A Simple Solution to the Unrecognized Bias in NPV

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Draft: November 21, 2016

Abstract

Current best practices for evaluating capital investments follow a mainstream academic instruction still widely taught today: calculate a project's net present value (NPV) by discounting its incremental after-tax operating cash flows at the firm's weighted average cost of capital (WACC). In this paper, we discuss the largely overlooked corporate finance foundational literature that calls current practice into question, and argue that an inherent bias in this commonly used method leads to an overstatement of a project's NPV estimate. We present a simple solution to address the bias.

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EFM Classification Codes: 130, 210, 220

Keywords: Net Present Value; Weighted Average Cost of Capital; Capital budgeting; Capital structure; Cost of capital; Financial distress costs; Financial flexibility

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1. Introduction

When teaching capital budgeting methods in the classroom, finance professors consistently teach that the Net Present Value (NPV) for the firm's typical project is estimated by discounting incremental after-tax operating cash flows by the firm's weighted average cost of capital (WACC). Using the firm's WACC to estimate the required return on potential investment opportunities is recommended by nearly all popular finance textbooks; for examples, see Brealey, Myers, and Allen (2011), Ross, Westerfield, and Jaffe (2013), Brigham and Ehrhardt (2013), and Higgins (2012).[1] Additionally, surveys document that managers most commonly use the firm's estimated WACC to establish the required return on their potential investment opportunities (see Brotherson, et al., 2013; Graham and Harvey, 2002; and Bruner, et al., 1998). However, we will explain that even for projects that satisfy standard assumptions[2], using the firm's WACC as the project's required return likely understates the true cost of capital. We argue that current best practices in estimating the WACC have been simplified in a way that creates an optimistically biased estimate of a project's NPV. This bias could lead management to accept value-destroying projects.

The central contribution of this paper is to report an unrecognized inconsistency in the factors practitioners consider when making capital structure decisions, and the factors they consider when evaluating capital investments. Theoretically, the WACC reflects both the value-enhancing aspects of debt (interest tax savings) and the value-destroying aspects of debt (including

[1] According to Brotherson et al. (2013), these four textbooks are the top-selling MBA level textbooks in corporate finance.

[2] The WACC is generally regarded as the appropriate discount rate under the assumption that a potential investment opportunity has a similar level of systematic risk as the firm, and that the systematic risk and the capital structure are expected to be constant over the life of the investment.

transaction costs, increased financial distress costs, and the costs associated with a decrease in financial flexibility—or, the "non-interest costs of debt"). In practice, when determining the use of debt in a firm's capital structure, financial managers consider the interest tax shields, and appear to at least qualitatively consider the non-interest costs of debt by limiting the amount of debt they are willing to employ in the firm's capital structure. However, when these same practitioners estimate WACC and evaluate capital investments, they tend to quantify the interest tax savings, but omit the non-interest costs associated with debt financing. Due to this striking omission of the non-interest costs of debt by academics and practitioners alike, current curricula and practices for evaluating capital investments inherently produce downwardly-biased estimates of a project's required return (or discount rate), and leads to the aforementioned upward bias in NPV estimates. We offer a simple solution to address this bias.

The remainder of this paper is organized as follows. Section 2 briefly presents the foundational corporate finance literature regarding the determination of the firm's optimal capital structure and the estimate of a firm's WACC. Section 3 explains how the inconsistency between the application of capital structure theory and the application of capital budgeting creates bias. Section 4 proposes a simple solution to eliminate the bias in WACC and NPV estimation. Section 5 concludes.

2. Review of the foundational capital structure and cost of capital literature

Miller and Modigliani's (1958) seminal work demonstrates that if we assume no corporate income taxes and perfect capital markets, then the capital structure decision is irrelevant as it does not alter the firm's WACC or the firm's value. The implication for capital budgeting decisions is

that the financing decision becomes irrelevant to the accept/reject decision and firms should make the capital budgeting decision separate from the "irrelevant" financing decision. Miller and Modigliani (1963) allow for the existence of corporate income tax and suggest that to minimize the firm's WACC and to maximize the value of the firm, the optimal debt to asset ratio is 99%.[3] Given that we do not observe firms so highly leveraged, however, they conclude that there must be a cost associated with debt financing not captured by the model, and propose a "need for preserving financial flexibility" as a likely candidate.

