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THE PINK BALANCE SHEET: AN EASY WAY TO TEACH CAPITAL STRUCTURE BASICS

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ABSTRACT

Students of corporate finance must learn the basics of capital structure theory. However, most textbook discussions are confusing and include too many equations. We present a simple model of tax-related capital structure basics that incorporates only three components: a market-value balance sheet, colors that represent risk, and one equation. Students mastering the pink balance sheet should be able to remember easily the various implications of basic capital structure models, including beta relationships such as the Hamada equation.

JEL: G32

KEYWORDS: Capital Structure, Beta Levering, Hamada Equation

INTRODUCTION

"Debt can be an asset." So says the Henry Kravis character in HBO's 1993 movie *Barbarians at the Gate* (HBO, 1993). His point was that debt "tightens a company," since required debt service reduces the free cash flow available for managers to appropriate (Jensen, 1986). In basic corporate finance courses, students learn about another way that debt can be an asset: if the firm is taxed, the tax shield created by interest payments can raise company value.

Managers trying to create value for their shareholders wish to choose their mix of debt and equity—their capital structures—to optimize the value of the interest tax shield. The implications of the firm's financing choices on the value and risk of its equity are extremely important for corporate financial managers, and therefore they form an integral part of the basic corporate finance curriculum for business students. This curriculum proceeds in a very structured way, and has for the last thirty years. However, while the textbook approach to capital structure is highly standardized, it is also highly opaque: there are far too many equations and far too little emphasis on the most fundamental ideas. Engagement on both sides of the classroom can devolve into "some people said capital structure was irrelevant, but it's not." It does not have to be this way.

In this paper, we present a simple framework of only three concepts that will help students master the canonical tax-related models of capital structure. Once students know this material, it will be easier for them to learn enhancements based on asymmetric information, agency costs, and control issues.

The concepts we use are not original, but our user-friendly package is. It should help students develop an intuitive appreciation for the basics of capital structure—or at least a better grasp than they can get from the standard textbook presentation. The pink balance sheet approach simplifies capital structure pedagogy by explicitly identifying the two types of assets that a taxed firm has, highlighting the contribution of the interest tax shield; by providing a visual representation of risk; and by using a single framework equation rather than dozens of case-specific expressions. In both undergraduate and graduate corporate finance courses, I have found this approach to facilitate the capital structure discussion considerably, and to improve students' understanding and retention of the ideas.

The paper proceeds as follows. After a literature review, we present the pedagogical framework. We then apply it to the fundamental models of capital structure. Before concluding, we provide two brief example applications.

LITERATURE REVIEW

The pink balance sheet is a simplified and intuitive approach to teaching students how a firm's debt/equity mix affects its value. It is therefore based on the academic capital structure literature, and it is a response to the rather muddled textbook attempts to cover that literature. In this section, we consider both elements: first the literature itself, and then traditional textbook coverage.

The Capital Structure Canon

A survey of the canonical capital structure literature would usually start with Modigliani and Miller (MM, 1958), since "[s]urveys of the theory of optimal capital structure always start with the Modigliani and Miller (1958) proof that financing doesn't matter in perfect capital markets" (Myers, 2001). However, we instead will start with common extensions of MM's work (both the 1958 irrelevance theorem and the 1963 extension incorporating taxes), because we discuss MM at length in the next section.

MM do not consider personal taxes, so Miller (1977) does. He shows that MM's (1963) prediction of extreme leverage—a consequence of the tax shield created by debt financing—is mitigated when investors face higher personal tax rates on debt than on equity.

Other theories also attempt to moderate MM's predictions. Harris and Raviv (1991) review asymmetric information, agency costs, and corporate control theories. Myers (2001) adds a review of tax-motivated "trade-off" theories, in which firms balance leverage gains against costs of financial distress. He concludes that while taxes tactically affect financing choices, there is little evidence that interest tax shields materially increase firm value.

Bradley, Jarrell, and Kim (1984) call the trade-off theories the "general academic view of the 1970s." Their own model—"the modern balancing theory of optimal capital structure"—incorporates the full range of contemporary adjustments to MM (1958): personal taxes on both debt and equity, bankruptcy costs, agency costs, and the availability of non-debt tax shields. They predict, and find, that leverage decreases with increasing costs of financial distress and variability of firm value.

These "balancing" theories are often easier to understand than the equations spawned by the tax-related theories, so the pink balance sheet focuses on the latter. We therefore must consider two other approaches concerned with the proper valuation of the interest tax shield: Myers' (1974) adjusted present value (APV), and Miles and Ezzell's (1980) adjusted discount rate.

Myers' (1974) APV framework breaks project value into an all-equity base case plus adjustments for financing and project interaction effects. Myers highlights the importance of a constant market-value leverage ratio to the validity of the textbook WACC equation, and he explains that maintaining this ratio means that tax shields are not riskless. This is a critical point for students, and it is developed further in Miles and Ezzell (1980).

Miles and Ezell (1980) "clarify" the textbook WACC's role in valuing projects of any length, showing that WACC can be used to discount unlevered cash flows to obtain (levered) value. The critical issue is not length, but debt rebalancing: WACC requires that debt is rebalanced to maintain a constant debt/value ratio. Thus, even "though the firm might issue riskless debt, if financing policy is targeted to realized market values, the amount of debt outstanding in future periods is not known with certainty (unless the investment is riskless) and, consequently, the magnitude of the tax shields cannot be known with certainty" (p. 721). (Myers, 1974, p. 22, agrees: even if a given tax shield is safe, a constant D/A implies that "the aggregate value of the instruments obtainable is uncertain. We have in effect a compound lottery; the fact that the second stage is risk-free does not mean that the lottery itself is safe.") This insight is critical for students learning how to unlever and relever betas, as we discuss below.

In their 1983 paper, Ezzell and Miles reconcile the APV and WACC approaches to capital budgeting. They show that while APV discounts all tax shields at the cost of debt, WACC does so only for the first period; all future shields are discounted at the rate appropriate for the operating assets. Their "modified APV" approach leads to an intimidating weighted average discount rate that we suggest introductory students ignore.

Harris and Pringle (1985), however, offer a more user-friendly option. They decompose the textbook WACC equation into an operating component and a tax shield-related component. Defining the former as the discount rate applicable to the firm if it were unlevered makes it straightforward to estimate the required returns for projects whose risks are different from average: find the operating piece using a comparable pure-play firm, then use the debt ratio that is optimal for the target project.

