

Will Real Options Ever Get the Respect They Deserve?

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Abstract

Finance stands out amongst business disciplines as one where academic theory has had the most impact on industry practice. The most spectacular example is the theory of derivatives, which has spawned an enormous industry in hedging, risk management, speculation, portfolio management, corporate risk management and so forth. Our theories of asymmetric information models and incentives have led to corporate governance design, mergers and acquisitions, incentive compensation policy, etc. Our theories of auction design have led to frequency spectrum auctions that were very profitable for governments and crippled the bidders who were caught in a winner's curse—not all of the stories are good!

We have found anomalies in security returns that have led to special portfolios designed to earn higher performance using them. We have studied the impact of taxation on valuation and asset/liability decision making and it has affected both.

Many of these theories are based on the technique of valuing one asset given the market price of a close or perfect substitute. But, this means that these techniques are only powerful when they aren't needed—they are redundant. Yet, industry loves these models and spends hundreds of millions if not billions annually on salaries and infrastructure in the derivatives and hedging industry alone. How much is spent annually on real options analysis? Perhaps a dozen conferences averaging 100 attendees, paying about \$10,000 per person to attend in travel costs and fees and opportunity cost. That is \$12 million per year. Add in a few books and a few consultants, and we are likely well short of \$100 million per year in global real options spending. This is not the estimate of the cost of acquiring real options, but the estimate of the cost of managing them. Can we really believe that real options are that unimportant to corporations? They spend many times that on financial risk management, which is irrelevant, as a first order approximation. Real options are relevant as a first order approximation.

The questions, then are:

1. Are real options indeed really valuable?
2. If they are valuable, why isn't more done to manage them effectively?
3. If more needs to be done, what is the best way to go about it?

My answer to the first question is “Yes”. I hope that this is the obvious answer to everyone else.

The really interesting questions are the second and third questions.

Impediments to effective management of real options include:

- The smooth pasting condition. Not understanding it, but the lack of discipline that it allows.
- Activity-based compensation systems that encourage management to exercise their real options too early.
- A fear that the models are really too complicated to use safely.
- A presumption that the models are really trivial, and that the firm is “doing it anyway” with a good dose of intuition.

Things that favour of management by real options include:

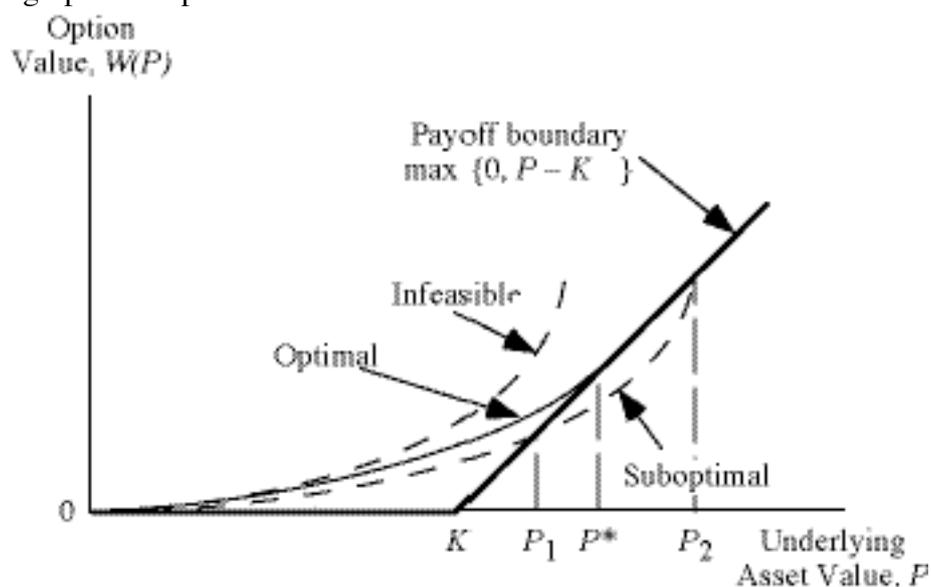
- Real options are inherently socially acceptable. Other financial innovations have had some problems in the press and the eye of the public: leveraged buyouts, executive stock options, tax-based arbitrage, (abuse of) financial derivatives, program-trading inducing market crashes.
- Real options are generally a positive-sum game: they create value as a Pareto improvement, whereas some other financial innovations tend to be zero-sum games (agency models, auction models). The current accounting scandals are examples of incentive/information models getting out of control.
- Real options have hysteresis: they delay adoption and they delay abandonment. This smoothes the usage of scarce resources, particularly human resources. This can make employees want them adopted, as well as social policymakers. Other investment strategies have volatility-inducing positive feedback (e.g. spending free cash flow, which is popular in many industries such as R&D, petroleum and government).

