

## Mutual Dependence and Firm Decisions

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### ABSTRACT

*This paper explores the implications of the probable dependence between investment and financial decisions for calculating project cost of capital and making investment decisions. Based on this examination, the firm's post-adoption target debt ratio, if it can be identified, should be used to calculate the cost of capital. More importantly, attempting to adjust to the post-adoption debt ratio may result in a change to the value of the assets in place, which is not taken into account by the most widely used capital budgeting techniques.*

JEL Classification:

Key Words: mutual dependence, financing decisions, investment decisions, target debt ratio, net present value, relative net present value, WACC

### INTRODUCTION

Researchers in Managerial Finance hope to be able to determine the variables that differentiate good decisions from bad. The goal of this search is to foster better outcomes for both organizations and society as a whole. The problem in any social science is that the real world is so complex that models must necessarily limit the number of variables considered at any given point in time in order to have any chance of drawing clear conclusions. The basic procedure is to begin with a very simple model that, by assumption, eliminates many of the variables potentially related to a type of decision. The model is then used to make predictions about behaviors or outcomes that can be compared to observations from the real world. How well the predictions match the real world allow us to either have more confidence that the variables in the model are important, or to discard some of these variables from consideration in the future.

Business organizations make investment and financing decisions on a regular basis. Investment decisions involve individual project evaluations and the final selection from these projects with the goal of maximizing firm value. A particular investment project is acceptable based on whether or not the cash inflows are more valuable than the outflows. Managers must decide what types of cash flow are involved in purchasing and utilizing the project and attempt to estimate the current value of those that are incremental. Financing decisions, or capital structure decisions, relate to how the organization interacts with the financial markets to obtain the capital needed to support the asset portfolio in a way that maximizes value. The literature indicates that financing decisions are not as well understood as are investment decisions. Discussions of the influence of taxation, financial distress costs, agency costs, and asymmetrical information, among others, provide insights into what a comprehensive theory of capital structure might involve, but to date, little progress has been made in combining these ideas into a testable theory.

Although no one can specifically determine what the optimal capital structure is, organizations still have to make this decision. Both investment and financing decisions clearly affect the size and predictability of the cash flows generated by the firm. The size and the riskiness of this cash flow jointly determine the value of the organization. Following the scientific process described earlier, the first theoretical developments regarding these decisions assumed that each decision could be made independently of the other. This idea is often referred to as the separation principle. When discussing the project cost of capital, current texts typically assume that the separation principle holds. Discussion of

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investment decisions assumes that the appropriate cost of capital is known and fixed. This implies the financial decision has been made. Likewise, when discussing the financing decision, texts typically assume that the investment decisions have been made. This assumed separation undoubtedly makes it relatively easy to teach investment and financing decisions in the classroom.

In an imperfect, real world market, however, this separation theorem does not apply. When the manager estimates the value now of a potential project's expected cash flows, he needs to determine an appropriate cost of capital to use as the discount rate. The cost of capital relies, in part, on the way the firm raises capital in the financial markets over the life of the project. Thus the information we use to evaluate investment decisions is dependent on the financing decision. Conversely, the capital structure choice is based on what the firm's assets will be. A firm with less predictable assets will be forced to pay relatively more for the money it raises. Thus the financing decision depends on the investment decision. Although briefly mentioned in some texts, such as Copeland and Weston (1988) and Haley and Schall (1979), the dependence of the decisions and the implications are never fully discussed.

The purpose of this paper is to explore the nature and implications of the mutual dependence between investment and financing decisions. We do this by exploring the inconsistencies in the way that calculating a project's cost of capital to make investment decisions is presented. A demonstration of these inconsistencies may be useful to those who investigate decision-making. Those who are trying to improve or develop their own decision-making skills might benefit from the view that we must have information about what we don't know and why before we can fully understand what we think we know. By sharing the results of our consideration of this issue, we hope students and decision makers feel more comfortable in drawing conclusions from an unfinished theoretical and empirical process. The next section of this paper explores the implications of mutual dependence on the calculation of the cost of capital. We then describe a number of investment decision complications.

