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NOTE ON CASH FLOW VALUATION METHODS: COMPARISON OF WACC, FTE, CCF AND APV APPROACHES

INTRODUCTION

Valuation of a firm or project hinges on measurement of two basic parameters: assessment of future cash flows and finding out a discount rate that reflects risk involved in the cash flow estimate. Note that when valuing a project, discounted cash flow analysis is carried out on incremental cash flows related to the project. These cash flows represent the difference between the cash flows of an entity with the project, and the cash flows of the entity without the project. The value of the firm or project, in the most general case, can be written as the present value of expected free cash flows as follows:

$$PV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t}$$

where PV = present value as of today, CF_t = cash flow in year t, r = the suitable discount rate and n = the number of years during which the project will generate a cash flow. The equation is useful when cash flows for a finite number of years in the future are available.

It is often difficult to estimate cash flows accurately for n number of years in the future and therefore the following variants are often used to measure the present value of cash flows. If it is presumed that the cash flows per year remain unchanged and that cash flows will be available forever, then the PV estimation simplifies to

$$PV = \frac{CF_{per\ year}}{r}$$

When cash flows are predicted to grow at a constant growth rate in the future in perpetuity, the present value of such cash flows is

$$PV = \frac{CF_1}{(r-g)}$$

where CF_1 is the cash flow of the forthcoming year and g is the constant growth rate.

As time passes, it becomes increasingly difficult for a firm to maintain the initial high growth, and cash flows eventually grow at a rate less than, or equal to, the growth rate of the economy in which the firm operates. When estimating cash flows for the initial few years and then assuming that cash flows will grow at the sustainable growth rate in perpetuity, the present value can be estimated as follows:

$$PV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} + \left(\frac{CF_{n+1}}{r-g}\right) / \frac{1}{\left(1+r\right)^n}$$

In all the above cases, *r* represents the rate at which cash flows are to be discounted. Therefore, in finding out the present value of a company or project, there are two distinct issues:

- Which items of cash flows should go to the numerator?
- What is the proper discount rate in the denominator?

Measurements of these two parameters have resulted in several alternative methods for project and firm valuations. In this note, we will discuss the following valuation methods, highlighting their similarities and applicability in a particular situation (see Exhibit 1).

- Weighted Average Cost of Capital (WACC);
- Flow to Equity (FTE);
- Capital Cash Flow (CCF);
- Adjusted Present Value (APV).

MEASUREMENT OF CASH FLOW STREAM AND DISCOUNT RATE

The free cash flow (FCF) is the sum of the cash flows to all stakeholders of the firm, including both equity holders and debt holders. An easy way to obtain free cash flow to the firm is to estimate the cash flows from the income statement of the firm. Starting with the earnings before interest and tax (EBIT), we add the depreciation amount, as it is a non-cash expense, take away taxes payable, and add new capital spending and changes in working capital needed.

FCF = EBIT (1 – tax rate) + Depreciation – Capital Expenditure – Δ Working Capital

Since debt payments are not considered in the above formula, it is often referred to as an unlevered cash flow. Free cash flow to the firm does not consider any of the tax benefits because of interest payments. Applicable tax benefits, if any, need to be considered separately in the discount rate.

The discount rate that should be applied to the cash flow stream depends on the risk involved in the cash flow stream. The discount rate becomes complex for cash flow related to equity investments. To estimate the cost of equity, the expected rate of return of the company's stock needs to be found out. Since expected rates of return are not directly available, we can use an asset-pricing model that converts risk into expected returns. The most common asset-pricing model is the capital asset pricing model (CAPM). The CAPM suggests that the expected rate of return of a security equals the risk-free rate plus the security's beta multiplied by the market risk premium:

$$r_e = r_f + \beta_e \left(E(r_m) - r_f \right)$$

where r_f is the risk-free rate, β_e is the equity beta of the firm and $E(r_m)$ is the expected return from a market portfolio. In the model, the common risk-free rate (r_f) and market risk premium ($E(r_m) - r_f$) are applicable to all firms; however, the beta coefficient varies across firms.

