

BUSINESS VALUATION

Cost of Capital

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7 October 2026

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INTRODUCTION

This article discusses how the Cost of Capital is calculated for a simplified capital structure (debt and equity) to give a blended rate ('Weighted Average Cost of Capital' or 'WACC') that can be used in a traditional Discounted Cash Flow valuation (the article should be read in conjunction with 'Business Valuation: DCF Methods'). Part 1 deals with a 'home' WACC, where the investor holds a diversified portfolio in the market where the company being valued is located; Part 2 extends the discussion to include investors who are located in another country, and considers what their required return might be in a cross-border valuation. Appendices provide a WACC example, a detailed discussion on tax shields and WACC theory and a summary of cross-border CAPM versions.

PART 1: DOMESTIC WACC

Overview of WACC

Total and Required Return for each investor

The actual return from holding equity or debt instruments is the increase in wealth for the investor over some measurement period compared to opening wealth (market values). 'Total Return' measures the change in market value over the period plus any income (dividends, interest or coupons), as a percentage of the opening market value (i.e. capital gain plus income yield). The required return is the Total Return that an equity or debt investor would expect to receive before deciding to invest, referred to as the 'Cost of Equity' (K_e) and 'Cost of Debt' (K_d), respectively.

Pre- and Post-Tax Required Return for all investors

The pre-tax average rate of return required by all providers of financial capital to the business, adjusted for the perceived riskiness of the cash flows distributable to them ('Free Cash Flows to the Firm' / 'FCFF') and weighted by the market values of each source of financing, is the pre-tax 'Weighted Average Cost of Capital' ('WACC'). FCFF exclude financing and related tax cash flows, so the WACC should be calculated on an after-tax basis. As debt interest is tax deductible in most jurisdictions, whereas equity dividends are not (they are paid out of taxed profits), the pre-tax cost of debt must be adjusted to the after-tax equivalent, assuming tax relief is available in the same period the interest is paid (effectively giving a cash inflow).

¹ This is a new version of a paper originally dated 7 May 2026, updated for cross-border discount rates.

WACC definition

Taking the simple case of debt and equity as the only sources of financing, the WACC can be shown as:

$$\text{Post-tax WACC} = \text{Cost of Equity } (K_e) \times (1 - L) + \text{Cost of Debt } (K_d) \times (1 - t) \times L$$

where L = Leverage or Debt / (Debt + Equity) using market values

t = marginal tax rate

K_d = the expected yield from holding the debt to maturity (if issued at par or face value, the promised yield at issue would be the coupon or interest rate: the expected yield may be lower because of expected default losses).

Risk Premium

If risk is defined as the uncertainty about the timing and amount of expected or promised cash flows, then the rate of return on a financial instrument would be considered risk free if the timing and amount were certain. The closest we can get to that would be some type of fixed interest debt instrument whose issuer would not fail to repay (zero default risk), such as a government bond.

Dividends to equity investors are not promised but at the company's discretion, and there is no obligation to return the amount invested. By contrast, interest payments and debt principal repayments are contractually promised. This makes equity riskier than debt, giving it a higher risk premium.

The cost of debt and equity can be written in terms of the risk free rate (R_f) and risk premium:

- Debt return (Cost of Debt K_d) = $R_f + \text{Debt Risk Premium ('DRP')}$ ²
- Equity return (Cost of Equity K_e) = $R_f + \text{Company's Equity Premium}$

Cost of Debt

Pre-tax Cost of Debt

The pre-tax cost of debt represents the 'marginal return' expected at the valuation date on new borrowing with a maturity and currency matching the cash flow forecast. It should be based on the expected cash flows from a debt instrument, representing the contractual (promised) cash flows adjusted downwards for likelihood of non-payment (probability weighted cash flows) over the period to maturity, meaning the promised yield to maturity will be more than the expected yield (as for R_f in the CAPM, the time to maturity should be long term as well, to match the forecast cash flows in the valuation).

² The 'Debt Risk Premium' ('DRP') is the required return for debt holders (pre-tax cost of debt) in excess of the risk free rate: $K_d = R_f + \text{DRP}$. As for the cost of equity, DRP can be expressed in terms of the market Equity Risk Premium ('ERP'): an assumed CAPM-consistent expected debt premium, $\text{DRP} = \beta_d \times \text{ERP}$, where β_d is the 'Debt Beta' equal to DRP / ERP (see <https://edbodmer.com/debt-beta-and-credit-spreads/>).

A quoted debt instrument could be used, issued by the company being valued itself or issued by a 'proxy' company with a similar credit risk (for example, by estimating a likely 'synthetic' credit rating for the business using a credit rating model, determining what promised yield is available in the market for such a rating and adjusting for expected credit losses). Alternatively, an estimate could be made for the actual cost of debt the business would incur if it borrowed new long-term funds (the marginal or incremental pre-tax cost of debt).

Post-tax Cost of Debt

Assuming debt interest obtains full tax relief in the year paid (the 'tax shield' being interest x tax rate – discussed in more detail in [Appendix 2](#)), the pre-tax cost of debt should be reduced to reflect the lower after tax cost (post-tax cost of debt = pre-tax cost of debt x (1 – tax rate)). The tax rate should be the actual rate that would apply to the interest paid, typically the 'marginal' rate, which may or may not be the same as the statutory rate.

The tax deductibility of debt interest effectively generates a tax cash inflow ('Tax Shield') which can be forecasted and discounted at an assumed risk-adjusted rate. The value of the geared company (V_g) should, in theory, equal the value of the ungeared company (V_u) plus the value of the Tax Shield (V_{TS}) (Modigliani and Miller (1963)).

Optimal Leverage

The capital structure should be adjusted towards some optimum level that minimises WACC and maximises value, so the textbooks say. As the cost of debt is less than the cost of equity, due to lower risk and the tax deductibility of interest, increasing debt in the capital structure should reduce WACC (and hence increase value for equity investors), but at some level this benefit will reverse as the risk of financial distress and default increases both the cost of debt and equity. In practice, the capital structure may be adjusted so as to align with the sector peer group (the industry average for comparable companies with similar growth and business risk).

Leverage and DCF Valuations

Over the forecast period, the WACC is often assumed to be constant (assuming the business is relatively mature). This implicitly assumes that either all the inputs to the calculation change in a manner that leaves the total WACC unchanged or, more likely, that leverage (based on market values) is constant and maintained at its optimal level by adjusting the level of debt (borrowing/repaying) and/or equity (distributing income as dividends or capital as buybacks). Since DCF forecasts ignore financing, no further leverage analysis need be done when assuming a constant WACC.

A constant WACC assumption may not be appropriate for some businesses or projects if leverage is required to change (in leveraged buyouts or project finance, for example, where debt repayments are scheduled and often not discretionary). Furthermore, as discussed in 'Business Valuation: DCF Methods', forecasting debt levels will be required if tax shields are being valued separately. Debt can be assumed (1) to remain at a fixed amount throughout the forecast and terminal period (unrealistic, but assumed by Modigliani & Miller (1963) – see [Appendix 2](#)), (2) to change according to cash flow requirements

and mandatory repayment schedules or (3) to change in line with the value of the business. This third assumption is used in this article.

In a private company DCF valuation, in the absence of debt and equity market prices, leverage based on market value can be determined from the Enterprise Value ('EntV') at each period. If leverage is not assumed, but depends on debt financing assumptions (rather than the other way round), an iterative calculation is required (leverage and EntV depend on each other). In practice, this means working backwards from the EntV at the end of the forecast period ('Terminal Value' / 'TV'), setting debt at this date and then calculating the EntV at the previous period (this will equal the TV plus final year FCFF, both discounted back one period) and setting debt balances at this date and so on.

Debt and Cash

Excess cash (and liquid investments) that could be used to repay some debt at any time (with no impact on operating cash flows), can be netted off 'gross debt' to 'net debt' (gross debt – cash). If net debt is used in the WACC calculation, there must be consistency in the assumptions:

- Debt deducted from EntV when calculating Equity Value ('EqV')
- Leverage in the WACC: $L = \text{Net Debt} / (\text{Net Debt} + \text{Equity})$
- Equity beta in CAPM Cost of Equity, when re-gearing using Net Debt / Equity
- Cost of debt in the WACC (see Damodaran (2025) ch.15):

$$\text{Cost of net debt } K_{\text{net}} = \frac{(\text{Cost of gross debt } K_{\text{dgross}} \times \text{Debt}) - (\text{Return on cash } R_{\text{cash}} \times \text{Cash})}{\text{Gross debt} - \text{Cash}}$$

The required return for cash would typically be the risk free rate (R_f), so that $K_{\text{dgross}} = (R_f + \text{DRP})$ and $K_{\text{net}} = R_f + (\text{Debt} / \text{Net Debt} \times \text{DRP})$

Some argue that total cash on the balance sheet (and liquid investments), and not just a proportion deemed (arbitrarily) to be excess cash, should be deducted off gross debt (which would remove the issue of whether or not operating cash is treated on its own or part of working capital) or treated separately. Ignoring the net debt option and going for gross debt means cash is treated as a non-operating asset like other such items (e.g. investments in associates, equity investments, head office property etc.).