## MUTUAL DEPENDENCE AND ESTIMATING THE COST OF CAPITAL

If financing and investment decisions are mutually dependent, actually analyzing potential investments can become quite complex. One result of this complexity is a lack of agreement among researchers and teachers concerning the estimation of the weighted average cost of capital (WACC) for a project:

$$WACC = W_D R_D (1-T) + W_S R_S \quad (1)$$

In this equation  $W_D$  is the debt ratio, or the portion of the capital financed with debt;  $W_S$  is the equity ratio, equal to  $1-W_D$ ;  $R_D$  is the cost of debt financing;  $T$  is the tax rate for the firm; and  $R_S$  is the cost of equity financing. The functional difference among the proposed methods for calculating WACC is basically centered on the values of  $W_D$  and  $W_S$  used in this equation. One approach is to use the project's "appropriate debt ratio." This method is used by Keown, Martin, Petty, and Scott (2005), Grinblatt and Titman (2002), and Brealey, Myers, and Allen (2011). However, they do not offer a formal definition of "appropriate debt ratio" for a project. For the purpose of this paper, we define it as the debt ratio that conforms to the project's debt capacity. Other writers identify  $W_D$  as the firm's long-run target debt ratio, such as Ross, Westerfield, and Jaffe (2005), Berk and Demarzo (2011), and Graham, Smart, and Megginson (2010).<sup>1</sup> There is no discussion in the literature as to which approach is the correct one. Although this disagreement about the definition of the weights causes confusion, it is unlikely to be fully resolved until researchers have obtained consistent empirical results about the linkages between the weights and the component costs.

<sup>1</sup> Emery, Finnerty, and Stowe (2004) uses an approach that implies that the debt ratio for a project is the average of the debt ratios of those firms that are similar to the project. Brigham and Ehrhardt (2008) and Gitman (2009) use methods that do not require the determination of  $W_D$ .

### Using the project's debt ratio

If it is appropriate to use the project's debt ratio and if the separation principle holds, one could easily argue that the firm's optimal debt amount would just equal the sum of all the appropriate amounts of debt for each individual project. The WACC for a new project can be determined solely based on the project's risk and debt capacity without consideration of firm wide effects. After obtaining the financing for the project, the firm's debt ratio may not be the same as before, but the firm would still be at the optimal capital structure. Assume that the firm is comprised of  $M$  projects. Let  $V_T$  be the total value of the firm:

$$V_T = \sum_{J=1}^M V_J \quad (2)$$

where  $V_J$  is the value of project  $J$ . Let  $D_J$  be the appropriate debt amount for project  $J$  and  $D_T$  be the optimal debt amount for the firm.

$$D_T = \sum_{J=1}^M D_J \quad (3)$$

Under this scenario, the optimal debt ratio for the firm is  $\frac{D_T}{V_T}$ . Project capital structure is an area not

widely discussed in the literature. Possibly, the amount of debt a project can support would be a function of the predictability and size of the expected cash flows. It might also be affected by whether or not the assets needed for the project trade in a well-developed secondary market and are valuable as collateral.

Thus, if separation exists, investment and financing decisions would be much less complicated than are inferred in much of the scientific study of Finance. Projects could in fact be evaluated separately from financing decisions. The firm's optimal use of debt would not be a mystery. The value additive principle would negate any academic interest in the concept of firm level financial effects on valuation. Since most of the things we think we have learned about capital structure depend on firm level effects, it seems clear that separation does not exist in the real world. Thus, we conclude that the use of the project's

debt ratio is not appropriate. In other words, if the firm's optimal debt ratio is not equal to  $\frac{D_T}{V_T}$ , one cannot use the project's debt ratio as  $W_D$ , because Project  $J$  is actually not financed by  $D_J$ .