Harris and Pringle (1985) focus on the asset side of the balance sheet. They use their operating asset rates to value a firm's interest tax shields, using the models of MM (1963), Miller (1977), and Miles-Ezzell (1980). While their approach is pedagogically beautiful, their focus on operating cash flows leads to equations for the unlevered cost of equity, rather than for the levered cost (as is standard in textbooks). They also do not distinguish total assets from operating assets when examining the market-value balance sheet. We provide both of those enhancements in this paper.

Having described the underlying literature, we now consider how several popular introductory textbooks cover these tax-related capital structure theories.

<u>The Traditional Textbook Approach to Presenting Capital Structure</u>

Finance "students" include those preparing for the Chartered Financial Analyst (CFA) exams. Level I of the CFA curriculum is arguably comparable to a finance undergraduate curriculum, so its coverage should include the essential corporate finance topics. However, in 2012, Level I covered beta unlevering/relevering using only the Hamada equation (Courtois, *et al.*, 2012). Starting with portfolio beta, the authors simply multiply all debt terms by (1-T), "due to interest deductibility"; they then "assume that a company's debt does not have market risk," which leads them to the Hamada equation. They wrap up by presenting four versions of this same equation, solving for both levered and unlevered betas, for both firms and projects. Presenting the same structural relationship four different ways obscures the point and sows confusion.

As for students in traditional undergraduate programs, they have long used "Brigham books" in introductory finance courses. A recent iteration, Brigham and Daves (2013), devotes two chapters to capital structure. The first covers MM (1958, 1963) and Miller (1977), and presents the Hamada equation. These sections alone merit seven equations, even without Proposition II. The authors save that relationship for the second chapter—a chapter that presents 14 equations as it delves into the same three papers. This chapter also presents the Ehrhardt and Daves (2002) growth-adjusted model (which we discuss below), requiring another seven equations. Although some of these are repeats or rearrangements, the sheer number of equations is overwhelming.

Titman and Martin's (2016) sophisticated cost of capital chapter requires 12 numbered (and more unnumbered) equations. They include a brilliant "technical overview" that is the clearest exposition of the market value balance sheet that may exist in the textbook universe. However, even they fall prey to rearrangement-of-equations mania, and they pay more attention to the Ezzell and Miles (1983) refinement than most students will appreciate.

Now, the big kahuna. Brealey and Myers have been defining corporate finance education for decades. Brealey, Myers, and Allen's (BMA, 2014) eleventh edition of *Principles of Corporate Finance* is now the standard-bearer.

BMA devote three chapters to cost of capital issues. Chapter 17 goes through MM's (1958) arbitrage proof of irrelevance, describing propositions I and II. It shows that the beta of assets equals a weighted average of claims' betas. It compares MM's views on the effects of leverage to those of "traditional" approaches. Chapter 18 then turns to the value of the tax shelter: how large MM (1963) said it was; how Miller (1977) used personal taxes to predict it was smaller; how the "trade-off" theory incorporates costs of financial distress; and how the pecking order theory incorporates the interactions of the firm's internal cash flows and project opportunities. Bottom line: "Is there a theory of optimal capital structure? No."

The chapter most relevant for this paper is 19, especially the coverage of unlevering and relevering an equity beta. This chapter has 24 footnotes, one of which has 11 equations in it. They cover MM (1963), Myers (1974), Miles and Ezzell (1980), and Hamada (1972). More tellingly, they include "some final advice," "tricks of the trade," and "your questions answered" sections—clear evidence that they believe that they have left the waters muddied.

Our approach handles the same material with one main equation, one picture, and some colors. We describe our "pink balance sheet" approach in the next section.

THE PINK BALANCE SHEET

Our approach to teaching basic capital structure has three parts:

1. a market value balance sheet
2. colors for each piece of the balance sheet, representing relative risk
3. one equation, that comes from MM (1963)

None of these is original. However, students should benefit from this particular combination, which focuses on the big, underlying concepts rather than on the myriad special cases. Instead of memorizing equations, students concentrate on the broad effects of leverage: increasing leverage increases equity risk, but may increase the market value of the firm. Using colors helps the visual learners among us create a mental picture of how risk and market values change.

Creating the market value balance sheet is the first step in visualizing capital structure. Other authors have stressed the importance of this concept (e.g., Titman and Martin, 2016). However, we make the idea more concrete by drawing blocks depicting the balance sheet components, with the relative sizes of these blocks representing their relative values. What makes this explicitly a *market value* balance sheet is the block representing the value of the interest tax shield. When this is present, the value of the firm's total assets is larger than the value of its operating assets, and the frequently used textbook term "cost of assets" becomes ambiguous.

The colors of each block on the market value balance sheet reflect that component's relative risk. As risk rises, the intensity of color increases. (In 1958, MM also used an analogy to describe the allocation of risk, but today's students are less likely to relate to separating whole milk into butter fat and skim milk than they are to separating pink into white and red.) In our scheme, operating assets are pink. Risk-free debt is white; as debt becomes riskier, the debt block becomes pinker. Levered equity is red. Thus, as assets are financed by debt and equity, pink is made from white and red. (For a less vibrant—but still visual—approach, operating assets can instead be colored grey, with equity becoming blacker as it becomes riskier. Given the restrictions of journal printing, we will use this grey/black scheme in our figures below.)

Finally, we summarize the relationships from the pink balance sheet using one equation:

$$k_{eL} = k_{opA} + (k_{opA} - k_d)*(D/E)*(1\text{-}T_c), \tag{1}$$

expressing the cost of levered equity as a function of the cost of operating assets (k_{opA}), the cost of debt (k_d), the debt/equity ratio, and the corporate tax rate (T_c). This is MM's 1963 "with-tax" relationship. We have two introductory comments about this equation. First, this is not an intuitive expression, so students should be encouraged to learn its simple derivation (which we show below). However, for those students who prefer to have something to memorize, this is the equation to remember. Once they know it, all they have to do is substitute relevant values for the case they are considering (e.g., $T_c = 0$ for MM, 1958); they can also simply substitute betas for costs to measure systematic risk. Second, the "opA" subscript is inelegant, especially since k_{opA} is simply the cost of unlevered equity. However, "opA" reminds students that there can be more than one asset on the market value balance sheet, which the more commonly used "k_{asset}" or "k_{eU}" (for "unlevered equity") notation can obscure.

Having introduced the three basic parts of our approach, we now use the pink balance sheet to describe the basic tax-related capital structure models.

