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FAST WACC Formula

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Abstract

The **Weighted Average Cost of Capital (WACC)** is a very common metric used in Finance. Most resources that discuss the WACC teach a method for calculating the WACC that requires multiple steps and calculating several intermediate values. This paper presents the **Fast WACC Formula** (or algorithm) for calculating the WACC that can be used under certain conditions and which requires fewer calculation steps, requires calculating fewer intermediate values, and is less computationally complex than the most commonly published and commonly used methods for calculating the WACC and is therefore more efficient than most other published and commonly used methods.

The *Fast WACC Formula* can be used if one uses the **Harris-Pringle** equation¹ to calculate the leveraged return on Equity and one uses the CAPM² model for asset pricing. If these do not apply, then the *Fast WACC Formula* (Equation 1 below) does not apply.

FAST WACC Formula

$$WACC = K_A - \left(\frac{D}{V} \cdot \tau \cdot K_D \right) \quad (\text{Eq. 1})$$

Definitions

WACC : **Weighted Average Cost of Capital**

τ : **Corporate Tax Rate**

K_A : **Un-levered Return on Firm Assets**

r_f : **Risk-free Rate of Return**

K_D : **Cost of Debt**

r_p : **Risk Premium**

K_E : **Cost of Equity**

β_A : **Asset Beta** (unlevered)

D : **Market Value of Debt**

β_E : **Equity Beta**

E : **Market Value of Equity**

β_D : **Debt Beta**

V : **Value of Firm** — Combined Value of
Equity and Debt
($V = E + D$)

Eq. 1 does **not** assume the Beta of Debt (β_D) is 0 as many methods to simplify financial calculations do, and uses the Beta of Debt (β_D) implied by the actual Cost of Debt, assuming that Debt is priced according to the Capital Asset Pricing Model ([CAPM](#)).

¹ R.S. Harris i J.J. Pringle, Risk-Adjusted Discount Rates Extensions From the Average-Risk Case, Journal of Financial Research, 1985, s. 237-244.

² French, Craig W. (2003). "The Treynor Capital Asset Pricing Model". *Journal of Investment Management*. **1** (2): 60–72. [SSRN 447580](#).

The following equations define the inputs for the *Fast WACC Formula*

Number	Equation	Notes
Eq. 2	$K_A = r_f + (\beta_A \cdot r_p)$	CAPM (Capital Asset Pricing Model)
Eq. 3	$\beta_A = \left(\frac{E}{V} \cdot \beta_e\right) + \left(\frac{D}{V} \cdot \beta_D\right)$	Harris-Pringle equation. This equation is very intuitive and says that Beta is conserved and split between Equity and Debt.
Eq. 4	$V = E + D$	Total Value of Equity and Debt.

The Asset Beta (β_A) is observed or calculated from comparable companies.

Standard WACC Formula:

The standard equations to calculate the WACC using the Harris-Pringle Equation and CAPM model are shown below³:

Number	Equation	Notes
Eq. 5	$WACC = \left(\frac{E}{V} \cdot K_E\right) + \left(\frac{D}{V} \cdot K_D \cdot (1 - \tau)\right)$	Definition of WACC (Standard WACC Formula)
Eq. 6	$K_E = r_f + (\beta_E \cdot r_p)$	CAPM Formula based.
Eq. 7	$\beta_A = \left(\frac{E}{V} \cdot \beta_e\right) + \left(\frac{D}{V} \cdot \beta_D\right)$	Harris-Pringle equation
Eq. 8	$\beta_E = \left(\frac{V}{E} \cdot \beta_A\right) - \left(\frac{D}{E} \cdot \beta_D\right)$	Harris-Pringle equation solved for β_E . There are alternate ways to represent this.
Eq.9	$V = \frac{CF}{WACC}$	Valuation using WACC Formula.

Calculating the WACC using the Standard Formulas generally requires the following steps given a target :

- 1) Calculating or finding the Asset Beta (β_A) based on comparable companies
- 2) Calculating the levered Equity Beta (β_E)
- 3) Calculating the levered Cost of Equity (K_E)
- 4) Using the Standard WACC Formula once all other variables are known.

In contrast, the *Fast WACC* formula does not require calculating the levered Equity Beta (β_E) or the Cost of Equity (K_E). It only requires knowing the Asset Beta (β_A), the Market Value of Debt (D) the Market Value of Equity (E), and the corporate tax rate.

^{3 3} The WACC Formula may first have been formulated by Harris-Pringle:

R.S. Harris i J.J. Pringle, Risk-Adjusted Discount Rates Extensions From the Average-Risk Case, Journal of Financial Research, 1985, s. 237-244.

Proof of FAST WACC Formula

The proof derives the FAST WACC Formula using Equations 2 through 7 and algebraic substitutions, as well as the following equations.

Number	Equation	Notes
Eq. 10	$K_D = r_f + (\beta_D \cdot r_p)$	Assumes Cost of Debt reflects Beta of Debt under CAPM model.