What needs to be done to get more people to adopt real options?

- Solid academic papers and discipline.
- Continuing research on the interaction of incentives and real options.
- More training opportunities for students regarding real options.
- More training opportunities for managers regarding real options: practitioner conferences, and sound consulting practice.
- Emphasis of the socially beneficial aspects of real options.

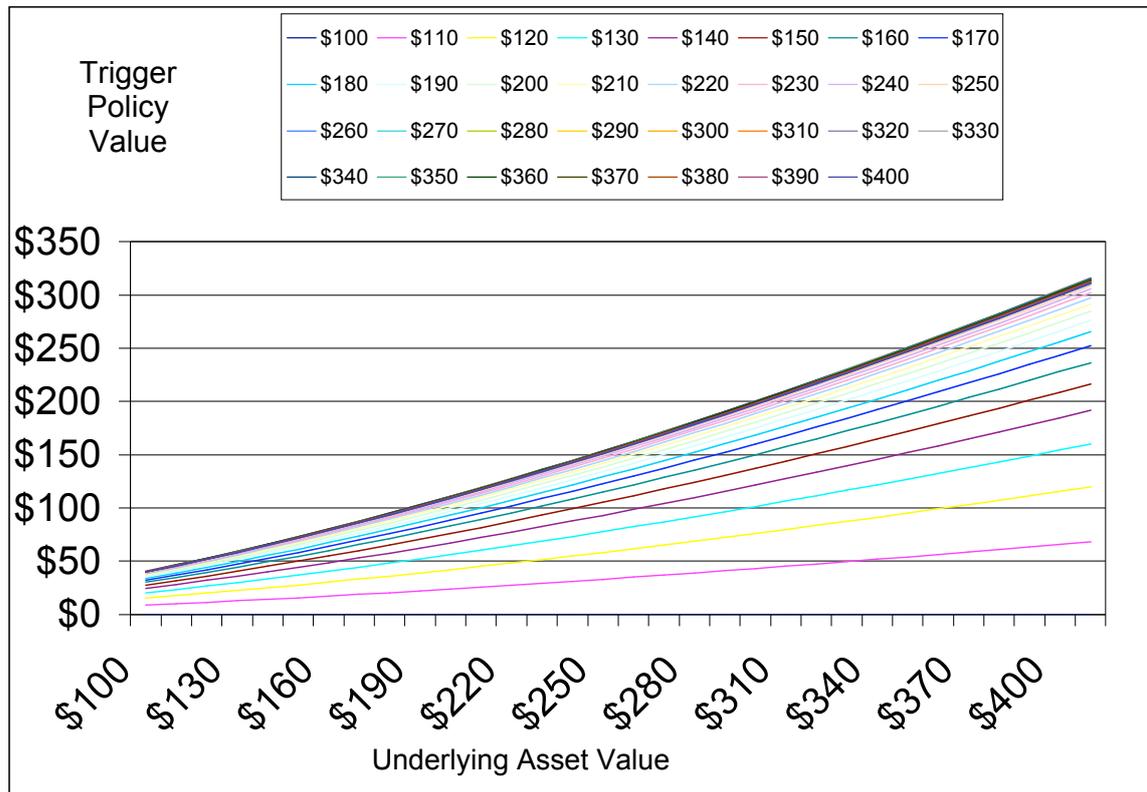
The Smooth Pasting Condition

The smooth pasting condition describes the trigger point of optimal exercise for an american (real) option. It occurs in a graph of option value versus the value of the underlying variable or driver. On this same graph is drawn the payoff to the real option at the time of exercise. At the trigger point, the graph of the option value is touches the payoff function and the two graphs are tangent to each other. This has the familiar graphical exposition that lies below.



