

What's wrong with modern capital budgeting?

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Abstract

I argue that the mainstream approach to capital budgeting focuses excessively on the special case where diversifiable risks do not affect the contribution of a project to the value of the firm. This approach ignores the impact of a new project on a firm's total risk and therefore often leads to an inappropriate assessment of the value of the project. I present arguments for why total risk is often costly and discuss how taking total risk into account in capital budgeting is necessary to make capital budgeting and capital structure decisions consistent.

Every MBA knows at the end of her studies how to value a project. She will have been taught that a project increases shareholder wealth if the net present value of that project is positive. To compute that net present value, she has to forecast the cash flows of the project and discount them at a discount rate that reflects the price charged by the capital markets for the risk of the cash flows. In computing the net present value of the project, the MBA student is told repeatedly that the volatility of the project's cash flows in no way affects its value. Comparing two projects that have the same expected cash flows, the project with more volatile cash flows can be more or less valuable than the project with the less volatile cash flows. Furthermore, the student will be told that it does not matter how the cash flows of the project are correlated with the cash flows of the firm because the firm's total risk does not affect its value. As a result of these arguments, the discount rate depends only on the project's risk as measured by the capital markets. Hence, unless there are synergies between the project and the existing investments of the firm, the project's value is the same irrespective of the firm that undertakes it.

The way capital budgeting is taught and practiced presents a huge paradox. Much of the academic research in corporate finance of the last twenty-five years has focused on emphasizing the implications for capital structure and investment decisions of real life impediments to contracting such as the impossibility of writing contracts that specify every contingency and the existence of important information asymmetries between managers and investors that hinder firms' ability to raise funds. Paradoxically, however, if these developments have an impact when it comes to the teaching capital budgeting or when firms implement capital budgeting as their managers were told to do in business schools, it is almost as an afterthought. Modern corporate finance started with the Modigliani-Miller

propositions. But the whole edifice built by modern corporate finance to cope with capital market imperfections that make the Modigliani-Miller propositions not applicable in many real world situations is mostly ignored when it comes to capital budgeting. One could interpret this situation in two different ways. One explanation for how capital budgeting is taught is that when the rubber hits the road, corporate finance theory of the last twenty-five years is not particularly relevant. Another explanation is that we are not doing justice to our students in teaching capital budgeting the way we do and that as a result what we teach is not applied consistently. Not surprisingly, I favor the latter explanation. In this talk, I want to convince you that we should teach and practice capital budgeting in a way that reflects what we have learned in corporate finance over the last twenty-five years and that doing so will create shareholder wealth, will make the teaching of corporate finance less schizophrenic, and will make academic corporate finance research more respected by practitioners.

There are many reasons why the Modigliani-Miller paradigm for capital budgeting is not the right one for the real world. After all, removing any of the perfect markets assumptions that underlie the Modigliani-Miller propositions typically but not always destroys the intellectual foundations for the capital budgeting rules we teach our students. Focusing on why the perfect markets assumptions are not appropriate has not proved very useful in fostering better capital budgeting practices. This is because there are so many ways in which these assumptions can be altered that we end with one capital budgeting rule for each possible change in assumptions, but no rule is sufficiently compelling to justify using it to replace the rules that MBA students are taught. In the 1970s, a large number of papers were written showing the limitations of the Modigliani-Miller capital budgeting paradigm. Perhaps the most devastating of these papers was the one by Eugene Fama showing that the formula for discounting cash flows could not generally be obtained in a multiperiod framework. Yet, these

papers had essentially no impact on practice or on how capital budgeting is taught.