The return available from government default-free bonds is taken as a measure of the risk-free rate. To value a firm or long-term project, the return from a long-term treasury bill is usually considered appropriate, as the short-term rate cannot properly measure the opportunity cost of investment for longer-term projects.

However, the problem with implementation of the model is to find an appropriate risk premium and there is hardly any consensus among practitioners on how this measure is to be obtained. Fernandez and Baonza[1] (2010) carried out a global survey on market risk premium used by analysts in 2010 and compared 2,400 survey responses. They observed that, although individual usage varied widely, the average market risk premium used by analysts in 2010 in the United States was 5.1 per cent and in Europe it was five per cent.

Beta is a measure of risk and represents the sensitivity of a stock's price change when the market price changes. For a traded firm, beta can be estimated from the time series of the stock's price and the value of a benchmark index. Regressing returns of the stock against the index return, the beta of the stock can be obtained.

The required rate of return on equity also depends on the financial leverage of the firm. According to a Modigliani and Miller[2] proposition, the required rate of return to equity holders (r_e) can be obtained as follows:

$$r_e = r_u + \frac{D}{E}\left(1 - T_c\right)\left(r_u - r_d\right)$$

where r_u is the required rate of return from unlevered equity, D and E represent market values of the firm's debt and equity, respectively, T_c is the corporate tax rate and r_d is the interest rate on debt capital.

In a practical situation, this rate has to be obtained depending on ease and availability of information. A complete analysis of the determinants of discount rates is beyond the scope of this note. We, however, mentioned appropriateness of discount rates when discussing valuation methods. The implicit assumption is that the discount rate should adequately capture the risk involved in future cash flows.

Weighted Average Cost of Capital (WACC)

The most popular approach to project evaluation is the WACC method. This method estimates a project's value by discounting its unlevered cash flows using a constant weighted average cost of capital. In estimating unlevered cash flow, it is assumed that the project is fully financed by equity, and tax liability is estimated using earnings before interest payments. For a constant perpetual cash flow, the net asset value (*NPV*) of the project is

$$NPV = \frac{Unlevered\ CF_{per\ year}}{r_{wacc}} - initial\ investment$$

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[1] Pablo Fernandez and Javier Del Campo Baonza, "Market Risk Premium Used in 2010 by Analysts and Companies: A Survey with 2,400 Answers," May 21, 2010, http://ssrn.com/abstract=1609563.

[2] F. Modigliani and M.H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," The American Economic Review, 53, 1963, pp. 433-443.

If the project is simultaneously financed with debt and equity, the interest paid to the debt holder qualifies for tax exemption. These tax shields are accounted for in the discount rate. The discount rate is a weighted average of the after-tax cost of debt and the cost of equity. The benefit of the tax shield is incorporated in the r_{wacc} discount rate by multiplying the (1 – tax rate) factor in the cost of debt. The actual cost of debt is thus reduced to account for tax benefits available for interest expenses. The formula for the WACC discount rate is given below:

$$r_{wacc} = \left(\frac{equity}{equity + debt}\right)(\cos t\ of\ equity) + \left(\frac{debt}{equity + debt}\right)(\cos t\ of\ debt)(1 - tax\ rate)$$

In the above formula, the values of equity and debt are expressed in terms of market values, not at their book values. The advantage of the WACC approach lies in its simplicity. It embeds all financing considerations in a single discount rate and thus simplifies decision-making.

However, the risks involved in project cash flows are not always amenable to being measured with a single discount rate. The discount rate r_{wacc} changes when the debt to equity ratio of the firm varies on a year-to-year basis. Further, the measure provides little guidance when the tax structure also changes with time.