Robichek and Myers (1966) introduce the notion that, since debt financing may affect the firm's future investment decision when management is concerned with their ability to pay interest expense (costs of financial distress) or if the financial markets are unwilling to provide additional debt financing (costs of decreased financial flexibility), there are value-destroying aspects of debt financing offsetting the value-enhancing tax savings. Furthermore, they suggest that an optimal capital structure exists where the marginal benefits equals the marginal costs of debt financing, often referred to as the static tradeoff theory.

Myers (1974) presents the Adjusted Net Present Value (APV) model, that is consistent with the static tradeoff theory, suggesting the value created by the project equals the base case NPV (NPV for an all-equity financed investment), plus adjustments for the valuation effects of debt. The valuation effects of debt consist of adding the present value of the interest tax savings and subtracting the non-interest costs of debt (in general, these include financial distress costs, lost flexibility, transaction costs, etc.). The Myers (1974) APV model usefully separates sources of value into components, principally the value created or destroyed by the investment, and the value

[3] Miller (1977) also shows that the tax savings from interest expense at the corporate level are somewhat offset by the personal tax disadvantage of debt and, therefore, it is likely that 99% leverage is not optimal.

created or destroyed by the financing of that investment with debt—including both the benefits and non-interest costs.[4] Emphasizing the importance of these costs, Myers (1984) also presents a modified version of the pecking order theory, and posits that "firms have two main reasons to restrain themselves from issuing debt: 1) to avoid the costs of financial distress and 2) to maintain financial slack."

Haley and Schall (1978) present a model to estimate the firm's WACC that is consistent with the static tradeoff theory and the APV model because it includes both the benefits and non-interest costs of debt financing:

$$WACC = W_d * K_d * (1-\gamma) + W_e * K_e \quad (1)$$

where: W_d (W_e) is the weight of debt (equity), defined as the market value of debt (equity) divided by the market value of the firm;

K_d (K_e) is the cost of debt (cost of equity); and

γ includes the interest tax savings and the non-interest costs of debt (such as financial distress, lost flexibility, and/or transaction costs).

Thus, in their WACC equation, the $(1-\gamma)$ term adjusts the cost of debt (K_d) for both the benefits and the non-interest costs of debt. Haley and Schall (1978) posit that if debt financing involves no costs other than interest expense, then $\gamma = t$, and we arrive at the commonly taught and widely applied equation to estimate the firm's WACC:

$$WACC = W_d * K_d * (1-t) + W_e * K_e \quad (2)$$

where: t equals the firm's marginal tax rate, and therefore, $(1-t)$ adjusts for the tax-deductibility of interest expense.

[4] However, according to Graham and Harvey (2002), only 11% of firms surveyed reported that they use the APV model "always" or "almost always" when analyzing potential investment opportunities.

The concluding paragraph of Appendix A in Haley and Schall (1978) is critical of the assumption that the non-interest costs of debt financing (labeled "*F*") are zero; in the absence of this condition, they argue that their equation A.9 (equivalent to equation (2), above) is not a valid required return for future investment opportunities. They state,

> "*We see here the critical nature of the assumption that* F *= 0. In the absence of this condition, equation A.9 is not a valid 'cost of capital' for use in capital structure decisions, nor, is it a valid criterion for investment decisions. This is true regardless of whether capital markets are perfect or imperfect, since* F *includes real costs imposed on the firm due to financial distress or debt transactions.*"

The foundational capital structure literature establishes that financial managers should consider both the value-enhancing aspects of debt financing (interest tax savings) and the value-destroying aspects of debt financing (non-interest costs) when determining the firm's target debt-to-asset ratio. Thus, the implication from the capital structure literature is that corporate financial analysts evaluating capital investments should adjust either the project's NPV (Myers, 1974) or the project's required return (Haley and Schall, 1978) for both the marginal benefits and costs of financing a project with debt.[5]

3. An unrecognized inconsistency in corporate finance, and the resulting bias

The purpose of this paper is to inform practitioners who are involved in evaluating capital investments that the common practice of estimating a project's NPV by discounting the after-tax

[5] In the models of Myers (1974) and Haley and Schall (1978), it is clear that the cost of debt (K_d) and the cost of equity (K_e) do not include the non-interest costs of debt.

operating cash flows by the firm's WACC creates an optimistically biased NPV—and, that there is a simple solution to the problem. This bias is created because common practices used to evaluate capital investments are not consistent with both the theory and practice of capital structure decisions. The survey evidence presented later in this section suggests that while analysts do in fact consider both the benefits and non-interest costs of debt in capital structure decisions, when these same decision-makers evaluate capital investments, they tend to consider the interest tax savings[6] but ignore the non-interest costs associated with financing a project with debt. After describing the most significant non-interest costs (financial distress costs and decreased financial flexibility), we review the academic models developed to estimate these costs, provide survey evidence concerning the use of these models, and then discuss potential reasons these costs are typically not considered by practitioners when evaluating capital investments.