### Using the firm's long-term target debt ratio

In an imperfect market, the variables that have been proposed as affecting the choice of capital structure are firm level factors rather than project level. Taxes are assessed and paid at the firm level. Financial distress costs, agency relationships, and informational asymmetries may exist between the firm and the market, but not for separate projects. The interest in these types of variables lead one who reads between the lines to believe most theory and research in finance is based on the concept of mutual dependence.

Another idea that suggests implications for firm level effects on capital structure and supports the notion of mutual dependence is coinsurance. Often discussed in the literature on mergers, coinsurance is the idea that the combined post-merger capital structure may be different than the average capital structure of the pre-merger firms. Empirical results have indicated that post-merger firms have more debt capacity than the combined total for the pre-merger firms. Kim and McConnell (1977) is an example of this line of inquiry. The idea is that the imperfect correlation between the operating cash flows of the combining firms results in increases to the value of premerger debt at the expense of the shareholders. Increasing the use of debt after the merger is seen as possibly canceling this wealth transfer. This logic can be extended to the subject herein. If there is a coinsurance effect among assets in place and potential

projects within the firm, the optimal use of debt for the firm may well be higher than the sum of the individual project debt capacities.

In fact, if any of these firm level considerations exist, the optimal capital structure for the firm could be thought of as the cumulative level of project debt adjusted upwards for tax advantages and coinsurance, and downwards for distress and agency costs. If taxes and coinsurance outweigh agency and distress costs, the optimal level of debt financing would be greater than the sum of the projects', and vice versa. But the net effect of these factors in the long-run clearly would be dependent on both the assets in place plus any of the new projects under consideration that will eventually be adopted.

Textbooks proposing that WACC should be based on the firm's long term target debt ratio do not specify whether this ratio is based on the firm's existing projects alone or on both existing projects plus new ones adopted. The logic herein suggests that it should be the latter. By definition, the optimal capital structure is the one that maximizes the combined value of the firm plus the projects. For the purpose of this paper, we call it the "post-adoption target debt ratio." Without knowing this debt ratio, WACC is not obtainable, and the project's NPV cannot be calculated. Conversely, to determine this debt ratio, one would need to know what projects will be adopted; therefore, the investment and financing decisions are mutually dependent.

### THE EFFECT OF MUTUAL DEPENDENCE ON PROJECT VALUE

It may be that the authors of Finance texts intend to use the post-adoption target debt ratio but simply assume that any new investment will not change the target debt ratio. This assumption may be acceptable if the size of the project is small relative to the existing assets. If this is not the case, further complications may arise. One important consequence is that the change in the capital structure may result in a change to the value of the firm's assets in place due to the change in the discount rate. This new value may be higher or lower than before. It is even possible that a decrease in the value of the assets in place could outweigh the NPV of the new project, resulting in a positive NPV project lowering the total value of the firm. On the other hand, if this value is higher than before, and the increase is enough to offset the negative NPV of the new project, the project should still be accepted, even if it has a negative NPV. Therefore, project evaluation should be based on a measure that can account for the effect upon existing assets, such as the relative net present value (RNPV) presented below:

$$\text{RNPV}_J = V_{\text{POST}} - V_{\text{PRE}} + \text{NPV}_J \quad (4)$$

In this equation,  $V_{\text{POST}}$  is the present value of the cash flows expected to be provided by the existing assets. This value is calculated using a discount rate based on the post-adoption target debt ratio.  $V_{\text{PRE}}$  is such value prior to the adoption; in other words, existing asset cash flow discounted at the rate based on the optimal debt usage for the existing assets alone.  $\text{NPV}_J$  is the value of the new project J, calculated using the post-adoption target debt ratio. The firm should invest in the project if it provides for a positive RNPV, whether or not  $\text{NPV}_J$  is positive. It seems likely that a positive NPV project would be associated with a greater RNPV, but this would depend on the effect the project has on the firm's optimal capital structure. Also notice that if the addition of the new project has no effect on the firm's cost of capital, RNPV would be the same as NPV.