To develop capital budgeting rules that can be applied consistently by practitioners, it is critical to eliminate what without doubt is the Achilles' heel of the perfect markets model of capital budgeting. Consider a corporation that has equity with a market value of \$120m and cash holdings of \$110m. Suppose that this corporation is offered a gamble that takes the following form. By accepting the gamble, the corporation agrees that a coin is flipped immediately. If the coin comes up heads, the corporation receives a check for \$102m. The certified check is already written, so that there is no uncertainty about whether the corporation will receive that amount of cash. If the coin comes up tails, the corporation has to write a check for \$100m, so that most of its cash holdings disappear. Assuming that cash was valued dollar for dollar in the firm's equity, if the coin comes up tails, the value of equity falls to \$20m. Since the gamble takes one second to reveal its payoff, its payoff has to be, in the language of modern finance, unsystematic risk. Hence, its net present value is simply the expected payoff, which here is \$1m. The newly minted MBA student who applies what she was taught in school would come to the conclusion that this gamble is worth taking. I would be amazed if one could find a firm with equity slightly in excess of the positive payoff of such a gamble that would take it, but if no such firm takes that gamble, it means firms do not apply modern capital budgeting as it is usually taught in business schools.

We have clear evidence that firms do not take gambles that have large volatility for small expected gains. One example of such evidence has to do with the pricing of catastrophe reinsurance. Catastrophe reinsurance is insurance provided to insurance companies in case that a natural catastrophe, such as a hurricane or an earthquake, hits their customers and generates large losses for them. Catastrophe reinsurance risks are diversifiable risks, so that bearing these risks should not earn

a risk premium. This means that the price of insurance should be the expected losses discounted at the risk-free rate. Yet, in practice, the pricing of reinsurance does not work this way. Let's look at an example.¹ In the Fall of 1996, Berkshire Hathaway, Warren Buffet's company, sold reinsurance to the California Earthquake Authority. The California Earthquake Authority was selling contracts where the buyer would be responsible for a slice of losses occurring if there was an earthquake. For instance, a buyer could agree to pay the losses in excess of five billion dollars of losses up to six billion dollars of losses. The contract that Warren Buffet agreed to was for a tranche of 1.05 billion dollars insured for four years. The annual premium was 10.75% of the annual limit, or \$113m. The probability that the reinsurance would be triggered was estimated at 1.7% at inception by EQE International, a catastrophe risk modeling firm. Ignoring discounting, the annual premium was therefore 530% of the expected loss. If the standard capital budgeting model had been used to price the reinsurance contract, the premium would have been \$17.85m in the absence of discounting and somewhat less with discounting. Unless one thinks that the California Earthquake Authority deliberately mispriced the reinsurance contracts, the pricing of the reinsurance contract is a clear example that one cannot get corporations to take gambles that modern capital budgeting theory says they should take to maximize shareholder wealth.

The reason why corporations do not enter gambles with volatile payoffs and small positive expected returns is that managers know that generally volatility matters. In the example of a gamble that can lose \$100m, managers know that the firm with equity of \$20m is not the same firm as the one with equity of \$120m. This is because, as the value of the firm falls, the firm becomes unable to

¹ This example comes from Kenneth Froot, The limited financing of catastrophe risk: An overview, in "The Financing of Property Casualty risks", University of Chicago Press, 1997.

take advantage of valuable opportunities that it could take advantage of if it had more equity capital. Finance theory tells us that a firm that gets close to financial distress finds it difficult to enter contracts that require financial commitments on the part of the counterparties. Let's consider four reasons why this is so:

1) First, if a firm's probability of financial distress is not trivial, it becomes difficult to raise equity because of the underinvestment problem discussed by Stuart Myers. If the firm has debt outstanding, when the value of equity is low, funds provided by shareholders benefit mostly the debtholders by making the debt safer. Since the new shareholders expect a fair rate of return on their equity and the debtholders get the benefits from the equity, the old shareholders lose in that they must be the ones who provide the fair return to the new shareholders. As a result, the old shareholders will be reluctant to let the firm raise new equity and the firm will often not be able to fund new projects with equity.

