14

Options – IV

Real and Other Options

This chapter concludes the treatment of options with a brief discussion of real options and employee stock options.

Real options

Independently of the derivatives markets, life is full of situations involving 'options' in the conventional English language meaning of the term. These situations often do have financial consequences, as shown in Example 14.1.

Example 14.1

A Professor in a university who has a tenured (i.e., permanent) post is contemplating a new offer from a private company that offers her a much higher salary. She is not expecting to return to the University. However, there is always some uncertainty and less security of tenure in the private sector. She can retain a lien on her university post for three years by applying for leave without pay (sabbatical) but this involves paying a pension contribution which will not bring any extra pension benefit. If she is successful in the private sector, the amount she pays will be a waste. However, if she is unsuccessful, she can get back her University post. In this situation, retaining her lien would be the equivalent of buying a call option on the job—the premium is the amount of pension contribution. This is an example of a real option.

More formally and quantitatively, the concept of real options is used in corporate finance and capital budgeting. Stewart Myers coined the term 'real option' in 1977.

Example 14.2

M Ltd. proposes to acquire a copper mine. The mine is already in production and has some reserves, which are profitable to exploit at any price above $3,000. Current prices are approximately $6,000 per ton. Traditional discounted cash flow techniques have been used to arrive at a valuation of the cash flow from the production expected each year. However, there are also some reserves that will be viable to extract only at prices higher than $9,000. The seller is insisting that the price must include a premium to reflect this potential future value. There is no certainty that the price of $9,000 would ever be reached; however if it

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is reached then a substantial additional cash flow will arise. Intuitively, it is obvious that this potential has some value but X Ltd. is not clear how to value this.

This is another example of a real option. In this case, an options-based valuation approach would be to make estimations and calculations about the quantity of viable resources as a function of future price, the expected volatility of the mineral's price and various other factors. The tools used for calculating the price of this real option would be very similar to that for financial options (Black-Scholes, binomial, Monte Carlo etc.) Then, after appropriately discounting for time, the value of this option would be added to a net present value (NPV) calculation. The seller and/or buyer might use this calculation in their price negotiations.

The discounted value of future cash flows is an important consideration when companies and entrepreneurs decide whether to invest in specific projects. The NPV is the sum of the future cash flows generated by the project adjusted for the time value of money (gross present value), minus the investment(s), also adjusted for time value of money. The time value of money is essentially the fact that a rupee received today is worth more than a rupee received in future, because it can earn interest. The appropriate interest rate is the cost of capital to the firm. In some cases, the cost of capital is increased to reflect a risk premium.

Theoretically, there may be no limit to borrowing, and therefore 'rational' investors would never pass over any positive NPV project; but realistically there are limits to taking out loans and hence projects are often ranked by NPV or IRR (internal rate of return) or some simpler measures which do not entertain the pretence of precision. In practice, companies sometimes undertake investments on the basis of criteria other than cash flow or profitability, for various reasons including managerial empire-building, thwarting hostile takeovers or – in the case of breakthrough technologies or highly risky ideas – because future cash flows may be highly speculative or impossible to estimate. However, subject to these caveats, the following discussion of real options assumes that choices are driven by NPV.

Example 14.3

A mining company is considering leasing a gold mine for the next three years, and the mine has four broadly discernible deposits. One deposit has 100,000 ounces and the other three have 50,000 ounces each. Assume that the cost of extraction within each deposit is homogenous.

Cost of extraction	**Estimate of extractable resources**
1,100 USD/ounce	*100,000 ounces*
1,300 USD/ounce	*50,000 ounces more*
1,500 USD/ounce	*50,000 ounces more*
1,700 USD/ounce	*25,000 ounces more*

Currently the price of gold is $1,600 per ounce. Assume there are very low interest rates and storage costs. Because gold is a 'continuous storage' good with large stocks, futures prices are determined by the storage cost rather than expected prices. Therefore, the futures prices of gold in one, two, three years from now are also $1,600 in each case (ignoring storage costs). The following simplifying assumptions are made:

- *There will be no major change in the cost or technology of gold extraction in the next few years.*
- *There are only three possible scenarios for gold prices in the coming three years:*
  - *Scenario 1: Price increases by 10 per cent at the end of every year – 30 per cent probability*
  - *Scenario 2: Price remains constant – 40 per cent probability*
  - *Scenario 3: Price decreases by 10 per cent at the end of every year – 30 per cent probability*

In all three scenarios it is assumed that the price stabilises after year three, and that a discount rate of 10 per cent should be used for all calculations.