<u>MM 1958: No Taxes; Perpetual, Riskless Debt</u>

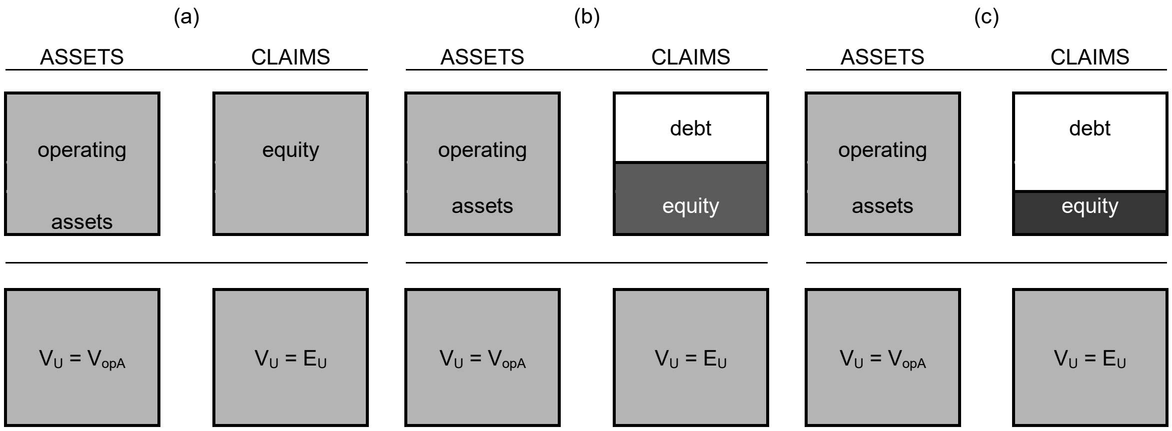
MM derive their original irrelevance theorem in a world with no taxes. They also assume that the "physical assets held by each firm will yield to the owners of the firm—its stockholders—a stream of 'profits' over time"—a stream of profits that is unaffected by capital structure. Capital structure choice does not affect the investment opportunity set of the firm, and firm value comes only from the operating assets of the company. In this case, capital structure is irrelevant (MM's proposition I).

Consider a market value balance sheet for a firm in this world. If the firm has no debt, its value is V_U, which the same as its equity value, E_U. This unlevered firm is depicted in panel (a) of Figure 1. The size of the blocks reflects the (equal) value of the operating assets and the unlevered equity, and the pink (grey) color represents their (equal) risk.

Firm value will remain V_U, and the overall risk must remain constant (the same shade of pink or grey), regardless of what we do with the claims on the right-hand side. However, although the whole remains unchanged, adding debt means that the components of the claims side *will* change. As the value of debt rises, the value of levered equity must fall; the more debt we add, the smaller the equity block becomes. It also becomes a darker red, as more of the risk of the operating assets becomes concentrated into the shrinking amount of equity. For example, in Figure 1's panel (b), debt makes up half of the value of the operating assets, so the debt block is the same size as the equity block; in panel (c), in contrast, D/A is 70%, so the equity block is smaller and darker.

A numerical example may help clarify these points. Let us assume that the value of the operating assets—and therefore of the unlevered equity—is 100. In panel (b) of Figure 1, then, we add 50 of debt, reducing our equity value to 50. In panel (c), using 70 of debt means that equity falls to 30. Under MM's irrelevance case, adding a dollar of debt reduces the market value of equity by a dollar.

Figure 1: Capital Structure in a World with No Taxes (MM, 1958)



This table illustrates the world of MM (1958). Since there are no taxes, the value of the firm always equals the value of the operating assets; thus, the asset side of each of the three balance sheets includes only the operating asset block. When there is no debt, as in panel (a), the value of the firm's equity equals the value of the entire firm, so the equity block on the claims side of the balance sheet is the same size as the operating asset block; it is also the same color, since the risk of the equity is simply the risk of the operating assets. However, when the firm adds debt, as in panels (b) and (c), the equity block gets smaller (its value falls) and darker (its risk increases). Since MM assume that debt is riskless, we use white to color the debt block. In panel (b), debt makes up 50% of the capital structure, so the equity block is twice as dark as the operating asset block. In panel (c), debt is 70% of the capital structure, so equity is 3.333 times as dark.

As for relative risks, since MM assume that debt is riskless, we have colored the debt blocks in Figure 1 white; all of the risk of the operating assets is concentrated in the equity. In panel (b), where D/A = 50%, the equity block is therefore twice as dark as the operating asset block; in panel (c), where D/A = 70%, the equity block is colored 3.333 times ([0.7+0.3]/0.3) as dark as the operating assets.

We can easily quantify this concentration of risk by noting how k_{eL} (the cost of levered equity) rises as the amount of debt increases. Since the weighted average of the costs of claims must remain equal to k_{opA} (and stay a constant shade of pink), we have:

$$k_{opA} \quad = \quad w_d{*}k_d + w_{eL}{*}k_{eL} \quad = \quad (D/V_L){*}k_d + (E_L/V_L){*}k_{eL},$$

where w_d and w_{eL} are the market value weights of debt and the levered equity, respectively, and V_L is the value of the levered firm (which, given our current assumptions, is the same as the value of the unlevered firm, the operating assets, and the unlevered equity). Substituting ($D + E_L$) for V_L and rearranging, we have:

$$k_{eL} \quad = \quad k_{opA} + (k_{opA} - k_d){*}(D/E_L),$$

which is simply our framework equation (1), assuming that $T_c = 0$. It is more famous, of course, as MM's proposition II. It simply tells us that, if the weighted average of k_d (white) and k_{eL} (red) must always end up as the same shade of pink, then adding more debt means that k_{eL} must get darker red.

As an example, assume that $k_{opA} = k_{eU}$ is 8% and that k_d = 3%. If debt makes up half of the firm's market value, as in Figure 1(b), then the cost of the levered equity will be 13%. If the debt ratio is 70%, as in Figure 1(c), then k_{eL} will rise to 19.67%.

While MM focus on riskless debt, they do comment on the "seemingly paradoxical result" that occurs if k_d is allowed to rise with leverage: "the increased cost of borrowed funds as leverage increases will tend to be offset by a corresponding reduction in the yield of common stock" (p. 274). Students can visualize this result easily with colors. Since the asset side must remain the same shade of pink, if the debt piece gets pinker (riskier), the equity piece must get lighter red. The equity is getting less risky—as the debt is reflecting some of the (constant) risk of the operating assets—and therefore offers a lower yield.

Two things are happening here: (1) the debt piece is getting larger, making equity riskier; but (2) the debt itself is getting riskier. The "paradox" relates to the latter: *once the amount of debt is determined*, making that debt riskier makes the equity safer. MM note that incorporating the two countervailing effects together makes k_e a nonlinear function of leverage, abrogating proposition II.

