

**TECHNICAL NOTE --**

**THE WEIGHTED AVERAGE COST OF  
CAPITAL AND SEQUENTIAL MARGINAL  
COSTING: A CLARIFICATION**

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**INTRODUCTION**

In a recent article, Paulo [14] argues that the weighted average cost of capital (WACC) is subject to serious reservations if used as a capital budgeting discount rate. He claims that a discount rate based on sequential marginal costing (SMC) will provide superior valuations to those based on the WACC. This subject is very important because the firm can not make the correct investment decisions without a proper discount rate.

However, the comparison between the WACC and the SMC as presented by Paulo may not be appropriate. First of all, the merits and weaknesses of the WACC have been studied at length in literature. In particular, Haley and Schall [9] provide detailed analysis of the conditions for the WACC to be the proper rate for discounting the firm's future cash flow. Myers [13] presents the adjusted-present-value method that embraces the WACC as a special case. Other refinements and alternatives are discussed in [3,4,7,10,12] among others. With these extensive elaboration, a dichotomy argument between the WACC and SMC seems incomplete and possibly misleading.

More importantly, there are some misconceptions about the WACC in his discussions. For example, without mentioning the critical assumption regarding to the project risk, he asserts that the WACC is not applicable to the risky projects. He also claims that the WACC is not acceptable from a portfolio's point of view, but fails to discuss the relationship between the WACC and the required rate of return. Especially, he has misinterpreted the WACC as not reflecting ex-ante marginalism, and therefore criticized it as "the intentional introduction of financial inconsistency into the valuation process, for marginalism is then negated by averaging, historicism, and fixed cost ex-post statism" [14, p. 180].

The purpose of this note is to clarify some confusions in Paulo's article so that the debates can be directed to the right issues. First the WACC is more properly explained in response to the critiques he has raised. Then one of the problems with Sequential Marginal Costing is demonstrated. The last section concludes.

### THE WEIGHTED AVERAGE COST OF CAPITAL

Conceptually, the cost of capital to the firm is the required return investors demand. Since the required return is affected by the risk undertaken, the cost of capital very much depends on the level of risk in the investment. It is usually assumed that the projects under consideration do not differ in systematic risk from that of the firm as a whole and that the residual risk of the projects does not provide any diversification benefits to the firm. Meanwhile, the financing of the new projects does not change the financial risks of the firm, either. In this context, the WACC is used as the overall cost of capital in capital budgeting.

Paulo first argues that the WACC is an average cost which is in conflict with the principle of marginalism applied for the cash flow analysis since only marginal revenues and marginal costs are counted. However, the WACC is actually the weighted average of the marginal cost of each new dollar of capital raised. It is not the average cost of capital the firm has raised in the past or will raise in the future. The principle of marginalism is fully applied for the component costs in capital. Due to the spill-over effects as recognized by Paulo, the composite cost of funds is used for capital budgeting purposes. Therefore, it seems inaccurate for the WACC being criticized as the average cost in its ordinary meaning.

Meanwhile, the WACC is considered ex-post in Paulo's article and so inconsistent with the ex-ante evaluation of NPV or IRR. Here again the cost rates being averaged are not the historical costs but the marginal costs of the new capital. Given the conditions that investment risk and financing policies remain unchanged, we use the current market rates as estimates of the costs since they reflect the current business and financial risks of the firm. The weights used in the WACC calculation are also not the historical proportions in the capital structure but the target weights of the firm. There are some debates on the issue of proper financing mix to keep a constant financing policy [6,8]. But considering the WACC as ex-post fixed cost is certainly not appropriate.

Another issue mentioned by Paulo is whether or not the cost of current liabilities should form part of the WACC. By definition, short term liabilities are to support the operation of the firm. Their costs are operating cash outflows and are deducted from the operating cash inflows. So their impacts are considered in the determination of the net operating cash flows. If there are current

liabilities which form part of the firm's permanent financing and they have explicit interest costs, they ought to be included in the WACC.

