What's (not) wrong with modern capital budgeting

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Abstract

Capital market imperfections cause a relevance of a project's contribution to the firm's total risk, e.g. because of costs of financial distress. Based on this observation Stulz (1999) argues that modern capital budgeting leads to an inappropriate assentment of the value of a project since only systematic risk is considered. I show that a project's contribution to total risk and the resulting indirect effect on the firm's value can and has to be considered without basically changing the established principle of modern capital budgeting.

1. Introduction

In a stimulating paper Stulz (1999) argues that modern capital budgeting ignores the insights of the last 25 years of research in corporate finance. Since the total risk has an influence on the value of the firm if markets are not perfect, a project cannot be valued without taking into account its contribution to total firm risk. Higher risk means higher probability of default, and hence, e.g. underinvestment becomes more likely[1], the agency costs of debt rises[2], stakeholders are more reluctant to make firm specific investments, etc.

Simply calculating the net present value of a project with a discount rate that only reflects the price charged by the market for the systematic risk of its cash flow may therefore be misleading. This procedure does not incorporate the contribution to total risk of the firm and hence the project might be over- or undervalued.

This consideration suggests that the discount rate should depend not only on the project-specific systematic risk priced by the market but also on the projects contribution to total risk. We show that this is not necessary and that modern capital budgeting in its standard form can indeed cope with what we know from the theory of corporate finance under the assumption of imperfect markets. The core of our argument is to think of the costs (or benefits) of changing total risk

[1] See Myers (1977).
[2] See Jensen/Meckling (1976).

as a matter which has to be considered in calculating the additional cash flow to shareholders from investing in a certain project. Then, no modification in the method of valuation, e.g. by introducing a total-risk-factor, is necessary.

To make our point clear we start with a reexamination of the simple example in Stulz (1999). Then, we will look at the problem in a generalized setting and show how to cope with the fact that total risk matters, without inventing a new capital budgeting principle.

2. A simple example

Consider, as in Stulz (1999), a corporation that has equity with market value of \$120 and cash holdings of \$110. This corporation is offered a gamble of the following form: A coin is flipped and if it comes up heads, the corporation receives a check for \$102, if it comes up tails, the corporation has to pay \$100, so that most of its cash holdings disappear. The expected cash flow out of this gamble is \$1. Since the cash flow would realize immediately and has only unsystematic risk there is no need to discount this expected value. The net present value (NPV) of the gamble is one.

But, Stulz suspects that no firm with equity slightly in excess of what the firm could loose in the gamble[3] would take the risk, in spite of the positive NPV. And

[3] Stulz (1999) refeers to the positive payoff, but, actually the focus is on the negativ.

who's to contradict?

The reluctance to accept the gamble can easily be rationalized within standard capital budgeting[4]: If the firm looses in the gamble it has to pay \$100 by assumption out of its cash holdings. Given the initial market value of equity, \$120, the remaining value is \$20. But, only if markets are perfect. If the firm looses its ability to invest in other profitable projects or the cost of (potential) financial distress or the agency costs of debt rise because of the now much lower equity and higher leverage, the value of equity will even be lower than \$20 after loosing at the gamble. Assume that it drops to e.g. \$15. Then, this additional loss in value has to be considered in the calculation of the gamble's incremental cash flow. The payoff of the gamble is therefore a gain of \$102 or a loss of \$105, and hence the expected cash flow is -\$1.5. Now, we can use standard capital budgeting without any modification to reveal that the gamble is disadvantageous for the firm's shareholders.

With any drop in equity value in the bad state of at least \$2, a non-positive NPV for the gamble results if this negative side effect is considered and correctly integrated into the calculation.

[4] Since the NPV of the gamble is positive for any finite risk premium to be used in discounting the expected value ot the cashflow, adusting the discount rate for total risk won't help explaning the suspected reluctance to accept the gamble.