From here, we can prove the *Fast* WACC Formula using algebraic substitutions. Begin with the Standard WACC Formula:

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_D \cdot (1 - \tau) \right) \quad (\text{Eq. 5})$$

Substitute Equations 6 and 10 into Equation 5

$$WACC = \frac{E}{V} \cdot (r_f + \beta_E \cdot r_p) + \frac{D}{V} \cdot (r_f + \beta_D \cdot r_p) \cdot (1 - \tau) \quad (\text{Eq. 11})$$

Substitute Equation 8 into Equation above:

$$WACC = \frac{E}{V} \cdot \left(r_f + \left(\frac{V}{E} \cdot \beta_A - \frac{D}{E} \cdot \beta_D \right) \cdot r_p \right) + \frac{D}{V} \cdot (r_f + \beta_D \cdot r_p) \cdot (1 - \tau)$$

Expand terms in previous equation above:

$$WACC = \left(\frac{E}{V} \cdot r_f \right) + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \beta_D \cdot r_p \right) + \left(\frac{D}{V} \cdot r_f \right) + \left(\frac{D}{V} \cdot \beta_D \cdot r_p \right) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right)$$

Cancel terms:

$$WACC = \left(\frac{E}{V} \cdot r_f \right) + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \beta_D \cdot r_p \right) + \left(\frac{D}{V} \cdot r_f \right) + \left(\frac{D}{V} \cdot \beta_D \cdot r_p \right) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right)$$

$$WACC = \left(\frac{E}{V} \cdot r_f \right) + (\beta_A \cdot r_p) + \left(\frac{D}{V} \cdot r_f \right) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right)$$

Rearrange terms:

$$WACC = \left(\frac{E}{V} \cdot r_f \right) + \left(\frac{D}{V} \cdot r_f \right) + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right)$$

Combine r_f terms:

$$WACC = \left(\frac{E+D}{V} \cdot r_f \right) + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right) \quad [\text{Note that } V = E + D]$$

$$WACC = \left(\frac{V}{V} \cdot r_f \right) + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + \beta_D \cdot r_p) \right)$$

$$WACC = r_f + (\beta_A \cdot r_p) - \left(\frac{D}{V} \cdot \tau \cdot (r_f + (\beta_D \cdot r_p)) \right)$$

Note that the first two terms above represent K_A in Equation 2, and we also have a similar expression for K_D in the equation above. Simplifying:

$$WACC = K_A - \left(\frac{D}{V} \cdot \tau \cdot K_D \right) \quad \text{[Fast WACC Formula]} \quad \text{(Eq. 1)}$$

We can also define the variable Debt Percentage ($D\%$) as:

$$D\% = \frac{D}{V} = \frac{D}{D + E}$$

$$WACC = K_A - (D\% \cdot \tau \cdot K_D) \quad \text{[Fast WACC Formula in terms of Debt Percentage]}$$

The *Fast WACC* Formula greatly simplifies the process of calculating of the WACC when the conditions met for its use apply (Harris-Pringle Equation for calculating levered Equity Beta (β_E)).

Faster Proof of FAST WACC Formula

The first proof uses algebra to derive the *Fast WACC* Formula. There is another extremely simple way to derive the *Fast WACC* Formula. First, expand the Standard WACC Formula as follows:

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_D \cdot (1 - \tau) \right) \quad \text{(Standard WACC Formula)}$$

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_D \right) - \left(\frac{D}{V} \cdot K_D \cdot \tau \right) \quad \text{(Eq. 12)}$$

We can simplify the first two terms above. The [Modigliani - Miller Theorem](#)⁴ tells us that if τ (Corporate Tax Rate) is zero, then the Debt Ratio (and capital structure) has no impact on the value of the firm, and hence no impact on the WACC. That is, if ($\tau = 0$) then the resulting WACC is always equal to K_A for **all** capital structures. Plugging ($\tau = 0$) into Eq 5. and setting this equal to K_A yields:

$$K_A = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_D \right) \quad \text{[This is the WACC when } (\tau = 0)\text{]} \quad \text{(Eq. 13)}$$

The above relationship in Eq. 12 holds for **all** capital structures, regardless of the value of τ . Hence the above equation is true for all capital structures, even when ($\tau \neq 0$).

Looking at Equation 112, we see the first two terms are the same as Equation 13. Therefore, Equation 11 simplifies to:

$$WACC = K_A - \left(\frac{D}{V} \cdot \tau \cdot K_D \right) = K_A - (D\% \cdot K_D \cdot \tau)$$

⁴Modigliani – Miller The Cost of Capital, Corporation Finance, and the Theory of Investment
The American Economic Review, June 1958
<https://www.jstor.org/stable/1809766?seq=1>

