On the Applicability of WACC for Investment Decisions

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Abstract

Although WACC is appropriate for project and firm valuation, it is not a good rule for investment decision making. The reason is that by mixing up the value of the project itself with the tax shield, WACC can often turn unattractive projects into apparently acceptable ones. Real investments must be accepted only if they yield positive NPVs when discounted at the unleveraged discount rate, that is, without accounting for the tax shield. WACC enters the picture only to assess the impact of a new project on firm value, once it has been accepted, and when a fixed debt ratio policy is in place.

Introduction

According to Miller & Modigliani (1958, 1963), hereinafter MM, the cost of capital WACC of a firm after corporate taxes (but before personal taxes) is given by the formula:[1]

$$WACC = \frac{D}{V} \cdot (1 - T_C) \cdot r_D + \frac{E}{V} \cdot r_E \tag{1}$$

The following relationship also holds:

$$WACC = \left(1 - \frac{DT_C}{V}\right) \cdot r_0 \tag{2}$$

Where,

r_o is the asset discount rate after taxes

D is the market value of debt

T_C is the corporate tax rate

V is the market value of the firm

r_D is the cost of debt

E is the market value of equity

r_E is the cost of equity

If the terms are reordered, the following expression is found for the return on equity with taxes:

[1] I would like to thank Randolph Westerfield,Carlos Jaramillo, Carlos Molina, and Maximiliano González for helpful comments.

$$r_E = r_0 + \frac{D}{E} \cdot \left[\left(r_0 - r_D \right) \cdot \left(1 - T_C \right) \right] \tag{3}$$

There is also the following equivalent formula:

$$V = V_u + DT_C \tag{4}$$

Where V_u is the value of the unleveraged firm after taxes.

This last formula shows that the value of the firm rises with debt by an amount equal to DT_C. This amount is known as the tax shield.

The above results are based on the following assumptions:

No transaction costs

This assumption ensures that everyone has the same access to financial markets. For example, with transaction costs the possibility of adjusting personal portfolios to compensate for the firms' financing decisions would be costly, and might not be valid. Therefore, leverage would not be irrelevant when computing firm value.

Perfectly competitive financial markets

With this condition nobody has advantages in the financial markets. If this were not the case, leverage preferences could differ among market participants and debt levels would not be irrelevant.

No agency costs

This implies that the manager's sole objective is to maximize shareholders' wealth. Therefore, the financial mix does not have any relation with the particular interests of administrators nor any impact on firm value.

No personal taxes

Individuals do not pay taxes.[2]

All cash flows are no-growth perpetuities

This assumption merely helps to simplify the formulas for the cost of capital and the value of the firm.

MM's work gave rise to two equivalent approaches for firm and project valuation.[3] The value of a firm or a project can be computed either by discounting asset cash flows after taxes at WACC, or by discounting asset cash flows after taxes at the unleveraged discount rate r_0 and adding the PV of the tax shield. The latter approach is known as Adjusted Present Value (APV).[4]

In the following, it will be shown that although discounting at WACC is appropriate for project and firm valuation, it is not a good rule for investment decision making. For the sake of simplicity the argument will be illustrated with a practical example.

[2] Miller (1977) shows how MM's results are modified in the presence of personal taxes.
[3] Ruback (2002) proposes a third equivalent method: Capital Cash Flows.
[4] APV has been generalized to include other effects on value besides the tax shield. For further information refer to Ross, Westerfield & Jaffe (1999).

WACC and Project Valuation

Assume that a firm is started with a project yielding a $1 million yearly perpetual cash flow after taxes.[5] The project requires an initial investment of $100 million and will be fully financed with equity. The project demands 12% annual return after taxes.[6]

The project's present value PV is:

$$PV = \frac{10MM}{0.12} = +\$83.34MM \tag{5}$$

The NPV will be:

$$NPV = +83.34MM - 100MM = -\$16.67MM \tag{6}$$

Thus, the project must be rejected.[7]

In the event of the project being undertaken the financial balance sheet[8] of the firm would look like this:

Assets	**Liabilities**
Project: +$83.34MM	Equity: +$83.34MM

Investors would have put up $100 million in exchange for equity worth just $83.34 million. A bad decision, clearly. The present value rule has guided us wisely.