Flow to Equity (FTE)

In the WACC method, cash flow to the firm measures the cash flow available to all investors, but "cash flow to equity" is a measure to find out what is left over (the residual) for equity holders. It estimates residual cash flow available to equity holders of the firm after payments are made to other stakeholders.

Cash Flow to Equity = Free Cash Flow to Firm – Interest and Debt Repayments

As cash flow is measured from the shareholders' perspective, the suitable discount rate is the shareholders' required rate of return (r_e) and not r_{wacc}. The advantage of using this method is that cash flows accruing to debt holders are not directly considered. In cases where the debt amount varies on a year-to-year basis, this method becomes handy.

Capital Cash Flow (CCF)

Capital Cash Flow (CCF) is a relatively new method proposed by Ruback.[3] In this method, cash flows take into account cash available to all capital providers, including the interest tax shields. Since tax shields are included in the cash flow estimates, the benefits should not be double-counted in the denominator. The appropriate discount rate to value Capital Cash Flows (CCFs) is a before-tax rate, as the tax benefits of debt financing are included in the cash flows. The pre-tax rate here matches the risk level of the cash flows.

$$r_{ccf} = \left(\frac{equity}{equity + debt}\right)(\cos t\ of\ equity) + \left(\frac{debt}{equity + debt}\right)(\cos t\ of\ debt)$$

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[3] *Richard S. Ruback, "Capital Cash Flows: A Simple Approach to Valuing Risky Cash Flows," March 2000, http://ssrn.com/abstract=223080.*

Similar to in the WACC method, the values of equity and debt are taken at their market values, not at their book values.

Adjusted Present Value (APV)

In the Adjusted Present Value (APV) method, we first estimate the value of the firm using full-equity financing, and in the second step, we include the benefits and the costs of debt financing. With debt financing, the primary benefit of borrowing is a tax benefit and the fact that the most significant costs are issue costs and increased risk of bankruptcy.

APV = Present value of the unlevered firm or project + Present value of the side effects associated with the financing

In this approach, the firm or project is first valued, assuming it is solely financed by equity capital. The present value of the unlevered firm or project is obtained from the unlevered cash flow discounted at the unlevered cost of equity. For a constant perpetual cash flow, the net present value of the unlevered project is

$$NPV_{all\,equity} = \frac{Unlevered\ CF_{per\ year}}{r_{all\,equity}} - initial\ investment$$

Whenever project financing includes the debt ingredient, the interest paid on debt capital qualifies for a tax rebate. For a perpetual debt, the interest payment per year will remain constant at $r_d.D$ per year and the amount of tax shield per year will be $r_d.D.T_c$ (r_d is the interest rate on debt, D is the amount of debt and T_c is the applicable tax rate). The present value of this tax shield, discounted at r_d, is

$$NPV_{tax\,shield} = \frac{tax\ shield_{per\ year}}{r_d} = \frac{r_d.D.T_c}{r_d} = D.T_c$$

Apart from tax shield benefits, debt financing may also have other side effects in the form of *issue costs*, *bankruptcy costs*, *agency costs*, etc. The influences of these other side effects are added separately.

$$APV = NPV_{all\,equity} + NPV_{tax\,shield} + PV_{other\,side\,effects}$$

However, influences of other side effects associated with debt financing are applicable to all methods described in this note. Therefore, we ignore other side effects here for keeping similarity of comparison across various methods.

AN EXAMPLE

To compare the net present value of a project using the methods discussed above, the following example is considered.

A new company is considering a project that would generate cash flows of $3 million per annum for perpetuity. The initial investment needed for the project is $10 million. The project can be financed either by

- Full contribution from equity shareholders; or
- $5 million by equity and the remaining $5 million through a debt that carries 10 per cent interest per year.

We also assume that the discount rate on an all-equity-financed project in this risk class is 20 per cent and that the firm's marginal tax rate is 40 per cent.

Should the project be accepted?