For the example in Appendix 1 of 'Business Valuation: DCF Methods' (the WACC for that valuation is shown below), all excess cash is paid out and only operating cash is on the balance sheet (treated as part of working capital, so the WACC is calculated based on net debt).

Cost of Equity

Risk and the Cost of Equity

As expectations change in the future (risk, operating returns, growth, dividends, etc), so the cost of equity changes. Expected return increases with risk, as indicated by the level of volatility or standard deviation of returns. Equity risk will depend on market risk (share price volatility due to market volatility, as measured by some market index), business risk (riskiness associated with FCFF) and financial risk (risk associated with leverage affecting 'Free Cash Flows to Equity' / 'FCFE', used to pay dividends, subject to sufficient legally distributable profits being available).

Effect of leverage

For equity investors, leverage adds financial risk (a greater chance the business defaults on its debt) to the business risk (the uncertainty as to the amount and timing of future operating cash flows). Equity investors will require a higher 'geared' (or 'levered') cost of equity (K_g) when facing both types of risk, whereas an ungeared (or unlevered) all-equity financed business will be expected to generate an ungeared cost of equity (K_u) that compensates them for business risk only.

Identifying relevant risks

Asset pricing models try to identify which risks are relevant to equity investors and how to capture such risk in the required return. The CAPM assumes only some of the total risk of any stock needs to be rewarded. Assuming an investor is sufficiently diversified and constructs a portfolio of investments with a total risk that is less than the risk of the individual portfolio stocks, some of the risk of the stock (the specific, unique or unsystematic part) can be eliminated, leaving residual risk that relates to the market as a whole (systematic or market risk). This means that, ignoring leverage for now, the sensitivity of the stock to market risk is all that needs to be considered. Other models have expanded on CAPM to introduce additional risk factors (Fama & French (2015)).

CAPM-derived Cost of Equity

The volatility of the return on the stock may or may not exactly match volatility of the market index (as measured by the ratio of the standard deviation of their returns: $\sigma_{\text{stock}} / \sigma_{\text{market}}$). This relationship, when adjusted by how closely the returns match each other (correlation coefficient of stock vs. market returns), indicates the sensitivity of the stock to market risk, as measured by the equity 'beta' (= correlation coefficient $\text{stock vs market returns} \times \sigma_{\text{stock}} / \sigma_{\text{market}}$).

If the stock risk matches market risk, $\text{beta} = 1.0$ and the required return would be the market return, comprising the Risk Free Rate (R_f)³ and the 'Equity Risk Premium' ('ERP')⁴. The stock's sector is likely, however, to have different risk to the whole market, so the beta⁵ reflecting business risk (asset beta β_a , also known as the ungeared / unlevered beta β_u) would not be 1.0, but lower or higher if the risk was lower or higher, respectively, than the market as a whole:

$$\text{Cost of Equity (ungeared)}(K_u) = R_f + \beta_u \times \text{ERP.}$$

For a private business, the ungeared cost of equity can be estimated by taking the average or median of a sample of 'proxy' equity betas observed in the market (reflecting the same business risk characteristics as the private business), and adjusting for leverage to arrive at an average asset beta that can be used for the valuation and geared up to reflect leverage chosen for the valuation.

If financial risk is introduced via leverage, the asset beta needs to be increased to the equity beta (or geared / levered beta β_g) to reflect the extra risk:

$$\text{Cost of Equity (geared)}(K_g) = R_f + \beta_g \times \text{ERP.}$$

All components of the WACC will have a value weighted beta (geared equity beta β_g and debt beta β_d in this simple example) that measures the sensitivity of returns to market returns. If the debt beta is assumed to be zero, this assumes that debt holders do not bear any systematic risk and that equity investors are allocated all of the systematic risk.

The method chosen to calculate the geared equity beta makes implicit assumptions about debt financing policy (tax shield) and debt systematic risk (whether or not the debt beta is zero). This is discussed in more detail in [Appendix 2](#), but a brief technical discussion follows:

- **Ignoring tax**, the value of an ungeared company (V_u) should theoretically equal the value of an otherwise identical geared company ($V_g = D + E$) and the beta relationship would be:

$$\begin{aligned} \beta_u &= \beta_g \left(\frac{E}{D + E} \right) + \beta_d \left(\frac{D}{D + E} \right) \\ \therefore \beta_g &= \beta_u + (\beta_u - \beta_d) \frac{D}{E} \end{aligned}$$

³ R_f is typically measured using the yield to maturity, at the valuation date, for a government bond maturing in 10 years, in the same currency as the stock currency / cash flows. This yield is meant to estimate the risk free return over the period for which the cost of equity is being calculated, which for a constant cost of equity (or WACC) would be the life of the business or project. As risk free yields comprise a real risk free rate, a premium for expected inflation and a premium for market risk (the general level of interest rates affecting bond prices), a longer term bond might be more sensitive to unexpected changes in inflation and not risk free.

⁴ ERP should be a forward looking estimate, but may, in practice, be based on observed historic returns over a long term period, on the assumption that the ERP will revert to the long term average. An ERP, however, can be implied from current market prices using stock valuation tools. The ERP should be the market required return in excess of whatever risk free rate is used in the WACC

⁵ Asset betas can be estimated by de-levering observed quoted company equity betas, and are available from beta consultancy firms or other providers (e.g. Bloomberg).

If we assume $\beta_d = 0$, then

$$\beta_g = \beta_u \left(1 + \frac{D}{E} \right)$$

- **Including tax**, the value of an ungeared company V_u plus the value of the tax shield V_{TS} (PV of tax recoverable on debt interest cash flows) should equal the value of the otherwise identical geared company ($V_g = D + E$). The general equation for beta is calculated as follows:

$$\begin{aligned} V_u + V_{TS} &= E + D \\ \beta_u \left(\frac{V_u}{D + E} \right) + \beta_{TS} \left(\frac{V_{TS}}{D + E} \right) &= \beta_g \left(\frac{E}{D + E} \right) + \beta_d \left(\frac{D}{D + E} \right) \\ \therefore \beta_g &= \beta_u + (\beta_u - \beta_d) \frac{D}{E} - (\beta_u - \beta_{TS}) \frac{V_{TS}}{E} \quad \text{General } \beta \text{ Equation} \end{aligned}$$

If debt is assumed to vary as a constant proportion of enterprise value (debt amount = leverage % x Enterprise Value, where debt is continuously rebalanced to achieve the required leverage), the riskiness of the tax shield is the same as business risk and hence $\beta_{TS} = \beta_u$. This gives the same equation as if tax was ignored, and, as above, if we assume $\beta_d = 0$, the re-gearing beta formula becomes what is called the 'Practitioners' Formula':

$$\beta_g = \beta_u \left(1 + \frac{D}{E} \right)$$

If debt does not depend on the value of the business but is a known amount, the riskiness of the tax shield can be assumed to be the same as the riskiness of debt, so that $\beta_{TS} = \beta_d$. Assuming a perpetuity scenario, the PV of the tax shield would equal the tax on debt interest divided by the discount rate ψ :

$$V_{TS} = \frac{K_d \cdot t \cdot D}{\psi} \quad (K_d = \text{pre-tax cost of debt, } t = \text{tax rate, } D = \text{amount of debt})$$

If the tax shield risk equals the debt risk, $\psi = K_d$, so $V_{TS} = t \cdot D$

Substituting $\beta_{TS} = \beta_d$ and $V_{TS} = t \cdot D$ into the general beta equation and re-arranging, we have:

$$\beta_g = \beta_u + (\beta_u - \beta_d) \frac{D}{E} (1 - t)$$

If we assume $\beta_d = 0$, the re-gearing beta formula becomes what is called the 'Hamada Formula'.

$$\beta_g = \beta_u \left(1 + \frac{D}{E} (1 - t) \right)$$

WACC Formula

In the WACC formula, deductibility of interest is incorporated by reducing the cost of debt by the marginal tax rate (t):

