Documenting tax and non-tax tradeoffs

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1. Introduction

The largest body of tax research in accounting—referred to as *trade-off* research—builds on the Scholes-Wolfson paradigm (Scholes et al., 2003) by examining how firms' business decisions reflect the coordination of taxes and other factors (Shackelford and Shevlin 2001, 326). Randolph, Salamon, and Seida (2005) contribute to this literature by analytically modeling the decision to shift taxable income across time and showing how a linear regression can be used *to quantify* the aggregate costs of taxable income shifting. Although much of the trade-off research is primarily concerned with documenting—rather than quantifying—the factors that influence taxable income shifting decisions, the model and method developed in Randolph et al. has implications for interpreting the empirical results produced by this body of research. Specifically, Randolph et al. provide insights regarding the interpretation of main-effect and interaction variable coefficient estimates in linear regression specifications where a measure of taxable income shifting is regressed on variables that proxy for tax benefits and non-tax costs associated with the shifting activity. However, the implications these insights have for interpreting the results from extant trade-off research and the design of future studies are not well developed. This paper reconciles the linear regression model developed in Randolph et al. with the (different) linear regression specification common to trade-off research and articulates the implications for extant and future trade-off research. In doing so we clarify the need for interaction variables in trade-off research designs, a methodological concern debated by Shackelford and Shevlin (2001, 370) and Maydew (2001, 400).

We begin with the basic model of optimal income shifting developed in Randolph et al. and discuss the empirical modeling of tax and non-tax tradeoffs using a 2x2 research design in order to establish certain insights. The optimal level of income shifting—in instances where some book/tax conformity exists—is defined as a function of the tax rate incentive and a single variable that represents the aggregate non-tax cost of income shifting. In their review of the empirical tax research literature, Shackelford and Shevlin (342) conclude that the research consistently documents that firms' tax planning decisions reflect the coordination of tax and non-tax factors but question whether much of the prior research has modeled *trade-offs* appropriately (370). Specifically, Shackelford and Shevlin suggest that interaction terms between tax and nontax variables are necessary to document trade-offs. Maydew (2001, 400), in his review of Shackelford and Shevlin, questions this contention and suggests that an interaction is not a necessary condition for documenting trade-offs. This paper articulates alternative connotations of the term trade-off and reconciles the countervailing views expressed by Shackelford and Shevlin (2001) and Maydew (2001). Our analysis demonstrates that significant interaction term regression coefficients are not necessary to document trade-offs, where the term trade-off is defined as the balancing of factors all of which are not simultaneously attainable, but interaction terms are necessary to document that the *nature of the trade-off*—i.e., the rate, or manner in which countervailing incentives are balanced—varies depending on the level of tax and non-tax factors examined.[1]

Given the potential for added insights by incorporating interaction terms into regression models examining effective tax planning, we discuss the factors that make it difficult, *a priori*, to predict whether coefficient estimates on interaction and main effect variables will be positive or negative. We present two scenarios that demonstrate how firms facing a relatively high marginal non-tax cost could—depending on the relative shape of the firms' marginal non-tax cost functions and the magnitude of the marginal tax benefits examined—be observed as either more or less responsive to a change in tax incentive relative to firms facing a relatively low marginal non-tax cost. The scenarios develop an intuitive understanding of the difficulty inherent in predicting the sign on interaction and main effect variable coefficient estimates unless, *a priori*, the overall shape of firms' non-tax cost functions is known. We use the analytic model in Randolph et al. to

[1] This is consistent with the analysis and statements in Randolph, Salmon, and Seida (2005, 321).

mathematically demonstrate the difficulty in predicting signs on the coefficient estimates for both interaction and main effect variables.

Next, we broaden our 2x2 research design to examine research specifications that include multiple non-tax cost variables (such as agency costs and financial reporting costs), as is commonly found in the trade-off research literature. We extend the aggregate non-tax cost variable model developed in Randolph et al. to include multiple non-tax cost variables. Doing so allows us to analytically show why linear regression specifications designed to document (or quantify the cost of) various factors that influence the taxable income-shifting decision should, theoretically, include not only interactions between the tax and non-tax incentive variables, but also interactions between the non-tax variables.

The remainder of this paper is organized as follows. Section two discusses issues related to the research design of trade-off studies, including the interpretation of main effect and interaction variable coefficient estimates and the difficulty in determining the expected coefficient sign on interaction terms. Section three reconciles the theoretical model of optimal income shifting presented in Randolph et al. with the trade-off models generally used in prior research. Section four summarizes and concludes.

2. Effective tax planning research design: modeling tax, non-tax trade-offs

In this section we examine the modeling of tax, non-tax trade-offs using a 2x2 research design. We begin with the analytical model of optimal income shifting developed in Randolph et al. (2005) designed to *quantify* the aggregate (non-tax) cost of taxable income shifting and then examine a specification representative of the designs commonly used in prior research to *identify* the factors that influence the taxable income shifting decision. Our analysis reconciles the two approaches and resolves methodological concerns over linear regression specifications common to the trade-off literature.