Since the MM papers predate the CAPM, MM do not address betas. Nonetheless, textbooks do, and students must. This is easy: simply replace the return (k) values in equation (1) with beta values. Thus, we start with:

$$\beta_{eL} \quad = \quad \beta_{opA} + (\beta_{opA} - \beta_d)*(D/E_L)*(1\text{-}T),$$

then replace T_c and β_d with zeros (since, with MM 1958, we have no taxes and debt is riskless), leaving us with:

$$\beta_{eL} \quad = \quad \beta_{opA}*[1 + (D/E_L)].$$

If we want to avoid starting with a memorized equation, we can reach this same conclusion by employing the "portfolio approach." Since the beta of a portfolio is a weighted average of the betas of the portfolio's components, we can simply set the beta of the left-hand side of the market-value balance sheet equal to the beta of the right-hand side:

$$\beta_{opA} \quad = \quad w_d*\beta_d + w_{eL}*\beta_{eL} \quad \rightarrow \quad \beta_{eL} \quad = \quad \beta_{opA}*[1 + (D/E_L)].$$

For a numerical example, let's start by assuming that the beta of the operating assets, and the unlevered equity, is 1. Since riskless debt has a beta of 0, this implies that the levered equity in panel (b) of Figure 1 must have a beta of 2, while the even riskier equity in panel (c)—where debt makes up 70% of the market value of the operating assets—is 3.333.

<u>MM 1963: Corporate Taxes; Perpetual, Riskless Debt; Riskless ITS</u>

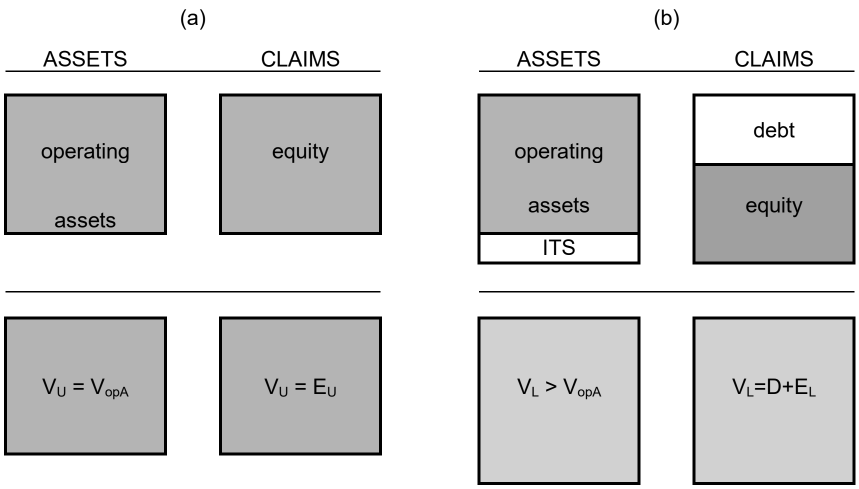
MM's propositions I and II assume a world of no taxes. MM did extend their analysis to consider taxes in the 1958 paper, recognizing that debt would add value by sheltering some income from taxation. However, in 1963, they corrected that extension by lowering the interest rate that they used to discount the interest tax shield to the interest rate on the debt (k_d), leading them to conclude that "the tax advantages of debt financing are somewhat greater than we originally suggested."

In fact, they found that debt now added the increment T_c*D to the value of the unlevered firm. Debt is still perpetual and riskless: "All bonds… are assumed to yield a constant income per unit of time, and this income is regarded as certain by all traders…" (MM, 1958); "both the tax rate and the level of debt are assumed to be fixed forever…and… the firm is certain to be able to use its interest deduction to reduce taxable income" (MM, 1963). This implies that the annual interest tax shield (ITS) equals the interest payment times the corporate tax rate, $[T_c*D*k_d]$, and that its value can be found by discounting it as a perpetuity. Thus, once MM assume that the cash flows from tax shields "are identical in uncertainty to the debt service payments" (Harris and Pringle, 1985), so that the appropriate discount rate is k_d, V_{ITS} becomes $[T_c*D*k_d]/k_d = T_c*D$.

(Students should note two things at this point. First, this increment to firm value seems to imply that debt adds value without limit. However, MM themselves note that "the existence of a tax advantage for debt financing…does not necessarily mean that corporations should at all times seek to use the maximum possible amount of debt in their capital structures"; p. 442. Explaining why is the mission of the tradeoff theories. Second, students must be reminded that when debt is neither riskless nor perpetual, the value of the ITS will not equal T_c*D, but will be something—perhaps much—lower.)

The balance sheet for this case is shown in panel (b) of Figure 2 (with the no-tax case repeated in panel (a) for comparison). Two things are happening: firm value is rising, and it is becoming less risky.

Figure 2: Capital Structure with Taxes (MM, 1963)



In this figure, panel (b) illustrates MM's (1963) with-tax case. Here, the value of the interest tax shield (ITS) increases the market value of the firm. Thus, the V_L block in panel (b) is larger than the V_U block from the unlevered firm in panel (a). Since MM assume that the ITS is riskless, we have colored the ITS block white. This decreases the risk of the overall firm (whose market value is now composed of both the risky operating assets and the riskless ITS). The V_L block is therefore a lighter color than the V_U block. The levered equity in panel (b) is both larger (more valuable) and darker (riskier) than the unlevered equity from panel (a). More interestingly, it is larger and lighter (less risky) than the equity from Figure 1's panel (b), which had the same amount of debt. In this tax case, the riskless tax shield is added to both the assets and to the equity, so the levered equity here incorporates this new, riskless component, lowering its overall risk relative to the no-tax case. (Note: The shading in this figure is exaggerated to clarify these effects.)

When we incorporate taxes, the interest tax shield adds value to the firm. Thus, we add a new block to the asset side of the market-value balance sheet, and we show a larger block for firm value (since $V_L = [V_{opA} + V_{ITS}] > V_U = V_{opA}$). The value of levered equity is still less than the value of unlevered equity in Figure 2(a), because we must make room for debt (and $D > V_{ITS}$). However, E_L is now larger than it was in the no-tax case of Figure 1(b) (which had the same debt value), since the value of the ITS accrues to the equity.

The color of the ITS block is important. Since MM assume that the cash flows from tax shields have the same risk as the underlying debt, we color the block white, just like the debt block. Now, the risk of the levered firm's total assets is lower (lighter pink) than that of the unlevered firm's, since we have added something riskless (white) to the left-hand side of the balance sheet. Since the ITS accrues to the equity, we are also effectively adding this same white ITS block to the equity. Equity is now comprised of the red rectangle from the no-tax case (from Figure 1(b)) plus a new, smaller white rectangle; this larger value of E_L implies a higher weight of equity overall, lowering the D/E ratio and decreasing the cost of equity relative to the no-ITS case. We now have a larger (more valuable), lighter (less risky) equity block.

