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# Return to Basics: Are You Properly Calculating Tax Shields?

## Regresar a lo básico: ¿Está usted calculando correctamente el crédito fiscal?

**ABSTRACT**

**Everybody uses tax shields, TS, when calculating the Weighted Average Cost of Capital (WACC). The textbook formula includes the tax shield with the (1-T) factor affecting the contribution of debt to the WACC. Tax shields are a strange mix of accounting and accrual related to WACC that relies on market values.**
**In this short work, we show some limitations and care that have to be takeninto account when using tax shields.We illustrate these ideas with simple examples. We show that TS depends on Earnings before Interest and Taxes, EBIT, and/or on financial expenses.**

**Keywords: Weighted Average Cost of Capital, WACC, firm valuation, tax shields, tax savings.**
**JEL codes: D61, G31, H43.**

**RESUMEN**

**Todo el mundo utiliza créditos fiscales, CF, (TS por sus siglas en inglés), cuando calcula el Coste del Capital Medio Ponderado (WACC). La fórmula de los libros de texto los incluye con el factor (1-T) afectando la contribución de la deuda al cálculo del WACC. Los créditos fiscales son una extraña mezcla de contabilidad y causación que relaciona el WACC y los valores del mercado.**
**Este trabajo muestra algunas de sus limitaciones y precauciones que deben tenerse en cuenta cuando se trabaja con créditos fiscales. Muestra también algunos ejemplos de ello así como se demuestra cómo los créditos fiscales dependen del Beneficio Antes de Intereses e Impuestos, BAIT, y/o de los gastos financieros.**

**Palabras claves: Coste del Capital Medio Ponderado, WACC, valoración de la empresa, créditos fiscales, escudo, fiscal, ahorro de impuestos.**

**Clasificación JEL: D61, G31, H43.**

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"I know that most men, including those at ease with problems of the greatest complexity, can seldom accept even the simplest and most obvious truth if it be such as would oblige them to admit the falsity conclusions which they have delighted in explaining to colleagues, which they have proudly taught to others, and which they have woven, thread by thread, into the fabric of their lives". Leo Tolstoy. What Is Art and Essays on Art. As quoted by physicist Joseph Ford in Chaotic Dynamics and Fractals (1985) edited by Michael Fielding Barnsley and Stephen G. Demko.

## 1. INTRODUCTION

Modigliani and Miller, MM, (1958) proposed that in the absence of taxes capital structure does not matter regarding the value of the firm. This is true in an ideal and perfect market. One of the major market imperfections are taxes. When corporate taxes exist (and no personal taxes), the situation posited by MM is different. They proposed that when taxes exist the total value of the firm does change. This occurs because no matter how well managed is the firm, if it is a subject of taxes there exists what economists call an externality. When the firm deducts any expense, the government pays a subsidy or contribution for the expense. It results in less tax payments. In particular, this is true for interest payments. The amount of the subsidy (the tax saving) is $T \times Kd \times D_{t-1}$, where T is the tax rate, Kd is the market cost of debt (assumed to be identical to the contractual cost of debt) and D is the market value of debt (assumed to be identical to its book value) at the end of previous period. The textbook formula for the Weighted Average Cost of Capital, WACC, captures these tax savings as follows

$$WACC_t = Kd_t \times \frac{D_{t-1}}{V_{t-1}} + Ke_t \times \frac{E_{t-1}}{V_{t-1}} - \frac{Kd_t \times D_{t-1} \times T}{V_{t-1}} = Kd_t \times (1-T) \times D\%_{t-1} + Ke_t \times E\%_{t-1} \qquad (1)$$

Where WACC is the weighted average cost of capital, Kd is the cost of debt, T is the corporate tax rate, $D_{t-1}$ is the market debt value at t-1, $Ke_t$ is the cost of levered equity, $E_{t-1}$ is the market value of equity, $V_{t-1}$ is the market value of the firm, and D% and E% are the weights of debt and equity in the cost of capital.

The textbook formula captures the effect of the tax savings with the (1-T) factor affecting the contribution of debt to the WACC. Tax shields are a strange mix of accounting and accrual related to WACC that relies on market values.