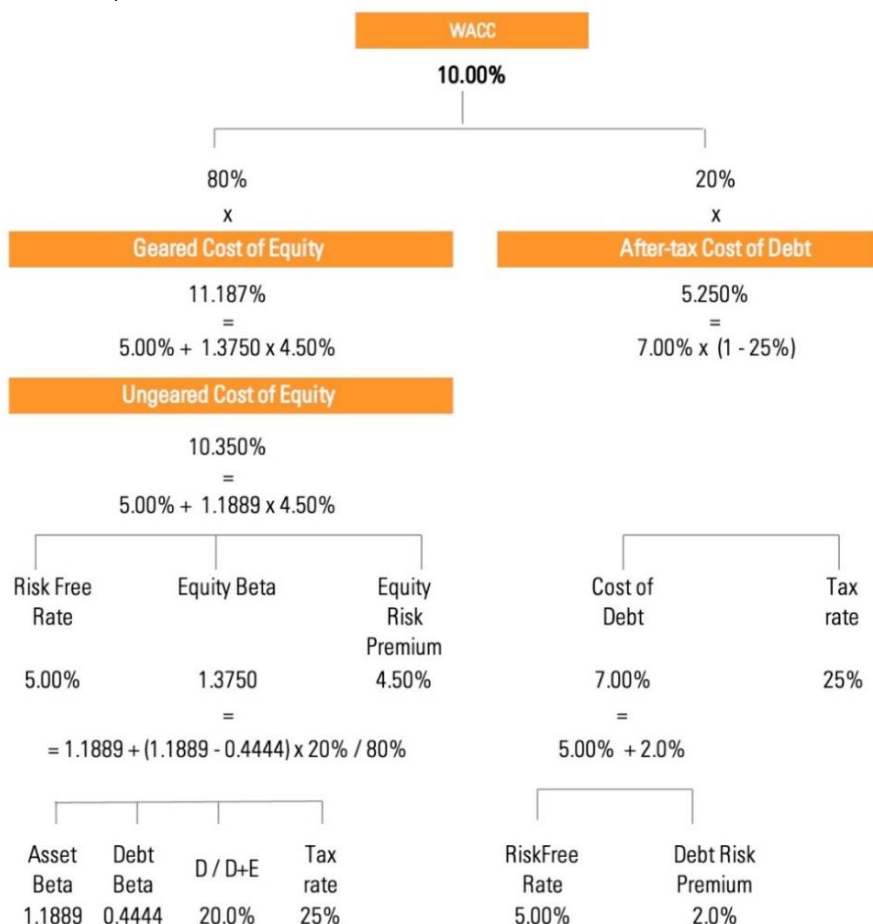
$$\begin{aligned} \text{WACC}_{\text{post-tax}} &= \text{Cost of Equity} \times \text{Equity weighting} + \text{Post-tax Cost of Debt} \times \text{Debt weighting} \\ &= K_g \times \left(\frac{E}{D + E} \right) + K_d (1 - t) \times \left(\frac{D}{D + E} \right) \end{aligned}$$

D and E represent the market values of debt (gross or net) and equity (D + E equals the Enterprise Value).

In the article 'Business Valuation: DCF Methods' it was noted that the DCF Enterprise Value is reduced by the market value of debt and items treated as debt for the valuation (debt-equivalents, like pension deficits) as part of the calculation to reach the DCF Equity Value. The financing claims included in the WACC calculation must be consistent with how FCFF and Enterprise Value are defined. Other non-operating net assets can be valued separately as part of the Enterprise-Equity Value 'Bridge'.

WACC Example

The following example assumes that debt depends on the enterprise value and that the debt beta is not zero (see [Appendix 1](#) for derivation of the WACC used in the example in Appendix 1 of 'Business Valuation: DCF Methods'):



The debt beta is calculated as Debt Risk Premium (2.0%) / Equity Risk Premium (4.50%). The asset beta is assumed and would be based on a sample of 'proxy' quoted companies.

This example uses the Harris & Pringle (1985) approach (see [Appendix 2](#)), and allows the Cost of Equity and WACC to be calculated ignoring the beta entirely:

$$\begin{aligned}
 K_g &= K_u + (K_u - K_d) \frac{D}{E} \\
 11.187\% &= 10.350\% + (10.350\% - 7.00\%) \times 20\% / 80\% \\
 WACC &= K_u - K_d \cdot t \cdot L \\
 10.000\% &= 10.350\% - 7.00\% \times 25\% \times 20\%
 \end{aligned}$$

PART 2: INTERNATIONAL WACC

Cross-Border Valuation and WACC

Foreign Risk

The return required by investors for investing in a business located outside their 'home' country will reflect the different risks compared to a business located in their jurisdiction. A number of variations to the general CAPM have been suggested to estimate the return required by equity investors ('home' investors) when they invest in entities located outside their jurisdiction ('foreign' or 'local' entities), where the risks are likely to be different to an otherwise identical business based in their home country. Such risks include: political risk (e.g. default on government bonds making them risky and not risk free, or tax changes), currency risk (e.g. exchange rate fluctuations affecting conversion of foreign currency to home currency denominated cash flows), and inflation risk (affecting nominal cash flows and discount rates). How these incremental risks are quantified and incorporated into the discount rate has led to a variety of approaches.

As for the general CAPM, the risk reflected in the discount rate should, the theory says, be risks that cannot be diversified away via portfolio allocation. The discount rate for an investor in a fully integrated market who holds a globally diversified portfolio that allows country risk to be diversified away is likely to be different to the rate for an investor in a segmented market who only holds investments in that market.

Basic International DCF Principles

Forecast cash flows should reflect the expected consequences of political risk. Scenario analysis that applies real-world probabilities to a mutually exclusive complete set of outcomes- including base, downside and, where relevant, upside scenarios - is one method [see Koller et al. (2025) p.818, Bekaert & Hodrick (2018) §14.2]. This is not the same as risk adjustment: "The expected cash flows, computed by considering the possibility of poor outcomes, are not risk adjusted... Risk adjustment requires us to adjust the expected cash flow further for its risk" [Damodaran (2026) p.51].

Expected losses are reflected in the cash flows. Assuming the marginal investor is globally diversified, the discount rate prices the covariance of those losses with the world market return - the undiversifiable (systematic) component- and that risk should be captured in the WACC to the extent it is not already reflected in the beta, equity risk premium or cost of debt. Godfrey & Espinosa (1996), although subsequently proposing a broader practical approach, summarise the traditional theoretical position as follows: “[T]he standard theory of capital budgeting goes on to suggest that, in assessing the risk and required return for a project using NPV analysis, companies should use discount rates that reflect only “covariance” risk [and] corporate planners should not adjust their required rates of return for ‘country-specific’ risks ... provided such risks can be diversified away by investors” [Godfrey & Espinosa (1996) p.81]. “[T]he final evaluation of specific projects should employ expected cash flows based on various scenarios, with discount-rate adjustments reflecting only market covariance risk” [Lessard (1996) p.59].

No further adjustments should be made to the probability-weighted cash flows to reflect a risk-pricing adjustment for the same risk; that would price the same risk twice. A country risk premium may also involve double-counting within the discount rate: “[To] the extent that the credit spread and the equity premium reflect the same underlying sources of uncertainty and volatility, such measures of country risk will involve ‘double counting’ and hence require a downward adjustment” [Godfrey & Espinosa (1996) p.82].

The article ‘Security Valuation: Option Pricing’ (p.7) illustrates the distinction using a binomial model, where a payoff can be valued by discounting expected values (real world) at the appropriate discount rate (risk-free rate plus risk premium) or by discounting its risk-neutral expected values (certainty equivalents) at the risk-free rate. Applying the risk premium to the risk-neutral expectation would double-count the premium.

Cash flows of the foreign operation can be forecasted in the foreign currency and:

- discounted at a rate that reflects that currency, in either real or nominal terms, and the present value translated into the home currency at the valuation date spot rate, or
- translated into home currency at expected future exchange rates and discounted at a rate based on the home currency.