2.1 The analytical model of optimal taxable income shifting developed in Randolph, Salamon, and Seida (2005)

Randolph et al. (2005) develop and analytical model the optimal cross-time taxable income shifting decision that assumes: (1) conformity exists between book and taxable income with respect to the income shifting mechanism, (2) firms face a non-linear (non-tax) cost function, and (3) the cost function is quadratic in nature.[2] The total cost function is defined in terms of dollars shifted (ds) for firm *i* in period *t* as follows:

$$\text{total cost}_{it} = l_{it} \cdot ds_{it} + q_{it} \cdot ds_{it}^2, \quad (1)$$

where l_{it} and q_{it} are the linear and quadratic parameters of the firm's non-tax cost function. The first derivative of (1), with respect to ds, provides the <u>marginal</u> non-tax cost:[3]

$$mc = l_{it} + 2q_{it} \cdot ds_{it} \;. \quad (2)$$

The marginal tax benefit to firm *i* from shifting income from current period *t* into future periods is defined as mtb_{it}. Provided that the total tax benefit is proportional to dollars shifted (i.e., the total tax benefit is equal to $ds_{it} \cdot mtb_{it}$), the net benefit of shifting income into the future (NB_{it}) is:

$$NB_{it} = mtb_{it} \cdot ds_{it} - (l_{it} \cdot ds_{it} + q_{it} \cdot ds_{it}^2) \quad (3)$$

Firms are assumed to shift income provided that the marginal tax benefit exceeds the marginal non-tax cost for the given level of income shifting (i.e., there is a net tax benefit). The optimal value for ds_{it}, labeled ds^*_{it}, is the value of ds_{it} that makes the first derivative of Equation (3) with respect to ds_{it} equal to zero.[4] This value is:

$$ds^*_{it} = \{1/(2q_{it})\} mtb_{it} - \{(1/(2q_{it})) l_{it}\} \quad (4)$$

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[2] Randolph et al. point out that a non-linear cost function is required to have a meaningful balancing of tax and non-tax incentives; a linear cost function would imply that firms shift either all income out of the current period (if the marginal tax benefit exceeds the marginal non-tax cost) or shift no income (if the marginal tax benefit is less than the marginal non-tax cost). A quadratic non-tax cost function captures the expectation that the marginal cost of income shifting is increasing in the amount of income shifted.
[3] Positive signs for l_{it} and q_{it} are assumed, implying that both total and marginal costs are positive and increasing as more dollars are shifted.
[4] The balancing of tax and non-tax incentives could result in firms shifting taxable income into—rather than out of—the current period. In such case, the ds^*_{it} in Equation (4) would be negative. For purposes of our discussion we assume $mtb_{it} > (l_{it} + 2q_{it})$, thereby restricting ds^*_{it} to non-negative values.

Randolph et al. point out that Equation (4) can be viewed as a linear regression (without an error term), and the regression coefficients (shown within {·} in Equation (4)) are algebraically related to the linear and quadratic term parameters in the firms' cost functions. Denoting the tax incentive to shift income from the current period into the future as *Tax,* the linear regression specification, where β_0={-l/(2q)} and β_1={1/(2q)}, is:

$$ds^*_{it} = \beta_0 + \beta_1 Tax_{it}, \tag{5}$$

The linear regression specification implied by Equation (4) implicitly assumes that all firms share the same non-tax cost function (i.e., it generates an average cost function). Randolph et al. extend Equation (4) to allow for two classes of firms that differ in their non-tax cost sensitivity.[5] Denote two classes of firms as type **a** (low non-tax firms) and type **b** (high non-tax cost firms), distinguished by subscripts a and b, respectively. The following separate relations between ds^*_{it} and mtb_{it} for **a** and **b** firms are obtained:

$$ds^*_{it} = \{1/(2q_a)\}mtb_{it} - \{(1/(2q_a))l_a\} \tag{6a}$$

$$ds^*_{it} = \{1/(2q_b)\}mtb_{it} - \{(1/(2q_b))l_b\} \tag{6b}$$

In essence, the optimal amount of dollars to shift from the current period into the future is a linear function of the marginal tax benefit per dollar shifted for both types of firms, but **a** and **b** firms are allowed to have regression coefficients that differ in both slope and intercept. One can consider a sample that contains both **a** and **b** firms and let $Cost_{it}$ be a cost function indicator variable that is zero for type **a** firms and one for type **b** firms in period t. The relation between the optimal dollars shifted and the marginal tax benefit of doing so for both firm types can be specified as follows:

$$ds^*_{it} = \{1/(2q_a)\}mtb_{it} - l_a/(2q_a) + \{½\, [(l_a /q_a) - (l_b /q_b)]\}Cost_{it} + \{½\, (1/q_b - 1/q_a)\}mtb_{it} \cdot Cost_{it} \tag{7}$$