3. Generalization

If a firm invests in an additional project the value of its equity changes because of (i) the projects NPV (if it is non-zero), (ii) a possible wealth transfer from or to debtholders due to increasing or decreasing risk, and because of (iii) an increase or decrease in some agency costs and other costs of financial distress. Let the value of equity before the investment be S_0 and $S_0^{'}$ if the project gets started. Equity will be valued at the market based on expected future value and systematic risk. We can state that[5]

$$S_0 = \frac{E(S_1) - \lambda Cov(S_1, r_M)}{1 + r_f} \tag{3.1}$$

with:

$\lambda = \frac{E(r_{\mathsf{M}}) - r_{\mathsf{f}}}{\sigma^2_{\mathsf{M}}}$	market price of risk
$S_1 =:$	future value of equity (including any dividends), without the project to decide on
$r_M =:$	market return
$r_f =:$	riskfree rate
$\sigma_M^2 =:$	market risk (variance of r_M).

[5] See e.g. Brealey/Myers (2000), p. 249.

If the firm invests, equity value will be $S_0^{'}$, which is

$$S_0^{'} = \frac{E(S_1^{'}) - \lambda Cov(S_1^{'}, r_M)}{1 + r_f}. \tag{3.2}$$

Now, present value of equity is determined by the uncertain future value $S_1^{'}$ which differs form S_0 because of the projects cash flow and its impact on total risk.

Shareholders gain from the investment if it rises equity value, that is, if $S_0^{'} > S_0$. To analyze the gain (or loss) from investing we have to look at the change in future total cash flows to shareholders. In our model, this change is reflected in the difference between S_1 and $S_1^{'}$. Investing in an new project changes future equity value (including dividends at $t = 1$) and hence its present value.

The change from $S_1^{'}$ to S_1 has three sources: The first is the cash flow directly assignable to the project. Its value in $t = 1$ shall be called V_1 from which we have to deduct $(1 + r_f)$ times the investment I necessary to start the project in $t = 0$. The second possible source is a wealth transfer from or to the firm's debtholders if the project increases or decreases their risk. If ΔD stands for the change in debt value, shareholders realize a gain of $-\Delta D$. The third source is a loss or gain in equity value that comes from higher or lower agency costs or other costs of financial distress because of an increase or decrease in total risk of the firm. These costs may be due to an change in the firm's ability to exercise real options, higher incentives for management to invest in risky projects with negative NPV, reluctance of stakeholders to invest in firm specific capital, etc. For simplicity, we call all these costs just agency costs. Let the change in these agency costs after investing be ΔAC.

Hence,

$$S_1^{'} = S_1 + V_1 - (1 + r_f)I - \Delta D - \Delta AC. \tag{3.3}$$

With this expression for $S_1^{'}$, and (3.2), the present value of equity after investing, $S_0^{'}$ can be written as follows

$$\begin{aligned} S_0^{'} &= \tfrac{E(S_1+V_1-(1+r_f)I-\Delta D-\Delta AC)-\lambda Cov(S_1+V_1-(1+r_f)I-\Delta D-\Delta AC, r_M)}{1+r_f} \\ &= \tfrac{E(S_1)-\lambda Cov(S_1,r_M)}{1+r_f} + \tfrac{E(V_1-\Delta D-\Delta AC)-\lambda Cov(V_1-\Delta D-\Delta AC,r_M)}{1+r_f} - I \\ &= S_0 + \tfrac{E(V_1-\Delta D-\Delta AC)-\lambda Cov(V_1-\Delta D-\Delta AC,r_M)}{1+r_f} - I \\ &= S_0 + \tfrac{E(V_1)-\lambda Cov(V_1,r_M)}{1+r_f} - I - \tfrac{E(\Delta D+\Delta AC)-\lambda Cov(\Delta D+\Delta AC,r_M)}{1+r_f} \\ &= S_0 + NPV - \tfrac{E(\Delta D+\Delta AC)-\lambda Cov(\Delta D+\Delta AC,r_M)}{1+r_f}. \end{aligned} \tag{3.4}$$

Hence, the shareholders gain from the investment if

$$S_0^{'} > S_0 \Leftrightarrow \tag{3.5}$$

$$NPV - \frac{E(\Delta D + \Delta AC) - \lambda Cov(\Delta D + \Delta AC, r_M)}{1 + r_f} > 0. \tag{3.6}$$