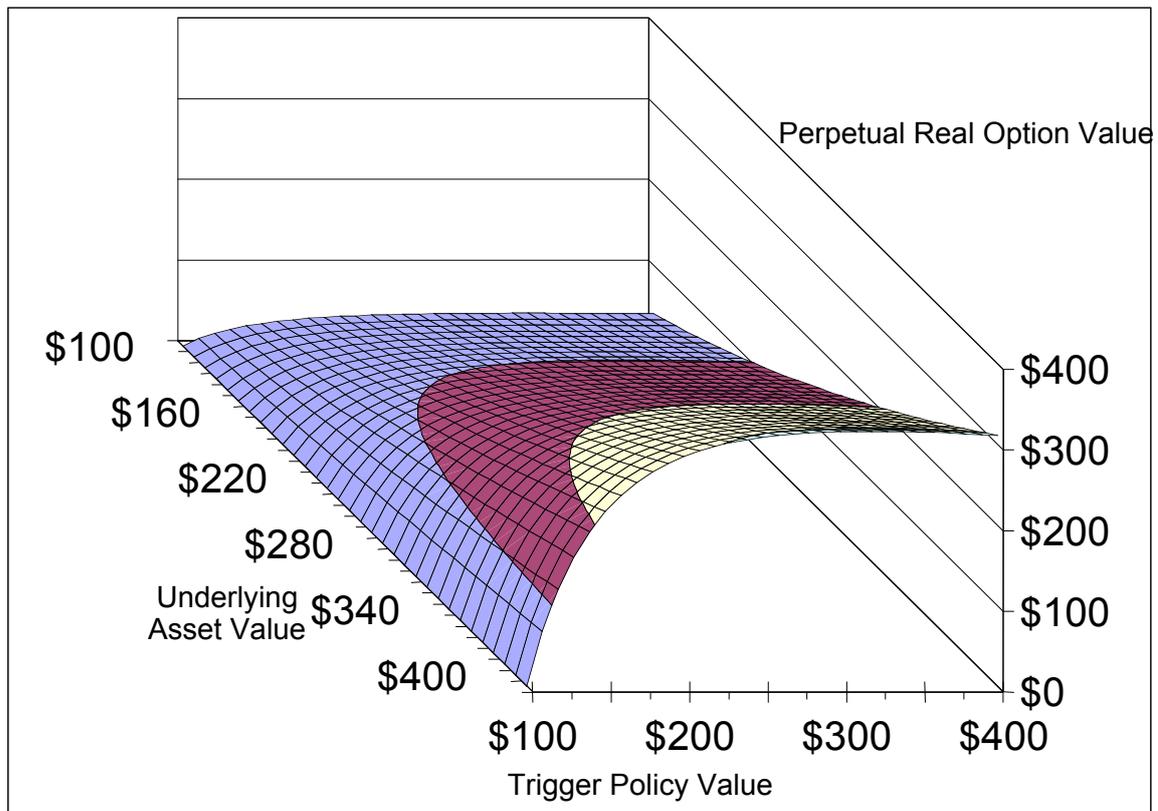
That is fine, since it can be used to help solve for the optimal real option value. The problem arises because one can exercise a real option a little too early (when the underlying is below its trigger value) or a little too late (when the underlying is above its trigger value) and the value of the option is not significantly impaired. Using this for a perpetual real option with a development cost K of \$100, a