In this work, we show some limitations and care that have to be taken into account when using tax shields. We illustrate these ideas with simple examples. We show that TS depends on Earnings before Interest and Taxes, EBIT, and/or on financial expenses.

This paper is organized as follows: In Section One we review the existing literature on calculation of TS and its value. In Section 2 we explain what the tax shields are and illustrate how do they arise. In Section 3 we show some special and typical cases when the firm is levered and summarize the conditions to totally or partially earn the tax shields and show that the textbook formula for WACC is a very special case. We develop a procedure for calculating TS; In Section Four we present a general formulation for WACC; In Section Five we conclude.

## 2. SECTION 1. LITERATURE REVIEW

There is a stream of literature where the task is to calculate the value of tax savings. However, it devotes less effort to examine how the tax savings have to be calculated. Apparently, there is not a procedure to estimate the cash flow associated to the TS, except that of calculating it from the interest payments (interest rate). The general approach for calculating tax savings, TS, is simply the tax rate times interest payments. This is, the

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implicit assumption is that the only source of TS is interest payments and there is always enough profit to earn the tax savings. For instance see MacKie-Mason 1990, Gonedes, 1981 and Liu, 2009.

An example is Liu commenting, "tax shield is a function of interest rates". "[…] Tax shield is a function of four variables 'net income, interest rate, debt, and tax rate.' However, the value of the MM tax shields only includes two variables 'debt and tax rate,' is independent of interest rate, and cannot be true". Liu, 2009, p. 1071. Another example is Gonedes, 1981, who favors the calculation of TS with the interest payments.

> The fact that the NIPA [National Income and Product Accounts] imputations are appropriately disregarded when measuring tax shields is not the only reason for favoring, on grounds of principle, the net monetary interest variable. When the net interest variable is used to measure the debt-induced tax shield against expected inflation, double counting is a result. Gonedes, 1981, p. 248.

On the other hand, we find that firms obtain tax savings different from the simple calculation of interest times tax rate or at least do not obtain the TS in the year they pay taxes. For instance, see Grabowski, 2009, Dammon and Senbet, 1998, and Graham 2000.

Graham, 2000, recognizes that "each marginal tax rate incorporates the effects of non-debt tax shields, tax-loss carrybacks, carry forwards, tax credits, the alternative minimum tax, and the probability that interest tax shields will be used in a given year" Graham, p. 1902. In Grabowski words:

> Do companies realize deductions at the statutory tax rate (get full benefit of interest tax deduction in the period in which the interest is paid)? Researchers have developed a simulated expected tax rate model that simulates taxable income into the future. This process has shown that many companies do not expect to pay the highest marginal rate for long periods of time. Because of tax loss carry-backs and carry-for-

wards and the cyclical nature of some industries, a substantial number of companies can expect a very low tax rate. Grabowski, 2009, p. 38.

As seen, we do not find an algorithm for calculating TS. This is of interest of analysts when forecasting financial statements and cash flows to estimate values of firm and equity. We deal with this problem in Section 3.

On the other hand, the idea of not being "able to utilize all their interest deductions fully because of […] insufficient taxable income" (Cordes and Sheffrin, 1983, p. 95) is not an academic straw man. It is real, several papers report this situation, and they intend to estimate of the effective tax value associated with interest expenses. See for example, Newbould, Chatfield and Anderson, 1992 (p. 53), when they say that "the ability to use tax shields each year is forecast and excess shields are rolled forward until they can be used".

This is very relevant because, as Fama, and French, 1998, put it, "good estimates of how the tax treatment of dividends and debt affects the cost of capital and firm value are a high priority for research in corporate finance" p. 819.

## 3. SECTION 2

**What the Tax Shields Are?**

Tax shields or tax savings TS, are a subsidy that the Government gives to those who incur in deductible expenses. All deductible expenses are a source of tax savings. This is, labor payments, depreciation, inflation adjustments to equity, rent and any expense if they are deductible. As we discount cash flows with a discount rate that takes into account the sources of financing (debt and equity), we introduce the effect of tax savings in what we know as the Weighted Average Cost of Capital (WACC). For this reason we are especially interested in the financial expenses (mainly, interest payments).