Equation (7)—like Equation (4)—can be viewed as a linear regression (without an error term) and the regression coefficients (shown within {·} in Equation (7)) are algebraically related to the

[5] Randolph et al. also extend Equation (4) to develop a size-scaled model. We present this extension in Section 3.1.

linear and quadratic term parameters in the firms' cost functions. The linear regression specification, where $\beta_0=\{-l/(2q)\}$ and $\beta_1=\{1/(2q)\}$, $\beta_2=\{½ [(l_a /q_a) - (l_b /q_b)]\}$, and $\beta_3=\{½ (1/q_b - 1/q_a)\}$ is:

$$ds^*_{it} = \beta_0 + \beta_1 Tax_{it} + \beta_2 Cost_{it} + \beta_3 Tax_{it} * Cost_{it} \quad (8)$$

Equation (7) reveals that, in theory, the aggregate cost a firm incurs to shift taxable income can be *quantified* using the estimated cost function parameters derived from the linear regression given by Equation (8). In contrast, the linear regression specifications common to trade-off research have been typically designed to identify—rather than quantify—the factors that influence the taxable income shifting decision.

2.2 Interpreting main effect and interaction variable coefficient estimates

To begin to reconcile the different approaches and to establish certain insights about the interpretation of main effect and interaction variable coefficient estimates, in this section we examine a 2x2 research design that is representative of the linear regression specification commonly used in prior trade-off research. For illustrative purposes, we follow the same assumptions that underlie the Randolph et al. model of optimal income shifting that allows for two classes of non-tax cost functions. Specifically, it is assumed that agency and financial reporting costs accompany the income shifting activity and firms' sensitivity to such costs can be captured by a single non-tax cost (binary) indicator variable denoted *Cost*.

The research design commonly used to investigate tax and non-tax trade-offs is a regression specification where a measure of taxable income shifting is regressed on variables that proxy for the tax and non-tax factors believed to influence the optimal amount of income to shift (e.g., Guenther [1994]), but where interaction variables are omitted. A typical trade-off model without an interaction variable takes the following form:

$$ds_{it} = \beta_0 + \beta_1 Tax_{it} + \beta_2 Cost_{it} + \varepsilon_{it}. \quad (9)$$

The intercept, β_0, is the predicted value for *TIShift* if both *Tax* and *Cost* equal zero. If both independent variables cannot equal zero, then β_0 in isolation does not have a meaningful interpretation. β_1 represents the change in the predicted value of *TIShift* for each one-unit change in *Tax*, holding *Cost* constant. Similarly, β_2 represents the change in the predicted value of *TIShift* for each one-unit change in *Cost*, holding *Tax* constant. However, if either *Tax* or *Cost* is a categorical variable coded as 0 or 1, a one unit change represents switching from one category to the other. The coefficient estimate on the categorical variable (e.g. *Cost*) then captures the mean difference in *TIShift* between the category for which the variable equals zero (e.g., low *Cost*) and the category for which the variable equals one (e.g., high *Cost*), holding the other variable (e.g., *Tax*) constant.

A statistically significant positive coefficient estimate on *Tax* is interpreted in prior research as providing evidence that the incidence of income shifting is related to the magnitude of the accompanying tax benefits (after controlling for non-tax factors): as *Tax* increases *TIShift* increases, holding *Cost* constant. Similarly, a statistically significant negative coefficient estimate on *Cost* is interpreted as suggesting that non-tax concerns limit firms' taxable income shifting decisions: as *Cost* increases *TIShift* decreases, holding *Tax* constant. Because *Tax* and *Cost* represent competing incentives that are not simultaneously attainable (given some degree of book/tax conformity), research has interpreted significant coefficients on either or both main effect variables, i.e., *Tax* and/or *Cost*, as evidence that firms *trade-off* tax and non-tax incentives.

Shackelford and Shevlin [2001, p. 370] question the interpretation that significant main effect variables provide evidence that firms *trade-off* tax and non-tax incentives. It is important to note, however, that the connotation Shackelford and Shevlin (hereafter S&S) give to the term "trade-off" implies more than the act of balancing competing tax and non-tax incentives. Specifically, S&S question whether significant main effect variables provide evidence that "the effect of taxes on the firm's choice depends on the level of the non-tax costs, or conversely, the effect of non-tax costs on the firm's choice depends on the firm's marginal tax rate" (S&S, p.

370). The question S&S raise is not whether significant main effect variables provide evidence that firms balance competing tax and non-tax incentives, it is whether the main effect variables provide evidence that *the manner in which* competing incentives are balanced differs across different levels of tax and non-tax incentives. For purposes of our discussion, we refer to the act of balancing competing tax and non-tax incentives as a trade-off. We refer to *the manner in which* competing tax and non-tax incentives are balanced (or *the degree to which* firms incur non-tax costs in order to achieve tax benefits) as the *nature of the trade-off*. It is possible—though not expected, as we discuss later—that firms trade-off competing tax and non-tax incentives, but that the *nature of the trade-off* does not differ across varying levels of tax benefits or non-tax costs.