Financial distress costs generally refer to instances when debt financing affects the firm's future investment decisions because management is concerned about the firm's ability to pay interest expense; and, in more advanced stages of distress, when the firm incurs costs associated with deteriorating stakeholder relationships, renegotiating debt contracts, or even bankruptcy.[7] To estimate the expected increase in the costs of financial distress associated with a new investment, an analyst must consider both the change in probability of the firm entering financial distress in

[6] Estimates of interest tax savings should be regarded as maximum benefits. Due to uncertain future cash flows, and the presence of non-debt tax shields, it is possible the firm will fail to fully realize the tax benefit as scheduled. Moreover, corporate tax benefits are often calculated using tax rates associated with financial statements in the firm's annual reports, not the marginal tax rates that are reflected in the firm's IRS financial statements—which often have a much lower applied tax rate. Graham and Mills (2008) state "As is well known, financial statement data can vary greatly from tax return data" and show that for their sample of US firms, the average effective marginal tax rate is 5% lower than the statutory tax rate. Lastly, as argued by Miller (1977) – but not incorporated in the WACC method – the personal tax disadvantage of debt erodes the corporate tax advantage

[7] Distress costs can be significant. For example, in a study of highly leveraged transactions, Andrade and Kaplan (1998) estimate the probability-weighted loss in present value attributable to financial distress is 10-23% of pre-distress firm value; Passov (2003) estimates that the actual loss upon entering distress is up to 80% for firms with high levels of intangible assets, e.g., for biotech and software firms.

the future and the incremental loss in firm value if distress occurs, both conditional on the firm accepting this new investment opportunity. Regarding the incremental loss in firm value upon distress, a significant portion occurs because a distressed firm might forgo value-enhancing projects in the future; however, without knowledge today what those projects might be, it is difficult to estimate the value of forgoing them.

The standard approach offered by academics (e.g., Altman, 1984) to estimate the cost of financial distress is to use historical default rates (corresponding to the firm's credit ratings) to estimate the probability of financial distress, multiplied by an estimate of the distress costs when they occur; the product is then discounted at a risk-free rate. Almeida and Philippon (2007, 2008) note that estimating the costs of financial distress has proved elusive in practice, and that for these costs, it is difficult to derive the "correct" discount rate that reflects their true risk and uncertainty. The authors circumvent this problem by adjusting not the discount rate, but instead the probability that distress actually occurs. Ultimately, their model uses risk-adjusted default probabilities derived from corporate bond spreads to approximate the probability of distress, and thus impounds a systematic default risk premium in present-value estimates of financial distress costs. Almeida and Philippon (2008) concludes that "since standard valuations of bankruptcy costs ignore these economy-wide risks, corporate managers who follow this practice will underestimate the actual expected costs of debt and may end up with excessive leverage in their capital structure."[8] The state-of-the-art models in Almeida and Philippon (2007, 2008) are relatively complex to apply,

[8] Even these efforts incompletely capture financial distress costs. The model assumes that default states and distress states are the same, and therefore the estimates will likely understate the present value of distress costs. In reality, firms incur many types of distress costs well before default; e.g., foregone opportunities, managerial distraction, degrading supplier relationships, loss of customers, and loss of key employees, to name a few.

and neither these models nor the more simplified, traditional approach in Altman (1984) are consistently covered by corporate finance textbooks.

Financial flexibility can be understood as a firm's ability to respond quickly and in a value-maximizing manner to unexpected changes in the firm's cash flows or investment opportunity set.[9] Suppose that due to a firm's elevated leverage or a decrease in operating cash inflows, financial markets might be unwilling to provide additional debt financing for promising future projects. The costs associated with a decrease in financial flexibility in this case amount to the potentially lost NPV of the future projects; however, to estimate these costs the manager would need to possess unrealistic foresight concerning both the likelihood of the external capital constraint occurring, and the value lost by foregone future projects that have not yet been identified.