Continuing with our numerical example, we have the value of the operating assets remaining at 100, and we use the case from Figure 1(b), where debt equals 50. We will assume that the corporate tax rate is 40%.

Thus, our interest tax shield equals Tc*D = (.40)*(50) = 20, and our total asset value is $[V_{opA} + V_{ITS}] = [100 + 20] = 120$. Since D = 50, we now have levered equity value of 70, which is higher than the value from the no-tax case in Figure 1(b) by the value of the ITS, 20. The D/E ratio is now 50/70 = 0.71, lower than the no-tax value of 50/50 = 1; as we will see below, this will imply a lower cost for the levered equity. If, instead, we set D = 70, as in Figure 1(c), we would have $V_{ITS} = 28$, $V_L = 128$, $E_L = 58$, and D/E = 1.21 (lower than the 70/30 = 2.333 from the no-tax case). Adding more debt raised the risk and lowered the value of the equity *within* the tax-shield case, but raised the value and lowered the risk relative to the no-tax case.

MM call these risk effects another apparent "paradox." Adding leverage actually reduces the variability of total returns ("interest plus net profits")! Students can resolve this easily with colors. Again, if the risk of the operating assets remains pink, then adding more white (debt) on the claims side concentrates more red onto the equity ("[t]he variability of stockholder net profits will… be greater in the presence than in the absence of leverage"; p. 435). However, since any uncertainty in the value of the tax shields is "of a different kind and order from that attaching to the stream generated by the assets" (that is, the risk of the ITS is lower than the risk of the operating assets; p. 435), adding V_{ITS}–a white block—to the left-hand side makes total firm value larger and lighter. The red of the equity is now part of a lighter-pink whole. Thus, the risk of the equity increases with leverage "relatively less so than in an otherwise comparable world of no taxes" (p. 435).

Now, let us consider the rate equations for this tax case. Students can easily derive MM's (1963) "correction" equations if they remember the main story:

$$V_L = V_{opA} + V_{ITS} = V_{opA} + T_c{*}D \quad (2)$$

Using the "portfolio approach," we have:

$$w_{opA}{*}k_{opA} + w_{ITS}{*}k_{ITS} = w_d{*}k_d + w_{eL}{*}k_{eL}$$

Since $V_{ITS} = T_c{*}D$, $(V_L - T_c{*}D) = (E_L + D - T_c{*}D) = V_{opA}$ (the numerator of w_{opA}), and $k_d = k_{ITS}$, we rearrange to find equation (1):

$$k_{eL} = k_{opA} + (k_{opA} - k_d){*}(D/E_L){*}(1-T_c).$$

(Again, students should remember that this simplification requires that $V_{ITS} = T_c{*}D$, which in turn requires a perpetually available tax shield of the same risk as the underlying debt.) To find the beta of our levered equity, we now simply substitute β for k:

$$\beta_{eL} = \beta_{opA} + (\beta_{opA} - \beta_d){*}(D/E_L){*}(1-T_c),$$

which becomes, when we replace β_d with zero (since the debt is riskless):

$$\beta_{eL} = \beta_{opA}{*}[1 + (D/E_L){*}(1-T_c)], \quad (3)$$

the Hamada equation.

MM do not derive the Hamada equation, of course, but equation (1) is theirs, and students may like their approach to finding it. They start with WACC. Since they assume that the cash flow (CF) to investors is unaffected by leverage, the value of an unlevered firm is CF/k_{opA}, and the value of a levered firm is CF/WACC. Substituting into (2), then rearranging, we get:

$$CF/WACC = [CF/k_{opA}] + T_c*D, \quad (4)$$

so that

$$WACC = k_{opA}*[1 - (D*T_c)/V_L]. \quad (5)$$

(BMA, 2014 call (5) "r_{MM}," and they do not stress that it is a WACC, not a cost of equity. For any student for whom this is not obvious, the fact that "r_{MM}" is less than k_{opA} can be confusing. In fact, this whole rearrangement, while essentially done by MM themselves, is confusing; unless (5) appears in the textbook, students would be much better off just to remember (4). See Myers, 1974, for a concise discussion.)

Once we've defined WACC this way, we can equate this definition to the textbook WACC equation:

$$WACC = k_{opA}*[1 - (D*T_c)/V_L] = w_d*k_d*(1-T_c) + w_{eL}*k_{eL},$$

which, when rearranged to solve for ke_L, leads us right back to equation (1).

As always, when students are working with WACC, they need to be careful about the embedded rebalancing assumptions. The textbook WACC equation assumes that debt is rebalanced constantly (or *almost*; see BMA, 2014), keeping the firm's debt ratio constant; in contrast, MM assume that debt is a fixed dollar amount. However, given that MM's cash flows are perpetuities, firm value—and thus the debt ratio—remain constant, as the textbook approach requires.

To put some numbers on this, let us return to our example where k_{opA} = 8% and k_d = 3%. With a tax rate of 40% and D = 50 (the case from panel (b) of Figure 2), the levered cost of equity is 10.1% and its beta is 1.43. Both of these values are lower than the comparable values for the no-tax case (13% and 2, respectively), demonstrating the risk dilution that comes from adding the market value of the riskless ITS to the levered equity. WACC is 6.67%, lower than k_{opA} for the same reason. When D = 70 (as in Figure 2(c)), k_{eL} = 11.6% and β_{eL} = 1.72: higher than the Figure 2(b) case, since risk rises with added leverage, but lower than the no-tax case, because of the tax shield. WACC is now 6.25%, falling as more of the tax-subsidized funding source is employed.

<u>Miles and Ezzell: Corporate Taxes; ITS Risk = Operating Asset Risk</u>

MM's identification of the value of the ITS as T_c*D—which results in the nice "D*(1-T_c)" terms in so many textbook capital structure equations—is a consequence of their discounting the tax shield at the cost of debt. However, the ITS may actually be riskier than the underlying debt; it also will fluctuate with operating assets if the debt ratio remains constant. Miles and Ezzell (1980) therefore advocate for discounting the ITS at k_{opA}. Figure 3 shows the balance sheet for this case.

Since we have an interest tax shield, we add the value of the ITS to the asset side, as in Figure 2. However, now that $k_{ITS} = k_{opA}$, we color the ITS block pink. The whole asset side is the same shade of pink as it was for the unlevered firm, but now it is larger. On the claims side, debt can be riskless (as MM assume; shown in panel (b)) or not (panel (c)), but we always have $k_{eL} > k_{opA} = k_{ITS} > k_d$.