2) Second, Jensen and Meckling emphasized that when the firm's probability of financial distress is not trivial, it becomes profitable for the shareholders to increase the risk of the firm even if it is costly to do so. The reason for this is that when a firm is performing poorly, default makes the shares worthless. By taking large risks, shareholders have a chance to restore value to their equity if the risks work out. If the risks result in large losses, shareholders are not worse off since in that case equity would have had little or no value anyway. Because of the incentives for firms to increase risk close to distress, a firm that is close to distress finds it difficult to raise funds from banks and from the debt markets. Potential investors will assume that the firm will want to raise risk, so that new funds might be prohibitively expensive or might be encumbered by restrictions that rob the firm of the flexibility it needs to take advantage of new opportunities.

3) Third, as the probability of financial distress increases, stakeholders no longer find it worthwhile to invest in their relationship with the firm. For any firm to be successful, there must be individuals and corporations who find it worthwhile to invest in firm-specific capital. Such investment is worthwhile if the firm is healthy and growing, but becomes less so when the firm is distressed and cannot take advantage of its growth opportunities. As a firm becomes closer to distress, workers feel that they are better off working on improving their value to other firms than on increasing their knowledge specialized to the firm. Suppliers will not expand their capacity to deliver products whose use is specific to the firm because they do not know whether the firm will be able to grow and use these products. Customers may be reluctant to buy products from the firm because they cannot be sure that after-sale services and warranties will correspond to what was promised. As a result of these difficulties, firms close to distress have to pay more for some services or have to offer lower prices to customers to offset the impact of their financial fragility.

4) As I showed in my paper on managerial discretion, a firm with a weak financial situation finds it more difficult to raise funds when managers pursue their own objectives and value firm growth. This is because capital markets find it difficult to distinguish between good projects that increase firm value and bad projects that management wants to undertake to increase firm size. As a result of the fact that management pursues its own objectives and has information about projects that the capital markets do not have, firms with large cash flow shortfalls are often unable to finance valuable projects.

It follows from this that a firm with a non-trivial probability of financial distress may not be able to invest in projects that it would find valuable if its probability of distress was zero. This is because it may not be able to raise the funds to invest in such projects or because the costs of such

projects may be too high because of the firm's financial fragility. Increases in total risk make it more likely that a firm will end in a situation where it cannot take advantage of valuable projects and hence such increases are costly to the firm. Capital budgeting techniques developed under the assumption that capital markets are perfect allow no role for the cost of increases in total risk associated with new projects because they assume that contracting is costless and perfect. With such an assumption, the problems that crop up when a firm becomes close to financial distress disappear because the firm can always costlessly recapitalize itself so that it is no longer close to financial distress. In the real world, such costless recapitalization is a dream. As a result, total risk matters and has to be taken into account when a firm evaluates a project.

When total risk matters, the capital budgeting techniques taught to MBAs are simply not correct and have to be changed in a straightforward way.² Each project has a cost that is not taken into account when the techniques taught in business schools are applied, and that cost is the impact of the project on the firm's total risk. To take this cost into account, firms have to quantify their total risk, have to understand the cost of increasing total risk, and have to understand how a new project impacts the total risk of the firm. From our discussion of the costs of total risk, it follows that the appropriate measure of total risk is not the firm's cash flow or equity return volatility. Increasing the risk of the firm when the probability of distress is not affected has no obvious cost to a firm. However, any increase in risk that increases the probability of distress is costly and should be accounted for when evaluating the costs and benefits of a project. Because the risk that is costly is the risk associated with large losses, the appropriate measures of risk are lower-tail measures of risk

² For more details, see chapter 4 in my forthcoming book **Derivatives, Risk Management, and Financial Engineering**, Southwestern College Publishing. This chapter is available at <http://www.cob.ohio-state.edu/fin/faculty/stulz>.

such as Value-at-Risk or Cash-flow-at-Risk rather than measures such as volatility of stock returns or volatility of cash flows.