We prefer to consider financial expenses as a general concept instead of interest expenses because financial expenses comprise interest, banking commissions, (in

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some countries) foreign exchange losses, adjustment of stock of capital when inflation adjustments are applied to the financial statements, interest on capital stocks as in Brazil (see, Vélez-Pareja and Benavides, 2011). All these financial expenses are sources of tax savings and not necessarily are included in the textbook formula for WACC (1). This means that using it indiscriminately results in an upward bias in the estimation of WACC and a downward one for firm value.

In general, an after tax expense $E_{at}$ is equal to the before tax expense, $E_{bt}$ times (1-T) and the tax shields or tax savings are $E_{bt} \times T$.

$$E_{at} = E_{bt} \times (1\text{-}T) \tag{2a}$$

This means that the subsidy the firm receives from the government (the tax shield or tax savings) is

$$TS = E_{bt} \times T \tag{2b}$$

In the case of financial expenses (assuming that the only source of TS is interest payments) the TS is $T´Kd´D_{t-1}$ where all the variables are defined above. The firm acquires the right to earn the TS if there are enough Earnings before Interest and Taxes, EBIT plus Other Income, OI, to offset the financial expenses. However, the **firm actually receives that subsidy when it pays taxes; this is when the firm writes a check to pay them**.

Let us explain all this with a simple example. Assume a firm with Sales revenue of 1,000, a Cost of goods sold, COGS of 500, Financial Expenses FE, of 200 and a corporate tax rate of 30%,

| Income Statement (up to EBIT) | | |
|---|---|---|
| | **No debt** | **With debt** |
| Sales revenue | 1,000 | 1,000 |
| Cost of goods sold, COGS | 500 | 500 |
| EBIT | 500 | 500 |
| Table 1a | | |

What would happen if in the next line we include financial expenses? The first reaction would be that the new expenses would reduce Net Income by 200. However, as we show in Table 1b it is true for Earnings before Taxes, EBT, as follows:

| Income Statement (up to EBT) | | |
|---|---|---|
| | **No debt** | **With debt** |
| Sales revenue | 1,000 | 1,000 |
| COGS | 500 | 500 |
| EBIT | 500 | 500 |
| FE | 0 | 200 |
| EBT | 500 | 300 |
| Table 1b | | |

However, Table 1b is not the complete picture. We have to see what happens with Net Income.

| Complete Income Statement | | |
|---|---|---|
| | **No debt** | **With debt** |
| Sales revenue | 1,000 | 1,000 |
| COGS | 500 | 500 |
| EBIT | 500 | 500 |
| FE | 0 | 200 |
| EBT. | 500 | 300 |
| Taxes (30%) | 150 | 90 |
| Net income, NI | 350 | 210 |
| Table 1c | | |

If financial expenses increased by 200 (from 0 to 200) the first reaction was to think that the new expense will reduce Net Income by 200. What we found in the complete picture is that FE do not reduce NI by 200 but by 140. Using (2a) we have

$$E_{bt} \times (1\text{-}T) = 200 \times (1\text{-}30\%) = 140$$

Observe that the difference in taxes is the same as the difference between $E_{at}$ and $E_{bt}$ as expected. In fact, the tax savings are the difference in taxes (150 – 90 = 60). And at the same time, that difference is, using (2b), $E_{bt} \times T$ or $200 \times 30\% = 60$.

## 4. SECTION 3

**Special and Typical Cases: An Algorithm for Tax Savings Calculation**

Is it true that in all cases the firm earns the full TS as in the example? It does not always happen. The reader will easily identify situations where the previous conditions are not met, such as start-ups and firms in financial distress. Let us consider two situations:

1. Tax shields when EBIT+OI>FE
2. Tax shields when EBIT+OI<FE

The question the reader has the right to ask is if it makes any difference. We will show this in the next simple example.