To conclude that the *nature of the trade-off* varies with the level of tax benefit or non-tax cost, S&S contend that a regression model that incorporates interaction between tax and non-tax variables such as that represented in Equation (10) is necessary:

$$TIShift_{it} = \beta_0 + \beta_1 Tax_{it} + \beta_2 Cost_{it} + \beta_3 Tax_{it} * Cost_{it} + \varepsilon_{it}. \qquad (10)$$

The presence of a significant interaction variable coefficient, β_3, indicates that the effect of one independent variable on the dependent variable is different at different values of the other independent variable. Or, in the words of S&S, "the effect of taxes on the firm's choice depends on the level of the non-tax costs, or conversely, the effect of non-tax costs on the firm's choice depends on the firm's marginal tax rate" (S&S, p. 370).

Note that Equation (10) directly reconciles with Equation (8); including an interaction between the tax and non-tax variables as recommended by Shackelford and Shevlin (2001) produces a linear regression specification that aligns with analytical modeling of the income shifting decision. Conversely, omitting the tax/non-tax interaction variable—as is common in the trade-off literature—results in a linear regression that is not fully specified. In Section 3 we further develop this point and consider its implications.

It is important to note also that the presence of an interaction term in Equation (10) changes the interpretation of the coefficients on *Tax* and *Non-tax* relative to Equation (9).

Without the interaction term, β_1 represented the unique effect of *Tax* on *TIShift* holding *Cost* constant. However, the statistically significant interaction term implies that the sensitivity of *TIShift* to changes in *Tax* is conditional on the values (or levels) of *Cost*. This can be more clearly seen by taking the partial derivative of (10) with respect to *Tax*:

$$\partial TIShift/\partial Tax = \beta_1 + \beta_3\, Cost. \tag{11}$$

Thus, the unique effect of *Tax* on *TIShift* is not limited to β_1, but also depends on β_3 and *Cost*. β_1 in isolation represents the sensitivity of *TIShift* to changes in *Tax* if *Cost* is zero. If zero is not a possible value for *Cost*, then β_1 has little interpretive value in isolation. S&S also refer to the partial derivative of (10) with respect to Cost:

$$\partial TIShift/\partial Cost = \beta_2 + \beta_3 Tax. \tag{12}$$

This partial derivative represents the sensitivity of *TIShift* to changes in *Cost*. A nonzero β_3 implies that the sensitivity of *TIShift* to changes in *Cost* is conditional on *Tax*; the unique effect of *Cost* on *TIShift* is not limited to β_2, but also depends on the values of β_3 and *Tax*.

If the non-tax cost proxy is a valid measure of management's perceptions regarding the influence of income shifting on non-tax costs, then we would expect firms that vary in their sensitivity to non-tax concerns to respond differently to a change in tax incentive because the firms likely face differing marginal non-tax costs. Consequently, a significant interaction term coefficient should be observed if the non-tax cost proxy is a valid measure of firms' income-shifting cost sensitivity (and provided sufficient variability of tax incentives exists).

2.3 Predicting the sign on interaction and main effect variable coefficient estimates in trade-off models

Sections 2.1 and 2.2 develop a recommended regression specification for investigating tax, non-tax tradeoffs. The specification, represented by Equations (8) and (10), includes variables that proxy for the marginal tax benefit and relative level of aggregate non-tax costs that a firm faces, and an interaction of the two. Below, we discuss the factors that make it difficult, *a priori*, to predict whether the coefficient estimates on these variables will be positive or negative.