That is, not only the projects NPV, calculated on a stand alone basis with respect to market risk matters, but also the projects impact on debtholders wealth and the change in agency costs. To decide wether the project rises shareholder value, nothing else but net present value calculation in well known form with reference to market risk is necessary. One has to calculate the projects stand alone NPV, and, furthermore, the NPV of ΔD and ΔAC, the changes in debt value and agency costs. The latter is the cost of the project's impact on the firm's total risk. Substracting it from the stand alone NPV is the necessary crucial change in project valuation as called for by Stulz (1999).

A slightly different, perhaps more appealing approach to look at a project from the perspective of the firm's shareholders is by using the third row of (3.4) instead of the last. From this expression for S_0' we can conclude that the project is advantageous if

$$\frac{E(V_1 - \Delta D - \Delta AC) - \lambda Cov(V_1 - \Delta D - \Delta AC, r_M)}{1 + r_f} - I > 0. \tag{3.7}$$

This is again a simple net present value criterion which is based on discounting not only the projects own cash flows, but also the change in future shareholder value due to the side effects ΔD and ΔAC. This implies nothing else but the obvious fact that the value of a project from the viewpoint of the firm's shareholders depends on their additional cash flows, not on the project's stand alone cash flow.. The later can be smaller in some states or higher in other states than shareholder's additional cash flows.. In states of bankruptcy e.g., the project cash flow accrues (mostly) to debtholders.. If the project's cash flow solves e.g. an underinvestment problem in some state, shareholders wealth rises more than by just the cash flow.. The relevant risk to be considered in the NPV-calculation is again only a systematic covariance-risk. Hence, we can stick to the principle of NVP-calculation that can be found in any text book in finance.

4. Concluding remarks

Modern capital budgeting is based on the principle of NPV-analysis. There is no need to change this if we consider market imperfections that are the core of modern corporate finance.

Market imperfections result in a relevance of a firms total risk. But not the total risk per se is relevant for the value of the firm and its equity. Relevant are the (future) consequences of the risk on (future) decisions determining future cash flows.. Hence, if an investment project changes total risk, the resulting change in the firm's cash flow has to be added to the project's directly assignable cash flows.. Then, no further consideration of the project's effect on total risk in the discount rate is necessary.

Only if market imperfections call for valuation based on individual preference instead of market prices (e.g. because the firm's shares are not tradeable), that is, we can not rely on Fisher-Separation, standard NPV-analysis based on market valuation gets into trouble. But this is a different story.

In practice the implementation of project valuation with respect to shareholders' additional cash flows from investing might be difficult, e.g. because of problems to assess changes in agency costs. If only the cash flows directly assignable to a project can be estimated, the firm might use insights from empirically observing the effects of a change in total risk in calculating the projects impact on shareholder value.

The first step of this approach is to assess the firms total risk and its change if an additional investment takes place. Then, the effect of such a change in total risk on shareholder value has to be anticipated. This can be done based on an empirical analysis of the (relative) change in equity value of firms in the same industry that announce a change in total risk or experience an up- or downgrade in their rating.

Given that information about the pure effect of a change in total risk, the firm can value an investment in an additional project by adding two numbers. First it has to calculate the project's stand alone NPV, that is the NPV of the directly assignable cash flows.. Second, the gain or loss in equity value due to a change in risk, anticipated based on the empirical experience, has to be added.

References

[1] Brealey, Richard A./Myers, Stewart C. (2000): Principles of Corporate Finance, sixth ed.

[2] Jensen/Meckling (1976): Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, Journal of Financial Economics, vol. 3, p. 305-360.

[3] Myers, Stewart C. (1977): Determinants of Corporate Borrowing, in: Journal of Financial Economics, vol. 5 (1977), p. 147-175.

[4] Stulz, René M. (1999): What's wrong with modern capital budgeting, Financial Practice and Education, Fall/Winter 1999, p. 7-11.