The academic literature has only recently proposed models for estimating the value of flexibility, or conversely, the costs associated with lost financial flexibility. Gamba and Triantis (2008) develop a complex model that endogenizes investment, payout, and financing policies, and ultimately show that the value of financial flexibility depends on myriad factors, such as the firm's taxes, growth opportunities, profitability, and reversibility of capital. The model implies that firms with high levels of financial flexibility should be valued at a premium relative to less flexible firms, and that this premium varies with firm characteristics. However, the authors acknowledge that the model is limited in its ability to accurately match empirical findings related to corporate financial policy. Marchica and Mura (2010) document that maintaining financial flexibility can lead to greater and more effective investment. However, while the authors characterize their results as a "crucial missing link in capital structure theory," the paper stops short of a valuation methodology

[9] See Denis (2011) for a recent overview of the financial flexibility literature.

for flexibility. Rapp, Schmid, and Urban (2014) maintain that financial flexibility has largely been ignored in the empirical literature to date, and speculate that a potential reason for this "may be that the value of financial flexibility is not directly observable." In a multi-step approach, Rapp, Schmid, and Urban (2014) break new ground by building on the five-factor theoretical model of Gamba and Triantis (2008) to measure the value that shareholders assign to financial flexibility, and show that their measure of financial flexibility correlates with corporate financial policy decisions such as payout policy, capital structure, and cash holdings.

Finally, one academic paper has endeavored to capture costs associated with both financial distress and lost flexibility. A comprehensive model proposed by van Binsbergen, Graham, and Yang (2011) seeks to estimate the "all-in" costs of debt, including expected losses due to financial distress, lost flexibility, and agency costs between managers and creditors. The authors develop a relatively complex cost of debt function that can be applied to their data on thousands of public companies. They derive firm-specific estimates for the non-interest costs of debt given characteristics such as a firm's size, profitability, growth opportunities, and the tangibility of its assets. Their estimates imply that the non-default costs are roughly equal in magnitude to the financial distress costs, underlining the need to incorporate the costs due to lost flexibility. These estimates are at the firm level, and there is no clear prescription for applying the framework at the project level.

The models and results discussed above suggest that the finance literature has, to a modest degree, offered tools for practitioners to estimate the non-interest costs of debt financing. Although these non-interest costs are difficult to quantify, financial managers do consider these costs, even if only qualitatively, when deciding whether to issue debt. The most direct evidence that financial managers consider these non-interest costs when making capital structure decisions

is provided by the most commonly cited survey article by Graham and Harvey (2002) entitled "How Do CFOs Make Capital Budgeting and Capital Structure Decisions?". The CFO survey results suggest that financial flexibility is the number one factor that affects the decision to issue debt. After flexibility, CFOs ranked the firm's credit rating, earnings and cash flow volatility, interest tax savings, and bankruptcy/distress costs as other key factors concerning this decision. Similar results concerning capital structure are also reflected in surveys of European managers; for examples, see Bancel and Mittoo (2004) and Brounen, De Jong, and Koedijk (2004).

Kisgen (2006, 2009) provides empirical evidence that credit ratings are of paramount concern for financial managers making capital structure decisions. The evidence in these studies implies that the common objective of many firms is to maintain a strong credit rating (e.g., an "A" rating from Standard & Poor's), and that firms are reluctant to issue debt in the face of potential credit-rating changes. Such a policy will tend to curtail the use of debt, and in turn suggests that financial managers do in fact consider the non-interest costs associated with debt when determining their target debt-to-asset ratio. Finally, anecdotal evidence from area businesses supports this idea. The VP and Treasurer of a large, multi-national enterprise (headquartered near the authors' universities) opines that the optimal debt-to-asset ratio is not necessarily at the point that minimizes the firm's WACC, but rather at a lower leverage ratio when qualitatively considering the cost of lost financial flexibility; this cost is implicitly ignored in the WACC calculation.[10]

Taken together, the evidence strongly supports the notion that financial managers typically consider both the costs of financial distress and decreased financial flexibility when

[10] The Treasurer's comments are taken from a May 25, 2016 presentation to an accounting class at the Albers School of Business and Economics, and reiterated during a follow-up personal meeting on July 26, 2016 at the firm's headquarters.