volatility for the underlying asset of 30%, a riskless rate of 3% and convenience yield of 3% yields to an optimal trigger value P^* of \$319 for the underlying asset. If the underlying asset is valued below \$319, we should delay and the first time it rises to \$319, we should adopt. Now, what happens if we choose other triggers and adopt early or late? The theoretical graph above shows the option value for three trigger policies, P_1 , P_2 and P^* . Actually calculating the payoff for alternative adoption



strategies leads to very flat value curves that are not too sensitive to the choice of the trigger variable. Below, we consider 31 hurdle trigger values of \$100 to \$400 and a close look at the graph shows that many of them are bunched close to the optimal hurdle at about \$320.

Graphed another way, so that we can see the value function for many different trigger hurdles, we can see the flatness of the real option value to various choices of the hurdle trigger level.



Why is this a problem? Well, there is no sense of urgency to get the exercise point precisely right. The common problem is exercising too early, but little value is lost by exercising too early (unless we exercise near the breakeven point where the DCF NPV is 0). Exercising too late is just like procrastination – the job never gets done without a deadline, and there is little loss in exercising too late, either.

Later, we will discuss the misplaced incentives for exercising too early.

The smooth pasting condition gives us the luxury of robustness of the real option to not acting in the precisely optimal way. But this same robustness allows us to be sloppy in analyzing real options. This allows us to use rules of thumb or other dangerous proxies for real option management that cause us to lose sight of the real problems.

For example, the oil industry is quite aware of real options, but few firms have any tools in place to optimize the value of real options. However, they regularly acquire tools to do “portfolio management” which is a mean-variance analysis technique for selecting projects that is lacking in any theoretical or market-based underpinnings.

Similarly, oil companies regularly employ capital rationing techniques, which resemble real option techniques inasmuch as they force the firm to delay projects beyond the point where the NPV is simply positive. However, they get the details of the process dangerously wrong. Typically, the budget for capital rationing is set to equal the free cash flow of the firm, which is basically income from the prior year, plus depreciation less dividends and required capital expenditures. Thus, if the prior year’s income is high, the capital budget is high and more projects are accepted.

This results in a pro-cyclical investment pattern that lags rather than leads oil prices and the economy. A real options analysis requires forecasting to determine the value of an exercised project and leads the economy. A pro-cyclical spending pattern just leads to a boom and bust economy, which does nobody any good.

Activity-based compensation systems

Incentive compensation must be based on something that can be measured objectively. Ideally, one would like to choose a compensation system that measures an individual's contribution to the value of the firm. This is the basis for value-based incentive compensation systems, such as Stern Stewart's Economic Value Added (EVA). In the right circumstances, these can provide the incentives for managers to maximize the value of the firm. There are other popular measures of performance that don't do so well. In order to be objective, these measures are often based on measurable activity. Thus, managers are often given compensation based on the level of sales (or sales growth), the level of profit, the number of employees they supervise or the dollar value of the assets that they administer.

Since a real option to defer often has little measurable activity associated with it until it is exercised, there is a strong tendency to not give incentive compensation to a manager who maximizes option value by deferring. Incentive-based compensation often induces managers to destroy real option value by exercising too early.

It is instructive to understand the circumstances under which compensating the manager with EVA induces her to maximize firm value. If the manager

- lives forever,
- doesn't leave her job, and
- has the same adjustment or discount for risk as a well-diversified shareholder,

then she will manage and select projects to maximize the present value of the risk-neutral expectation of EVA-based incentive compensation. If her compensation is linear in EVA, this means she maximizes the risk-neutral expectation of the stream of EVA. If her discount for risk is the same as that of a diversified shareholder ("the market"), she has the same risk-neutral expectation operator as does the market. If she lives forever in the same job, she looks at precisely the same stream of cashflows as does the market. Thus, in maximizing the value of the stream of her EVA, she maximizes the market value of the firm, including the value of all its real options.