In a world in which dependence exists, RNPV, or some other measure that accounts for the interaction, would need to be used in the place of NPV and other traditional capital budgeting techniques. But even this simple technique is called into question if the change in the capital structure from project acceptance results in the need to discard existing assets. Based on the new post-adoption target debt ratio, each existing asset may have a new WACC and, therefore a new value. It is even possible that the new value is negative. This raises the question of whether or not existing assets should be eliminated because of the addition of new, unrelated assets. Furthermore, it may be that the deletion of existing assets would require the re-estimation of the post-adoption target debt ratio. This could begin an endless cycle of calculation and recalculation.

Mutual dependence also has important implications for a firm considering multiple new investment projects. In effect, equation (4) above could be extended to

$$RNPV_K = V_{POST,K} - V_{PRE} + \sum_{J=1}^L NPV_J \quad (5)$$

Assume a two-project case involving Project A and Project B. Managers would first determine  $V_{PRE}$ . Then they must estimate the post-adoption target debt ratio for each of the K options, respectively: Option A-only, Option B-only and Option A-and-B. The post-adoption target debt ratio is possibly different for each option, resulting in different  $V_{POST}$  and/or NPV. For example, Project A may have a different NPV in each option. The final task would be to select the option that provides the greatest RNPV. For example, assume that Option A-and-B has the highest RNPV; the decision would be to accept projects A and B even if one or both has a negative NPV. For a firm with N projects to consider, a final decision would be made based on  $K=2^N - 1$  RNPVs.<sup>2</sup>

Although one may argue that it is rare to have a new project that significantly affects a firm's target debt ratio and thus its impact on the values of the existing assets may be ignored, we believe that the possibility needs to be examined as a logical result of mutual dependence. Take for example mergers and acquisitions. A merger candidate can be thought of as a project that is large in size relative to the acquiring firm, and its risk can be materially different from the acquiring firm. Based on the logic followed in this paper, to evaluate a merger candidate, the WACC should be based on the target firm's riskiness and the combined firm's post-merger target debt ratio. The effect of this new debt ratio on the acquiring firm's WACC and thus value should be taken into account in making the merger decision. In their merger evaluation model, Emery, Finnerty, and Stowe (2004) use the acquiring firm's target debt ratio to calculate the WACC for the target firm; while Grinblatt and Titman (2002) use the target firm's WACC, which implies the use of the target firm's debt ratio. The literature has not provided an answer as to which way is correct. Our analysis, based on the likely mutual dependence, argues that the WACC to evaluate the target firm should be based on the target firm's risk and the combined firm's post-merger target debt ratio.

## CONCLUSION

The RNPV is just a suggestion of how one might think about decision making if it becomes fully acknowledged that investment and financial decisions are interdependent. The current assumption that investment decisions can be made with traditional techniques such as NPV seems to be based on the simplifying idea that investment can be separated from financial choices. Investigations into the concept of firm capital structure, however, seem to clearly not follow that simplifying idea. All the factors considered in financial structure theory are aggregate firm level effects. This dichotomy of approaches leads to inconsistencies and ambiguities found in the financial literature. If there is dependence, project evaluations should be based on the firm's post-adoption target debt ratio. This debt ratio could be affected by new investment. Subsequent changes in the WACC can affect the value of the firm's existing assets. This valuation effect ought to be considered before new projects are selected.

<sup>2</sup> The impact of a new project on the existing projects discussed so far is not the same as the "incidental effect". The term incidental effect refers to the impact of a new project on the cash flows of existing or other new projects. In this paper, we are referring to the effect of a project on the firm's use of debt and therefore the WACC. Textbooks typically take into account the incidental effect between a new project and the existing projects, and ignore such effect among the new projects simply because when one project is examined at a time, it is impossible to know which other projects will also be accepted. The RNPV method is able to take into account the incidental effect between a new project and existing assets, as well as among the new projects considered in the same option.

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