Effective Tax Planning

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Abstract: Based on the Scholes-Wolfson paradigm, effective tax planning is not simply tax minimization but rather the consideration of all taxes, all parties and all costs when maximizing after-tax returns. Nonetheless, much tax research focuses on tax minimization. We use data envelopment analysis (DEA) to generate a firm-level measure of *effective tax planning* that captures how efficiently firms maximize after-tax returns given their levels of pre-tax income, research and development expenditures, intangible assets, interest expense, and capital intensity. Because DEA identifies which of these inputs are most important to each firm, we can also identify "channels" of tax planning. We validate our measure by showing it predicts lower future tax expense, tax payments and settlements with tax authorities. We also provide evidence that our measure captures theoretical characteristics of effective tax planning outlined in the Scholes-Wolfson paradigm; our measure is positively related to strong corporate governance, and tax effective firms hold less cash for precautionary reasons thereby incurring fewer non-tax costs of tax planning. This measure is useful to research examining the determinants and consequences of tax planning, particularly in light of recent studies highlighting the theoretical and empirical limitations of using effective tax rates to proxy for tax planning.

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I. INTRODUCTION

The Scholes-Wolfson (SW) paradigm provides a framework for examining the role of taxes in organizations, and serves as one of the fundamental building blocks for empirical tax research in accounting (Shackelford and Shevlin 2001). A key tenet of the SW paradigm is that effective tax planning is not tax minimization but rather the consideration of all taxes, all parties, and all costs when implementing the decision rule of maximizing after-tax returns (Scholes et al. 2014, p.2). Despite the clear distinction between effective tax planning and tax minimization, a sizable literature focuses on the minimization of explicit taxes, which academic research often refers to as "tax avoidance".[1] Because tax avoidance can result in substantial non-tax costs that offset tax benefits and actually reduce after-tax returns, focusing on tax avoidance is not necessarily theoretically consistent with the SW paradigm. However, this focus is understandable due to the ease of measuring avoidance (e.g., with ETRs) and the difficulty of measuring effective tax planning (e.g., no proxy for effective tax planning currently exists). We develop a firm-level measure of *effective tax planning* that is more theoretically aligned with the SW paradigm. Our measure is intended to capture how efficiently firms maximize their after-tax returns given their level of pre-tax income and other operating, investing and financing decisions.

We follow the methodology in Demerjian, Lev and McVay (2012) (hereinafter "DLM") and use data envelopment analysis (DEA) to construct our measure of effective tax planning. DEA allows us to measure how efficiently a firm maximizes its after-tax return on equity relative to its industry peers given its pre-tax foreign and domestic income, research and development (R&D) expenditures (R&D), intangible assets, leverage, and capital intensity.[2] DEA generates firm-

[1] Hanlon and Heitzman (2010) define tax avoidance as actions taken to reduce explicit taxes.

[2] Because DEA involves an optimization across all inputs, we limit the number of inputs for tractability. We acknowledge other factors are associated with both after-tax returns and potential tax planning opportunities.

specific optimal weights for each input and uses those weights to compute the optimal level of output (i.e., after-tax return on equity) that a firm can achieve given its level and mix of inputs. We use the ratio of a firm's actual to optimal output to measure its effective tax planning. Although DEA is typically described as providing measures of efficiency, we consider firms that achieve a greater ratio of actual to optimal output to be more *effective* tax planners. That is, given a firm's operating, investing and financing decisions, which we believe to be first-order considerations, we estimate how effectively a firm maximizes after-tax returns.

We validate our measure using three separate analyses. First, we investigate the relation between our measure of effective tax planning and future tax outcomes. We document that firms we categorize as effective tax planners in the current year report lower future GAAP and cash ETRs and lower future settlements with tax authorities. Importantly, the ETR results are robust to scaling taxes paid and tax expense by total assets instead of by pre-tax income to reduce the likelihood that the ETR results are confounded by differences in profitability (Henry and Sansing 2017; Schwab et al. 2018) or earnings management (Guenther et al. 2017). These results suggest tax effective firms are capable of reducing their tax burden and ultimately retaining a larger portion of their uncertain tax positions upon audit.