Knowing this, we can identify the source of the wedge between shareholder value maximization and EVA compensation and perhaps develop EVA adjustments that mitigate these problems. Of course, we could develop whole new compensation systems. The problem becomes a principal-agent problem with an asymmetry between the information (agent) of the manager and the less-informed shareholders (principal). Fortunately, we have some research being done in this area and some of the work is being presented at this conference.

Earnings smoothing can destroy real option value

Firms and shareholders are taking very narrow views of firm performance these days. They focus on sequential earnings growth so that they can compare quarter-to-quarter earnings changes or year-to-year earnings changes. Perhaps the recent accounting scandals will defuse some of this excessively narrow focus by making investors understand the extent to which earnings can be manipulated with various accounting treatments.

However, many managers are still deluded to believe that smooth earnings really is a key component of share value. I recently had a senior manager at an energy company, which had an electric utility division and a petroleum production division, who said that he couldn't really afford to adopt a real options strategy because it would cause him to defer projects sometimes and develop them at other times. The result is that his company's earnings stream would be more volatile and the market would regard his electric utility assets as being less of a source of income than his oil and gas assets. In other words, he thought that the oil and gas division would command a lower P/E multiple than the utility division would. He thought he had to smooth earnings to make the oil and gas side resemble a utility, and hence command a higher multiple. If this can really be true, it is a sorry indictment of the poor quality of accounting information coming out about his firm.

Indeed, as I put the final touches on this talk, I read the *Wall Street Journal* of

July 2 and notice a front-page discussion of questionable accounting practices at WorldCom. One of the alleged practices is to create a “cookie jar” of reserves that firms can add to or subtract from in order to smooth earnings. In WorldCom’s case the cookie jar was filled with reserves for potential bad debts and litigation losses. The firm can reverse these reserve accruals if it has good reason to believe that the reserves are no longer needed. But this is just an opinion and not fact. Perhaps one good thing that will come of this is that investors will become inherently suspicious of activity as reported in accounting numbers and look to deeper understandings of whether the firm is being properly managed. Hopefully, investors will expect a meaningful real options strategy to be spelled out in the Management Discussion and Analysis (MDA) section of their Annual Reports.

Two Wrongs Don’t Make a Right

The oil industry and the governments holding oil resources often follow an unusual investment strategy that creates two wrongs that never balance each other to make a right.

These governments, such as the one of my own Province of Alberta, as well as the US Federal Government, are in a position to control the sale of assets. Alberta sells oil leases with a 7-year term to maturity. Similarly, OPEC countries sell oil. If oil prices fall, an income-smoothing strategy will suggest that the government would sell more oil or auction off more oil leases. If many governments pursue this strategy, falling oil prices will cause overproduction. This drives oil prices even lower, creating a pro-cyclical supply response: oversupply begets more supply. The result is a boom and bust oil economy.

That is one of the wrongs. The other wrong is the increasingly popular worldwide policy of annually balanced budgets. Certainly governments of the 1960s and 1970s lacked fiscal discipline as they pursued a Keynesian policy of injecting deficits into an economy to get it going faster, when the net result was really to get more inflation. The response of the 1990s for governments of all stripes around the world was to focus on balancing budgets. They balanced budgets on an annual basis, not even averaging over a multi-year period. This is just a matter of spending out of free cash flow that poorly managed corporations pursue. It seems that politicians think that their electorates have so little faith in their government’s ability to follow a disciplined investment strategy that they precommit to an irrational investment strategy --- giving up their rights to manage investment properly in order to precommit to not manage investment really poorly. This results in a pro-cyclical investment strategy on the demand side (demand for investment goods): when the economy is booming and cash flows are high, they spend more, creating more of a boom. When times are bad, they cause more contraction of the economy.

A real options strategy of development and abandonment is characterized by a hysteresis effect: firms are less likely to start a project and less likely to abandon a project than a simple NPV analysis would suggest. Thus, there is a smoothing effect in the projects being deployed, which assists in the planning of scarce resources, such as key personnel who are needed to manage or engineer projects. However, this investment smoothing doesn’t necessarily smooth earnings.