But, what is behind the present value rule?

[5] In reality cash flows are not certain but expected.
[6] The discount rate can be determined by the CAPM or any other asset pricing model such as the APT.
[7] Throughout the paper it is assumed that management maximizes firm value (i.e. there are no agency problems) and that there are no costs of financial distress.
[8] Meaning a balance sheet in market value terms.

Its key assumption is that all investors have equal access to financial markets and that these markets are complete and efficient. In our example, this implies that the investor always has the choice of placing the $100 million in a comparable portfolio of financial assets.

In an efficient financial market the return on this portfolio must be equivalent to a $12 million annual perpetuity and the NPV of the financial investment would be zero. Hence, the investor will never undertake a negative NPV project if he has the choice of investing in a zero NPV portfolio. This is why the present value rule dictates that only positive NPV projects must be accepted.

Let us now see what happens when the same firm decides to take leverage to finance the project.

Enter leverage

In general, the financial balance sheet of a leveraged firm[9] is given by:

Assets	**Liabilities**
Investments	Debt
Tax shield (DT_C)	Equity
Total value	Total value

Now imagine that our firm has a 50% corporate tax rate and decides to partially finance the project with $50 million of debt at a 4% annual interest. Notice that it is understood that the borrowing and investment decisions are independent.

[9] Assuming all cash flows are no-growth perpetuities.

If the project is accepted the financial balance sheet of the firm will be:

Assets	**Liabilities**
Project: +$83.34MM	Debt: $50MM
Tax shield: +$50MMx0.5 = $25MM	Equity: $58.34MM
Total value: $108.34MM	Total value: $108.34MM

Using MM's formulas:

The value of WACC is:

$$WACC = r_0 \cdot \left(1 - \frac{DT_C}{V}\right) = 0.12 \cdot \left(1 - \frac{\$50MM \cdot 0.5}{\$108.34MM}\right) = 9.23\% \quad (7)$$

And the value of r_E is:

$$r_E = r_0 + \frac{D}{E} \cdot \left[\left(r_0 - r_D\right) \cdot \left(1 - T_C\right)\right] = 0.12 + \frac{\$50MM}{\$58.34MM} \cdot \left[\left(0.12 - 0.04\right) \cdot \left(1 - 0.5\right)\right] = 15.43\% \quad (8)$$

Discounting at WACC, the PV of the project will now be:

$$PV = \frac{\$10MM}{0.0923} = \$108.34MM \quad (9)$$

And its NPV:

$$NPV = \$108.34MM - \$100MM = +\$8.34MM \quad (10)$$

So, it seems that the use of leverage has turned an unattractive project into an acceptable one.

Why WACC is not Appropriate for Investment Decision Making

The difference in PVs between the unleveraged and the leveraged project is:

$$108.34 - 83.34 = \$25MM \tag{11}$$

This amounts exactly to the tax shield. The result can be more clearly appreciated if APV is used instead. The APV of the leveraged project equals the PV of the unleveraged project plus the PV of the tax shield:

$$APV = E\left(PV_{unleveraged}\right) + DT_C \tag{12}$$

In our example:

$$APV = 83.34 + 50 \cdot 0.5 = \$108.34MM \tag{13}$$

But, is it correct to accept a negative (unleveraged) NPV project just because of the tax shield it generates?

I think the answer is no, in general. If all investors have equal access to complete and efficient financial markets it will still be possible to invest $100 million in an equivalent portfolio of financial assets. This portfolio will be equivalent to a $12 million annual perpetuity after taxes. And since, like the real project, it will be partially financed by $50 million of debt, the investor will conserve the benefit of the tax shield.