Second, we provide evidence that our measure is distinct from tax minimization. We observe relatively low correlations between our measure and various one- and five-year GAAP and cash ETRs. Corroborating these low correlations, we provide examples of equally effective tax planning firms reporting very different ETRs. For example, both Apple and McDonalds have tax effectiveness scores of about 98% in 2011, yet McDonalds reports a cash ETR more than 2.5 times greater than Apple (i.e., 25.7 percent vs. 9.8 percent). These correlations and examples reinforce the limitations of using low ETRs to identify effective tax planning.

Third, we provide evidence that our measure is distinct from non-tax efficiency measures. We compute the correlation between our tax effectiveness score and the revenue efficiency score generated by DLM. We find that the measures are virtually uncorrelated (ρ = 0.010), which suggests that our measure is not simply capturing a firm's ability to efficiently generate revenues and profits. This low correlation is not surprising because our measure captures firms' ability to maximize after-tax returns *given their levels of pre-tax income*. Thus, if one firm is better at selecting R&D projects that increase revenues and/or pre-tax income, that direct effect will already be accounted for in the pre-tax income input. Collectively, these validation tests suggest our measure primarily captures the effects of tax planning as an input to maximizing after-tax returns.

After validating our measure, we exploit a powerful advantage of DEA to identify channels of effective tax planning. Specifically, we use the firm-specific optimal weight for each input generated by DEA to observe which inputs receive greater weights and are therefore more important in maximizing firms' after-tax returns. Among firms in the top decile of our tax effectiveness measure, capital expenditures and interest expense provide the largest contributions to after-tax returns, followed by pre-tax foreign income, intangible assets, and R&D.[3] Providing validation for our observed channels of effective tax planning, we note that channels vary across industries in expected ways. For example, R&D is very important in the Business Equipment industry and interest expense is very important in the Banking and Finance industry. Moreover, we provide examples of firm-specific channels varying in expected ways across time as a result of shocks to a firm's operating, investing and financing decisions.

Finally, we conduct two analyses that both offer new insights into questions considered in existing studies and provide further validation of our measure. We first examine whether corporate

[3] We do not consider pre-tax domestic income as a channel of tax planning.

governance is a determinant of effective tax planning. Prior studies provide mixed evidence on the association between governance and tax *avoidance* (e.g., Desai and Dharmapala 2006; McGuire et al. 2014, etc.), which is not entirely surprising given that the theoretical link between tax avoidance and governance is ambiguous (Armstrong et al. 2015). In contrast, the theoretical link between *effective tax planning* and corporate governance is clear; firms with stronger governance should undertake investments aimed at maximizing after-tax returns, such as effective tax planning. Consistent with expectations, we find a significant positive association between effective tax planning and strong corporate governance.

Next, we examine precautionary cash holdings as a non-tax cost of uncertain tax avoidance. Hanlon et al. (2017) predict and find that firms reporting higher levels of uncertain tax benefits increase their "precautionary" cash holdings to cover potential future repayments of tax benefits to the tax authority upon audit. Given our findings that tax effective firms sustain a greater proportion of their UTBs, we predict and find that tax effective firms retain less precautionary cash, holding constant their reported levels of UTBs. Collectively, these results suggest that tax effective firms reduce both their explicit tax liabilities and their non-tax costs, such as the agency and opportunity costs of holding higher levels of excess cash. Moreover, these results are consistent with the "all taxes, all costs" feature of the SW paradigm.

This study makes two contributions to the literature. First, we develop a firm-year measure of *effective tax planning* that is theoretically aligned with the SW paradigm. Unlike proxies for tax avoidance that do not account for non-tax costs, our measure captures both the tax and non-tax costs associated with tax planning that taxpayers must consider when maximizing after-tax returns. Our measure is especially important in light of recent evidence that a substantial portion of the variation in ETRs, a common proxy for tax avoidance, arises from factors unrelated to taxes (e.g., Drake et al. 2018; Edwards et al. 2018; Schwab et al. 2018). Future research can use our measure to revisit existing questions or address new questions about the determinants and consequences of effective (or ineffective) corporate tax *planning*. We expect such studies to yield new empirical insights.

Second, our methodology allows us to provide direct evidence on the channels of effective tax planning. Our estimation of the ways in which firms use various inputs to maximize after-tax returns will be useful to researchers in examining new questions about differences in firm-level tax planning. This feature of our analysis is particularly beneficial to accounting research given the dearth of publicly available tax planning information and the fact that OLS regressions capture only on-average associations between firm characteristics and tax outcomes.