2.3.1 Interaction variable coefficient estimates

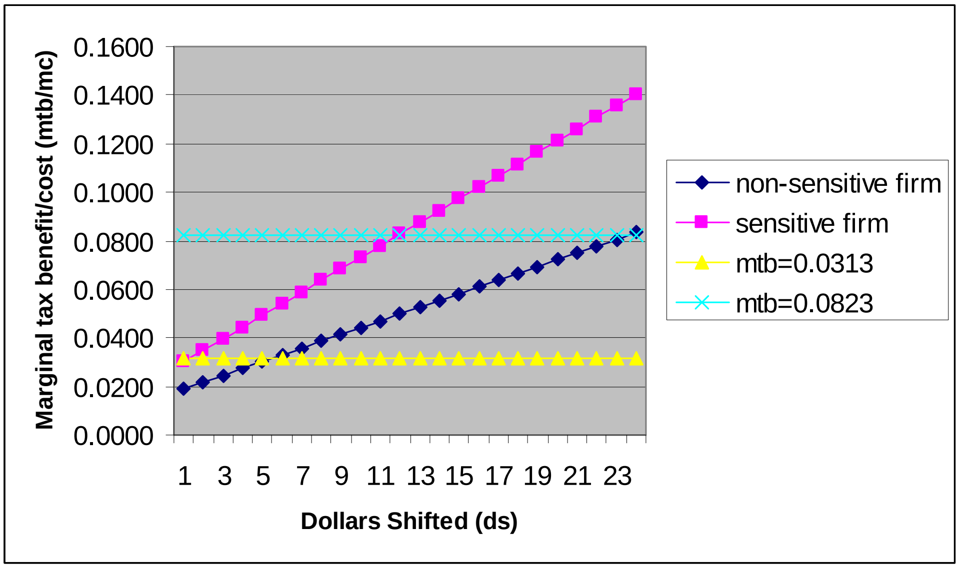
Section 2.2 clarifies that a statistically significant interaction term in the linear regression specification given by Equations (8) and (10) implies that a firm's optimal level of taxable income shifting changes for variation in tax incentive conditional on the values (or levels) of non-tax cost. Specifically, examining the partial derivative of Equation (4) with respect to dollars shifted (where dollars shifted is itself a function of marginal tax benefit) reveals that a firm's response to a change in tax incentive will depend on the size of the firm's non-tax cost function quadratic term parameter:

$$\partial ds^{*}_{it}/\partial mtb_{it} = 1/2q_{it} \quad (13)$$

Given a change in tax incentive, the resulting change in optimal level of taxable income shifting will be larger for firms facing relatively smaller quadratic term parameters. The difficulty in predicting how one firm (or group of firms) will respond to a change in tax incentive relative to another firm (or group of firms) arises because we do not know with specificity the relative sizes of the quadratic term parameters for the two groups of firms. We use two different cases to demonstrate firms' relative responsiveness to changes in tax incentive. The scenarios provide an intuitive appreciation for the mathematical presentation in Section 3.

Assume firms are divided into two groups that differ in terms of their non-tax cost functions. The two classes of firms are denoted as type **a** and type **b**. First consider the case where the type **b** firm faces linear and quadratic non-tax cost function parameters that are both larger than the respective parameters for the type **a** firm (i.e., $l_b > l_a$ and $q_b > q_a$). This implies that the optimal *level* of income shifting will be greater for the type **a** firm than for the type **b** firm at any level of marginal tax benefit (because the type **a** firm faces a lower marginal non-tax cost regardless the magnitude of dollars shifted) and that the optimal level of income shifting for the type **a** firm will *change* more in response to a change in tax incentive (because the type **a** firm faces a lower quadratic term parameter). Classifying the type **a** (**b)** firm as the low (high) non-tax cost firm implies a negative sign on the interaction variable coefficients in Equation (2). We illustrate this effect in Figure 1.

Figure 1



Next, consider the case where the type **b** firm faces a linear (quadratic) non-tax cost function parameter that is larger (smaller) than the respective parameter for the firm characterized as a type **a** firm (i.e., $l_b > l_a$ as before, but now $q_b < q_a$). Because they type **b** firm faces a lower quadratic term parameter, the optimal level of income shifting for the type **b** firm will always *change* more in response to change in tax incentive. However, because that the type **b** firm faces a higher linear term parameter, the type **b** firm could face a relatively higher marginal non-tax cost—and thus its optimal *level* of income shifting could be lower—despite the relatively lower quadratic term parameter.[6] In this case, classifying the type **a** (**b**) firm as the low (high) non-tax cost firm implies a positive interaction variable coefficient in Equation (2).[7] We illustrate this effect in Figure 2.

[6] The type **b** firm faces a higher marginal non-tax cost (despite facing a lower quadratic term parameter) if its linear term parameter is sufficiently larger than the linear term parameter for the type **a** firm. Specifically, the type **b** firm faces a higher marginal non-tax cost provided $(l_b - l_a) > 2\cdot(q_a - q_b)$.

[7] Assume, for example, that the type **b** firm faces "unmanaged" earnings that fall short of its targeted earnings per share (EPS), while the type **a** firm faces "unmanaged" earnings that exceed its targeted EPS.