Financed by Equity Holders

Let us first calculate the *NPV* of the project assuming 100 per cent equity contribution from the shareholders. When the project is 100 per cent equity financed, the discount rate for this project will be 20 per cent (as given).

$$NPV = \frac{After\,Tax\,CF_{per\,year}}{(discounting\,rate)} - initial\,investment$$

$$NPV = \frac{3,000,000(1-0.40)}{0.20} - 10,000,000 = -1,000,000$$

Since the *NPV* of the project is a negative number, the project is not viable for all-equity financing.

Financed Jointly by Equity and Debt Holders

Since the project is not acceptable with all-equity financing, we examine the viability of the project with $5 million equity and $5 million debt financing that carries 10 per cent interest a year using the FTE, WACC, CCF and APV methods.

Using Flow to Equity (FTE)

When the project is financed with 100 per cent equity, the equity holders expect that the rate of return will be 20 per cent. However, when the company takes debt to finance the project, the project becomes levered and more risky. As a result, shareholders' expected rate of return (r_e) from this project increases to compensate for the added risk (r_e > 20%).

Let us now estimate cash flows accruing to the equity holders.

1	EBIT (given)	3,000,000
2	Payment of interest 10% of \$5 m	500,000
3	EBT	2,500,000
4	Tax @ 40%	1,000,000
5	Cash flow to equity holders	1,500,000

The equity holders have initially invested \$5 million in the project, but the market value of this equity has changed in accordance with future cash flows and the discount rate. Since the project is expected to generate a cash flow of \$1,500,000 every year, the changed

$$Market\,Value\,of\;Equity = \frac{1,500,000}{r_e}$$

Presuming that the market value of debt remains unaltered at \$5 million, the market value of the firm will be the sum of market values of equity and debt.

According to the Modigliani and Miller proposition, the rate of return required by equity holders is

$$r_e = r_{all\,equity} + \frac{D}{E}(1-T_c)\left(r_{all\,equity} - r_d\right)$$

$$\therefore r_e = 0.20 + \frac{\$5m}{\$1.5m/r_e}(1-0.40)(0.20-0.10)$$

$$\therefore r_e = 0.20 + 0.2\,r_e$$

$$\therefore 0.8\,r_e = 0.2$$

$$\therefore r_e = 0.25$$

As the required rate of return from the levered equity has become 0.25, the new market value of equity (E) is changed to

$$\frac{1,500,000}{r_e} = \frac{1,500,000}{0.25} = \$6\,\text{million.}$$

Thus, the initial equity investment of \$5 million is now valued in the market at \$6 million and the *NPV* of the project from the equity holders' perspective is \$6 million – \$5 million = \$1 million.

In other words, the value of the firm has increased to \$5 million (debt) + \$6 million (equity) = \$11 million. The *NPV* of the project is \$11 million (new value) – \$10 million (initial investment) = \$1 million.

Using WACC

The WACC method estimates a project's value by discounting its unlevered cash flows using a constant weighted average cost of capital.

$$r_{wacc} = \left(\frac{equity}{equity + debt}\right)(\cos t\ of\ equity) + \left(\frac{debt}{equity + debt}\right)(\cos t\ of\ debt)(1 - tax\ rate)$$

In the above formula, we are required to consider the market value of debt and equity and not the book values. As calculated in the previous method, that market value of equity has increased to $6 million from the initial investment of $5 million and therefore the new equity value has become $6 million. The cost of equity for the levered investment has also gone up to 25 per cent as estimated in the previous section. Using these new values of equity and cost of equity, the weighted average cost of capital is

$$\mathrm{r}_{\mathrm{wacc}} = \left(\frac{\$6m}{\$6m + \$5m}\right)(0.25) + \left(\frac{\$5m}{\$6m + \$5m}\right)(0.10)(1 - 0.40) = 0.1636$$

The WACC method considers the unlevered cash flow of the project as if the project is fully financed by equity. The benefit of the tax shield for debt financing is incorporated in the r_{wacc} formula, where the factor (1 – tax rate) reduces cost of debt. The unlevered cash flow from the project is

1	EBIT (given)	3,000,000
2	Tax @ 40%	1,200,000
3	Cash flow to equity holders and debt holders	1,800,000

$$NPV = \frac{CF_{per\ year}}{(discounting\ rate)} - initial\ investment$$

$$NPV = \frac{1,800,000}{0.1636} - 10,000,000 = 1,000,000$$

Thus, the *NPV* of the project using the WACC method is equal to the *NPV* value obtained using the FTE method.

