

1 Revisiting WACC

2 Prof. S. K. Mitra¹

3 ¹ Institute of Management Technology, Nagpur, India

4 *Received: 22 September 2011 Accepted: 17 October 2011 Published: 28 October 2011*

5

6 **Abstract**

7 The paper compares classic WACC valuation method with equity cash flow and capital cash
8 flow methods. As WACC method always use market values of debt and equity to determine
9 weights, the method can give erroneous results whenever there are mismatches in the market
10 valuation of debt. The tax-shield benefits are related to the actual interest amount that is
11 based on the book value and therefore, the WACC computation method need to account tax
12 shield benefits using book values. The paper used an example to compare valuation of a
13 project using various valuation methods and found that the net present value obtained using
14 modified version of the WACC, that used book value of debt to account tax shield, was
15 comparable to other methods.

16

17 **Index terms**— Cash Flow Discounting, Cost of Capital, Net Present Value, WACC

18 **1 INTRODUCTION**

19 To assess the value of a project or business, a number of cash flow valuation methods are used. The most common
20 method to value the business is to determine free cash flow to the business and discount the cash flows by weighted
21 average cost of capital (WACC). Though the method is quite popular and used since mid of last century, the
22 method do not accurately measure effects of interest tax shields benefits whenever market value of debt differs
23 substantially from its book value and therefore valuing of a project using the classic WACC method is not always
24 correct. This distortion is apparent when the same project is valued using other valuation methods.

25 The accuracy of ascertaining discounting rate is important as a small change in this single estimate alters the
26 Net present Value (NPV) measure of the project in a significant manner. The use of classic WACC formula may
27 often present an optimistic NPV and consequently lead to a wrong investment decision. In this paper the WACC
28 method of valuing cash flows is compared with the method of valuing a project from cash flow accruing to equity
29 holders and capital cash flow (CCF) method proposed by Rubeck ??2002). It was found that a minor adjustment
30 in WACC computation method will make valuation using all the methods identical.

31 **2 II.**

32 **3 WACC**

33 From the seminal contribution of Modigliani and Miller (1958), finance theory has accepted that a project's cash-
34 flows should be discounted at a rate that reflects the project's risk characteristics. Whenever a Author : Institute
35 of Management Technology, Nagpur, India. (Telephone : +917122805000 Email : skmitra@imtnag.ac.in)
36 company's equity structure consists of both equity and debt, the appropriate discounting rate is weighted average
37 cost of capital (WACC).

38 WACC method is the most popular approach used to value a project by discounting its unlevered cash flows
39 using a weighted average after tax cost of capital. It is assumed that the project is fully financed by equity and
40 therefore tax liability is estimated on earning before interest payment. The net asset value (NPV) for a constant
41 perpetual cash flow of the project is measured as follows:

42
$$1 (??)n t t t wacc FCF NPV I r = = ? +$$

7 B) CAPITAL CASH FLOWS

4 ?

44 Where FCF is free cash flow, I is the initial investment from the project and rwacc is the weighted average cost
45 of capital.

46 When the project is financed with both debt and equity, the interest expense qualifies for tax exemption and
47 reduces effective cost of debt. The benefit of tax shield is incorporated in the discounting rate by multiplying a
48 factor (1-tax rate) to the cost debt. The effective cost of debt after tax is thus reduced to account for tax benefit
49 available for interest expense. The usual formula to estimate WACC is given below:

50 .

51 . (1). According to the formula, the weighted average cost of capital embodies the relative proportion of debt
52 and equity supplied by investors at the respective required rates of return. The cost of debt capital depends on
53 a company's outstanding interest bearing debt. Since interest expense qualifies for a tax deduction, the formula
54 captures the cost of debt at the company's effective tax rate. The WACC approach incorporates all financing
55 considerations in a single discount rate and simplifies decision making.

56 In the formula, market values of equity and debt are taken instead of their book values. The market value of
57 the company's equity can be obtained from stock price quotes. The market value of debt capital can be estimated
58 by considering cash flow accruing to debt holders and the market interest rate.

5 CASH FLOW MEASURES

60 In the paper following three cash flow estimates are discussed: ? Free Cash Flow ? Cash flow to Equity ? Capital
61 Cash Flows a) Free Cash Flow

62 The value of a business is equal to the discounted value of future cash flows. The free cash flows (FCF) to the
63 business equal the cash flow generated by the project during its life less capital invested in the business. The free
64 cash flow of the firm includes the cash flows available to all investors -equity holders and bond holders. Thus free
65 cash flow is independent of capital structure of the business.