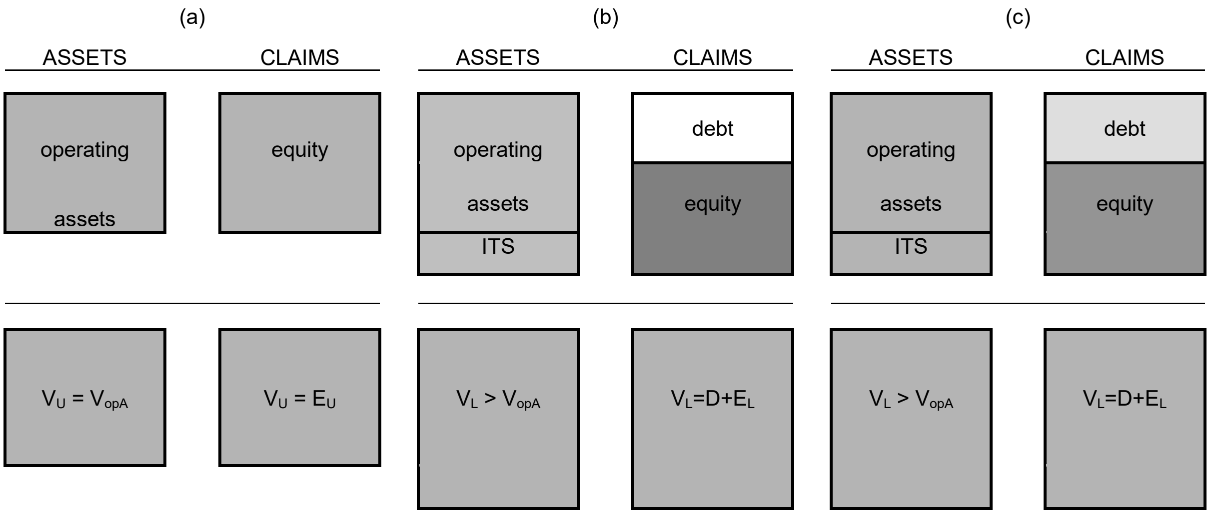
To solve for k_{eL} using the portfolio approach, we substitute k_{opA} for k_{ITS}:

$$w_{opA}*k_{opA} + w_{ITS}*k_{opA} = w_d*k_d + w_{eL}*k_{eL} \quad \rightarrow \quad k_{eL} = k_{opA} + (k_{opA} - k_d)*(D/E_L),$$

or proposition II. Thus, when we assume that the ITS has the risk of the operating assets, we are back in the world of MM, 1958—just with a larger V_L, larger E_L, and a correspondingly lower D/E ratio.

Brealey, Myers, and Allen (2014) use proposition II to find k_{eL} and β_{eL}, since they assume that D/A will stay constant (as the WACC equation requires). Students accustomed to a steady diet of the Hamada equation may wonder how this can be right. Those students must remember the different models' underlying assumptions: Hamada assumes that debt is *fixed*, not fluctuating along with the operating assets. Since the Hamada equation is so integral to capital structure pedagogy, we briefly consider it below.

Figure 3: Capital Structure when Risk of ITS = Risk of Operating Assets



This figure illustrates what happens when we assume that the ITS has the same risk as the operating assets. This would occur if the D/A ratio is maintained, as is assumed in the WACC equation. Now, the asset side of the balance sheet has the same risk after the ITS is added: total assets rise, but their risk does not change. Since the ITS's value accrues to the equity, equity value rises relative to the no-tax case (shown in panel (a) for comparison). Relative to the riskless-ITS case in Figure 2, we are now adding a risky ITS block to the equity, so each dollar of ITS lowers equity risk by less here. (Note that we can no longer assume that $V_{ITS} = T_c*D$, since debt is no longer perpetual and riskless; the size of the ITS block is therefore shown as the same size as that from Figure 2 only for convenience.) If we assume that debt is not riskless, as in panel (c), then equity risk rises by less, relative to the no-tax case.

The Hamada Equation

It might surprise students to learn that the familiar "Hamada equation" does not appear in Hamada's (1972) paper. Instead, he presents a form that is actually easier to remember:

$$\beta_{eL}*E_L = \beta_{opA}*E_U \quad (6)$$

To derive the more familiar relevering form (equation (3)), we must be clear about Hamada's underlying assumptions: he "assume[s] the validity of the MM theory from the outset" (p. 437). Thus, Hamada assumes riskless, perpetual debt. That debt is perpetual is not hard to see, since students will recognize the "T_c*D" term as coming from MM's $[k_d*T_c*D]/k_d$ valuation. However, the "riskless" part, while perhaps not so clear, is critical. Hamada assumes "as an empirical approximation that interest and preferred dividends have negligible covariance with the market"—that is, that their betas are zero (p. 439). In MM's world, there is no doubt about the value of the ITS, so its beta is also zero.

Given these assumptions, we can apply our balance sheet approach (this time starting with betas):

$$w_{opA}*\beta_{opA} + w_{ITS}*\beta_{ITS} = w_d*\beta_d + w_{eL}*\beta_{eL}$$

Substituting 0 for β_d and β_{ITS}, and noting that $w_{opA} = V_{opA}/V_L = (V_L - V_{ITS})/V_L = (V_L - T_c*D)/V_L$ and that $w_{eL} = E_L/V_L$, we find equation (3).

Of course, we get the same result if we start with Hamada's own equation, (6). In fact, even though (6) is not in most textbooks, students should be encouraged to start there: it is much easier to remember, and much more intuitively appealing, than (3).

Equation (6) also allows students to consider the relationship between unlevered and levered equity. Since we know that the beta of a levered firm must exceed that of an unlevered firm, equation (6) implies that $E_U > E_L$. Students might be inclined to think that—since a levered firm is more valuable than an unlevered firm—levered equity also must be more valuable than unlevered equity. However, the right-hand side of the levered balance sheet contains both debt and equity. Thus, since $V_L = E_L + D = E_U + T_c*D$, and since $D > T_c*D$, it must be that $E_U > E_L$.

Hamada's paper also highlights a broader point. For many students, it is obvious that operating activities create risk, but harder to see how capital structure does. Nonetheless, risk can come from the right-hand side of the balance sheet as well as from the left, and equity risk can change even if total risk is constant. "The total firm's systematic risk may be stable (as long as the firm stays in the same risk class), whereas the common stock's systematic risk may not be stable merely because of unanticipated capital structure changes" (p. 443)..."adjusting correctly for leverage is not frequently done and can be very critical" (p. 436). Although Hamada was commenting specifically about studies attempting to determine the "fair rate of return" for utilities—about fifty years ago—his point is still integral to the study of capital structure.

APPLICATIONS

We now briefly discuss two papers to which students may practice applying the pink balance sheet approach. The first of these papers is Ehrhardt and Daves (2002), who explicitly incorporate asset growth; the second is Kolari and Velez-Pareja (KVP, 2012), who advocate discounting the interest tax shield at k_{eL}.