Before moving forward let us consider the following assertion: The "right" to earn the TS is based on results from the Income Statement, IS and this financial statement is based on accruals that do not imply a cash flow. This means that the calculation of TS needs accounting figures. In fact, any one could verify that estimation of taxes use accounting results that imply accruals. As can be seen from the IS, the "right" to the TS depends on EBIT and OI.

Next table presents the first case. We will use the same idea of a levered and unlevered firm that is subject to income taxes.

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| Tax shields when EBIT+OI>FE | | |
|---|---|---|
| | **No debt** | **With debt** |
| EBIT | 200 | 200 |
| FE | 0 | 150 |
| EBT | 200 | 50 |
| Taxes 40% | 80 | 20 |
| Net Income | 120 | 30 |
| TS = difference in taxes | 0 | 60 |
| **Table 2a** | | |

We increased the FE from 0 to 150. Net Income decreases from 120 to 30. The net reduction was 90 and the TS were 60. This is 150 × 40% = 60, according to eq. (2b). Usually, when EBT is negative or zero, the firm pays no income taxes[1]. From the previous case, we have: *When EBIT+OI>FE tax shields are the corporate tax rate times the financial expenses.*

| Tax shields when EBIT+OI<FE | | |
|---|---|---|
| | **No debt** | **With debt** |
| EBIT | 100 | 100 |
| FE | 0 | 150 |
| EBT | 100 | -50 |
| Taxes 40% | 40 | 0 |
| Net Income | 60 | -50 |
| TS = difference in taxes | 0 | 40 |
| **Table 2b** | | |

Observe that in this case EBIT is 100 and we increased FE from 0 to 150, BUT EBIT < FE. This means that Net Income reduces from 60 to -50. The net reduction was 110. And TS were 40. This 40 IS NOT 150× 40% = 60 as predicted by eq. (2b). This means that our rules (2a) and (2b) do not apply! It is interesting to observe that the firm is subject to income tax BUT it does not pay taxes in this case. Taxes are zero and yet we are saying that the firm earns TS of 40. From this case, we have: *when 0<EBIT+OI<FE, tax shields are not cor-*

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*porate tax rate times financial expenses. On the contrary, tax shields are corporate tax rate times EBIT plus other income.When EBIT+OI<0, tax shields are zero.*

We can summarize these ideas in the following tables. Table 3a shows the case when EBIT+OI >FE.

| Case 1 EBIT+OI>FE | | |
|---|---|---|
| **No debt** | **Debt** | **Tax Shields = difference in taxes** |
| EBIT + OI | EBIT + OI | |
| 0 | FE | |
| EBT = EBIT + OI | EBT = EBIT + OI- FE | |
| Tax = T × (EBIT + OI) | Tax = T × (EBIT + OI - FE) | TS = T×FE |
| Table 3a | | |

In the previous case we say that the TS is equal to the financial expense times the tax rate. This is the case where the traditional textbook formula works. Now, in table 3b, we work an example where EBIT + OI < FE.

| Case 2 0<EBIT+OI <FE | | |
|---|---|---|
| **No debt** | **Debt** | **Tax Shields = difference in taxes** |
| EBIT + OI | EBIT + OI | |
| 0 | FE | |
| EBT = EBIT + OI | EBT = EBIT+OI – FE < 0 | |
| Tax = T × (EBIT + OI) | Tax = 0 | TS = T × (EBIT + OI) |
| Table 3b | | |

In this second case, we see that the TS IS NOT T times the financial expenses, as predicted by eq. (2b) but T times EBIT + OI. This is a very important conclusion. In table 3c we show the case when EBIT+OI < 0.

| Case 3 EBIT+OI <0 | | |
|---|---|---|
| **No debt** | **Debt** | **Tax Shields = difference in taxes** |
| EBIT + OI | EBIT + OI | |
| 0 | FE | |
| EBT = EBIT + OI < 0 | EBT < EBIT + OI - FE <0 | |
| Tax = 0 | Tax = 0 | TS = 0 |
| Table 3c | | |

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In this third case, we say that when EBIT + OI is negative, the TS is zero. Observe that it is not true that TS arise when the firm actually pays taxes. TS arise when the firm is subject to income taxes even if in a particular case the firm does not pay taxes, as in table 3b. The condition for the existence of TS is that the firm is subject of income taxes AND EBIT + OI is positive.