(N.B. More detailed and sophisticated calculations could be done through the Monte Carlo and other techniques like Binomial modeling, if these simplifying assumptions were not present.) The expected prices in the different scenarios are as follows:

Price (of gold in USD/ounce)	***Year 1***	***Year 2***	***Year 3***	***Year 4 onwards***
Scenario 1	*1600*	*1760*	*1936*	*2129.6*
Scenario 2	*1600*	*1600*	*1600*	*1600*
Scenario 3	*1600*	*1440*	*1296*	*1166.4*

Scenario 1

- *Scenario 1- Profits in Year 1: Since the price is $1,600, only reserves costing less than $1,600 to extract are worth extracting. Hence profits are: $[100,000 (1,600-1,100)+50,000 (1,600-1300)+50,000 (1,600-1,500)] = $70 million*
- *Scenario 1- Profits in Year 2: Since the price is $1,760, all the reserves are worth extracting. Hence profits are: $[100,000 (1,760-1,100)+50,000 (1,760-1,300)+50,000 (1,760-1,500)+25,000 (1,760-1,700)] = $103.5 million*

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- *Scenario 1- Profits in Year 3: Since the price is $1,760, all the reserves are worth extracting. Hence profits are: $[100,000 (1,936-1,100)+50,000 (1,936-1,300)+50,000 (1,936-1,500)+25,000 (1,936-1,700)] = $143.1 million.*

The future cash flows have to be discounted; since the interest rate is 10 per cent (or 0.1), amounts received in year two will be valued at 1/ (1+ 0.1), those in year three at 1/(1+0.1) (1+0.1) = 1/1.21.

Present value (PV) of profits = (70 + 103.5/1.1 + 143.1/1.21) = $282.35 million

Scenario 2

Since the price is $1,600, only reserves costing less than that to extract are worth extracting. The price remains unchanged for all three years. Hence, profits are:

- *Year 1: $ [100,000 (1,600-1,100)+50,000 (1,600-1,300)+50,000 (1,600-1,500)] = $70 million*
- *Year 2: $[100,000 (1,600-1,100)+50,000 (1,600-1,300) + 50,000 (1,600 - 1,500)] = $70 million*
- *Year 3: $[100,000 (1,600-1,100)+50,000 (1,600-1,300)+50,000 (1,600-1,500)] = $70 million*

PV of profits = (70 + 70/1.1 + 70/1.21) = $191.48 million

Scenario 3

- *Scenario 3- Profits in Year 1: Since the price is $1,600, only reserves costing less than that to extract are worth extracting. $[100,000 (1,600-1,100)+50,000 (1,600-1,300)+50,000 (1,600-1,500)] = $70 million*
- *Scenario 3- Profits in Year 2: Since the price is $1,440, only reserves costing less than that to extract are worth extracting. $100,000 (1,440-1,100)+50,000 (1,440-1,300) = $41 million*
- *Scenario 3- Profits in Year 3: Since the price is $1296, only reserves costing less than that to extract are worth extracting. $100,000 (1,296-1,100) = $19.6 million*

PV of profits = $(70 + 41/1.1 + 19.6/1.21) = $123.47 million
Expected value (without taking the lease expense) = $ (0.3 x 282.35 + 0.4 x 191.48 + 0.3 x 138.02) million= $202.7 million.

However, if the analysis had taken into account only static prices, the lease would not be worth more than $191.5 m, whereas now it is worth 202.7 m, i.e., 11.2 million dollars more. This extra 'premium' is in effect what the mining company is paying for the 'real option' of using the more difficult and expensive to extract deposits the lifetime of the lease of the entire mine. It is the difference in value between a mine which has only deposits which are profitable now and a mine which also has some deposits which are not profitable now, but may possibly become profitable in the future.