The discount rate must be consistent with how the cash flows are measured, so a nominal or real foreign ($WACC_{Fn}, WACC_{Fr}$) or home ($WACC_{Hn}, WACC_{Hr}$) rate must match with nominal or real foreign or home currency cash flows. If only inflation and exchange rates are determining factors, real home and real foreign discount rates should in theory be the same, where $(1 + WACC_{Hn}) / (1 + \text{home inflation rate}) = (1 + WACC_{Fn}) / (1 + \text{foreign inflation rate})$. This assumes all cash flow components are affected equally by inflation, which might not arise in practice. The first step would be to forecast FCFF in local currency nominal values ($FCFF_{N/LC}$), based on probability-weighted outcomes. The next step is to decide which route to take: translate and discount nominal local currency FCFF to home currency PV with or without deflating:

FCFF (Nominal – Local Currency):	N - LC	N – LC	N – LC	N - LC
<i>Translate at forecast exchange rate</i>	✗	✓	✗	✗
<i>Deflate nominal to real cash flows</i>	✗	✗	✓	✓
<i>Translate at spot exchange rate at valuation date</i>	✗	✗	✗	✓
FCFF (Nominal/Real – Local/Home Currency):	N - LC	N - HC	R - LC	R - HC
<i>Discount at Nominal / Local Currency WACC</i>	✓	✗	✗	✗
<i>Discount at Nominal / Home Currency WACC</i>	✗	✓	✗	✗
<i>Discount at Real / Local Currency WACC</i>	✗	✗	✓	✗
<i>Discount at Real / Home Currency WACC</i>	✗	✗	✗	✓
<i>Translate at spot exchange rate at valuation date</i>	✓	✗	✓	✗
Present Value in Home Currency	PV _{HC}	PV _{HC}	PV _{HC}	PV _{HC}

The PV is the same in all pathways because interest, exchange and inflation rate differentials have been set to be consistent with relevant parity relationships, and the real WACC is the same in both markets (home and local). In the following example, valuation date spot exchange rates are used to translate the present value of local currency cash flows (nominal and real) and actual value of home currency cash flows (real); forecast equilibrium (parity) exchange rates are used to translate the actual value of home currency cash flows (nominal).

	Nominal N	Local L		FORECAST YEAR					
	Real R	Home H	Year 2 workings	0	1	2	3	4	5
DCF PATHWAYS									
Nominal, local currency FCFF	N	L			500.0	800.0	1,245.0	1,710.0	2,120.0
Nominal:									
Nominal, local discount rate	N	L	See Assumptions		15.654 %	16.169 %	16.684 %	16.684 %	16.684 %
Discount factor			= 1 / (1 / 0.8647 x (1 + 16.17%))		0.8647	0.7443	0.6379	0.5467	0.4685
PV - Nominal, Local				3,750.0	432.3	595.4	794.2	934.8	993.2
Spot rate				125.00					
PV - home currency				PV = 30.0					
Parity (equilibrium) exchange rate _t			See Assumptions	125.00	131.74	139.49	148.38	157.83	167.89
Nominal, home currency FCFF	N	H	= 800.00 / 139.49		3.8	5.7	8.4	10.8	12.6
Nominal, home discount rate	N	H	See Assumptions		9.737 %	9.715 %	9.693 %	9.693 %	9.693 %
Discount factor			= 1 / (1 / 0.9113 x (1 + 9.71%))		0.9113	0.8306	0.7572	0.6903	0.6293
PV - home currency				PV = 30.0	3.5	4.8	6.4	7.5	7.9
Real:									
Inflation index		L	= 1.075 x (1 + 8.000%)		1.075	1.161	1.260	1.367	1.483
Real, local currency FCFF	R	L	= 800.00 / 1.161		465.1	689.1	988.3	1,251.1	1,429.6
Real, local & home discount rate	R	L = H	See Assumptions		7.585 %	7.564 %	7.543 %	7.543 %	7.543 %
Discount factor			= 1 / (1 / 0.9295 x (1 + 7.56%))		0.9295	0.8641	0.8035	0.7472	0.6948
PV - Real, Local				3,750.0	432.3	595.4	794.2	934.8	993.2
Spot rate				125.00					
PV - home currency				PV = 30.0					
Real, local currency FCFF	R	L			465.1	689.1	988.3	1,251.1	1,429.6
Spot rate					125.00	125.00	125.00	125.00	125.00
Real, home currency FCFF	R	H	= 689.06 / 125.00		3.7	5.5	7.9	10.0	11.4
PV - home currency				PV = 30.0	3.5	4.8	6.4	7.5	7.9

				FORECAST YEAR					
				0	1	2	3	4	5
DISCOUNT RATES									
WACC - Local									
Real Risk Free Rate	R	L = H	See Assumptions		3.000 %	3.000 %	3.000 %	3.000 %	3.000 %
Inflation		L			7.500 %	8.000 %	8.500 %	8.500 %	8.500 %
Nominal Risk Free Rate	N	L	$= (1 + 3.000\%) \times (1 + 8.000\%) - 1$	10.725 %	11.240 %	11.755 %	11.755 %	11.755 %	11.755 %
Risk Premium		L = H	See Assumptions	4.929 %	4.929 %	4.929 %	4.929 %	4.929 %	4.929 %
Nominal Discount Rate	N	L	$= 11.240\% + 4.929\%$	15.654 %	16.169 %	16.684 %	16.684 %	16.684 %	16.684 %
Real Discount Rate	R	L = H	$= (1 + 16.169\%) / (1 + 8.000\%) - 1$	7.585 %	7.564 %	7.543 %	7.543 %	7.543 %	7.543 %
WACC - Home									
Real Risk Free Rate	R	H = L	See Assumptions		3.000 %	3.000 %	3.000 %	3.000 %	3.000 %
Inflation		H	See Assumptions		2.000 %	2.000 %	2.000 %	2.000 %	2.000 %
Nominal Risk Free Rate	N	H	$= (1 + 3.000\%) \times (1 + 2.000\%) - 1$	5.060 %	5.060 %	5.060 %	5.060 %	5.060 %	5.060 %
Risk Premium		H = L	See Assumptions	4.929 %	4.929 %	4.929 %	4.929 %	4.929 %	4.929 %
Inflation differential			See above	x 0.9488	x 0.9444	x 0.9401	x 0.9401	x 0.9401	x 0.9401
Risk Premium adjusted	N	H	$= 4.929\% \times 0.9444$	4.677 %	4.655 %	4.633 %	4.633 %	4.633 %	4.633 %
Nominal Discount Rate	N	H	$= 5.060\% + 4.655\%$	9.737 %	9.715 %	9.693 %	9.693 %	9.693 %	9.693 %
Real Discount Rate	R	H = L	$= (1 + 9.715\%) / (1 + 2.000\%) - 1$	7.585 %	7.564 %	7.543 %	7.543 %	7.543 %	7.543 %
DIFFERENTIALS									
Exchange rates			$= 139.490 / 131.740$	1.0539	1.0588	1.0637	1.0637	1.0637	1.0637
Interest: $(1 + R.L) / (1 + R.H)$			$= (1 + 11.240\%) / (1 + 5.060\%)$	1.0539	1.0588	1.0637	1.0637	1.0637	1.0637
Inflation: $(1 + Inf.L) / (1 + Inf.H)$			$= (1 + 8.000\%) / (1 + 2.000\%)$	1.0539	1.0588	1.0637	1.0637	1.0637	1.0637
Risk Premium			$= 4.929\% / 4.655\%$	1.0539	1.0588	1.0637	1.0637	1.0637	1.0637
$(1 + \text{Nominal Home Discount Rate})$			$= 1 + 9.715\%$	1.0974	1.0971	1.0969	1.0969	1.0969	1.0969
x Inflation: $(1 + Inf.L) / (1 + Inf.H) - 1$			$= 109.715\% \times 1.0588$	15.654 %	16.169 %	16.684 %	16.684 %	16.684 %	16.684 %
ASSUMPTIONS									
Free Cash Flows to the Firm (FCFF)	N	L		500.0	800.0	1,245.0	1,710.0	2,120.0	
Real Risk Free Rate	R	H = L		3.000 %	3.000 %	3.000 %	3.000 %	3.000 %	
Risk Premium	N	H = L		4.929 %	4.929 %	4.929 %	4.929 %	4.929 %	
Inflation (Home)		H		2.000 %	2.000 %	2.000 %	2.000 %	2.000 %	
Inflation (Local)		L		7.500 %	8.000 %	8.500 %	8.500 %	8.500 %	
Parity (equilibrium) exchange rate _t			$= 131.740 \times (1 + 8.000\%) / (1 + 2.000\%)$	125.00	131.74	139.49	148.38	157.83	167.89

Cost of Foreign Equity

When using the CAPM to estimate the return required (cost of equity) by a globally diversified investor in a world with fully integrated markets, the undiversifiable (systematic) risk from investing in any given company, wherever located, will reflect how that company's returns vary with the world market returns (the beta for that local company measured against the world market returns x the world equity risk premium, 'ERP'). In this case, the local market is treated as part of the world market and a 'World CAPM' (or 'Global CAPM') would be appropriate. "If world capital markets are integrated, then the CAPM should hold and expected returns are determined by their covariance with world returns... [However] the following problem exists when applying a world CAPM to individual stocks in emerging markets. When regressing the company return (measured in U.S. dollars) on the benchmark return (either U.S. portfolio or the world portfolio), the beta is either indistinguishable from zero or negative." [Harvey (2005), p.4,5]

The World CAPM version assumes markets are fully integrated and real risk free rates are the same in every country. If parity conditions do not apply, a risk premium for systematic currency exposure can be added, converting the single factor World CAPM to the two-factor International CAPM (Solnik (1974), Sercu (1980), Adler & Dumas (1983)). The extra term reflects the exposure of the company returns to a weighted foreign currency index (currency beta) and the risk premium for systematic exchange rate risk.