making capital structure decisions; however, these same financial managers do not include these non-interest costs when they evaluate capital investments. The aforementioned Graham and Harvey (2002) study provides indirect evidence that financial managers do not consider the non-interest costs when evaluating capital investments. In the list of topics asked of CFOs regarding their methods applied to capital budgeting decisions, there is not a single question that relates to the cost of financial distress or financial flexibility. It is also clear that these CFOs employ a WACC that includes the interest tax savings associated with debt financing. Related survey evidence is gathered by Brotherson et al. (2013), who report on the practices of corporations and financial advisors when estimating the WACC ("Best Practices" in Estimating the Cost of Capital: An Update, Brotherson, Eades, Harris and Higgins, 2013). Their results clearly demonstrate that both corporate financial managers and financial advisors consider the interest tax savings from issuing debt, but again the survey does not ask whether these professionals even consider the non-interest costs of issuing debt in the WACC estimate. Finally, Brotherson, Eades, Harris and Higgins (2014) report on their interviews with eleven well-known investment bankers in an article entitled "Company Valuation in Mergers and Acquisitions: How is Discounted Cash Flow Applied by Leading Practitioners?". They report that 100% of these investment bankers use the WACC to discount future cash flows, but there is no mention of adjusting the WACC for the non-interest costs of debt financing. In conclusion, it appears that financial managers consider the non-interest costs for debt issuance decisions, but do not consider these costs when evaluating capital investments. We propose and discuss several possible reasons why this is so.

First, it is possible non-interest costs are ignored because there is a belief that financing a capital investment at the firm's targeted debt-to-asset ratio does not incrementally increase the

non-interest costs of debt financing and, therefore, there is no reason to consider these costs in the analysis. However, this is incorrect. There are relevant, incremental costs for additional debt financing, even holding capital structure proportions constant; although investing in a project might not increase the probability of distress in this situation, the project nevertheless increases the scale of the firm, and therefore will increase the amount of value destroyed should distress occur.

Second, there may be a presumption that the non-interest costs are somehow included in the estimated required returns on debt and equity when estimating the firm's WACC. However, as detailed in Section 2, the foundational capital structure literature makes plain that these non-interest costs are not included in the costs of debt and equity in WACC estimation.

Finally, and in our opinion, the most likely reason these non-interest costs are ignored derives from the complexity of the available models, and the difficult-to-justify assumptions required in these models; this in turn leads practitioners to infer that these models are not practical or useful. Our conversations with practitioners also suggest that the models are not well understood, and importantly, also difficult to communicate to internal stakeholders.[11] As reflected in the comments and quotes below, even though the foundational literature stresses the need to incorporate non-interest costs in financing and investment decisions, academics continue to struggle with models for estimating these costs, and practitioners have understandably shown reluctance to pick up and apply the proposed models.

[11] In a recent conversation, the aforementioned VP and Treasurer of a large, multi-national enterprise suggested that these models are not easy to explain to non-finance decision-makers, thus rendering them less practical and less desirable.

"Interestingly, few firms adjust either discount rates or cash flows for book-to market, *distress*, or momentum risks…" – Graham and Harvey, 2001.

"Because financial distress costs cannot be expressed in a precise way, no formula has yet been developed to determine a firm's debt level [debt capacity] exactly" – Ross et al., 2005, p. 444.

"…little is known about financial flexibility"; and, "since there is no well-defined measure of flexibility in the literature, this is an unobservable factor that depends largely on managers' assessment of future growth opportunities." – Marchica and Mura, 2010

The above Marchica and Mura (2010) quote nicely summarizes the difficult and nebulous nature of valuing flexibility. And, while papers like Gamba and Triantis (2008) and Rapp, Schmid, and Urban (2014) provide useful frameworks for understanding the value of flexibility in approximate terms, such complex models are not easily integrated in the firm's capital budgeting processes.

We conclude that while the non-interest costs of debt are qualitatively considered by the CFO when determining the firm's target capital structure, the principals evaluating individual capital investments understandably tend to ignore these non-interest costs in their WACC and NPV estimates. Therefore, as currently estimated and applied, the WACC will understate the true required return for a firm's average-risk project and thus can lead to the overstatement of NPV and ultimately the acceptance of value-destroying projects.

4. A simple solution: a "base case" WACC estimate for an unbiased NPV

Our recommended approach for evaluating capital investments: ignore the valuation effects of the debt used to finance the investment, and focus solely on whether or not an investment opportunity increases value for the firm. For most capital investments, analysts should separate the investment decision from the financing decision. This simplified approach is significantly better than what is commonly taught and practiced because it eliminates the bias introduced when estimating a project's key performance measure: NPV. If the procedures used to estimate a project's NPV do not include the value-destroying aspects of using debt to finance the project, then these procedures should not include the value-enhancing aspect, namely the interest tax savings.