Figure 2

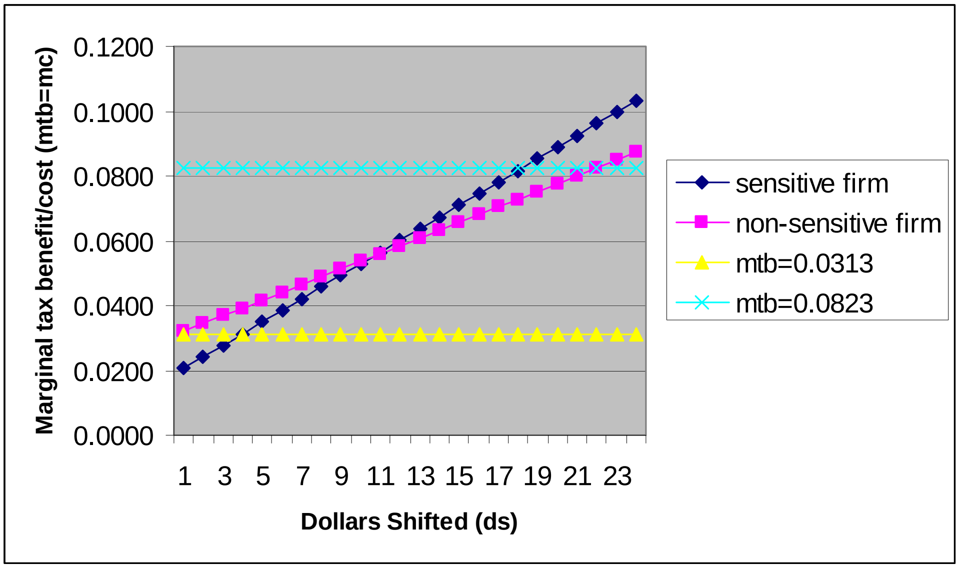


Figure 2 illustrates that without knowing the shape of the firms' non-tax cost functions one cannot reliably predict the sign on the interaction variables in Equation (2). If the type **b** firm faces a higher marginal non-tax cost at low levels of tax incentive despite a facing a lower quadratic term parameter (because of the higher linear term parameter), a graph of the marginal cost functions for the two firm types shows that the marginal cost faced by the two classes of firms will intersect if large enough variation in the tax incentive is examined.[8] Whether the type **a** and type **b** firms are correctly classified as "low non-tax cost" or "high non-tax cost" based on marginal non-tax cost depends on which side of the point of intersection the researcher examines.

Because it has failed to meet targeted EPS, the type **b** firm may face a higher marginal non-tax cost than the type **a** firm (and hence shift less taxable income at a "low" level of tax incentive). But, in response to a change in tax incentive (an increase, say), the type **b** firm may be more *responsive* (i.e., the type **b** firm will *change* the amount of taxable income that it is willing to shift more than will the type **a** firm) because of the diminishing marginal non-tax cost to falling short of targeted EPS (e.g., the "big bath" theory; the type **b** firm faces a lower quadratic term parameter despite the (initially) higher marginal non-tax cost). As the type **a** firm shifts more taxable income (in response to the increased tax incentive) and approaches its target EPS, the affect of its relatively larger quadratic term parameter may result in the type **a** firm (eventually) facing a higher marginal non-tax cost than the type **b** firm.

[8] From Equation (4) note that the optimal amount of income shifting is increasing in mtb, and from Equation (2) note that the marginal cost is increasing in dollars shifted; that is, Equations (4) and (2) reveal that the marginal cost of income shifting is increasing in mtb. The rate at which the marginal cost increases depends on the firm's quadratic term parameter.

That is, the proper classification as high or low non-tax cost can depend not only on the shape of the firms' non-tax cost functions, but also on the levels of marginal tax benefit examined.

2.3.2. Main effect variable coefficient estimates

The discussion in Section 2.3.1. clarifies that the optimal level of taxable income shifting for a firm whose non-tax cost function is characterized by a relatively lower quadratic term parameter will always *change* more in response to a change in tax incentive. However, whether or not the optimal *level* of income shifting is greater for that type firm will depend on its (total) marginal non-tax cost relative to another. That is, it depends on the relative magnitudes of the firms' linear and quadratic term parameters and, in instances where the firm with the higher linear term parameter faces a lower quadratic term parameter, also the level of marginal tax benefit examined.[9]

In the context of the linear regression specification given by Equations (8) and (10), the underlying analytical model (Equation (7)) shows that the coefficient estimate on the main effect variable is a function of the linear and quadratic term parameters of both type **a** and **b** firms. As Randolph et al. (2005, footnote 7) illustrate, the coefficient estimate on the non-tax cost indicator variable, β_2, can theoretically take on either positive or negative values depending on the *relative sizes* of l_a, q_a, l_b, and q_b, despite the type **b** firm always facing a higher marginal non-tax cost (i.e., β_2 can be either positive or negative depending on the relative sizes of l_a, q_a, l_b, and q_b, even if both $l_a < l_b$ <u>and</u> $q_a < q_b$).

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[9] Stated differently, whether or not a firm is the "high non-tax cost" firm—as measured by marginal cost—depends on the relative magnitudes of the linear and quadratic term parameters and, in instances where the firm with the higher linear term parameter faces a lower quadratic term parameter, also the level of marginal tax benefit examined. As the optimal level of dollars to shift increases (in response to an increase in marginal tax benefit), the degree to which the quadratic parameter influences the marginal cost will increase and the marginal cost for the two types of firms will rise at differing rates.