In summary, we have

$$TS = \begin{cases} T{\times}FE \text{ if EBIT+OI} \geq FE \\ T{\times}(EBIT{+}OI) \text{ if } 0 \leq EBIT{+}OI \leq FE \\ 0 \text{ if EBIT+OI} < 0 \end{cases} \quad (3)$$

What we have is a segmented function of TS depending from EBIT + OI. Exhibit 1 depicts this.

It is interesting to note that Wrightsman, 1978, supported this idea. The surprise comes out because the author wrote this more than 30 years ago and yet, we find most textbooks and papers assuming TS as tax rate times interest charges. This has implications because there is a generalized use of the WACC textbook formula as if that were true in all cases. Observe what Cooperand Franks, 1983, p.572-573, assert:
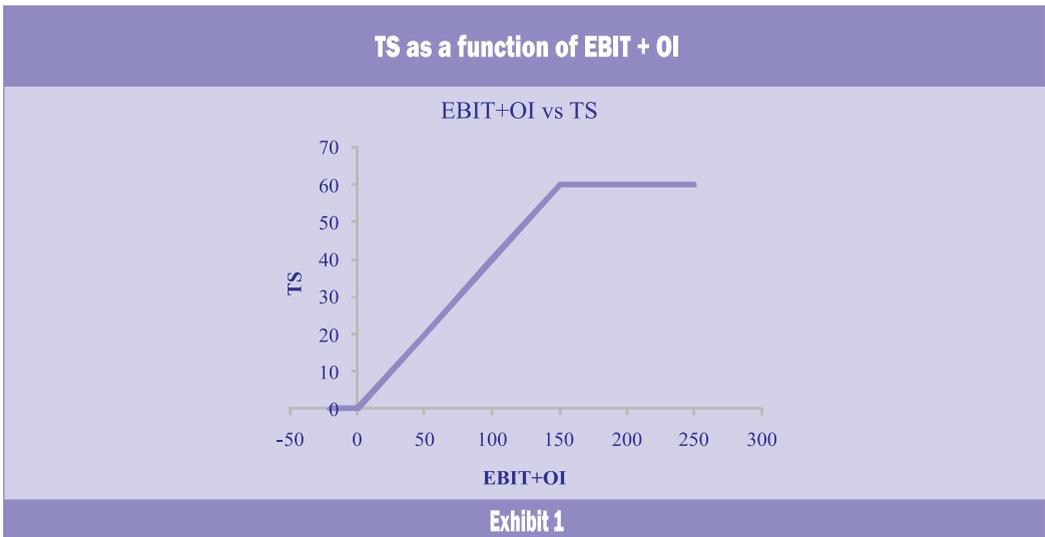
"With taxes as the only imperfection, no corporation pays taxes if it issues sufficient corporate debt to make interest charges always equal to taxable income from operations. Interest charges provide a costless alternative mechanism for sheltering taxable income, so alternative tax shield substitutes have no value. The capital budgeting rule requires that all projects should be evaluated on the basis of their pre-tax cash flows, using an unlevered equity required return as the discount rate".

This is wrong. If EBIT offsets interest charges, then taxable income is zero, BUT the tax shields are corporate tax rate times financial expenses according to (3). Hence, the discount rate has to include the effect of tax shields.

On the other hand, Aivazian and Berkowitz, 1992 suggest that the firm obtains tax shields when it pays taxes. As seen above, the firm could not pay taxes and still get some TS. See the second segment of equation (3). When the firm is in that second segment it does not pay taxes and yet get some TS equal to T×(EBIT + OI).

This segmented function (3) is very important because in reality, at least in the beginning years for new ventures or startups, EBIT+OI might be less than FE or negative. This means that in those cases we cannot assume the firm earns the entire TS. It might be either zero or less than T×FE.