If a local market is not integrated with any other market but is segmented (for example, due to foreign direct investment restrictions), local risks are priced by local investors and a 'Local CAPM' would be suitable: "If a country is segmented from the rest of the world, then an asset's expected return should be related to the covariance with the local market return." [Harvey (2005), p.4].

If it is assumed that markets are partly integrated and investors globally diversified, then the World CAPM (or a proxy version using US parameters) can be adjusted for local undiversifiable risk, such as country risks that are not reflected in the ERP, by either adding an extra premium for country risk and/or adjusting the beta. A number of versions have been proposed that add a premium for country risk either alone or combined with an adjustment to the company's equity risk premium [see Bodnar (2003), Estrada (2007), Horn (2017), Harrington et al. (2023)].

See [Appendix 3](#) for a discussion of the various models proposed.

CONCLUSION

The traditional DCF method discussed in the article 'Business Valuation: DCF Methods' estimates the intrinsic value of a business (operating Enterprise Value) by discounting expected (probability-weighted) Free Cash Flows to the Firm (FCFF) at the post-tax weighted average cost of capital (WACC). Each provider of financial capital - assumed in this article to be lenders and shareholders – requires an expected Total Return (capital gain plus income, as a percentage of opening market value) equal to what it could earn on an alternative investment with identical risk (an opportunity cost), comprising a risk-free rate plus a risk premium. The WACC is a blended rate with each return weighted by the market value of each provider's claim. The required return for debt holders (pre-tax cost of debt) is the expected yield to maturity and is adjusted for tax relief on interest to determine the post-tax cost of debt. The required return for equity investors under CAPM is the risk-free rate plus the beta-adjusted market equity risk premium that rewards investors only for risk that cannot be diversified away (systematic risk).

When using this standard method of calculating WACC in a DCF, a number of issues need to be considered:

- Assumptions about leverage - whether or not debt is assumed to be a percentage of the entity market value, as measured by the operating DCF enterprise value - should be treated appropriately in the CAPM-derived cost of equity calculation (specifically, the riskiness of the tax shields and treatment of tax in the equity beta calculation). For a mature business, a constant leverage assumption (net debt / operating DCF enterprise value) using the Harris & Pringle beta re-levering formula (reducing to the Practitioners' beta formula if $\beta_d = 0$ - see A2.12 in Appendix 2) would be a reasonable approach (less so for a leveraged buyout or project finance valuation, where debt depends on factors other than the value of the business).
- The CAPM inputs should be estimated using best practice approaches: a risk-free rate based on default-free government bond yields for a 10 year maturity; an asset / ungeared beta correctly

derived from an observable equity beta for a selection of comparable 'pure play' proxy businesses; an equity / geared beta re-geared using an appropriate method; a market equity risk premium that is consistent with the risk free maturity and is forward looking.

- A cross-border valuation should incorporate overseas risk (political, inflation, exchange rate) in the cash flows and discount rate in a theoretically correct and consistent manner (without double counting).
- The base case WACC assumption should be adjusted up and down to determine the enterprise value for a range of WACC. This is particularly important for the TV, which normally accounts for a significant proportion of the enterprise value (for example, in Appendix 1, a 10% base case WACC with a +/- 1% adjustment produces a TV range of $849.52^{-106.25} / +141.51$ or $^{-12.5\%} / +16.7\%$).

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A.I. Disclosure

The author wrote the article and built the Excel models. A.I. (Claude Opus 5 and Codex GPT-6 Astra) assisted with the following: (1) general: checking formulae, example arithmetic, cross references, citations and consistencies; (2) specific: cross-border CAPM versions in App. 3, the nature of relevant risks and the final CAPM comparison spreadsheet.

Appendix 1: WACC Example

The DCF example in Appendix 1 of the article 'Business Valuation: DCF Methods' uses a constant WACC each period, where net debt is set as a constant proportion (20%) of the enterprise value. Following the principles in Appendix 2, the tax shields are discounted at the ungeared cost of equity and hence re-levering of the beta ignores the tax adjustment $(1 - t)$. The procedure involves working backwards from the terminal value, setting debt at 20% of enterprise value at each date.

DCF VALUATION

		Forecast Year				
		1	2	3	4	5
Free Cash Flows to the Firm		70.62	52.39	54.42	56.05	57.73
Terminal Value		-	-	-	-	849.52
Post-Tax WACC at start of year		10.00%	10.00%	10.00%	10.00%	10.00%
Discount factor		0.9091	0.8264	0.7513	0.6830	0.6209
PV of cash flows today	750.00	64.20	43.30	40.89	38.28	563.33
less: market value of debt at valuation date	(150.00)					
Equity Value	600.00					
Enterprise value at year end	750.00	754.38	777.43	800.75	824.77	849.52
Debt	(150.00)	(150.88)	(155.49)	(160.15)	(164.95)	(169.90)
Equity	600.00	603.51	621.94	640.60	659.82	679.61
Debt / Enterprise Value		20.00%	20.00%	20.00%	20.00%	20.00%

FCFF Perpetuity TV

Final year FCFF	57.73
Growth rate	3.00%
Discount rate	10.00%
TV = $57.73 \times (1 + 3.00\%) / (10.00\% - 3.00\%)$	849.52

Final year NOPAT	76.17		
Reinvestment Rate	24.20%	g	3.00%
FCFF	57.73	RONIC	12.40%
First terminal period EBITDA			189.43
Implied Forward EBITDA x			x 4.5

Cost of debt

Risk free rate	R_f	5.00%	5.00%	5.00%	5.00%	5.00%
Debt Risk Premium	DRP	2.00%	2.00%	2.00%	2.00%	2.00%
Pre-tax cost of debt	K_d	7.00%	7.00%	7.00%	7.00%	7.00%
Tax rate	t	25.00%	25.00%	25.00%	25.00%	25.00%
Post-tax cost of debt	K_{dt}	5.25%	5.25%	5.25%	5.25%	5.25%
Debt ratio - target assumed	L	20.00%	20.00%	20.00%	20.00%	20.00%
Weighted rate		1.050%	1.050%	1.050%	1.050%	1.050%

Cost of equity

Risk free rate	R_f	5.00%	5.00%	5.00%	5.00%	5.00%
Equity risk premium	ERP	4.50%	4.50%	4.50%	4.50%	4.50%
Ungeared, assets beta	β_a	1.1889	1.1889	1.1889	1.1889	1.1889
Implied debt beta		0.4444	0.4444	0.4444	0.4444	0.4444
Ungeared cost equity	K_u	10.35%	10.35%	10.35%	10.35%	10.35%
Geared equity beta	β_e	1.3750	1.3750	1.3750	1.3750	1.3750
Geared Cost of Equity	K_g	11.19%	11.19%	11.19%	11.19%	11.19%
Equity ratio	1 - L	80.00%	80.00%	80.00%	80.00%	80.00%
Weighted rate		8.950%	8.950%	8.950%	8.950%	8.950%

WACC (post-tax)

WACC (pre-tax) (i.e. assume $t = 0$)

		Forecast Year				
		1	2	3	4	5
WACC (post-tax)		10.00%	10.00%	10.00%	10.00%	10.00%
WACC (pre-tax) (i.e. assume $t = 0$)		10.35%	10.35%	10.35%	10.35%	10.35%

MM Theory

Ignoring the tax benefits of debt, Modigliani & Miller (MM 1958) stated that the value of a business should not be affected by how it is financed, as FCFF will be the same ($FCFF_{\text{ungeared}} = FCFF_{\text{geared}}$), implying the WACC will be the same with or without any leverage. If the tax deductibility of interest is considered (MM 1963), the value of the geared business will be greater than the value of the ungeared business due to the present value of the tax inflows ('Tax Shield' / 'TS') from interest deductibility (Value of the 'Tax Shield' / 'V_{TS}')

$$\text{Value of geared firm (V}_g\text{)} = \text{Value of ungeared (V}_u\text{)} + V_{TS}$$

$$\text{and since } V_g = \text{Equity Market Value (E)} + \text{Debt Market Value (D)}$$

$$V_u + V_{TS} = E + D$$

$$\text{so } V_u = E + D - V_{TS}$$

Assuming perpetual debt of D (a constant amount each year), with interest at the cost of debt K_d paid annually in perpetuity, V_{TS} can be calculated using the no-growth perpetuity formula (see Part 1), discounted at a rate Ψ that reflects the riskiness of the tax shield, so that:

$$V_g = V_u + \frac{K_d \cdot t \cdot D}{\Psi} \Leftrightarrow V_{TS}$$

Assuming $\Psi = K_d$ (MM also assumed $K_d = R_f$), this expression simplifies to:

$$V_g = V_u + t \cdot D$$

Myers (1974) assumed $\Psi = K_d$ (but not $K_d = R_f$) on the basis that debt levels do not depend on FCFF or the EntV and the risk of tax shields relates to the ability of the business to generate sufficient income to offset the tax deductions. Miles and Ezzell (1980) assumed debt was periodically rebalanced, based on the assumed leverage as from the end of the first year rather than the valuation date. As the interest in the first year would be known, based on an assumed amount of debt at the valuation date (not dependent on the value of the business), the tax shield in the first year would be discounted at the cost of debt (risk-free rate if debt is riskless) and thereafter at the ungeared cost of equity. The valuation at any future date would follow the same principle in respect of new debt issues in the first year after the valuation date. Harris and Pringle ('HP') (1985) assumed $\Psi = K_u$ on the basis that debt levels (leverage) depend on the EntV and hence FCFF and business risk. As the tax shield cash flows depend on the value of the business, they should be discounted at the ungeared cost of equity (it is assumed that debt is continually adjusted to ensure leverage is constant with effect from the valuation date)

