (1981), ”The Role of Market Forces in Assuring Contractual Performance”, Journal of Political Economy, 89(4): 615-641.

Kogut, B. and Kulatilaka, N. (2001), ”Capabilities as Real Options”, Organization Science, 12(6): 744-758.

Kogut, B. and Zander, U. (1992), ” Knowledge of the Firm, Combinative Capabilities and the Replication of Technology”, Organization Science, 3(3): 383-397.

Luehrman, T.A. (1998), ”Strategy as a Portfolio of Real Options”, Harvard Business Review, 76(5): 89-99.

Mun, J. (2002), ”Real Options Analysis: Tools and Techniques for Valuing Strategic Investments and Decisions”, Wiley.

Myers, S.C. (1984), ”Finance Theory and Financial Strategy”, Interfaces, 14: 126-137.

Penrose, E.T. (1959), ”The Theory of the Growth of the Firm”, Wiley.

Prahalad, C.K. and Hamel, G. (1990), ”The Core Competence of the Corporation”, Harvard Business Review, 63(3): 79-87.

Reiner, E. and Rubinstein, M. (1991), ”Unscrambling the Binary Code”, Risk, 4(9): 75-83.

Taylor, M. and Oinas, P. (eds.) (2006), ”Understanding the Firm: Spatial and Organizational Dimensions”, Oxford University Press.

Vlachý, J. (2009), ”Corporate Strategy and Financial Theory”, Politická ekonomie, 57(2): 147-162 (in Czech: ”Strategie podniku a finanční teorie”).

Vlachý, J. and Vlachý, J. (2008), ”The Effect of Cancellation Rights on the Value of Contracts”, European Financial and Accounting Journal, 3(2): 51-69.

Williams, J.C. and Wright, B.D. (1991), ”Storage and Commodity Markets”, Cambridge University Press.