Using Capital Cash Flow (CCF)

The CCF method includes all cash flows that are available to all investors invested in the company's assets (that is, both equity holders and debt holders). This method relies on after-tax cash flows that take account of taxes paid on net income and tax shield benefits on interest payments.

Cash flows of the CCF method are discounted at the before-tax weighted average cost of capital as the interest tax shield benefits are already accounted for in cash flows.

$$r_{ccf} = \left(\frac{equity}{equity + debt}\right)(\cos t\ of\ equity) + \left(\frac{debt}{equity + debt}\right)(\cos t\ of\ debt)$$

As in the WACC method, we are required to consider the market values of equity and debt, which are already estimated as $6 million and $5 million, respectively. The discount rate for the Capital Cash Flow method is

$$r_{ccf} = \left(\frac{\$6m}{\$6m + \$5m} \right)(0.25) + \left(\frac{\$5m}{\$6m + \$5m} \right)(0.10) = 0.1818$$

The CCF method uses the actual cash flow available to all stakeholders. The relevant cash flows are as follows:

1	EBIT (given)	3,000,000
2	Interest 10% of $5 m paid to debt holders	500,000
3	EBT	2,500,000
4	Tax @ 40%	1,000,000
5	Cash flow to equity holders	1,500,000
6	Cash flow to equity holders and debt holders	2,000,000

The cash flows accruing to both equity holders and debt holders together are $2,000,000 per year. Taking the CCF discount rate of 18.18 per cent, the *NPV* of the project works out to

$$NPV = \frac{CF_{per\ year}}{(discounting\ rate)} - initial\ investment$$

$$NPV = \frac{2,000,000}{0.1818} - 10,000,000 = 1,000,000$$

Thus, the *NPV* of the project using the CCF method is equal to the *NPV* value obtained using the FTE and WACC methods.

Using Adjusted Present Value (APV)

Adjusted Present Value (APV) is based on the following:

APV = NPV of project assuming it is all-equity financed + NPV of financing effects

Financing with debt not only results in tax shields, but also brings other side effects such as issue costs, bankruptcy costs, agency costs, etc. However, for the time being we will ignore other side effects and consider only the benefit of the tax shield, as is considered in other methods. To obtain the *NPV* with all-equity financing, we take cash flows, ignoring interest payments, as follows:

1	EBIT (given)	3,000,000
2	Tax @ 40%	1,200,000
3	Cash flow to equity holders	1,800,000

The discount rate applicable to all-equity financing (r_u) is 20 per cent, as given in the problem.

$$NPV_{all\,equity} = \frac{Unlevered\;CF_{per\,year}}{r_u} - initial\;investment$$

$$NPV_{all\,equity} = \frac{1,800,000}{0.20} - 10,000,000 = -1,000,000$$

When the project is financed with $5 million of debt, the *NPV* of the tax benefits (according to Modigliani and Miller) equals the tax rate multiplied by the debt amount.

$$NPV_{tax\,shield} = T_c B = 0.40(\$5m) = \$2m$$

Thus, the APV for the project is equal to

$$APV = NPV_{all\,equity} + NPV_{tax\,shield} = -1,000,000 + 2,000,000 = 1,000,000$$

It can be noted that the net benefit of the project using the APV method is also $1 million and that all methods discussed differ only in their approaches but yield identical results.