General Tax Shield Equations

Finite period (general equation)

FCFF are distributed to equity investors ('Cash Flows to Equity' / 'CFE' = dividends + stock repurchases) and debt providers ('Cash Flows to Debt' / 'CFD' = pre-tax interest + principal decrease / - principal increase) after tax relief on interest ('Tax Shield' cash flows = pre-tax interest x tax rate):

$$\text{FCFF} = \text{CFE} + \overbrace{(\text{D}_{n-1} - \text{D}_n + \text{K}_d \text{D}_{n-1})}^{\text{CFD}} - \overbrace{t \cdot \text{K}_d \text{D}_{n-1}}^{\text{Tax Shield (TS)}}$$

Cash flows can be expressed in terms of the change in values due to required returns:

$$\begin{aligned}\text{FCFF}_n &= (1 + \text{WACC}_g) V_{g_{n-1}} - V_{g_n} \\ \text{CFE}_n &= (1 + \text{K}_g) E_{g_{n-1}} - E_{g_n} \\ \text{CFD}_n &= (1 + \text{K}_d) D_{n-1} - D_{g_n} \\ \text{TS}_n &= (1 + \Psi) V_{\text{TS}_{n-1}} - V_{\text{TS}_n}\end{aligned}$$

Substituting into the above FCFF equation:

$$V_{g_{n-1}} \cdot \text{WACC}_g = E_{n-1} \cdot \text{K}_{g_n} + D_{n-1} \cdot \text{K}_{d_n} - D_{n-1} \cdot \text{K}_{d_n} t$$

$$\begin{aligned}\therefore \text{WACC}_{g_n} &= \frac{E_{n-1} \cdot \text{K}_{g_n}}{V_{g_{n-1}}} + \frac{D_{n-1} \cdot \text{K}_{d_n} (1 - t)}{V_{g_{n-1}}} \\ &= \frac{E_{n-1}}{(D + E)_{n-1}} \text{K}_{g_n} + \frac{D_{n-1}}{(D + E)_{n-1}} \text{K}_{d_n} (1 - t)\end{aligned}$$

The traditional WACC formula
(see: Fernandez (2011) Exhibit 1;
Mejia-Pelaez & Vélez-Pareja
(2011) App.C)

where:

V_{TS}, D, E - market values of tax shields, debt and equity, respectively

$\text{K}_g, \text{K}_d, \Psi$ - required return on equity and debt and the discount rate for tax shields

Under MM, the expected returns on the value of equity and debt equal the expected returns on the value of ungeared equity and the value of the tax shield:

$$E \text{K}_g + D \text{K}_d = V_u \text{K}_u + V_{\text{TS}} \Psi$$

Since $V_u = E + D - V_{\text{TS}}$

$$\boxed{\text{K}_g = \text{K}_u + (\text{K}_u - \text{K}_d) \frac{D}{E} - (\text{K}_u - \Psi) \frac{V_{\text{TS}}}{E}}$$

A2.1

Note: $D / E = L / (1 - L)$, where L is the leverage % $D / (D + E)$ (or D / V_g)

(See: Koller et al. (McKinsey)(2025) Eq.C.6 p.878); Tham & Vélez–Pareja (2019) Eq.14; Mejia-Pelaez & Vélez–Pareja (2011) Eq.2; Vélez–Pareja, Ibragimov & Tham (2008) p.17)

From the above equation for $V_{g_{n-1}}$. WACC_g:

$$V_{g_{n-1}} \cdot WACC_g + D_{n-1} \cdot K_d \cdot t = E_{n-1} \cdot K_{g_n} + D_{n-1} \cdot K_{d_n}$$

Substituting K_g in the general equation (A2.1) into the above:

$$WACC_g \cdot V_g + TS = \left(K_u + \frac{(K_u - K_d) D}{E} - \frac{(K_u - \psi) V_{TS}}{E} \right) E + K_d \cdot D$$

After re-arranging, this becomes the general WACC formula (see: Tham & Vélez–Pareja, I (2019) Eq. 28; Mejia-Pelaez & Vélez–Pareja (2011) Eq.3):

$$WACC = K_u - (K_u - \psi) \frac{V_{TS}}{D + E} - \frac{TS}{D + E} \quad \text{A2.2}$$

Note: $TS = K_d \cdot t \cdot D$ where $L = D / (D + E)$ and $D + E = V_g$

Perpetuity (general equation)

With constant growth, the value of the tax shield is (see: Mejia-Pelaez & Vélez–Pareja (2011) Eq.6):

$$V_{TS} = \frac{TS}{\psi - g} = \frac{K_d \cdot t \cdot D}{\psi - g}$$

The general equation K_g for a constant growth perpetuity is the finite equation (A2.1) with V_{TS} adjusted for growth:

$$K_g = K_u + \frac{(K_u - K_d) D}{E} - (K_u - \psi) \frac{\frac{TS}{\psi - g}}{E}$$

$$K_g = K_u + \frac{(K_u - K_d) D}{E} - (K_u - \psi) \left(\frac{K_d \cdot t}{\psi - g} \right) \frac{D}{E} \quad \text{A2.3}$$

The general equation WACC_g for a constant growth perpetuity is:

$$\begin{aligned} WACC &= K_u - (K_u - g) \frac{V_{TS}}{D + E} \quad (\text{see Fernandez (2011) Eq.10):} \\ &= K_u - (K_u - g) \frac{\frac{TS}{\psi - g}}{D + E} \quad (\text{see Vélez–Pareja (2005) Eq. B7d}) \end{aligned}$$

$$WACC = K_u - (K_u - g) \left(\frac{K_d \cdot t \cdot L}{\psi - g} \right) \quad \text{A2.4}$$

The general equations K_g and WACC for a zero growth perpetuity are (setting $g = 0$ in A2.3 and A2.4):

$$\begin{aligned}
 K_g &= K_u + (K_u - K_d) \frac{D}{E} - (K_u - \Psi) \frac{K_d \cdot t \cdot D}{\Psi E} \\
 \text{WACC} &= K_u \left(1 - \frac{K_d \cdot t \cdot L}{\Psi} \right) \\
 &= K_u \left(1 - \frac{V_{TS}}{V_g} \right)
 \end{aligned}$$

$$\text{Since } \frac{K_d \cdot t \cdot L}{\Psi} = \frac{K_d \cdot t \cdot (D / V_g)}{\Psi} \quad \text{and} \quad V_{TS} = \frac{K_d \cdot t \cdot D}{\Psi} \quad \text{when } g = 0$$

Beta

Weighted average betas can be applied to each component of the equation above:

$$\begin{aligned}
 V_u + V_{TS} &= E + D \\
 \beta_u \left(\frac{V_u}{D + E} \right) + \beta_{TS} \left(\frac{V_{TS}}{D + E} \right) &= \beta_g \left(\frac{E}{D + E} \right) + \beta_d \left(\frac{D}{D + E} \right)
 \end{aligned}$$

In terms of the equity or geared beta, this can be re-arranged into a general equation:

$$\beta_g = \beta_u + (\beta_u - \beta_d) \left(\frac{D}{E} \right) - (\beta_u - \beta_{TS}) \left(\frac{V_{TS}}{E} \right) \quad \text{A2.5}$$

Assuming $\Psi = K_u$ (Harris & Pringle)

Finite Period ($\Psi = K_u$)

If $\Psi = K_u$, it is assumed tax shield cash flows vary with FCFF and depend on the business risk.