To apply our recommended approach, the analyst simply excludes the tax benefits of debt financing by eliminating the (1-*t*) factor in the WACC calculation:

$$\text{Investment's required return} = K_a = \text{"base case" WACC} = W_d * K_d + W_e * K_e \qquad (3)$$

We label this approach the "base case" in the sense that it derives a discount rate devoid of adjustments for the potential valuation effects of debt. This discount rate should be interpreted as the required return on the firm's investment opportunities that have similar systematic risk as the firm. By excluding the valuation effects of debt financing, the base case discount rate in equation (3) will eliminate the bias created by using the standard discount rate in equation (2) that inconsistently includes the value-enhancing but not the value-destroying aspects associated with financing the firm's future investments at its targeted debt-to-asset ratio. To evaluate the fundamental merits of an investment decision, managers should simply discount the incremental after-tax cash flows from potential investment opportunities at the required return for the firm's assets, as given in the base case WACC shown in equation (3)—the resulting NPV tells the

manager whether investing in the asset, regardless of how it is financed, is creating or destroying value for the firm.

We believe that our proposed, simplified approach to correcting the bias is both more practical and more useful than the alternative solution, which would require estimates of both the benefits and non-interest costs of financing the investment with debt. From a practical perspective, the subjectivity and the complexity required to estimate the costs associated with both financial distress and decreased financial flexibility have understandably led practitioners to eschew existing academic models developed to estimate these hard-to-quantify costs. If a financial analyst cannot explain the methods and justify the assumptions used in her analysis to less financially sophisticated decision-makers, the analyst is at risk of losing credibility and, therefore, will choose not to apply these complex models.[12]

Another reason we recommend this simplified approach is that if firms are optimally financed, their targeted capital structure (debt-to-asset ratio) implies that the marginal cost equals the marginal benefit of issuing one more dollar of debt. If so, then issuing additional debt for a portfolio of new investment opportunities maintaining the same targeted debt-to-asset ratio will likely be value neutral, and the debt financing will thus likely not affect the estimated NPV of these investment opportunities.[13] In other words, if the marginal costs equal the marginal benefits,

[12] For significant decisions with great uncertainty like large technology investments or corporate acquisitions, an analyst with a sophisticated audience could effectively employ the van Binsbergen, Graham, and Yang (2011) model. For these types of decisions, we refer the reader to their paper (particularly Figure 7, p. 42) for a first-pass estimate of the non-interest costs of debt. However, for most decisions at the project level, our recommended approach provides a practical model for removing the bias inherent in current capital budgeting practices.

[13] Indeed, Almeida and Philippon (2007) suggest that this is the case: "We show that marginal distress costs can be as large as the marginal tax benefits of debt derived by Graham (2000)." Additionally, there is ample evidence that the average announcement-period abnormal return measuring the market reaction to corporate debt offerings is zero; e.g., see Ekbo (1986), and Smith (1986). These findings suggest that, on average, corporate debt offerings are value-neutral events.

then there is nothing gained by attempting to quantify the benefits or non-interest costs of debt financing in the WACC calculation.

Finally, even if the firm is not optimally financed (the marginal benefits of issuing debt do not equal the marginal costs), we argue that excluding the benefits and non-interest costs of debt financing is still appropriate when evaluating a project. Even for a particular capital investment where the incremental non-interest costs of debt are zero and the interest tax savings are significant, we recommend evaluating this investment by initially excluding the interest tax savings. Why? Because by including the interest tax savings in the WACC calculation and then estimating the investment's NPV, the decision maker cannot be sure if the source of value creation is the investment itself, or the interest tax savings generated from the debt used to finance the investment. Appendix A provides the details of such an example. The NPV using the after-tax cost of debt in the WACC calculation is a positive $24.12 million, but the NPV using the before-tax cost of debt, i.e. using the base-case WACC, in the calculation is a *negative* $20.0 million. In this example, using the standard after-tax WACC in equation (2) effectively includes interest tax savings totaling $44.12 million, and this is the sole reason the investment appears to be value-enhancing. The question is: should the firm make this investment? We recommend against it, because the investment itself would destroy $20.0 million of firm value, and the firm would be better off generating the interest tax savings by financing a value-neutral investment.[14] Thus, using the standard WACC approach, a manager would incorrectly accept a fundamentally value-destroying project. If the manager instead uses our proposed base case approach, the manager would correctly