We acknowledge our measure is subject to potential limitations. First, DEA is computationally demanding, which requires us to select a parsimonious and non-exhaustive list of inputs to tax planning. Although we have selected inputs that represent important channels of tax planning, our measure overstates effective tax planning for firms that use less common channels. Second, whereas the Scholes et al. (2014) paradigm contemplates both implicit and explicit taxes, our methodology most directly captures explicit taxes. We provide a more detailed discussion of the potential effect of implicit taxes in Section 3.2. Finally, our measure captures a firms' ability to maximize after-tax returns given their current levels of certain inputs. Although this seems appropriate given that taxes are often a second-order consideration after a firm has made it strategic operating, investing and financing decisions, this implies that our measure cannot speak to whether a firm could further increase after-tax returns by changing the levels of their inputs.

2. Related Literature

Given the magnitude of U.S. income taxes, shareholders, regulators, tax authorities, and academic researchers are interested in understanding the factors that enhance or inhibit firms' abilities to reduce explicit taxes. As a result, a large body of research in economics, finance and accounting is devoted to identifying firm- and manager-level characteristics that influence the level of corporate tax avoidance. Early research focused on firm-level determinants of tax avoidance including size, profitability, capital structure, ownership structure, asset mix and foreign operations (e.g., Gupta and Newberry 1997; Mills 1998; Rego 2003; Zimmerman 1983).

However, firms focusing on reducing explicit taxes can incur increased non-tax costs such as agency costs, reputational costs or political costs. Scholes et al. (2014) therefore define effective tax planning as "considering not only the role of taxes when implementing the decision rule of maximizing after-tax returns, but also consideration of other costs that arise in a world of costly contracting where implementation of tax-minimizing strategies may introduce significant costs along non-tax dimensions." Thus, tax minimization and effective tax planning are distinct.

Despite this distinction, and the fact that the SW paradigm serves as the foundation for much empirical tax research, existing studies often focus on tax minimization rather than tax planning. Although some studies are clearly interested in examining tax *avoidance* others are implicitly interested in tax planning but use measures of tax avoidance, such as ETRs, to capture tax planning. This research design choice is understandable given the lack of a measure of effective tax planning. Yet this approach can be problematic given the limitations of ETRs to capture differences in tax planning.

When using ETRs as a measure of tax planning, the implicit assumption is that lower ETRs represent greater tax planning. However, such an approach can conflate low ETRs with effective tax planning for several reasons. First, in isolation, ETRs do not reflect the firm's endowment of tax avoidance opportunities or constraints. Observing an ETR of 30 percent is uninformative for gauging tax planning without knowing the firm's opportunities and constraints. Such an ETR could reflect effective tax planning for a domestic, high-tech firm claiming state and federal R&D credits, but ineffective tax planning for a multinational entity with substantial opportunities for further reductions in taxes via strategic transfer pricing, etc. Thus, using ETRs as a measure of tax planning, particularly in studies examining the consequences of tax planning, can be problematic.[4]

Second, ETRs capture both the strategic operating, investing and financing decisions of the firm – from which tax benefits often naturally arise – as well as incremental actions firms take to reduce their tax liability (Armstrong et al. 2012). For example, a multinational firm can report lower ETRs simply because of investment location decisions absent any deliberate actions. It is difficult for researchers to isolate the portion of a low ETR that is attributable to intentional tax planning from that attributable to non-tax decisions. Third, recent studies reveal that a substantial portion of differences in ETRs is attributable to non-tax factors. For example, Edwards et al. (2018) describe tax burdens as a linear function where the intercept captures effects that are independent from current-period income. As a result, ETRs can change simply because of changes in pre-tax income. The authors estimate that 69 to 100 percent of time-series trends in ETRs can be explained by growth in pre-tax income and not in changes in tax avoidance. Drake et al. (2018) provide evidence that financial accounting for valuation allowances can drive predictable time-series variation in ETRs that confound inferences about changes in the extent of tax planning. Finally, Schwab et al. (2018) document systematic bias in both GAAP and cash ETRs that arises due to poor historical performance, with extremely low levels of ETRs being more likely to reflect poor

[4] When using ETRs as the dependent variable, studies typically include controls for tax planning opportunities and constraints such that the variable of interest in the study is essentially capturing a relation with unexplained ETRs, or tax avoidance holding constant non-tax factors. To the extent studies examining the consequences of tax avoidance do not similarly include such controls, results can be confounded. Additionally, the relatively low explanatory power of most ETR regressions suggests research has not yet successfully identified a robust set of variables to consistently explain cross-sectional differences in tax planning. On average, a sample of 14 studies examining the determinants of ETRs yield an adjusted R^2 of less than 15%. See Schwab et al. (2018) for more details.

performance than tax planning.