The general equation for K_g over a finite period (eq. A2.1) with $\Psi = K_u$ is adjusted to (see: Vélez–Pareja, Ibragimov & Tham (2008) p.17):

$$\begin{aligned}
 K_g &= K_u + (K_u - K_d) \frac{D}{E} - (K_u - K_u) \frac{V_{TS}}{E} \\
 \therefore K_g &= K_u + (K_u - K_d) \frac{D}{E} \quad \text{A2.6}
 \end{aligned}$$

The general equation for $WACC_g$ over a finite period (eq.A2.2) with $\Psi = K_u$ is adjusted to (see: Vélez–Pareja, Ibragimov & Tham (2008) p.17):

$$\begin{aligned}
 WACC &= K_u - (K_u - K_u) \frac{V_{TS}}{D+E} - \frac{TS}{D+E} \\
 \therefore WACC &= K_u - \frac{TS}{D+E} \\
 \therefore WACC &= K_u - K_d.t. \frac{D}{D+E} \\
 \therefore WACC &= K_u - K_d.t. L
 \end{aligned}$$

A2.7

This is the general equation for a zero growth perpetuity WACC with K_u replacing Ψ

$$WACC = K_u \left(1 - \frac{K_d.t.L}{\Psi} \right) \rightarrow K_u \left(1 - \frac{K_d.t.L}{K_u} \right) \rightarrow K_u - K_d.t.L$$

Perpetuity ($\Psi = K_u$)

With constant growth and $\Psi = K_u$, the value of the tax shield is (see: Fernandez (2011) Eq.4):

$$V_{TS} = \frac{TS}{K_u - g} = \frac{K_d.t.D}{K_u - g}$$

The general equation K_g for a constant growth perpetuity (eq.A2.3) with $\Psi = K_u$ is adjusted to:

$$\begin{aligned}
 K_g &= K_u + (K_u - K_d) \frac{D}{E} - (K_u - K_u) \frac{K_d.t}{K_u - g} \frac{D}{E} \\
 K_g &= K_u + (K_u - K_d) \frac{D}{E}
 \end{aligned}$$

same as finite

The general equation $WACC_g$ for a constant growth perpetuity (eq.A2.4) with $\Psi = K_u$ is adjusted to

$$\begin{aligned}
 WACC &= K_u - (K_u - g) \left(\frac{K_d.t.L}{K_u - g} \right) \\
 WACC &= K_u - K_d.t.L
 \end{aligned}$$

same as finite

Note: The equations for perpetuities are the same whether or not $g = 0$

Assuming $\Psi = K_d$ (Myers)

Finite Period ($\Psi = K_d$)

If $\Psi = K_d$, it is assumed tax shield cash flows do not depend on FCFF and business risk.

The general equation for K_g over a finite period with $\Psi = K_d$ is adjusted to (see: Vélez–Pareja, Ibragimov & Tham (2008) p.18):

$$K_g = K_u + (K_u - K_d) \frac{D}{E} - (K_u - K_d) \frac{V_{TS}}{E}$$

$$\therefore K_g = K_u + (K_u - K_d) \left(\frac{D}{E} - \frac{V_{TS}}{E} \right)$$
A2.8

The general equation for $WACC_g$ over a finite period with $\Psi = K_d$ is adjusted to (see: Vélez–Pareja, Ibragimov & Tham (2008) p.18):

$$WACC = K_u - (K_u - K_d) \frac{V_{TS}}{D + E} - \frac{TS}{D + E}$$
A2.9

Perpetuity ($\Psi = K_d$)

With positive growth and $\Psi = K_d$, the value of the tax shield is:

$$V_{TS} = \frac{K_d \cdot t \cdot D}{K_d - g}$$

The general equation K_g for a growing perpetuity with $\Psi = K_d$ is adjusted to:

$$K_g = K_u + \underbrace{(K_u - K_d) \frac{D}{E}}_{K_g \text{ if } \Psi = K_d} - (K_u - K_d) \cdot \left(\frac{K_d \cdot t}{K_d - g} \right) \frac{D}{E}$$

$$K_g = K_u + (K_u - K_d) \frac{D}{E} \left(1 - \frac{K_d \cdot t}{K_d - g} \right)$$
A2.10

The general equation $WACC_g$ for a growing perpetuity with $\Psi = K_d$ is adjusted to:

$$WACC = K_u - (K_u - g) \left(\frac{K_d \cdot t \cdot L}{K_d - g} \right)$$

A2.11

This assumes D grows at g

The general equations for K_g and WACC for a zero growth perpetuity with $\Psi = K_d$ are adjusted to (setting $g = 0$ in A2.10 and A2.11) (see Holthausen & Zmijewski (2012) p.63):

$$\begin{aligned} K_g &= K_u + (K_u - K_d) \frac{D}{E} (1 - t) \\ WACC &= K_u \left[1 - t \cdot L \right] \end{aligned}$$

Note: $V_{TS} = t \cdot D$ (with zero growth and $\Psi = K_d$)

Beta Re-levering

If debt is set as a proportion of the EntV ($D = \text{leverage} \times \text{EntV}$), the amount of debt will depend on business risk, so $\beta_u = \beta_{TS}$. The general beta equation (eq. A2.5) can be adjusted (see: Koller et al. (McKinsey)(2025) Exhibit C.3 p.880): Oded, Michel & Feinstein (2011) p.687):

$$\beta_g = \beta_u + (\beta_u - \beta_d) \left(\frac{D}{E} \right) - (\beta_u - \beta_d) \left(\frac{V_{TS}}{E} \right)$$

$$\beta_g = \beta_u + (\beta_u - \beta_d) \left(\frac{D}{E} \right) \quad \text{Harris \& Pringle re-levering formula}$$

If we assume $\beta_d = 0$ ('Practitioners' formula):

$$\beta_g = \beta_u \left(1 + \frac{D}{E} \right)$$

A2.12

If the amount of D is known and does not depend on the value of the business, the riskiness of the tax shield can be assumed the same as the riskiness of debt, so that $\Psi = K_d$ and $\beta_{TS} = \beta_D$. The equity beta formula (A2.5) becomes:

$$\beta_g = \beta_u + (\beta_u - \beta_d) \left(\frac{D}{E} \right) - (\beta_u - \beta_d) \left(\frac{V_{TS}}{E} \right)$$

$$\beta_g = \beta_u + (\beta_u - \beta_d) \frac{D(1-t)}{E}$$

where $V_{TS} = \frac{K_d \cdot t \cdot D}{K_d}$

If it is assumed $\beta_d = 0$, the general beta equation is the 'Hamada' equation (see Koller et al. (McKinsey) (2025) Exhibit C.3 p.880), Oded, Michel & Feinstein (2011) p.684 and Hamada (1972)):

$$\beta_g = \beta_u \left(1 + \frac{D}{E} (1 - t) \right) \quad D \text{ is constant} \quad \boxed{\text{A2.13}}$$

As Arzac (2008) states: [The Hamada] "equation ... is a special result that applies only when the level of net debt is constant and the tax shield is riskless..... [and] does not apply in the important case in which the firm maintains a constant net debt ratio and cash flows are discounted at the weighted average cost of capital (WACC)" (see also Koller et al. (McKinsey) (2025) p.318). Therefore, the Practitioners formula (eq. A2.12) should be used (provided a zero debt beta is assumed) when adjusting the asset beta for financial risk in a DCF valuation where WACC uses leverage based on market values (forecast debt theoretically should be based on this leverage as applied to period end EntVs).

Introduction

This appendix discusses versions of the Capital Asset Pricing Model that have been suggested when estimating the cost of equity (K) to use in the WACC for an overseas business DCF valuation. They differ because of assumptions about investor diversification, market integration, relevant political risk and other risk that should be priced.

World or Global CAPM

K (in US\$)	=	$R_{f\\$}$ + $\beta_{i,W,\\$}$ x $ERP_{W,\\$}$
$R_{f\$}$		US risk-free rate
$\beta_{i,W,\$}$		Beta of local company i returns measured directly against world market:
	$= \frac{\text{Cov}(r_i, r_w)}{\text{Var}(r_w)} = \rho_{i,W} \left(\frac{\sigma_i}{\sigma_W} \right)$	
	where $\rho_{i,W}$	correlation coefficient of the return on the local company to the world market return
	$\sigma_i \sigma_W$	standard deviation of local company and world market returns
$ERP_{W,\$}$		World market equity risk premium (expressed in US\$)

See O'Brien (1999) for a discussion on how to express a US dollar World CAPM rate in another currency – it is not achieved by simply translating the rate at the spot exchange rate.

The ERP and risk free rates must be in the same currency and relate to the world or local market, as measured by a representative market index (e.g. the MSCI All Country World Index). In practice, a developed market, such as the US market, may be used as a proxy for the world market.