3. Multiple non-tax cost variables

In Section 2 we examined effective tax planning decision-making within a 2x2 research design where firms could be categorized as either high or low non-tax cost firms as measured by a single, aggregate cost function indicator variable. The analysis clarified that the linear regression specification recommended by Shackelford and Shevlin (2001) and Randolph et al. (2005))—Equations (8) and (10)—allows the researcher to document tax, non-tax trade-offs and to quantify the (aggregate) incremental cost of taxable income shifting. In contrast, prior trade-off research has primarily sought to identify, rather than quantify, factors that influence taxable income shifting (e.g., Guenther [1994]). Unlike the recommended specification given by Equations (8) and (10), prior research specifications often include multiple non-tax factors, omit interaction variables, and utilize a measure of taxable income shifting that is scaled by a measure of firm size. For example:

$$TIShift_{it} = \gamma_0 + \gamma_1 Tax_{it} + \gamma_2 Lev_{it} + \gamma_3 Earn_{it} + \varepsilon_{it}, \qquad (14)$$

where $TIShift_{it}$ is a measure (often scaled) of taxable income shifting, Tax_{it} represents the tax incentive to defer taxable income, and Lev_{it} and $Earn_{it}$ represent two non-tax costs (i.e., costs associated with debt constraints and reported earnings) that accompany reductions in reported net income.

In Section 3.1 we incorporate multiple non-tax cost indicator variables into the size-scaled model of taxable income shifting and then analyze in Section 3.2 how this extension of Randolph et al. reconciles with the specification common to prior research (i.e., Equation (14)).

3.1 Extending the size-scaled analytic model in Randolph et al. (2005) to include multiple non-tax cost indicator variables

In addition to the analytic models previously discussed in Section 2.1, Randolph et al. present a size-scaled model of taxable income shifting that accounts for the likelihood that it is less costly for larger firms to reduce income.[10] As before (Section 2.1), it is assumed that firms face a non-linear (non-tax) cost function, such cost function is quadratic in nature, and firms can be segregated into groups that differ in terms of non-tax costs incurred in connection with a reduction in current earnings. If the linear and quadratic term parameters in an otherwise common quadratic cost function are differentiated based on a firm- and time-specific measure of size, denoted s_{it}, the following quadratic cost function is obtained:

$$\text{total cost}_{it} = (l/s_{it})ds_{it} + (q/s_{it})ds_{it}^2 \qquad (15)$$

The net benefit of shifting income into the future (NB_{it}) is:

$$NB_{it} = mtb_{it} \cdot ds_{it} - [(l/s_{it})ds_{it} + (q/s_{it})ds_{it}^2] \qquad (16)$$

and the optimal value of ds_{it}, labeled ds^*_{it}, is the value of ds_{it} that makes the first derivative of Equation (16) with respect to ds_{it} equal to zero. This value is:

$$ds^*_{it}/s_{it} = \{1/(2q)\}mtb_{it} - \{(l/(2q))/s_{it}\} \qquad (17)$$

Randolph et al. modify Equation (17) to incorporate an aggregate cost function indicator variable. However, in order to better understand what implications the models in Randolph et al. have for interpreting results from prior studies designed to identify the influence of multiple non-tax factors, we extend Equation (17) to assume that the level of total non-tax costs incurred is not captured by a single, aggregate measure, but is instead a function of two variables, say, leverage and reported earnings. The result is four classes of firms: type (1), low earnings/low leverage; type (2), low earnings/high leverage; type (3), high earnings/low leverage; and type (4), high earnings/high leverage. The linear and quadratic parameters that comprise the non-tax cost functions for the four classes of firms are a function of both leverage and reported earnings. Using subscript a (b) to denote relatively low (high) levels of non-tax costs related to either reported earnings or leverage, the non-tax cost functions for the four classes of firms can be stated as follows:

[10] Scholes et al. (1992) and Guenther (1994), for example, find that taxable income shifting is more prevalent in larger firms.

Type (1) firm: $l_1 = l_a^E + l_a^L$ or $l_1 = l_{a,e} + l_{a,l}$ and $q_1 = q_a^E + q_a^L$

Type (2) firm: $l_2 = l_a^E + l_b^L$ or $l_2 = l_{a,e} + l_{b,l}$ and $q_2 = q_a^E + q_b^L$

Type (3) firm: $l_3 = l_b^E + l_a^L$ or $l_3 = l_{b,e} + l_{a,l}$ and $q_3 = q_b^E + q_a^L$

Type (4) firm: $l_4 = l_b^E + l_b^L$ or $l_4 = l_{b,e} + l_{b,l}$ and $q_4 = q_b^E + q_b^L$