We attempt to overcome these theoretical and empirical limitations of ETRs as a proxy for tax planning by developing a firm-year measure of effective tax planning using DEA. We provide an overview of DEA and outline its benefits in Section 3.

3. Research Design

3.1. Overview of Data Envelopment Analysis

DEA is a statistical procedure that measures an entity's relative efficiency in generating a specific output given a set of inputs. In DEA, the entities are "decision-making units" (DMUs). We borrow heavily from DLM who measure firm-year efficiency as the ability of a firm to generate revenue (output) given certain firm inputs to the revenue-generating process including net property, plant and equipment, net operating leases, net R&D, purchased goodwill and other intangible assets, inventory costs, and general and administrative (SG&A) expenses.[5] Specifically, DEA efficiency is defined as the ratio of outputs to inputs:

$$\frac{\sum_{i=1}^{s} u_i y_{ik}}{\sum_{j=1}^{m} v_i x_{jk}} \quad k = 1, \dots, n \tag{1}$$

Following DLM, in equation (1), there are *s* outputs, *m* inputs, and *n* DMUs. DEA assigns each input and output a certain weight in calculating the efficiency score. The weights are defined as *v* for the inputs and *u* for the outputs. The variables *y* and *x* correspond to the actual quantities of outputs and inputs, respectively.

In our setting, after-tax returns, defined as pre-tax income less cash taxes paid (PI-TXPD) scaled by beginning owners' equity (CEQ), is our only measure of output. We subtract cash taxes

[5] DLM is most commonly cited for their measure of *managerial ability*, which they estimate as the residual from a series of regressions with firm efficiency as the dependent variable.

paid from pre-tax income so that our after-tax return measure captures both permanent and temporary tax planning strategies. We consider six inputs to maximizing after-tax returns: *Pre-tax Domestic Income, Pre-tax Foreign Income, R&D, Intangible Assets, Interest Expense,* and *Capital Expenditures.* We discuss our rationale for selecting these inputs in Section 4.2.1. Because different levels of certain inputs may provide different value, we estimate DEA using variable returns to scale.[6] We use firm-year observations as DMUs. This estimation measures a firm's relative efficiency in maximizing its after-tax return in a given year based on its level of pre-tax income and other inputs. This approach aligns with the definition of effective tax planning provided in the SW framework.

In the spirit of DLM we utilize the following steps in DEA:

1. We sort firms into their respective industries to enable relative comparison. The analysis then calculates a firm's efficiency in maximizing its after-tax return given its inputs relative to its industry peers. As DLM note, estimating DEA efficiency by industry increases the likelihood that comparison firms have similar business models and cost structures. We believe this approach is appropriate for a tax-specific efficiency measure given tax planning opportunities often cluster within certain industries (e.g., Balakrishnan et al. 2017; Dyreng et al. 2008). However, we discuss an alternative estimation by year in Section 6.
2. We then use DEA to identify the weights in u and v that maximize equation (1) for each firm. Using all firms in an industry, this calculation identifies the weights that maximize equation (1) for each firm relative to its industry peers. This analysis generates firm-specific optimal weights.

[6] For example, the first million dollars of *Capital Expenditures* could provide a greater after-tax return than the next million dollars.

3. The firm-specific optimal weights are then multiplied by the firm's output and input quantities and summed across all outputs (in the numerator) and inputs (in the denominator). We utilize the resulting ratio as our tax effectiveness score for each firm-year observation.
4. We then scale all tax effectiveness scores by the highest tax effectiveness score in the industry. This step sorts firms on relative effectiveness where the most effective firm-years have a value of one (i.e., the maximum effectiveness score within each industry is one). For example if the highest unscaled effectiveness score in an industry is 5, then that particular firm would have a tax effectiveness score of one (5/5) in that year, and a firm in the same industry that had an unscaled score of two would have a tax effectiveness score of 0.4 (2/5) in that year.
5. We presume that each input and output is valuable. Thus, weights u and v are constrained to be non-negative. This results in a lower bound tax effectiveness score of zero because the quantity of each input and output is also non-negative.