International CAPM

K (in US\$)	=	R_{fW} + $\beta_{i,W}'$ ERP_W + $\gamma_{i,C}'$ RPC
R_{fW}		World risk free rate (US dollar proxy rate)
$\beta_{i,W}'$. ERP_W		Beta against world market x world Equity Risk Premium
$\gamma_{i,C}'$. RPC		Beta against weighted currency index x Currency Risk Premium

Studies have suggested for some countries the difference between the single Global CAPM ('GCAPM') and two factor model International CAPM ('iCAPM') is not significant: "The GCAPM may be an acceptable alternative to the ICAPM for the average stock of some countries but not for many others" [Ejara et al. (2020)]. That paper studied 46 countries over Jan 1999 to Dec 2016: "The GCAPM tends to give lower discount rate estimates than the ICAPM by an average MD [Mean Difference] of 51 bp [0.51%] per developed country and 131 bp for emerging market countries" (the US difference was 10 bp).

Local CAPM

$$K \text{ (in local currency)} = R_{fL} + \beta_{i,L} \times ERP_L$$

R_{fL} Local risk-free rate (in local currency)

$\beta_{i,L}$ Beta of local company i returns measured directly against local market

ERP_L Local market equity risk premium (in local currency)

Country Yield Spread ('CYS')

$$K \text{ (in US\$)} = R_{fUS} + \beta_{US} ERP_{US} + CRP_1$$

R_{fUS} US risk free rate

$\beta_{USproxy,US}$ Beta of proxy US company (same sector) against US market

ERP_{US} US ERP

CRP_1 Foreign government bond yield (issued in US\$) – US Treasury bond yield

A premium for country risk can be added to a US equivalent cost of equity (or the investor's home cost of equity) [see Sabal (2004)]. This model is said to derive from the Mariscal & Lee model below. It assumes all local companies are equally exposed to the country risk: "even though different companies might have different exposures to country-specific risk" [Harvey 2005, p.6]

Damodaran Lambda (1999, 2003)

$$K \text{ (in US\$)} = R_{fUS} + \beta_{US} ERP_{US} + \lambda \cdot CRP_2$$

CRP_2 $CRP_1 \text{ (from CYS)} \times (\sigma_{equity} / \sigma_{bond})$

$\sigma_{equity} / \sigma_{bond}$ Standard deviation of the local equity market returns divided by standard deviation of local bond market returns (both denominated in US\$)

λ Sensitivity of company returns to country risk

The CYS model is adapted to adjust the CRP to reflect the local company's exposure to country risk that is not part of its exposure to market risk, as measured by lambda (based on revenues derived from the country and the production facilities located in the country, as reduced by risk management techniques, such as insurance).

Goldman Sachs 1: Mariscal & Lee (Goldman Sachs 1993)

- Fully Integrated:

$$K \text{ (in US\$)} = R_{f \text{ US}} + \beta_{\text{Mex, US}} \text{ ERP}_{\text{US}} + \text{CRP}$$

$R_{f \text{ US}}$	US risk free rate
$\beta_{\text{Mex, US}}$	Beta of Mexico market against US market
ERP_{US}	US equity risk premium
CRP	"The yield spread between dollar-denominated Mexican debt securities and analogous U.S. government instruments provides a 'crude' measure of the notion of country or sovereign risk " [Mariscal & Lee (1993) p.4].

This paper considered fully integrated and segmented CAPM versions as applied to the Mexican stock market from a US investor's point of view. This version is the version adopted in the CYS model.

- Fully Segmented:

$$K \text{ (in US\$)} = R_{f \text{ US}} + \left(\sigma_{\text{Mex}} / \sigma_{\text{US}} \right) \text{ERP}_{\text{US}} + \text{CRP}$$

$\sigma_{\text{Mex}} / \sigma_{\text{US}}$	Standard deviation of the Mexican market divided by standard deviation of US market
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"While we have chosen to apply it to the Mexican market, this methodology could be extended to any international market, industry, or particular stock" [Mariscal & Lee (1993) p.1].

Goldman Sachs 2: Mariscal & Hargis (1999)

$$K \text{ (in US\$)} = R_{f \text{ US}} + \left(\sigma_L / \sigma_{\text{US}} \right) \text{ERP}_{\text{US}} \times \beta_{i,L} \times (1 - \rho_{S,B}) + R_c + \text{CRP}$$

CRP	Country spread (country risk premium)
R_c	Company specific spread
$\beta_{i,L} (\sigma_L / \sigma_{\text{US}})$	Beta of company against local market, adjusted by relative volatility ("Our decision to use the ratio of standard deviations rather than the beta of the emerging market results from our assumption that local market volatility plays a greater role than betas in determining risk for foreign investors" [Mariscal & Hargis (1999) p.5]).
$\rho_{S,B}$	Correlation of US \$ returns between the stock market and sovereign bond ("Movements in sovereign spreads and equity market volatility are likely to reflect a similar change in risk of the underlying economy" [Mariscal & Hargis (1999) p.5]).

This is similar to the Mariscal & Lee model above (as applied to any country, not just Mexico), with additional terms: (1) a company specific beta, measured against the local market but adjusted by the relative volatility of the local vs. US markets, (2) an adjustment to remove the effects of the correlation between equity and bond returns (to avoid double counting), and (3) an additional component of the country spread due to company characteristics.

Godfrey & Espinosa (1996)

K (in US\$) = $R_{fUS} + (\sigma_L / \sigma_{US}) ERP_{US} \times 0.60 + CRP$	
σ_L / σ_{US}	"We recommend use of a measure of local business volatility that reflects the volatility of the local stock market relative to the volatility of the domestic (U.S.) market." [Godfrey & Espinosa (1996) p.82]
0.60	Adjusted to remove 40% of equity volatility reflected in country spread: "...one recent study finds that 40% of the variation in equity volatility can be explained by variation in credit quality. In light of this finding, a possible (but, we admit, ad hoc) adjustment for this problem of double counting would be to reduce the adjusted betas (or the business/equity volatility premia) by 40%." [Godfrey & Espinosa (1996) p.88]. Since $\beta_{L,US} = \rho_{L,US} (\sigma_L / \sigma_{US})$: "Reducing the adjusted betas by 40% could also be interpreted as using traditional betas in which the correlation coefficients are equal to 0.60." The study referred to is Erb, Harvey and Viskanta (1995) for 40 countries over 1980-1993: "Credit ratings explain 40% of the cross-sectional variation in volatility" (for returns in US dollars) [Erb, Harvey and Viskanta (1995), p.78].

This is similar to the Mariscal & Hargis later approach, in that a credit spread is added to the US risk free rate and the US ERP is adjusted by the relative volatility of the markets, except that: (1) no company specific beta is shown (the model is a market model), (2) a factor of 0.6 is applied to avoid double counting equity volatility that is already caught in the country credit spread.

This gives a country specific cost of equity: "...a measure of country risk rather than project risk... [which] requires an additional adjustment to capture any difference between the project's risk and that of the average investment in that economy" [Godfrey & Espinosa (1996) p.82].

An example comparing the models discussed above is shown below (using illustrative numbers):

	A	B	C	D	F	G	H
			Global CAPM	International CAPM	Damodaran lambda	Goldman Sachs (Mariscal-Hargis)	Godfrey-Espinosa
38							
39		Mature risk-free rate	4.25 %	4.25 %	4.25 %	4.25 %	4.25 %
40		Sovereign USD yield	-	-	6.75 %	6.75 %	6.75 %
41		Mature ERP	-	-	4.60 %	4.60 %	4.60 %
42		World ERP	4.60 %	4.60 %	-	-	-
44		Company beta vs world	0.86	0.86	-	-	-
45		Company beta vs S&P	-	-	0.82	-	-
46		Company beta vs local	-	-	-	1.05	-
49		Local equity volatility	-	-	26.00 %	26.00 %	26.00 %
50		Sovereign bond volatility	-	-	13.00 %	-	-
51		US equity volatility	-	-	-	15.50 %	15.50 %
55		Correlation equity-sovereign	-	-	-	0.62	-
56		Company specific spread	-	-	-	0.00 %	-
57		Company domestic revenue	-	-	72.00 %	-	-
58		Average local domestic revenue	-	-	96.00 %	-	-
60		Currency premium	-	0.45 %	-	-	-
62		Constant factor	-	-	-	-	0.60
63		Cost of Equity	8.21 %	8.66 %	11.77 %	9.83 %	11.38 %
65							
			=C39+C44*C42	=D39+D42*D44 +D60	=F39+F45*F41+(F57/F58)*(F40- F39)*(F49/F50)	=G39+G46*G41 *(1- G55)*(G49/G51) +(G40-G39)+G56	=H39+H41*H62 *(H49/H51)+H40- H39