## TS as a function of EBIT + OI



EBIT+OI vs TS

Exhibit 1

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Equation (4a) expresses the segmented function for TS as

TS = Maximum(T × Minimum(EBIT+OI, FE), 0)   (4a)

In Excel notation:

=Max(T*Min(EBIT+OI,FE),0)                              (4b)

If tables 3a to 3b and Exhibit 1 show the relationship between TS and EBIT, we can easily conclude that TS is a function of EBIT and hence has the same risk of EBIT (or Free Cash Flow). Wrightsman, 1978, calls this situation as risky debt; however, we consider that the riskiness of TS comes from EBIT, not from the debt itself. Following this, we consider that this means the proper discount rate for TS should be Ku, the cost of unlevered equity.

Regarding the risk of TS, Brennan and Schwartz, comments on cite the seminal paper by Modigliani and Miller, 1963:

> This paper is concerned mainly with relaxing the assumption that the tax savings due to debt issuance constitute a «sure stream.» Modigliani and Miller themselves acknowledge that «some uncertainty attaches even to the tax savings, though, of course, it is of a different kind and order from that attaching to the stream generated by the assets» (1963, n. 5). They attribute this uncertainty to two causes: first, the possibility of future changes in the tax rate and, second, the possibility that at some future date the firm may have no taxable income against which the interest payments on the debt may be offset. Brennan and Schwartz, 1978. P. 104.

If we examine textbook formula for WACC in (1) we have

$$WACC_t = Kd_t \times D\%_{t-1} \times (1-T) + Ke_t \times E\%_{t-1} \qquad (1)$$

But it only applies to case 1. This is, if EBIT + OI = 0 and taxes are paid the same period when accrued and interest payments are the only source of TS.

Now we will show how the (1-T) factor works. Assume a loan of 1,000 to be repaid next year. Tax rate is 40% and the firm pays taxes the same year as accrued. Next table shows Cash Flow of Loan, CFL.

| Taxes paid the same year. TS fully earned | | | |
|---|---|---|---|
| Year | CFL[2] | TS | After tax CFL |
| 0 | 1,000 | | 1,000 |
| 1 | -1,300 | 120 | -1,180 |
| IRR, Internal Rate of Return for the loan (from the firm's point of view) | 30% | | 18% |
| Table 4a | | | |

If tax rate T is 40%, then TS is 120. In the previous table, we have taxes paid the same year and the TS fully earned in the same year. In that case, after tax contractual Kd is Kd(1-T) = 30% × 60% = 18% which is equal to the IRR for the after tax CFL.

Now assume that the firm pays taxes next year. This means that the firm effectively receives TS when taxes are paid. In that case, we have:

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| Taxes paid next year. TS fully earned | | | |
|---|---|---|---|
| **Year** | **CFL** | **TS** | **After tax CFL** |
| 0 | 1,000 | | 1,000 |
| 1 | -1,300 | | -1,300 |
| 2 | | 120 | 120 |
| IRR, Internal Rate of Return for the loan (from the firm's point of view) | 30% | | 20% |
| **Table 4b** | | | |

In table 4b we can see that after tax contractual Kd IS NOT Kd (1-T). Observe that postponing the TS one year increases the after tax cost of debt from 18% to 20%. This is of utmost importance because the trend is to use (1) as a standard and general formula. In fact, it is not. On the contrary, (1) is a very special case that has to meet some conditions. These conditions are:

1. D%$_{t-1}$ (D$_{t-1}$/V$_{t-1}$) and E%$_{t-1}$ (E$_{t-1}$/V$_{t-1}$) are calculated with market value for E and V at the beginning of the period for which we calculate WACC.
2. Market values are the present value of future cash flows at WACC, hence circularity arises between WACC and V.
3. WACC may change from period to period due to changes in D% and external causes such as inflation rate.
4. Kd×(1-T) implies taxes are paid the same period when accrued.
5. Earnings before Interest and Taxes, EBIT plus Other Income, OI are greater than financial expenses and hence, the firm earns the full TS.
6. The only source of TS is the interest paid.

7. Market value of debt is equal to its book value and the contractual cost of debt is identical to the market cost of debt.