COMPARISON OF THE METHODS

The above example estimates the present value of a project, assuming a constant cash flow in perpetuity. The analysis could easily be extended to other variants of the PV model, wherein the nature of cash flow differs. If valuation methods are applied correctly, the choice of valuation method should not affect the *NPV* estimate. However, one method may be easier to estimate than another method under certain circumstances.

The most common technique for valuing risky cash flows that comprise a combination of equity and debt financing, is the WACC method. In this method, the tax shield of interest is treated as a decrease in the cost of capital using the after-tax weighted average cost of capital (WACC). Since the interest tax shield is included in the discount rate, these benefits are excluded from the free cash flows. Because the r_{wacc} is affected by changes in the capital structure, this method creates complications in highly leveraged situations. When the capital structure changes over time, the r_{wacc} will change in each period.

The CCF method is algebraically equivalent to the WACC method, but sometimes is easier to apply and gives less error. In the CCF method, changes in the tax structure from time to time or between types of projects (some projects are given tax rebates) are considered in the numerator. The discount rate used in the denominator of the *NPV* estimation is taken without considering the tax element. Thus, only the cash flow needs adjustments for changes in the tax structure.

The Flow to Equity method views the project only from the equity holders' perspective and is useful when debt levels change on a year-to-year basis. However, it is to be noted that the cost of equity does change with the change in the debt to equity ratio. Unless the debt to equity ratio is maintained, the change in debt level alters the required returns from equity and makes calculations complex.

Though the approach to the cash flow estimation differs between the WACC, FTE and CCF methods, all these methods are easy to apply when a constant debt to equity ratio is maintained. The FTE and CCF methods are therefore considered as variations of the WACC method. These methods become convoluted whenever an assumption related to a constant debt to equity ratio is not applicable. In such cases, discount rates for each period are to be estimated separately, considering changes of the capital structure and tax rate.

APV is particularly useful compared to the above three methods when capital and tax structures are uncertain. The firm is valued as a whole without consideration for its debt to equity ratio. APV considers the effect of debt as an independent variable and adds the tax shield benefits arising out of interest payments separately. Therefore, changing levels of debt and changes in the tax structure can easily be incorporated into APV without altering the discount rate of the base project.

Sometimes the APV approach gives a certain advantage. In a leveraged buyout, a large amount of debt is taken initially and debt is paid back over a predetermined number of years. Since the schedule of debt repayment and interest payments is known, tax shields for each year in the future can be estimated. In such a case where debt levels reduce year after year, the debt to equity ratio changes every year and as such, the CCF, FTE and WACC methods cannot be applied.

In some instances, a cash flow estimation is complex because of the inclusion of flotation costs, interest subsidies, bankruptcy costs, etc. In such cases, the APV method is easier as it treats each extra element separately.

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Exhibit 1

CASH FLOW AND DISCOUNT RATE ACROSS METHODS

Method	WACC	FTE	CCF	APV
Cash Flow Measure	Free cash flow to the firm	Cash flow to equity	Capital cash flow	
Cash Flow Components	EBIT - Tax: EBIT(1 – t)	EBIT - Interest = Earning before tax (EBT) - Tax on EBT = Net income	EBIT - Interest = Earning before tax (EBT) - Tax on EBT = Income to equity holders + Interest (to debt holders) = Income to capital providers	EBIT - Tax: EBIT(1 – t)
Other Adjustments	+ Depreciation - Capital expenditures - Increase in WC	+ Depreciation - Capital expenditures - Increase in WC	+ Depreciation - Capital expenditures - Increase in WC	+ Depreciation - Capital expenditures - Increase in WC
Discount Rate	r_{wacc}	r_e	r_{ccf}	r_e
	$\left(\frac{E}{E+D}\right)r_e + \left(\frac{D}{E+D}\right)r_d\left(1-T_c\right)$		$\left(\frac{E}{E+D}\right)r_e + \left(\frac{D}{E+D}\right)r_d$	
				Tax shields and other financing side effects are added separately