3.2. Advantages of Data Envelopment Analysis

DEA has two major advantages over conventional measures of efficiency. The first is that DEA allows for an ordinal ranking of relative efficiency compared to the Pareto-efficient frontier. As DLM note, this contrasts with parametric methods such as basic ratio comparisons or regression analysis that estimate measures of efficiency based on the *average* performance of the peer group, because the average performance of the peer group can be "lowered disproportionately by inefficient industry peers." (p.1233). For example, DLM compare the results of DEA to one where they re-estimate their efficiency measure using OLS, with revenue as the dependent variable and the inputs as the independent variables. They estimate this regression by industry and utilize the residual as a measure of performance relative to industry peers, where positive residuals represent over-performance, and negative residuals under-performance. They find that the Spearman correlation between their DEA-based measure of firm efficiency and the residual measure is only 0.109. The authors explain that the low correlation between the measures highlights the advantage of the multidimensional nature of DEA because it allows different firms to optimize across various outputs and inputs, and then compares the outcomes for each firm-year observation to the most efficient possible outcome given each firm's inputs. This approach contrasts with regression analysis, which benchmarks each firm against the average performance associated with each input measure as produced by peer firms.[7]

The second major advantage of DEA is that it allows for each DMU's (i.e., firm-year observation) optimal weights to differ. For example, recorded intangible assets can be very valuable in tax planning for firms that structure the acquisition of these assets in a tax efficient manner as well as for firms that can exploit strategic pricing of the intercompany use of these assets. For other firms, the interest expense associated with debt might be relatively more important to tax planning. A regression or ratio based analysis assumes that each of these inputs is equally important to all firms as they are to the "average" firm. Because DEA does not impose an explicit weight structure, it allows for different firms that produce the same output with different input mixes to be considered "efficient". Furthermore, DEA calculates the Pareto-efficient frontier using all possible combinations of inputs. Thus, firms that reach the same level of output using a less than optimal mix of inputs will receive efficiency scores lower than one.[8] This advantage of

[7] We perform a similar analysis (untabulated) and find Pearson (Spearman) correlations between our efficiency measure and the residual from an OLS regression of our output variable as a function of our input variables is 0.300 (0.321). Thus, as in DLM, we believe our measure of tax efficiency is substantially different from a measure of efficiency generated using OLS.

[8] An important consideration is that a firm's past and present operational decisions influence its ability to engage in tax planning. Because DEA measures the optimal output relative to inputs, it takes these inputs as "fixed" and measures what the potential "best outcome" for the firm would be given these inputs. We therefore view DEA as

DEA is particularly appealing in our setting because it allows us to identify the channels through which firms achieve efficient tax planning. That is, we can observe differences across firms in the relative importance of different inputs to maximizing after-tax returns.

We also note three potential limitations of DEA in our setting. First, because we are maximizing after-tax returns, measured as pre-tax income less cash taxes paid, a potential concern is that our measure captures how efficiently firms use inputs like R&D and capital expenditures to maximize pre-tax income rather than to maximize after-tax returns. We address this concern directly by examining how efficiently firms maximize after-tax returns *given a certain level of pre-tax income.* If a firm is better at utilizing R&D (or other inputs) to increase pre-tax income, that direct income effect will be accounted for in the pre-tax income input. Moreover, we provide extensive validation of the measure to show that it is related to tax outcomes in expected ways.

Second, this methodology will cause us to classify firms that face implicit taxes as more effective, on average. Returning to the example above regarding the tax benefits of intangible assets, companies generally incur additional tax and non-tax costs to structure acquisitions in a way that allows for the tax deductibility of acquired goodwill. Firms that incur these costs may therefore have a lower pre-tax rate of return on their investment because that particular acquisition is tax-advantaged. To the extent implicit taxes exist (and the pre-tax rate of return on this example acquisition is, in fact, lower), this firm would appear more tax efficient in our analysis than a firm that did not structure an acquisition to obtain tax-deductible goodwill. However, in untabulated analysis, we find evidence that more tax effective firms have *higher* pre-tax rates of return and higher after-tax rates of return. It therefore appears implicit taxes are not substantial enough in our sample to systematically affect our classification of tax effective firms. This is not surprising given

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appropriate because it allows us to gauge how well firms maximize after-tax returns given their first-order operational decisions, which influence the tax planning choice set of the firm.

limited empirical evidence on the existence of implicit taxes (e.g., Jennings, Weaver and Mayew 2012; Markle, Mills and Williams 2017).