66 The simplest route to measure free cash flow to the firm is to use information available in the income statement
67 of the firm. From the earning before interest and tax (EBIT) the non cash expense of depreciation is added, taxes
68 are deducted and net cash flows on account of new investments in assets and working capital are also deducted.

6 FCF = EBIT (1 -tax rate) + Depreciation -Capital Expenditure -I?" Working Capital

71 In the above formula, payments to debt holders are not considered; therefore the estimate is a measure of for
72 unlevered cash flow. Since leverage is not accounted, the tax benefits because of interest payments are also
73 excluded. It is therefore necessary to consider the tax benefits on interest tax shields in the discounting rate.

74 The discount rate for FCF need to represent rates of return required by both equity holders and bond holders
75 blended together. It is a single estimate of opportunity cost of capital for the whole business.

7 b) Capital Cash Flows

77 In capital cash flow (CCF) method, the cash flow includes the cash available to all capital providers, including
78 the interest tax shields. The interest tax shields decrease taxable income; decrease taxes and thereby increase
79 after-tax cash flows. Thus capital cash flows is equal to the total cash flows available to both equity holders and
80 bond holders including interest tax shield benefits accruing to equity holders.

81 Capital Cash Flow = Free Cash Flow + Interest Tax Shield Since tax shield benefits are included in the cash
82 flow estimates, the taxes are not again counted in the denominator. The discount rate to value Capital Cash
83 Flows (CCF) is a before-tax weighted average rate.

84 .

85 . The Free Cash Flow and Capital Cash Flow methods treat interest tax shields differently. In the first method,
86 the tax shield is considered in the discounting rate rwacc and in the second case it is included in the cash flow. As
87 per Ruback (2002), when debt is forecasted in dollar amounts or when capital structure changes over time, the
88 CCF method is easier to use as the interest tax shields are a part of the cash flows. In the method, the expected
89 return from the asset depends on the risk involved in the asset and therefore it is independent of changes in
90 the capital structure. Consequently, the discount rate for the capital cash flows need not be re-estimated every
91 period.

92 Ruback (2002) also showed that under certain assumption, the before tax WACC depends only on the market-
93 wide parameters for the risk-free rate, the risk premium and on the unlevered asset beta.

94 ()risk free unlevered p wacc beforetax r r R ? = +

95 Where p R is the risk premium and unlevered ? is unlevered asset beta of the firm.

96 In the formula the market values of equity and debt are not required for estimating the discounting rate. This
97 reduces the complexity of estimating WACC for every period. Though Ruback's method of measuring discount
98 rate apparently does not depend on capital structure of the company and need not be estimated afresh as capital
99 structure changes, the main implementation problem is to find out future values of risk premium.

100 8 c) Cash flow to Equity

101 In some instances financial cash flow statements are prepared from two points of view: 1. The total investment
102 point of view and 2. The owner's point of view.

103 The WACC and CCF method values the project from total investment point of view. However, it is also
104 sometimes useful to analyze a project by constructing the cash flow statements from different points of view to
105 establish whether the parties involved will find it worthwhile to execute the project. Cash flow to equity method
106 value the business from the perspective of equity holders claims in the cash flows. cash flow to the firm measures
107 the cash flow available to all investors but In the method, the suitable discount rate is shareholders required rate
108 of return (r_e) and not r_{wacc} .

109 IV.

110 9 PROBLEMS ASSOCIATED WITH WACC

111 According to theory, companies should value a project using a discount rate determined by the risk characteristics
112 of the project. Discounting the cash flows at the firm's weighted average cost of capital (WACC) is the most
113 popular but the method is sometimes inappropriate if the project differs in terms of its riskness from the rest
114 of the firm's assets. Thus WACC need to be calculated separately for each project. A survey carried out by
115 Bierman (1993) in the top 100 firms of the Fortune 500 found that 93% of the responding firms use a constant
116 company-wide WACC to value projects and only 35% used division-level discount rates. Graham and Harvey
117 (2001) reported that a large majority of firms use a common company-wide discount rate to value a project
118 independently of the risk characteristics of the project. Another survey carried out by Kruger et al (2011) found
119 that performing capital-budgeting using a unique firm-level WACC is common.