Let us recalculate the financial balance sheet in the event of the project being rejected and the $100 million being invested instead in the equivalent financial portfolio:

Assets	Liabilities
Financial portfolio: +$100MM	Debt: $50MM
Tax shield: +$50MMx0.5 = $25MM	Equity: $75MM
Total value: $125MM	Total value: $125MM

The new WACC will be:

$$WACC = 0.12 \cdot \left(1 - \frac{\$25MM}{\$125MM}\right) = 9.6\% \tag{14}$$

The new PV will be:

$$PV = \frac{12}{0.096} = \$125MM \tag{15}$$

Or, using APV:

$$APV = 100 + 25 = \$125MM \tag{16}$$

A result that is clearly superior to the $108.34 million obtained by investing in the project.

Therefore, the rule must be that whenever,

a) All investors have equal access to complete and efficient financial markets and,

b) Investment and borrowing decisions are independent of each other,

Then, a real investment must be accepted only if it yields a positive NPV when discounted at the unleveraged discount rate. Discounting at WACC might lead to unfavorable decisions.[10]

What Happens When the Assumptions do not Hold

Unleveraged negative NPV projects might be acceptable only when these assumptions do not hold. First, if an investor faces restrictions to access financial markets and/or financial markets are not complete or efficient, a financial portfolio equivalent to the project might not be attainable. In this instance, investing in an unleveraged negative NPV project might be justified as long as the benefit stemming from the expanded investment opportunity set is large enough.

Second, if the investment and borrowing decisions are closely tied, then the tax shield might not be possible without the project. Here again an unleveraged negative NPV project might be acceptable.

Nonetheless, we should be aware that the lack of validity of the assumptions does not justify the use of WACC for investment decision making. WACC remains an unsafe rule for the simple reason that it mixes up the value of the project itself with the tax shield, not allowing the valuation of projects on their own merits. In no case must an unleveraged negative NPV project be accepted.

As long as the investment and borrowing decisions are independent, it is always preferable to evaluate each investment opportunity on its own merits, meaning that the project's cash flows must be discounted at the unleveraged discount rate. Only then, its PV must be adjusted for the

[10] The conclusion is not altered when personal taxes are considered. The only difference is that the WACC tax rate and the tax shield are combined expressions including both the corporate and the personal tax rates.

possible effects of contingent debt and/or the benefits of an expanded investment opportunity set. Notice that this is no different from the APV approach.

The role of WACC

Up to this point it has been assumed that the borrowing and investment decisions are independent. However, many firms have a constant debt ratio policy.[11] When this is the case, every time a project is accepted the amount of debt must be adjusted to keep it in line with the value of the new assets that have been incorporated into the balance sheet.

It can be shown that it is quite cumbersome to use APV to allow for this tuning, whereas WACC takes account of it automatically[12] and thus is a more practical approach for quantifying the impact of the debt adjustment.

Nevertheless, this does not alter our earlier conclusion that projects must be accepted or rejected on the basis of their NPV by discounting their after tax cash flows at the unlevered discount rate. The conclusion still holds. WACC enters the picture only to assess the impact of a new project on firm value, once it has been accepted, and when a fixed debt ratio policy is in place.

Conclusions

MM's work gave rise to two equivalent methods for firm and project valuation. The value of a firm or a project can be computed either by

[11] This is true mostly in industrialized economies. In developing countries debt policy tends to be opportunistic. For further information refer to Sabal (2002).
[12] Refer to Inselbag & Kaufold (1997) on this point.

discounting asset cash flows after taxes at WACC, or by discounting asset cash flows after taxes at the unleveraged discount rate and adding the PV of the tax shield (i.e. the APV approach).

In this paper it has been shown that although discounting at WACC is appropriate for project and firm valuation, it is not a good rule for investment decision making. The reason is that by mixing up the value of the project itself with the tax shield, WACC can often turn unattractive projects into apparently acceptable ones. Real investments must be accepted only if they yield positive NPVs when discounted at the unleveraged discount rate, that is, without accounting for the tax shield.

Unleveraged negative NPV projects might be acceptable only when the investment and borrowing decisions are somehow related, the investor faces restrictions to access the financial markets, or financial markets are not complete or efficient.

WACC enters the picture only to assess the impact of a new project on firm value, once it has been accepted, and when a fixed debt ratio policy is in place.

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