Third, the accuracy of our measure is a function of the inputs we select. To reduce the computational burden of the optimization problem, we select only six inputs. Although we acknowledge other firm-level characteristics afford tax planning opportunities, we choose these specific inputs because they have been the focus of much tax research in finance and accounting. To the extent a firm relies on different channels that we do not include as inputs in our model, our measure will characterize them as more tax efficient than they actually are.

4. Sample Selection and Firm-Level Measure

4.1 Sample Selection

Our sample begins with all observations in Compustat from 1994 to 2016. We require firms to be incorporated in the U.S. to keep the applicable tax laws and legal systems consistent. We require positive pre-tax income and positive after-tax returns (i.e., pre-tax income less cash taxes paid scaled by beginning owners' equity) because loss firms face fundamentally different tax planning incentives relative to profitable firms. Finally, we exclude firm-year observations without the necessary data to calculate the variables of interest in our analysis. This results in a final sample of 65,317 firm-year observations.

4.2.1 Measurement of Firm-Level Tax Effectiveness

We utilize after-tax return as our output variable and select input variables that represent tax-related opportunities to maximize after-tax income. First, because our primary objective is to maximize the firm's after-tax return given its level of pre-tax income, we include both *Pre-tax Domestic Income* (PIDOM) and *Pre-tax Foreign Income* (PIFO) as inputs. We separately include domestic and foreign pre-tax income because firms can extract tax benefits from lower-tax foreign jurisdictions through tax-efficient supply chain management, strategic transfer pricing, tax holidays, etc. (Rego 2003; Dyreng et al. 2010; Dyreng et al. 2015).

We also include *R&D* (XRD) and *Intangible Assets* (INTAN) as input variables. We expect some firms to extract significant tax benefits from R&D spending by proactively claiming tax credits (instead of only deductions) and exploiting cost sharing agreements with foreign affiliates.[9] Recorded *Intangible Assets* are also often linked to tax planning because they can signal strategic acquisitions as well as opportunities to locate and price the use of intellectual property among affiliates in lower-tax jurisdictions both within and outside the U.S. Thus, some firms utilize *Intangible Assets* to generate tax savings to retain a larger portion of pre-tax income as after-tax income. Finally, we include *Interest Expense* and *Capital Expenditures* because debt and depreciable assets can provide substantial tax shields that often vary based on firms' operating, investing and financing decisions. So that all inputs and outputs are measured in terms of returns, we scale all input variables by beginning owner's equity.

We therefore use DEA to solve the following optimization problem:

$$\max_{v} \theta = Pretax\ Income_t - Cash\ Taxes\ Paid_t \cdot (v_1 Pretax\ Domestic\ Income_t \\ + v_2 Pretax\ Foreign\ Income_t + v_3\ R\&D_t + v_4 Intangible\ Assets_{t-1} \\ + v_5 Interest\ Expense_t + v_6 Capital\ Expenditures_t)^{-1} \tag{2}$$

All variables are scaled by beginning owner's equity. We measure *Intangible Assets* at the beginning of year *t.* The remaining inputs (*Pre-tax Domestic Income, Pre-tax Foreign Income, R&D, Interest Expense,* and *Capital Expenditures)* are measured over year *t.* We conduct DEA estimation by industry to allow for a comparison between firms that share more similar business

[9] The direct effect of potential increased revenue resulting from investments in R&D should be captured by increases in *Pre-tax Domestic Income* or *Pre-tax Foreign Income.*

models and tax planning opportunities. As in DLM, our estimation is subject to measurement error in accounting variables. First, U.S. GAAP measures intangible assets with error because firms cannot capitalize internally-developed R&D. Thus, we may understate the inputs related to intangible assets and intellectual property for our DMUs. Second, we estimate equation (1) by industry using the Fama French 30 classifications (e.g., Dyreng et al. 2008) but, as DLM note, firms are often diversified and operate in multiple industries such that our relative peer group is measured with noise. We do not believe these issues systematically bias our estimates of tax effectiveness, but we offer these caveats nonetheless.

4.2.2 Summary Statistics

Table 1 presents descriptive statistics for the sample including for the outputs and inputs in equation (1). By construction, the sample is profitable, with mean after-tax return on equity equal to 24 percent. As noted above, *Tax Effectiveness* ranges from zero to one. We report a mean (median) value of *Tax Effectiveness* of 0.494 (0.471) for the full sample, and note that 1.6% of these observations are on the Pareto-efficient frontier.[10]

[Insert Table 1 here.]