Non-CAPM Debt Pricing

This section discusses the case where debt is not priced according to **CAPM** model and occurs when the Cost of Debt is above or below the Cost of Debt predicted by CAPM based on the Beta of Debt (β_D). One common case where debt is not priced according to CAPM in academic coursework is when a problem or instructor assumes the Beta of Debt (β_D) is 0 but the Cost of Debt (K_D) is higher than the Risk Free Rate of Return r_f . However, CAPM states that if the Beta of Debt is zero, then ($K_D = r_f$). Since β_D is often small, some Finance instructors assume β_D is 0, but the Debt is still priced above r_f to compensate investors for the risk associated with corporate debt. Thus, assuming the Beta of Debt (β_D) is 0 when the Cost of Debt (K_D) is above the Risk Free Rate (r_f) is inconsistent with CAPM. Furthermore, in public markets, the overall market or investors may not price the debt based on what the CAPM model would predict given the Beta of Debt (β_D). The following modifications to the *Fast WACC* Formula will handle any situation with overpriced debt, or with Cost of Debt not equal to the Cost predicted by CAPM based on the Beta of Debt, if one uses the **Harris-Pringle equation** to calculate leveraged Equity Beta.

I Define K_{DM} as the Ideal Market Price of Debt as predicted by CAPM according to Eq. 13 below. In Equation 14, I define the D_p as the Debt Premium, meaning the difference between the actual Cost of Debt (K_D) and the Ideal Market Price of Debt (K_{DM}). The actual Cost of Debt remains K_D .

Number	Equation	Notes
Eq. 14	$K_{DM} = r_f + (\beta_D \cdot r_p)$	Ideal Market Price of Debt
Eq. 15	$K_D = K_{DM} + D_p = r_f + (\beta_D \cdot r_p) + D_p$	Debt Premium
Eq. 16	$D_p = K_D - K_{DM}$	Debt Premium

For example, if the Risk Free Rate is 4%, the Beta of Debt is 25%, and the Risk Premium is 8%, then the Market Cost of Debt (K_{DM}) would be 6%:

$$6\% = 4\% + 25\% \cdot 8\% = 4\% + 2\%$$

If the Actual Cost of Debt is higher than 6%, then there is a Debt Premium. For example, if the Actual Cost of Debt is 9%, this represents a Debt Premium of 3% ($9\% - 6\% = 3\%$). Using this definition of the Debt Premium (D_p) we can express the WACC in several ways:

Number	Equation	Notes
Eq. 17	$WACC = K_A - ((D\%) \cdot (\tau \cdot K_D - D_p))$	
Eq. 18	$WACC = K_A - ((D\%) \cdot (\tau \cdot K_D - D_p))$	
Eq. 19	$WACC = = K_A - (D\% \cdot K_{DM} \cdot \tau) + (D\% \cdot D_p \cdot \tau)$	

If we define $WACC_{EM}$ ("EM" stands for Efficient Market) as the value of the WACC if Debt is priced according to CAPM, then the actual WACC for arbitrary Debt pricing can be expressed as:

$$WACC = WACC_{EM} + (D\% \cdot D_p \cdot (1 - \tau))$$

Proof

Begin with WACC Formula:

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_D \cdot (1 - \tau) \right)$$

Substitute Eq 14 for K_D : $K_D = K_{DM} + D_p$

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot (K_{DM} + D_p) \cdot (1 - \tau) \right)$$

$$WACC = \left(\frac{E}{V} \cdot K_E \right) + \left(\frac{D}{V} \cdot K_{DM} \cdot (1 - \tau) \right) + \left(\frac{D}{V} \cdot D_p \cdot (1 - \tau) \right)$$

The first two terms in the equation above represent the WACC if Debt is priced efficiently according to CAPM and therefore represent the WACC in the initial portion of the document, and therefore represent the value of $WACC_{EM}$. Therefore:

$$WACC = WACC_{EM} + (D\% \cdot D_p \cdot (1 - \tau))$$

This is equivalent to:

$$WACC = K_A - (D\% \cdot K_{DM} \cdot \tau) + (D\% \cdot D_p \cdot (1 - \tau))$$

$$WACC = K_A - (D\% \cdot (K_{DM} + D_p) \cdot \tau) + (D\% \cdot D_p)$$

$$WACC = K_A - (D\% \cdot ((K_D \cdot \tau) + D_p))$$

Assuming Beta of Debt is Zero

Situation where the Beta of Debt is assumed to be zero can be handled by setting the Debt Premium appropriately. For example, setting the Beta of Debt equal to zero ($\beta_D = 0$) in Harris-Pringle Equation and solving for the Beta of Equity gives:

$$\beta_A = \frac{E}{V} \cdot \beta_E \implies \beta_E = \beta_A \cdot \frac{V}{E}$$

This sometimes known as the Practitioners Method. Since CAPM predicts that when Beta of Debt equal to zero ($\beta_D = 0$), the "Efficient Market" Cost of Debt is the Risk Free Rate of return ($K_{DM} = r_f$) then if the Beta of Debt is assumed to be zero, the Debt Premium (D_p) is calculated as:

$$D_p = K_D - r_f$$

This is because:

$$D_p = K_D - K_{DM} = K_D - r_f \quad (\text{as } K_{DM} = r_f)$$