Ehrhardt and Daves (2002)

Ehrhardt and Daves (2002) recast standard capital structure theory in the context of a growing firm. They employ the Gordon growth model to define the value of the interest tax shield as $[(k_d*D*T_c)/(k_{ITS} - g)]$, where g is the constant growth rate for operating assets and the ITS. They derive expressions for firm value, WACC, k_{eL}, and β_{eL} for the general case and for three special cases: MM's 1963 model (which uses $g = 0$ and $k_{ITS} = k_d$), adjusted present value (which also discounts the ITS at k_d), and compressed APV (which discounts the ITS at k_{opA}).

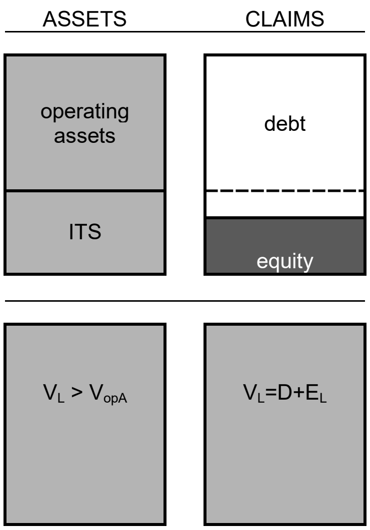
Students will be interested in one of their implications. They assert that, if the discount rate applied to the ITS is too low (that is—given their cases—if it is k_d), then the levered cost of equity can fall below the cost of unlevered equity: $k_{eL} < k_{opA} = k_{eU}$. A quick glance at panel (b) in Figure 2 shows that this is not a sensible outcome. Adding the ITS to the asset side increases firm value and lowers overall firm risk (given that the ITS is discounted at a rate lower than k_{opA}, which makes V_{ITS} lighter than V_{opA}). However, on the claims side, we have larger chunk of debt ($D > V_{ITS}$), which is no darker than V_{ITS}. Thus, to keep both sides of the balance sheet the same color, we should see equity get darker (more risky), so that $k_{eL} > k_{opA}= k_{eU}$.

Students should also be able to appreciate some details that the authors do not mention. Since both the operating assets and the ITS grow at the same rate, all of their growth cases are simply radial expansions of the initial balance sheet. Discounting the ITS at k_d gives a larger V_{ITS}, a larger V_L, and a lower weight of debt than does discounting at k_{opA}. However, regardless of the size of the initial balance sheet, once everything starts to expand at the same rate, we are firmly in Miles and Ezzell (1980) mode: the ITS expands right along with the operating assets, so the appropriate discount rate for the ITS is k_{opA}. This is the conclusion that Ehrhardt and Daves eventually reach (although they get there by rejecting their asserted implication that $k_{eL} < k_{opA}$).

Kolari/Velez-Pareja (2012)

The Kolari/Velez-Pareja (KVP, 2012) paper gives us even more opportunities to use the pink balance sheet. These authors assert that MM's models imply that "the after-tax value of equity with no interest deductions becomes *negative* when debt values exceed the unlevered value of the firm" (p. 54; emphasis original). Figure 4 depicts their premise.

Figure 4: The Kolari/Velez-Pareja Premise



KVP consider a case in which the value of the ITS can exceed the value of the equity. Here, we have assumed that the ITS is as risky as the operating assets, as in Figure 3.

The value of debt exceeds the value of the operating assets (as shown by the dashed line in the debt block), so the equity is worth less than the interest tax shield. Remove that shield (by eliminating interest deductibility), and the equity become negative. KVP seek to remedy this potential problem by discounting the ITS at k_{eL}.

Students can use the pink market-value balance sheet to evaluate KVP's problem, their proposed solution, and its implication for the cost of equity.

First: the problem. Students should recognize that no lender would lend against an "asset" that is created by the deductibility of the interest payments on that same debt. The ITS does not support debt. (If the debt is "old," then the firm is in financial distress, and we should not be using MM-type models.) As the authors note, the ITS belongs to the equity-holders. Thus $V_{EL} > V_{ITS}$, and there is really no problem.

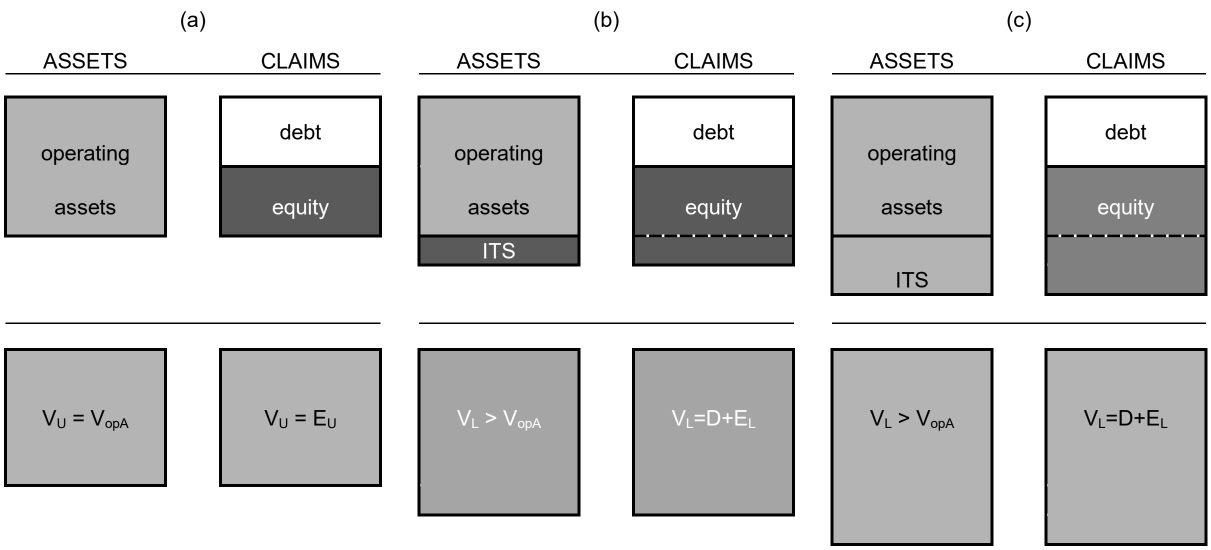
Nonetheless, KVP wish to address the discount rate for interest tax deductions. Dismissing MM's (1963) use of k_d, they consider Miles and Ezzell's (1980) suggestion to use k_{opA}, but assert that this will still lead to a nearly all-debt capital structure. They are missing the point of this approach: the ITS is discounted at k_{opA} because we assume that debt rises as operating assets increase, keeping D/A constant. This imparts the operating assets' variability onto the ITS. Since "the riskiness of each cash flow component determines its appropriate discount rate" (KVP, p. 57), the ITS should be discounted at k_{opA} when D/A is constant—contrary to KVP's contention that "because interest deductions are paid out to shareholders, they should be discounted at the (levered) cost of equity" (KVP, p. 67).