Table 1 also provides descriptive statistics for common tax avoidance proxies including one- and five-year measures of GAAP and cash ETRs. Consistent with prior tax avoidance research, sample firms report average cash ETRs ranging from 23 to 26 percent and GAAP ETRs around 30 percent.

Panel B presents *Tax Effectiveness* by Fama-French 30 industry classification. We note variation across industries but caution against across-industry comparisons because DEA efficiency measures are naturally higher on average in industries with fewer observations

[10] For comparison, DLM estimate 4.5% of observations in their sample are on the frontier for their firm-level measure of revenue efficiency.

(Demerjian 2017). For example, average *Tax Effectiveness* is 0.812 in the Coal industry, which has only 122 firm-year observations. This also illustrates the importance of ranking firms by effectiveness scores within their industry.[11]

4.2.3 Comparison of Tax Effectiveness Measure with ETR Measures

In Table 2, we compare *Tax Effectiveness* to one- and five-year GAAP and cash ETRs. Panel A presents Pearson and Spearman correlations between *Tax Effectiveness* and these ETRs. Unlike *Tax Effectiveness*, which is increasing in a firm's ability to maximize after-tax returns given its pre-tax returns and other inputs, ETRs are decreasing in tax avoidance. Thus, a negative correlation indicates more tax effective firms have lower ETRs. Although *Tax Effectiveness* is significantly correlated with the ETR measures, the magnitude of the correlations is relatively low. The largest correlations in absolute magnitude are with *Cash ETR 1* (ρ = -0.433) and industry adjusted one year cash ETRs (*Ind. Adj Cash ETR 1*) (ρ = -0.457). Other correlations range from -0.142 for *GAAP ETR 5* to -0.237 for *Ind. Adj Cash ETR 5.* These correlations indicate that *Tax Effectiveness* captures something related to, but distinct from, ETRs.

[Insert Table 2 here.]

Panel B presents the distribution of observations using a two-way sort based on quintiles of *Cash ETR 1* and *Tax Effectiveness.* That is, we independently sort all observations into quintiles of *Cash ETR 1* and *Tax Effectiveness* and document the overlap. Observations along the diagonal are ranked in the same quintile of both measures whereas observations in the off-diagonals are ranked in different quintiles. Random probability would assign four percent of the sample to each cell. A perfect correlation between the two measures would assign 20 percent of observations to each of the cells along the diagonal and no observations in the off-diagonals. We observe roughly

[11] In Section 6, we conduct our DEA estimation by year. One advantage of estimating DEA by year is that it allows for cross-industry comparison.

four percent of observations in most cells, consistent with random assignment. However, we note some overlap at the top and bottom quintiles; 10 percent of observations are in the highest quintile of *Cash ETR 1* and in the lowest quintile of *Tax Effectiveness*. Similarly, 10 percent of observations are in the lowest quintile of *Cash ETR1* and the highest quintile of *Tax Effectiveness.* This is over twice the amount we would expect based on random assignment but substantially less than the amount we would find if the measures were perfectly correlated.

Panel C repeats this analysis for *Ind. Adj Cash ETR 1* and finds nearly identical results. Overall, the distribution of observations in Panels B and C corroborates the correlations presented in Panel A and suggests that although there is some overlapping information between one-year cash ETRs and *Tax Effectiveness,* they are distinct constructs. In untabulated analyses, we document similarly low correlations between *Tax Effectiveness* and other commonly-used measures of tax avoidance or tax risk.[12]

4.3 Tax Effectiveness as a Predictor of Future Tax Outcomes

We next perform several tests to validate *Tax Effectiveness* and alleviate concerns that it merely captures firms' relative effectiveness in using inputs to maximize pre-tax returns. We first examine the relation between *Tax Effectiveness* and future tax payments measured using five-year cash ETRs *(Cash ETR 5)*. We expect that more tax effective firms will report lower future tax payments because: (i) *Tax Effectiveness* captures a firm's ability to maximize after-tax returns for a given level of pre-tax return, and decreasing taxes paid increases the after-tax return; (ii) we expect *Tax Effectiveness* is sticky such that tax effective firms in year *t* are likely to be tax effective in future years; and (iii) tax planning strategies in place in year *t* often persist and yield benefits in

[12] We find a significant Pearson (Spearman) correlation between *Tax Effectiveness* and *BTD* of 0.284 (0.167); between *Tax Effectiveness* and *DTAX* of 0.039 (0.048); between *Tax Effectiveness* and 5-year volatility of cash ETRs of -0.224 (-0.258); and between *Tax Effectiveness* and 5-year volatility of GAAP ETRs of -0.121 (-0.132). We consider this as evidence that *Tax Effectiveness* is also a distinct construct from *BTD*, *DTAX* and *ETR Volatility.*

future years.