For a firm that understands its total risk and the costs associated with an increase in total risk, project evaluation consists of using the approach taught in MBA programs with one crucial change: The project's value is decreased by the cost of its impact on the firm's total risk. Consider again the example we started from. With the traditional capital budgeting techniques taught in business schools, the gamble paying \$101m with probability 0.5 and losing \$100m with the same probability, has a value of \$1m for the firm that agrees to it. This project has a considerable lower tail risk since the firm could have four-fifth of its equity wiped out immediately. If the firm measures its lower tail risk and can estimate its cost, it can assess the cost of taking the gamble. One would expect this gamble to have a cost due to its impact on the firm's risk that exceeds \$1m and consequently the firm would not take the gamble. Hence, this simple change in how capital budgeting is undertaken will generally lead to a situation where projects with small positive expected returns and large volatility will not be undertaken. Though currently such projects are ignored by firms, managers ignore them because they feel that it is right to do so rather than because modern finance theory tells them to do so. Having capital budgeting rules that lead to correct decisions in the presence of capital market imperfections would lead to a situation where modern finance theory can be applied consistently in firms and in a way that increases their value.

When total risk matters, firms can increase their value and the value of projects through hedging. This makes risk management inseparable from project selection. Consider a project that has a hedgeable unsystematic risk. By hedging that risk, the value of the project does not change if we apply the capital budgeting rules that are taught in business schools because with these rules total risk

does not matter. However, if total risk is costly, then a project whose unsystematic risk can be partially or totally hedged is more valuable because it has a lower charge for its contribution to the firm's total risk. Hence, it is perfectly possible that an unhedged project is a negative net present value project while the same project hedged has a positive net present value. Further, as long as total risk is costly, hedging increases value by decreasing total risk.

The MBA student will have been taught that financing and investment decisions are separate decisions. In the framework we have developed so far, this is not true. The cost of total risk depends on how a firm is financed. If an all-equity firm makes a large loss, this loss has different implications for the investment policies of the firm than a large loss for a levered firm. This means that a firm must make capital structure decisions so as to manage its total risk optimally. If equity had no costs, there would be no cost of total risk because any firm could always have as much equity as it would need to set the probability of distress equal to zero. Unfortunately, agency costs and information asymmetries make equity costly and hence mean that every company has to trade off costs of total risk versus costs of equity. All firms seem to know that there is such a tradeoff since there are few all-equity firms. Yet, this tradeoff is ignored in capital budgeting models. This clearly makes no sense. If increasing equity to decrease the cost of total risk is costly, then at the margin the cost of total risk has to be the cost of equity so that increasing total risk has a significant cost that has to be taken into account in everything the firm does.

Corporate finance models that hold only when total risk does not matter cannot have any claim to generality. They fail whenever total risk does matter. In contrast, models that allow for a role for total risk work perfectly well when total risk is not important for a particular project for a particular firm. As a result, we should focus on models that allow total risk to affect firm decisions

rather than keep the role of total risk as an afterthought in textbooks and classrooms. It is a peculiarity of finance that we spend so much time on teaching about a world without frictions when everything that makes finance interesting has to do with what happens in the presence of frictions. It is time to reverse the order of things and focus on the real world first.

Telling students simultaneously that they should compute net present values using the Modigliani-Miller capital budgeting paradigm, that they should optimize the firm's capital structure by trading off costs of distress against equity costs, and finally that they should worry about risk management amounts to pure schizophrenia and does not have the slightest intellectual foundation in modern finance theory. Either total risk matters, in which case it has to be managed throughout the corporation and in principle affects all of the firm's decisions, including the choice of projects and the choice of the firm's capital structure or total risk does not matter, in which case we have not learned anything over the last twenty-five years. Since I am unaware of any empirical evidence that shows that total risk does not matter at the firm level but am aware of plenty of empirical evidence that shows it matters, I do not see how we can ignore total risk. Taking into account the impact of a project on the firm's total risk is straightforward. Doing so will insure that our teaching and our recommendations are on solid footing, that they incorporate what we have learned in corporate finance over the last twenty-five years, and that firms maximize their value when they follow the procedures we advocate.