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Why Pre-Tax Discount Rates Should be Avoided

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Abstract:

Lonergan (2009) and Jindra and Voetmann (2010) analyze comparative results from discounting post-tax cash flows at a post-tax discount rate versus discounting pre-tax cash flows at a pre-tax discount rate. While their results are correct within the context of the examples which they analyze, those examples do not include the most common and interesting problems which financial managers will face. This paper demonstrates that there is no simple standard adjustment which can be made to available post-tax discount rates to enable analysis of pre-tax cash flows in the general case. This problem is even more stark when valuation is attempted on a *real pre-tax basis*, as had been applied in a number of regulatory access pricing situations.

Introduction

There has been considerable debate over whether it is possible to undertake valuations using pre- (company) tax cash flows rather than post-tax cash flows. While pre-tax cash flow estimation may be easier than post-tax cash flow estimation, financial markets provide us with estimates of the cost of capital on a post (company) tax basis. While it might be thought that a pre-tax cost of capital can be readily estimated from a post-tax figure by a simple formula using the company tax rate, this is not generally the case. This issue has been of importance in regulatory access pricing where some regulators have used a "real pre-tax approach" and others have used a "nominal post-tax approach". In that context Davis (2006) shows that the real pre-tax approach is not appropriate because no unique rule exists for converting a market determined nominal post-tax rate of return into a real pre-tax rate of return.

Lonergan (2009) and Jindra and Voetmann (2010), focusing only on nominal magnitudes, analyze comparative results from discounting post-tax cash flows at a post-tax discount rate versus discounting pre-tax cash flows at a pre-tax discount rate. While their results are correct within the context of the examples which they analyze, those examples do not include the most common and interesting problems which financial managers will face. This paper demonstrates that there is no simple standard adjustment which can be made to available post-tax discount rates to enable analysis of pre-tax cash flows in the general case. Hence, use of a post-tax approach is recommended.

The Lonergan and Jindra-Voetmann Analysis

These authors use a number of examples to illustrate the relationship between results using pre and post tax discount rates and cash flows. Jindra and Voetmann demonstrate how consistency of results can be derived for Lonergan's examples. Their results are most simply demonstrated in tabular form (see Table 1).[1] They assume a post-tax discount rate of r = 0.14 and a corporate tax rate of t = 0.30 and show that the two approaches if implemented as per the table notation give equivalent results.[2]

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[1] Their fourth example is a multiperiod cash flow. For simplicity of exposition, the table considers as the fourth case a single Nth - period cash flow which can easily be generalized to multiple periods.
[2] Their paper gives numerical results.

Table 1: Pre and Post tax formulae for taxable cash flows

Example	Post-tax approach	Pre-tax approach
Perpetuity after-tax cash flow of c(1-t)	$V = c(1-t)/r$	$c/[r(1-t)]$
Growing perpetuity after tax cash flow of initially c(1-t)(1+g)	$V = c(1+g)(1-t)/(r-g)$	$V = c(1+g)/(r-g)(1-t)$
Single period after tax cash flow of C(1-t)	$V = C(1-t)/(1+r)$	$V = C/[(1+r)/1-t)]$
Period N after tax cash flow of C(1-t)	$V = C(1-t)/(1+r)^N$	$V = C/[(1+r)^N/(1-t)]$

Several points are apparent from this table. First, it is possible to derive a specific discount factor for each case – but the relationship between the post-tax and pre-tax discount factors varies according to the case. Second, this is purely a matter of algebra. Third, and most important, the approach assumes that the relationship between pre and post tax cash flows is exactly proportional to the tax effect of (1-t).

Cash flows and return of capital

In practice, cash flows of a project involve a mix of return of capital (depreciation) and return on capital. The former is not subject to company tax (depreciation is deducted from cash flows in deriving taxable income) while the latter is taxable. Consequently, the relationship between pre-tax cash flows and post-tax cash flows will depend upon how the tax system divides those cash flows into capital and income components. That may vary substantially, depending on the nature of the project.

In the Table above, the perpetuity examples assume no return of capital, such that all cash flows are taxable at the corporate tax rate of t. Similarly, the single and multi-period cash flow examples treat the cash flow as taxable income – implying that return of capital is taxable.

To see the implications of recognizing that cash flows involve both return of capital and income consider a simple three period example of a project which involves outlay of $100 at date 0 and cash inflows of $70 at date 1 and date 2. In Panel A, the tax system

allows depreciation (return of capital) at \$50 in each year. Using the post-tax cash flows and a discount rate of 14 per cent, the NPV is \$5.386. To achieve the same NPV by discounting pre-tax cash flows requires use of a "pre-tax" discount rate of 21.2 per cent.[3] Panel B of Table 2 differs from panel A only in so far as having a different depreciation schedule, with first period depreciation of \$70 and \$30 depreciation in period 2. Using the post-tax approach, it can be seen that the more delayed return of capital and front loading of taxes reduces the NPV. But the critical result is that when the pre-tax discount rate is calculated which gives the same NPV of \$4.740 it is now 21.7 per cent (compared to 21.2 per cent in panel A).

Table 2: Project pre and post tax cash flows and NPV

Panel A

Date	Cash flow	Depreciation	Taxable Income	Tax @ 0.3	After tax cash flow	Present value
0	-100					
1	70	50	20	6	64	
2	70	50	20	6	64	
after tax NPV @ r=0.14						5.386

Panel B

Date	Cash flow	Depreciation	Taxable Income	Tax @ 0.3	After tax cash flow	
0	-100					
1	70	30	40	12	58	
2	70	70	0	0	70	
after tax NPV @ r=0.14						4.740

Conclusion

The preceding example illustrates that there is no unique relationship between the post-tax discount rate and the pre-tax discount rate which can be applied in all circumstances. The reason is that cash flows will generally involve a combination of non-taxed return of capital and taxable income. The composition of the cash flow is thus a critical element in determining what pre-tax discount rate corresponds to a given post-tax discount rate. Because tax depreciation arrangements can vary between projects, there is no unique

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[3] This can be easily computed by using the "solver" function in Excel to find the discount rate which when used to discount pre-tax cash flows gives the same NPV of 5.386.

formula available for generating the appropriate pre-tax discount rate for a given post-tax discount rate. And because financial markets generate returns which are post-tax in nature, our estimates of required rates of return for investors are post-tax rather than pre-tax. Thus, even though the apparent simplicity of using pre-tax cash flows in project evaluation is appealing, it should be avoided because of the problems in deriving a correct estimate of a pre-tax discount rat from the post tax discount rate (which can be estimated (however approximately) from available data).

References

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