All these conditions mean that the formula applies to a very special and unique case. Also notice from table 4b that the firm receives tax savings when it pays taxes, not when they are accrued. Moreover, eventually, the firm could delay the payment of interest but pay the taxes and it earns the TS when it pays taxes.

Reality is not as simple as we have shown in the illustrative examples. Typical conditions in reality make the calculation and the "receipt" of TS a little more complex. Issues like inflation adjustment to the financial statements, losses carried forward, taxes paid in advance or delayed and exchange rate losses might make the calculation of TS difficult. Usually, in a financial model it is necessary to keep control of several conditions at a time and not all of them are reflected in the cost of debt after taxes, Kd×(1-T). If tax law allows Losses Carried Forward LCF, TS not earned one period the firm will recover them in the future when the firm offsets losses.

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## 5. SECTION 4

**If Textbook Formula is a Special Case, is there a General Formulation for WACC?**

Not all is lost. Before we proceed we have to mention that the value of the TS is its present value at a proper discount rate, ψ. We can be show that a general formulation for WACC for the FCF is (see Taggart[3], 1991, Tham and Vélez-Pareja, 2002, 2004):

$$WACC_t = Ku_t - \frac{TS_t}{V_{i-1}} - \left(Ku_t - \psi_t\right)\frac{V_{t-1}^{TS}}{V_{t-1}} \quad (6a)$$

Where $V^{TS}$ is the value of TS at ψ, Ku is the cost of unlevered equity and other variables have been defined previously. When we write WACC as a function of TS and its value as in (5a), the firm could earn TS at any time and from any source. It seems a complex formula, but it greatly facilitates work when of working with WACC and the FCF, that is what we need in order to calculate value. This formulation has the property of applying for any source of TS that affects the financing of the firm. For instance, it might be valid for some cases such as in the case of financial statements adjusted by inflation, where the procedure corrects and adjusts equity capital by inflation. It also might apply when part of dividends to shareholders are paid as interest on book value of equity, as in Brazil (see Vélez-Pareja and Benavides, 2011).

Depending on the assumption we make regarding the risk (the discount rate) of TS, ψ, the expression for WACC is more or less complicated.

If we assume ψ = Kd

$$WACC_t = Ku_t - \frac{TS_t}{V_{t-1}} - \left(Ku_{ti} - Kd_t\right) \times \frac{V_{t-1}^{TS}}{V_{t-1}} \quad (6b)$$

In this formulation, we keep assuming that market cost of debt is identical to contractual cost of debt.

If we assume ψ = Ku

$$WACC_t = Ku_t - \frac{TS_t}{V_{t-1}} \quad (6c)$$

As can be seen in the previous formulas tax savings are included explicitly if the formulation for WACC. This means that we can introduce all types of tax savings as suggested in Section 2.

## 6. SECTION 5

**Concluding Remarks**

We have shown the proper way to calculate TS. We also show how to include the TS in a general formulation for WACC. In addition, we showed that the condition for a firm to earn TS is not that it pays taxes; it is that the firm be subject to taxes **and** that EBIT + OI be positive.

We also have shown that TS depends on Earnings before Interest and Taxes, EBIT and Other Income, OI. This means that a proper discount rate for TS might be the cost of unlevered equity, Ku.

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Notas

1.- We are not considering here a situation where the firm is subject to presumptive taxation. However, when the firm has EBT < 0 this type of taxes applies precisely, hence the TS does not occur.

2.- Note that CFL is the negative of the Cash Flow to Debt, CFD (CFD would be -1,000 in time 0 and +1,300 in time 1). However, After tax CFL IS NOT After tax CFD. Tax shields are not something that reduces (that is what the debt holder receives), they are a reduction of what the firm pays out. The meaning of after tax IRR refers not to the after tax cost of debt (as perceived by the debt holder), but to the net cost paid by the firm. (I am indebted to my colleague Rauf Ibragimov for calling my attention to clarify this).

3.- Taggart does not derive the formula but presents it as part of a collection of formulas for different risk for the TS.

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