120 Additionally, risks involved in project cash flows are not always amenable to be measured with a constant
121 discounting rate. The discounting rate r_{wacc} changes when debt to equity ratio of the firm changes on year to
122 year basis. Miles & Ezzel (1980) showed that the WACC will yield correct valuations if the leverage ratio of the
123 firm remains constant through time. WACC method is suitable as long as the firm maintains a constant leverage
124 ratio. For project that need subsequent additional investment in future, maintaining constant debt to equity
125 ratio is difficult.

126 In WACC, the values of equity and debt are taken in terms of market values, not at their book values. As
127 market values of both equity and debt constantly changes, the WACC measure also changes with change in
128 market perceptions. In many instances, the cash flows are discounted at a constant WACC and all such cases
129 the implicit assumption is that the leverage of the business remains constant throughout the evaluation period.
130 But the assumption is erroneous as maintaining Should WACC be always measured on market Value? While
131 estimating discounting rates for WACC and CCF methods, market values of equity and debt are used. In case of
132 rwacc interest tax shields are incorporated in the discount rate in terms of market value of debt by application
133 of the factor . On the other hand, the actual interest tax shield benefit is linked to actual interest paid that
134 is related to the book value of debt. Thus interest tax shield need to be measured on book value and not on
135 market value of debt. Whenever there is a valuation mismatch between book value and market value of debt,
136 it is better to use book value of debt as interest tax shield is related to book value and not on market value.
137 Fernandez (2003Fernandez (, 2010)) argued that the WACC is the rate at which the Free Cash Flows need to
138 be discounted for obtaining the identical result as in the valuation using Equity Cash Flows.

139 To obtain identical valuation using rwacc the formula to estimate the discounting rate need to be modified as
140 follows: E_{mv} and D_{mv} are market values of debt and equity, D_{bv} is the book value of debt and r_{actual} is the the
141 interest rate payable on outstanding debt.

142 V.

143 10 VALUATION EXAMPLE

144 So far three methods using free cash flows, capital cash flows and equity cash flows are discussed and all methods
145 are found intuitively appealing! Let's now compare valuation using a simple numerical example.

146 The projected balance sheets and income statements of a hypothetical firm are given in table 1 and 2. The
147 firm made an initial equity investment of \$5500 at the beginning of the project and all incremental investment in
148 the business was raised from additional debt. The projected income statements gave estimates for the initial five
149 years and it was assumed that the cash flows after the initial five years would grow at 5% per year for perpetuity.
150 .

151 . The following cash flow estimates were made. ? Free Cash Flow ? Equity Cash Flow ? Debt Cash Flow ?
152 Capital Cash Flow To arrive at free cash flow estimates, the PAT (unlevered) was calculated assuming no debt
153 in the capital structure. From PAT (unlevered) depreciation is added back, additional investment in working
154 capital and fixed assets are deducted. Equity cash flows were estimated considering actual leverage in capital
155 structure. It was estimated from PAT adding depreciation and deducting additional investments.mv

156 Debt cash flow measures represented cash flows accrued to debt holders both in form of interest income and
157 change in the principal component of debt. Whenever new debt was added to the capital of a firm, cash flows in
158 hands of debt holders reduced. Capital cash flow was measured adding cash flows accrued to both shareholders
159 and bond holders.

160 **11 VALUATION OF THE PROJECT**

161 After ascertaining cash flows of the project in hands of different types of investors, the valuation of the project
162 was done using following discounting rates. It was observed from table 7 that valuation using WACC (after
163 tax) gave a different project valuation in comparison to other methods. To alleviate the difference of valuation
164 using WACC (after tax) method, WACC (modified) was estimated using book values of debt and revised project
165 valuation was given in table 8.

166 **12 CONCLUSION**

167 To value a business or project the post popular method is to use WACC as discounting rate. In its basic definition,
168 WACC is the weighted average of the cost of capital coming from both the equity and the debt. of the firm and
169 tax shield valuations linked to the divergence between book values and market values. In this paper disparity
170 due to tax shield valuation when market valuation of firm's debt differs from its book value is addressed.