I am particularly intrigued by my Province’s policy of leasing oil claims for 7 years, with the proviso that if the company discovers and produces oil within that period, it is allowed to extend the lease. The US Federal Government does the same thing with off-shore leases. When I talk to the oil firms that buy these leases, they point out that there is little real option value in delaying development, since they only have a 7 year horizon for delay. Indeed, firms with perpetual claims (“freehold” property) do have more patience and are much more inclined to delay development. This means that the real options investment decisions are actually being made at the government policy level in the decision of how much oil-prone land they auction off as leases. Socially, the governments should be pursuing a real options strategy to optimize their leasing policy, since they are giving leases that have very little remaining flexibility of delay. Unfortunately, I find scant evidence of any government

efforts to understand real option policy. They do seem to understand that they can use leasing policy as a tool for stimulating the economy, since putting out a lot of land for leases induces a lot of oil development, even if it results in excessively early exercise of real options.

Real options are too complex

Unfortunately, we hear this complaint too often from managers, and they use it as an excuse to ignore real options. Yet these same managers are eager to claim performance bonuses for managing the firm in very subtle and sophisticated ways. I must admit that Enron did have sophisticated management techniques and also did pursue real options strategies. It is unfortunate that the greed of a few senior officers at Enron caused the problems that caused its downfall, which had the effect of destroying the good strategies that were being pursued by junior managers, many of whom I know.

When the treasurer of Orange County, Robert Citron, pursued his duration-lengthening treasury policy to ride the yield curve in the early 1990s, he thought he was very sophisticated in understanding intricate financial dealings. When the whole house of cards collapsed on him, his defense was: "These financial instruments are so complex, I don't think anybody really understands them."

Managers will accept complexity. They are sometimes too accustomed to using claims of excessive complexity as a defense for poor management.

Our job as academics and practitioners is to make the complexities of real options make sense to the policy makers who use the claim of complexity to keep real options out of their house. We must make the complexity of real options make intuitive sense for them.

Real options are too simple

We all like to use rules of thumb. We think of a non-growth stock having a P/E ratio of 10 and a growth stock of having one of 30. If the overall market is over 20, many people get suspicious that it is over-bought.

- Real estate professionals often expect property to sell at 7 times net rental.
- Takeover specialists usually place a 50% to 100% control premium for a firm over current market value.
- When I'm in a hurry, I always tell my students or a client that their cost of capital is 10%. I'm rarely out by more than 100 basis points.

Derivatives traders usually expect the hedge ratio of an at-the-money option to be one-half.

- We sometimes hear of rules of thumb suggesting that real options should be exercised at a profitability index of 2. That is, that the hurdle P^* equals twice the value of K .
- I recently had a meeting with a client that has \$4 billion of real estate assets. I claimed, with some justification, that there was probably at least 25% or \$1 billion of real option value there---our job was to find it and help them maximize the value of it.

These rules of thumb can be helpful in deciding where to exert our energies. We shouldn't spend too much time considering the optionality of a daily versus weekly car rental, but we will spend some time deciding whether to take out a mortgage with a renegotiation period of 1 year, 5 years or 25 years. Rules of thumb help us to get an idea of what is at stake.

But, when we sit down and start analyzing a real option, it is easy to throw up our hands and say that we can't estimate the convenience yield and are not sure of the volatility and can't separate variable costs from fixed costs very well. Then we notice the smooth pasting analysis and realize that getting the analysis wrong doesn't really destroy that much value. Thus, it is too easy to stay with rules of thumb and not sit down and do any careful analysis.

What can we learn from a careful analysis? The first thing we learn is more about the risks that are ahead of us. The next more difficult step is to separate the risks to which we can respond (with flexibility or real options) from those to which we can't respond. Then we have to understand what flexibility we really do have. This allows us to start building a good real options model that will help us to unlock more real options value from our projects.