The reasoning is not clear for Paulo's statement that "the WACC is not acceptable because ...assets in the form of projects or securities, as plotted on the security market line, do not have a WACC as the required rate of return" [14, p. 180]. Actually, given the assumptions of the WACC, the required return on the firm's assets calculated by asset beta from the security market line is identical to the WACC. For example, assuming no taxes:

$$\begin{aligned}\beta_{\text{assets}} &= \beta_{\text{debt}}(D/V) + \beta_{\text{equity}}(E/V) \\ r_{\text{assets}} &= r_f + \beta_{\text{assets}}(r_m - r_f) \\ &= r_f + [\beta_{\text{debt}}(D/V) + \beta_{\text{equity}}(E/V)](r_m - r_f) \\ &= [r_f + \beta_{\text{debt}}(r_m - r_f)](D/V) + \\ &\quad [r_f + \beta_{\text{equity}}(r_m - r_f)](E/V) \\ &= r_{\text{debt}}(D/V) + r_{\text{equity}}(E/V) \\ &= \text{WACC}\end{aligned}$$

where  $\beta_{\text{assets}}$ ,  $\beta_{\text{debt}}$ ,  $\beta_{\text{equity}}$ : asset, debt, equity betas

$r_{\text{assets}}$ ,  $r_{\text{debt}}$ ,  $r_{\text{equity}}$ : rate of return on the firm's assets, debt and equity

$r_f$ ,  $r_m$ : risk-free interest rate and market return

$D$ ,  $E$ : market values of debt and equity

and  $V = D + E$ .

The case with taxes is more complicated but the result is similar. An example is given in Brealey and Myers [5, pp. 469-470].

Paulo also claims that working capital at the end of the life of the project should not be discounted at the firm's WACC. This seems to be an issue of the reinvestment rate which has been studied extensively [1,2,9,11,13]. It should be pointed out that the SMC approach favored by Paulo faces the same concern. So it is not relevant to our comparison here.

As mentioned above, the use of the WACC is only appropriate if the proposed investment falls into the same risk class as projects typically undertaken by the firm. If the risk involved is distinctly different from those of the overall firm, the use of the WACC will have a tendency toward incorrectly accepting risky projects and incorrectly rejecting less risky projects. As a result, adjustments or different approaches should be applied. For example, Harris and Pringle [10] provide a clear transition from the WACC to the general case of the

discount rates that vary with risk. A subjective approach based upon the WACC is discussed in Ross, Westerfield and Jordan [15, pp. 458-460]. Paulo criticizes that the WACC is not useful in both the certainty equivalent approach and risk adjusted discount rate approach. But the WACC in its basic form is not supposed to be used in those situations.

#### SEQUENTIAL MARGINAL COSTING

Paulo argues that the marginal cost curve for finance should take the form of a sequential marginal cost curve of the various capital components. Projects are then screened individually, qualifying for approval when the marginal return exceeds the marginal cost of the finance component used. The reasons are "sequentialism does not conflict with principles underlying the determination of the net cash flow and more actually describes the process of raising project finance" [14, p. 181].

The merit of the first reason is ambiguous since it does not provide the SMC any superiority. But the problem with the second reason can be serious because inconsistent investment selection decisions may result. Consider two investment opportunities in the same risk class arriving sequentially at different times. The first project which has a lower return is accepted due to the availability of the lower cost funding sources. But the next one, a high-return project, is rejected owing to the higher financing cost as the low-cost sources have been exhausted by the earlier one.

More importantly, MM propositions point out that the cost of equity is a positive function of leverage. An investment financed by low-cost debt might appear acceptable at first glance, but the use of debt could increase the overall risk of the firm and eventually make all forms of financing more expensive. The sequential marginal costing approach must address this issue and propose a method to calculate this opportunity cost. Otherwise, it is against the principle Paulo has used to criticize the WACC since opportunity cost is certainly relevant in the determination of the net cash flows and therefore should be accounted in the cost of capital.

#### CONCLUSION

The cost of capital is critical in the capital budgeting decisions. It is beyond the scope of this note to give a full discussion of the WACC. There are surely limitations and qualifications for its proper use. Paulo's critique would be more convincing if he had taken these into consideration.

Meanwhile, his arguments seem to contain some misinterpretations about the WACC. The WACC is certainly not ex-post, fixed average cost as he claims. Some of the critiques are directed to the functions that the WACC is not

supposed to perform. And usually the WACC has been adjusted to become a proper discount rate in those situations.

Reservation also exists regarding to his conclusion of superiority of SMC approach even though he emphasizes that "financing takes place in large chunks of a specific component". As stated in Fundamentals of Corporate Finance [15, p.444]: "The key fact to grasp is that the cost of capital associated with an investment depends on the risk of that investment. In other words, the cost of capital depends primarily on the use of the funds, not the source."

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