Define three binary non-tax cost variables, denoted E, L, and EL. E is equal to one when the firm is characterized as a relatively high non-tax cost firm due only to concern with its reported earnings (type 3 firm), and is equal to zero otherwise (firm types 1, 2, and 4). L is equal to one when the firm is characterized as a relatively high non-tax cost firm due only to concern with its leverage (type 2 firm), and is equal to zero otherwise (firm types 1, 3, and 4). EL is equal to one when the firm is characterized as a relatively high non-tax cost firm due to concern over both reported earnings <u>and</u> leverage (type 4 firm), and is equal to zero otherwise (firm types 1, 2, and 4). In this specification, firm types (2), (3), and (4) can be stated relative to firm type (1).[11] The model obtained is:

[11] An alternative specification is for the type 4 firm to have E=1 and L=1 and EL=1. With this specification the type 4 firm can be directly compared to types 2 and 3. Inferences will be the same regardless of the coding scheme used. We chose to code the type 4 firms with EL=1 to facilitate easier conversion of the regression coefficient to underlying cost function parameter estimates.

$$DS^*_{it} = B_0 + B_1TAX_{it} + B_2E_{it} + B_3L_{it} + B_4E_{it}{*}TAX_{it} + B_5L_{it}{*}TAX_{it} + B_6EL_{it} + B_7EL_{it}{*}TAX_{it} + \varepsilon_{it}. \quad (18)$$

Where,

$$DSit = \overbrace{\{1/2[1/(q_a^E + q_a^L)]\}}^{B1}\ TAX - \overbrace{\{1/2[(l_a^E + l_a^L)/(q_a^E + q_a^L)]\}}^{B0} s_{it}^{-1} +$$

$$+ \overbrace{\{1/2[(1/(q_b^E + q_a^L)) - (1/(q_a^E + q_a^L))]\}}^{B4} TAX{*}E + \overbrace{\{1/2[((l_a^E + l_a^L)/(q_a^E + q_a^L)) - (l_b^E + l_a^L)/(q_b^E + q_a^L))]\}}^{B2} E \cdot s_{it}^{-1}$$

$$+ \overbrace{\{1/2[(1/(q_a^E + q_b^L)) - (1/(q_a^E + q_a^L))]\}}^{B5} TAX{*}L + \overbrace{\{1/2[((l_a^E + l_a^L)/(q_a^E + q_a^L)) - ((l_a^E + l_b^L)/(q_a^E + q_b^L))]\}}^{B3} L \cdot s_{it}^{-1}$$

$$+ \overbrace{\{1/2[(1/(q_b^E + q_b^L)) - (1/(q_a^E + q_a^L))]\}}^{B7} TAX{*}EL + \overbrace{\{1/2[((l_a^E + l_a^L)/(q_a^E + q_a^L)) - ((l_b^E + l_b^L)/(q_b^E + q_b^L))]\}}^{B6} EL \cdot s_{it}^{-1}$$

3.2 Comparisons to prior trade-off models

Like Equations (4) and (8), Equation (18) can be viewed as a linear regression and the regression coefficients are algebraically related to the linear and quadratic term parameters in the firms' cost functions. Thus, in theory, a firm's non-tax cost function can be defined as a function of multiple non-tax variables and linear regression can be used to *identify* factors that affect taxable income shifting (*and also can be used to quantify* the incremental costs incurred).[12] As with the single factor analysis, it may be difficult for a researcher to specify, *a priori*, the direction of the interaction variables and possibly the main effect variables. Further, Equation (18) does not match the linear regression specifications typically used in the trade-off literature (e.g., Equation (14)). In order to algebraically relate the optimal level of taxable income shifting to its theoretical determinants, Equation (18) reveals that the linear regression specification include interaction variables for each possible combination of tax and non-tax main effect variables. The trade-off models commonly used in prior research typically do not do so, and

[12] Quantifying the costs associated with a multiple non-tax factors is considerably more complex than that from a single non-tax factor.

therefore may suffer model misspecification bias. Future research should examine the consequences of this misspecification on inferences drawn from prior research.

4. Conclusion

This paper clarifies the role of interaction variables in tax and non-tax trade-off research designs, a methodological concern debated by Shackelford and Shevlin (2001, 370) and Maydew (2001, 400). Consistent with Maydew (2001), this paper demonstrates that interaction term regression coefficients are not necessary to document the existence of tax and non-tax trade-offs. However, if the researcher wants to examine how countervailing incentives are balanced as the level of tax and non-tax costs change, then, as suggested by Shackelford and Shevlin (2001) an interaction term is necessary. We also show that making directional predictions about interaction and main effect variables is difficult due to the fact that the underlying shape of firms' cost functions is not known. While most of our analysis focuses on a case involving a single non-tax variable, we also extend the model to cover multiple non-tax variables. Additional non-tax variables add significant complexity to the model and make coefficient predictions more difficult. The multiple non-tax factor model we develop suggests that most prior trade-off research (i.e., income shifted as a dependent variable and tax and non-tax factors as independent variables) use an underspecified regression model. It is unclear how model under-specification affects inferences from the prior studies. Future research can use simulation analysis to gain insight on the ability to make directional predictions on the regression coefficients and the consequences of model misspecification.