Abandonment options

A corollary and mirror image of the real option to expand is the equally real option to abandon. Wherever such flexibility exists, management could apply the economic concept of 'sunk cost', curb operations and minimise variable costs. In the above gold mine and deposits' example, for instance, the investor need not even run the biggest deposit of 100,000 ounces if the price of gold falls below 1,100 USD per ounce (which was not in any of the three scenarios – but could well be in another scenario analysis). The value of this option may become clear if one considers two scenarios confronting a multi-national mining company: a mine in a socialist country where permission to cease operations may be needed and may not be given, versus another country where no permission is needed. Even if both mines have identical deposits and costs, the latter has a better 'abandonment option value'.

Inter-temporal comparison of positive NPV projects using real options

Any NPV project is good for the investor, but in real life borrowing is constrained so the investor has to choose. She must choose not only between projects, but also *across time of initiation and execution* for a given project. Suppose an investor is building a large hotel-cum-mall complex in a city where the next Olympics are likely to take place seven years from now. The investor can buy the land now, but delay the project execution enough to maximise NPV especially if the major portion of 'footfalls' and tourists are likely to come only with the sporting event. The different starting times are 'real options'.

Executive and employee stock options

Companies face a fundamental agent-principal problem – the shareholders (the principals who in theory own the company) want the profits to be maximised, but the managers (in theory, agents of the principals) too want their own 'profits' (i.e., income, remuneration and perhaps non-monetary benefits like prestige) to be maximised. The board of directors is in theory supposed to represent the shareholders and the management are supposed to be accountable to them – but this is almost never fully attained in practice.

For example, a CEO with no equity stake (or insignificant equity stake compared to his base pay and benefits) is likely to have other factors than the company's long term and sustainable profit growth in mind. He may want to focus on revenue growth and sacrifice margins because that may justify a bigger pay to manage a bigger and hence more prestigious, 'empire'. Similarly, he may initiate mergers and acquisitions (especially the latter) without due diligence about the probable synergies in cost-reductions and value-additions.

The result of such managerial behaviour could be that shareholders investments are eroded or do not keep up with better-run companies. This is a variation on the theme of conflict between labour and capital – albeit with the labour here being the rather well off bourgeoisie rather than the hand-to-mouth proletariat.

The question that arises is how to solve this 'principal-agent problem' and align the incentives of managers with those of the shareholders. One way is through performance-related variable, non-guaranteed bonus pay. This is generally useful for mid-level managers and lower-level workers. But, what about the top management? One solution is to make the top management part owners. However, the shareholders may not want to give stock to a CEO and his or her lieutenants at the time of joining: what is to stop them from resigning and just collecting their newfound wealth? Moreover, the stock ought not to be given for bad or even average performance. There ought to be this 'reward' only for good performance by the top management for the shareholders. One theoretically elegant solution which was evolved to combat this principal-agent problem in the corporate world was the concept of stock options.

The company gives senior management, and increasingly workers down the line, some stock options with an appropriate exercise price and an appropriate expiry date. The options can be structured in line with the aims in terms of retention of key staff. If the idea is to incentivise and prioritise length of stay, then the stock call options can have a low exercise price, and hence be in-the-money, but have an exercise date far in the future. To promote loyalty and length of service, the options 'vest' or can be exercised only if, as of the expiry date, the manager is still a bona fide employee of the company. (In practice, many more clauses can and are brought into stock option grants and contracts.)

If the objective is to create incentives for extraordinary growth and super-profits, top executives could be given 'deep out of the money' options which will only become profitable if the share price rises substantially above current levels. If the idea is to incentivise good performance without too much risk taking, then the exercise price can be at-the-money or near the current stock price (generally slightly above). This has the disadvantage of perhaps being too 'easy' compensation for the top management, whereas the advantage of this approach is that (unlike deep OTM options), slightly-out-of-the-money options do not goad the managers to go for an overly aggressive all-or-nothing approach, which could be catastrophic for the owners of the company i.e., shareholders (and possibly even for the senior bondholders).

Other approaches can also be tried – whereby the exercise price or the strike price can be a moving function of the broader market, with or without some adjustments for the beta of the company in question. The board of directors can try to ensure that the management is only compensated for outperforming the stock market over a given period of time rather than be beneficiaries of a broad rally even if the company has significantly under-performed. Other combinations and permutations can also be attempted.

Setting the 'ideal' expiry date and exercise price for stock options is more art than science.

Real life experience has shown that options are not as effective as their proponents thought in aligning the incentives of managers with those of shareholders.

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