171 However, the practical implementation of WACC concept often poses problem due to changing leverage The
172 net present value of a project using other methods was compared with the valuation using WACC method. It
173 was observed that value of the project using WACC (modified) accounted tax shield benefits more accurately
174 and produced result that were comparable to the results obtained from equity cash flow and capital cash flow
175 methods.

176 **13 Global**



Figure 1:

1

Revisiting WACC
wacc(modified) =
$$e/E \cdot r_e \cdot (1 - mv) + D/E \cdot r_D \cdot mv + D/T \cdot T_c$$

+
$$+ \frac{D}{E} \cdot r_D \cdot mv \cdot (1 - mv) \cdot (1 - T_c)$$

Figure 2: Table 1 :

3

Cash Flow Statements

Figure 3: Table 3 :

4

Table	Cash Flow	Discounting Rate	Value
Table 4	Debt cash flow	Cost of debt	Market value of debt
Table 5	Equity cash flow	Cost of equity	Market value of equity
Table 6	Capital cash flow	WACC (before-tax)	Market value of project/firm
Table 7	Free cash flow	WACC (after-tax)	Market value of project/firm

Figure 4: Table 4 :

5

Year	0	1	2	3	4	5
ECF		-58.50	577.20	887.90	1198.60	1509.30
r _e	0	18.89%	18.40%	18.20%	18.07%	18.01%
Value of Equity	7408	8866	9920	10837	11597	12177
Debt	6848	7230	7622	8023	8433	8855
Value of Business	14256	16096	17542	18860	20031	21032

Table 6 : Valuation using CCF

Year	0	1	2	3	4	5
CCF		106.50	764.20	1096.90	1429.60	1762.30
WACC (before tax)		13.66%	13.73%	13.77%	13.79%	13.80%
Value of Business	14256	16096	17542	18860	20031	21032
Debt	6848	7230	7622	8023	8433	8855
Value of Equity	7408	8866	9920	10837	11597	12177

Figure 5: Table 5 :

7

Year	0	1	2	3	4	5
ECF		-47.50	602.50	927.50	1252.50	1577.50
WACC (after tax)		12.31%	12.47%	12.55%	12.60%	12.62%
Value of Firm	14803	16673	18150	19501	20704	21740
Debt	6848	7230	7622	8023	8433	8855
Value of Equity	7956	9443	10529	11478	12271	12885

Figure 6: Table 7 :

8

Year	0	1	2	3	4	5
ECF		-47.50	602.50	927.50	1252.50	1577.50
WACC (modified)		12.58%	12.73%	12.80%	12.85%	12.88%
Value of Firm	14256	16096	17542	18860	20031	21032
Debt	6848	7230	7622	8023	8433	8855
Value of Equity	7408	8866	9920	10837	11597	12177

Figure 7: Table 8 :

178 [Bierman ()] 'Capital budgeting in 1992: a survey'. J H Bierman . *Financial Management* 1993. 22 (3) p. 24.

179 [Ruback ()] 'Capital Cash Flows: A Simple Approach to Valuing Risky Cash Flows'. R S Ruback . *Financial Management* 2002. 31 (2) p. .

181 [Fernandez ()] 'Equivalence of Ten Different Methods for Valuing Companies by Cash Flow Discounting'. P Fernandez . <http://ssrn.com/abstract=367161> *EFMA 2004 Basel Meetings Paper. Available at SSRN*, 2003.

184 [Modigliani and Miller ()] 'The Cost of Capital, Corporation Finance and the Theory of Investment'. F Modigliani , M H Miller . *American Economic Review* 1958. 48 p. .

186 [Graham and Harvey ()] 'The theory and practice of corporate finance: evidence from the field'. J Graham , C Harvey . *Journal of Financial Economics* 2001. 60 (2-3) p. .

188 [Kruger et al. ()] *The WACC Fallacy: The Real Effects of Using a Unique Discount Rate*, P Kruger , A Landier , D Thesmar . <http://ssrn.com/abstract=1764024> 2011.

190 [Miles and Ezzel ()] 'The Weighted Average Cost of Capital, Perfect Capital Markets, And Project Life: A Clarification'. J A Miles , J R Ezzel . *Journal of Financial and Quantitative Analysis* 1980. 15 p. .

192 [Fernandez ()] *WACC: Definition, Misconceptions and Errors*, P Fernandez . <http://ssrn.com/abstract=1620871> 2010.