[14] The example points out that, when managers include the financing benefits but ignore the costs, a project's total expected NPV might well be positive, but only because it includes the interest tax savings while ignoring the non-interest costs. Put another way, current practices using the after-tax WACC could lead management to accept a fundamentally value-destroying project. However, by using our proposed base case, before-tax WACC, management would avoid underestimating the firm's WACC and thus overstating the project's NPV.

reject such a project. We conclude that financing side effects are secondary and should not change the investment decision, and hence they should not be considered in the project's performance measures.[15] By using the simplified base case approach given by equation (3) to estimate the project's required return, the analyst avoids the need to estimate the expected increase in non-interest costs of debt, and – more importantly – avoids the bias created by including benefits while ignoring costs.

5. Conclusion

In this paper, we encourage practitioners involved in evaluating capital investments to simplify their methods by initially excluding all valuation effects arising from financing investments with debt. We argue that current practice implicitly includes only the value-enhancing aspects of financing the project with debt (the interest tax savings), but ignores the value-destroying aspects (the non-interest costs). Since the incremental change in the non-interest costs associated with financing an investment with debt are difficult to measure and generally ignored in investment evaluation, current practices are leading to an underestimated WACC and an overstated NPV. Our proposed base case model omits the interest tax benefits of debt, which aims to correct the bias in WACC estimation and ultimately provides a bias-free estimate of an investment's NPV. We recommend that the best, key performance indicator when evaluating capital investments is the base case NPV: discount incremental after-tax operating cash flows

[15] An exception to this rule occurs when financing side effects are project-specific; e.g., subsidized debt financing at below-market rates, or tax breaks (abatements) that are unique to the project. If financing side effects can only be generated by a particular investment opportunity, then these effects are relevant for the accept/reject decision.

based on a discount rate that reflects the systematic risk of the firm's assets, excluding the valuation side effects from debt financing.

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Appendix A

This appendix provides an example of a firm considering an investment of $270 million in a project expected to generate a $10 million after-tax cash inflow in year 1, beyond which time that cash flow is expected to grow by 4% per year in perpetuity. Assume this firm's weight of debt is 40% (weight of equity is 60%), the firm's cost of debt is 5% per year, and its cost of equity capital is 10% per year. Given the firm expects a corporate income tax rate of 30%, the firm's WACC equals:

$$WACC = W_d * K_d * (1-t) + W_e * K_e = .4 * 5\% * (1-.3) + .6 * 10\% = 7.4\%$$

and the project's expected NPV equals:

NPV = $10m / (.074 - .04) - $270m = $294.12m - $270.0m = $24.12 million.

This analysis, which includes the marginal benefit of debt but ignores the marginal cost of debt, suggests that this project is expected to be value enhancing and, therefore, should be accepted. If we evaluate this project excluding the marginal benefit of debt – the interest tax savings – then the WACC equals:

$$WACC = W_d * K_d + W_e * K_e = .4 * 5\% + .6 * 10\% = 8\%$$

and the project's expected NPV equals:

NPV = $10m / (.08 - .04) - $270m = $250.0m - $270.0m = -$20.0 million.

This analysis suggests that the project is value destroying and should be rejected. The expected NPV including the interest tax savings ($24.12m) minus the expected NPV excluding the interest

tax savings (-$20m) equals the anticipated interest tax savings from this project of $44.12 million. In other words,

$$\text{NPV} = \text{Base Case NPV} + \text{PV(Interest Tax Savings)} = -\$20.0\text{m} + \$44.12\text{m} = \$24.12\text{m}.$$

Even though the expected NPV is positive if we include the interest tax savings, the expected NPV is negative if we exclude the interest tax savings; we posit that this project should not be accepted, and that the inclusion of the interest tax savings creates an underestimate of the firm's WACC and an overstated estimate of the project's NPV. We believe that the firm should not invest because the investment opportunity by itself, excluding the expected tax benefits, actually destroys value. In this case, the firm would therefore be better off creating the benefits of debt financing on a value-neutral investment opportunity. If the valuation effects of debt financing are not going to change the investment decision, they should not be considered in the model—especially if, by using that approach, it leads to a bias towards overstating the project's NPV.