Been there, done that

Real options synthesizes several existing disciplines:

- Asset pricing models (CAPM, APT)
- Financial derivatives
- Decision theory
- Agency theory

There is a tendency for people from each of those separate disciplines to come to real options models and say "There is nothing new here, we do it better in our discipline." This leads to a certain disrespect from them and a bit of an inferiority complex from the real options practitioners. However, real options theorists put these all together in a package and this is the real value of real options modeling. It is integrated, which means that it isn't always the best at each of these four disciplines, but when considered as a package, it has no peers.

Most importantly, we can't allow badly motivated rules of thumb take root. These include income-smoothing, capital rationing and portfolio management within the context of the firm.

What needs to be done to get more people to adopt real options?

Solid academic papers and discipline.

We need more conferences, papers, papers in top journals and perhaps even real options journals are needed. Does anybody here want to start a real options journal? Sound industrial practice cannot be built in an intellectual vacuum.

Continuing research on the interaction of incentives and real options.

It is clear that the reason why people don't adopt real options is that they aren't paid to adopt real options. It may be written into their job description, but it is very difficult to build real options into compensation systems. We may take some encouragement or some concern when we note that the accounting profession is finally requiring disclosure of a valuation of executive stock options in financial statements. We really need to go a step further and have a more careful analysis of the firm's real option value and find a way of reporting it to the compensation committee and to shareholders.

More training opportunities for students regarding real options.

We don't have many courses on real options in our universities. At the MBA level, my University often cuts the capital budgeting course, even though it is popular, because we lack the teaching staff. We need more professional training activities in real options, such as the one at this conference and we need corporations and governments to be willing to send their people to these courses.

Do we need a formal certification in real options, as a Chartered Financial Analysis or a Chartered Accountant?

More sound consulting and management practice.

We have a few firms consulting in real options, but frankly, nobody is making a fortune at it. Will all those who flew here first class please raise their right hands? How many of us bought a Ferrari or Rolls Royce in the past year? Why not? Real options are more likely to create value for a company than a flashy CEO. What the CEO is really paid to do is to avoid making stupid mistakes that destroy corporate value. When CEOs make mistakes, they are disciplined by being fired.

Perhaps we should be advocating for real options in a similar way. That is, instead of suggesting that optimal real option management creates value, we might want to take the status quo as the firm endowed with optimally managed real options and ask whether the manager is destroying real option value. The market value will be less than this and it results from sub-optimal real options management. If a manager can't live up to the optimum, it is perhaps time to move on. This does sound threatening and intimidating. But, it isn't as intimidating as the practices of firms that fire the bottom 10% of their sales staff every quarter. That is because, there is room at the top level of real options management for many people. The top 50% could all be equally good. It isn't a zero-sum game.

Emphasis of the socially beneficial aspects of real options.

We are in world recession and the common thread of falling stock market valuations is an emerging mistrust of corporate managers. Shareholders doubt that their stock option incentives and golden parachutes were really warranted. They worry that the managers trade on inside information. They think that managers hide losses with secret investment deals or dubious accounting practices.

In earlier times, we have had losses from derivatives scandals, from stock market bubbles in gold mining, dot-coms, telecoms, technology firms.

Corporate hedging strategies are often simply designed to smooth earnings and have little beneficial effect for shareholders.

A unifying thread of these problems is that they occur in a zero-sum game environment. What I get is what I can get from you and vice-versa. This is inherently destructive of corporate and social value.

Real options create value but do not require that value be created at someone else's expense. We must find a way of making this simple fact plainly clear to the world. If we do, our job will be much easier.

Real options also has other socially beneficial characteristics. It's hysteresis effect tends to smooth the deployment of asset demand. This includes human resources and scarce investment resources (plant and equipment). When everybody adopts a real options strategy, we are less likely to have booms and busts that come from destructive pro-cyclical investment policies. We must make corporate

employees aware of this and we must make governments aware of this. If we do, our job will be much easier.

In summary, I don't think that real options get the respect they deserve. I hope that I've got us all thinking of finding ways to make them more commonly adopted in corporations.