This last contention is the heart of KVP's "revised tax model." They assert that discounting the ITS at k_{eL} leads to a conveniently U-shaped cost of capital curve, implying an optimal capital structure. However, students should understand that the risk of the ITS—while possibly higher than the risk of the associated debt—will not be as high as the risk of levered equity.

Moreover, a quick glance at Figure 4 should convince them that discounting the ITS at k_{eL} will not fix the problem. Making V_{ITS} redder and smaller will not change the fact that $V_{opA} < D$. The problem here is with the assumption that the firm is insolvent, not with the discount rate for the tax shield.

Colors are more immediately helpful when considering the final implication of KVP's revised tax model: "the cost of equity with and without interest deductions is the same" when the ITS is discounted at k_{eL} (KVP, p. 67). Consider Figure 5.

Figure 5: Kolari/Velez-Pareja's Cost of Equity Assertion



In panel (b), this figure illustrates KVP's contention about equity risk: if the ITS is valued using k_{eL}, then "the cost of equity with and without interest deductions is the same." This contention would require overall firm value to rise. A more plausible scenario is shown in panel (c), which repeats the Miles and Ezzell (1980) balance sheet from Figure 3. (Panel (a) presents the no-tax case, for comparison.)

Panel (a) shows the no-tax case (as in Figure 1(b)), and panel (b) adds the tax shield under KVP's assumption that $k_{ITS} = k_{eL}$. (We assume that $V_{opA} > D$.) The ITS is represented by a small rectangle on the asset side; it is matched by a similar rectangle added to the equity (as highlighted by the dashed line). Clearly, adding the same thing to both sides of the balance sheet means that the system is still in balance; similarly, adding a red rectangle (the ITS) to a red rectangle (the original equity) leaves you with a larger red rectangle—equity value has risen, but its risk stays the same, as KVP contend. However, what they do not consider is that *now the risk of the firm has risen* (note that the V_L rectangles have gotten darker under this scenario). Why should firm risk rise simply because it has taken advantage of a tax benefit? A more reasonable outcome is shown in panel (c), which discounts the ITS at k_{opA} (as in Figure 3). Here, firm value rises with the ITS, but overall risk does not; however, the risk of equity falls relative to the no-ITS base case in panel (a).

CONCLUSIONS

Siegel (2014) reminds us that studying the work of the "creators of classic finance theory in the 1950s and 1960s is "indispensable":

> Classic finance forms a base case or null hypothesis against which empirical facts, new theories, and conjectures can be tested. Without it, we are lost. With it, we have a set of very useful guideposts, a little like Newtonian mechanics in physics—we know it's not exactly right but use it where we can because it is so useful.

MM's capital structure irrelevance theorem is the poster child for this sort of null hypothesis. However, students who study it, and its associated tax-related enhancements, confront too many confusing equations. The pink balance sheet approach allows students to grasp the base case more easily, better preparing them for their study of more sophisticated models of capital structure.

The pink balance sheet frames the discussion of basic capital structure theory into three simple parts:

1-a market value balance sheet: It is critical for students to recognize that the value of any interest tax shield causes both the assets and the equity of a firm to rise, relative to the no-tax/irrelevance case. "Assets" is no longer a sufficient descriptor of the left-hand side of a firm's balance sheet; there are now both operating assets and the value of the ITS. By using blocks to represent the relative sizes of these balance sheet components, students are able to visualize their relative contributions to firm value. This facilitates their recognition that costs, betas, and WACC can be easily generated using straightforward "portfolio" weighted averages, and provides insights into the necessary relationships among these various rates.

*2-colors reflecting risks***:** Coloring the blocks in the market value balance sheet with various shades of red—pink for operating assets, white for riskless debt, and red for equity—furthers students' visualization of the relative risks of the balance sheet components. Visual learners, in particular, will have an intuitive feel for how increasing the size of the light debt block concentrates the risk (red) in the equity. Using different colors for the ITS block—white in the MM (1963) case and pink for Miles/Ezzell (1980), for example—clarifies the effect of adding the ITS on the risk of both the equity and total assets.

3-one equation: The traditional textbook approach to surveying capital structure literature involves far too many equations. The pink balance sheet approach uses one framework equation, from MM (1963), that students can use for both costs and for beta levering. All they need to do is apply the assumptions of their particular case: Are there taxes? Is debt riskless? By using the (admittedly inelegant) "opA" notation, this equation also reinforces the components of the market value balance sheet: when there is an interest tax shield, then there are *two* types of assets, and the risk and size of "total assets" may be different from that of the operating assets.

My assertions about the efficacy of the pink balance sheet approach are based on my experience teaching corporate finance to both graduate and undergraduate students for over twenty years. While I have not performed a formal assessment of the method, I have seen many students have "a-ha!" moments when we use colors—a reaction I never witnessed when simply presenting the standard textbook material. Of course, not all students are visual learners, and the approach should work better for those who are. But we cannot expect one approach to be ideal for every student (and every little bit helps).

This paper only covers the material presented in a standard corporate finance textbook, such as those surveyed in the literature review section. Thus, we focus on the value created from the deductibility of debt interest. We do not incorporate more advanced potential influences on a firm's choice of capital structure, such as the existence of takeover regulations or payout restrictions; management's desire for financial slack;

national culture; firm size; the use of convertible debt; the types of products a firm sells or the cost structure it employs; or the opportunity for a firm to organize as a pass-through entity (e.g., an S corp.) (see, for example, Titman and Wessels, 1988; Chui, Lloyd, and Kwok, 2002; Graham and Harvey, 2002). Adjustments to the pink balance sheet approach that allow for incorporation of these complications could be an interesting avenue for future research.

After surveying hundreds of CFOs about the actual use of various academic capital budgeting and capital structure approaches, Graham and Harvey (2002) found that the executives were much less likely to adhere to academic "factors and theories when determining capital structure." The authors mused that this could be because "business schools might be better at teaching capital budgeting than at teaching capital structure (and therefore firms do not follow academic guidance about capital structure as closely" (p. 28). This conclusion is not surprising, given the jumble of equations that make up the majority of mainstream textbook explanations of capital structure theory. The pink balance sheet approach is meant to present the most important elements of that theory in an intuitive, visually compelling way. I hope that it makes capital structure a more understandable topic for future students.

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