We also examine the association between *Tax Effectiveness* and five-year GAAP ETR to ascertain to extent to which tax effective firms employ temporary versus permanent tax planning strategies. A temporary strategy results in lower cash tax payments, but does not decrease tax expense reported in the financial statements. Comparing the effect of *Tax Effectiveness* on both GAAP and cash ETRs therefore allows us to evaluate the relative use of temporary and permanent strategies. Finally, we examine the relation between *Tax Effectiveness* and future tax settlements. We believe examining the ultimate outcome of tax planning strategies is important because it allows us to shed light on whether firms with high *Tax Effectiveness* scores report lower ETRs in the short run by engaging in aggressive tax strategies that are ultimately overturned upon tax authority examination.[13]

To test these relations, we estimate the following OLS regression:

$$\textit{Tax Outcome}_{,t+n,} = \beta_0 + \beta_1 \textit{Tax Effectiveness}_{it} + \textit{Controls} + \textit{Industry FE} + \textit{Year FE} + \varepsilon_{it} \quad (3)$$

The dependent variable, *Tax Outcome,* is *Cash ETR 5, GAAP ETR 5,* or *Settlements.* We measure *Cash ETR 5* and *GAAP ETR 5* from *t+1* to *t+5*. We define *Settlements* following Robinson et al. (2016) as the firm's settlements with tax authorities reported in the FIN 48 rollforward from *t+1* through *t+5* as a proportion of the firm's total unrecognized tax benefits at year *t*. This measure captures the percentage of unrecognized tax benefits in year *t* that are ultimately lost to tax authorities upon examination. A negative coefficient on β_1 provides validation for our measure.

We control for factors show in prior literature to affect tax outcomes including profitability

[13] An argument against using settlements to validate *Tax Effectiveness* is that while firms would clearly prefer fewer settlements to more settlements for a given level of historical tax avoidance, some evidence suggests firms "under-shelter" on average. Thus, taking more aggressive positions may be optimal to the extent it leads to a desirable level of tax avoidance in total. We acknowledge this limitation of settlements and attempt to mitigate it by controlling for the level of historical tax avoidance.

(PTROA) and size *(Log(Assets)).* Controlling for profitability in these analyses is especially important given potential concerns that our measure identifies firms that are efficient only at maximizing pre-tax returns. We also control for leverage *(Leverage),* capital expenditures *(CapEx_Assets),* R&D expenditures *(RD_Assets),* and intangible assets *(Intan_Assets)*, which are all scaled by total assets as the beginning of year *t.* We control for the percent of worldwide pre-tax income earned in foreign jurisdictions *(Foreign Income %)* and the presence of haven operations using Scott Dyreng's Exhibit 21 data. Finally, we include an indicator variable equal to one if the firm reports a net operating loss carryforward (TLCF) in Compustat *(NOL).* In some specifications, we also control for the firm's tax avoidance over the past five years (inclusive of current year) using *GAAP ETR 5* or *Cash ETR 5* measured from *t-4* through *t.* We include year and industry fixed effects, defined using the Fama-French 30 classifications, and cluster standard errors by firm. We estimate these regressions using the subsample of observations with sufficient data to calculate required variables.

Table 3 presents results of estimating equation (3). Columns 1 through 4 of Panel A present results using *Cash ETR 5* and *GAAP ETR 5* as the dependent variables. Columns 1 and 3 (Columns 2 and 4) do not control (control) for a firm's prior five-year *ETR* (measured from *t-4* to *t).* We estimate a negative and significant coefficient on *Tax Effectiveness* ($\beta_1 < 0$) across all four specifications. These results are consistent with our expectation that more tax effective firms in year *t* report lower ETRs in the future, even after controlling for current ETRs. In terms of economic magnitude, we find that after controlling for the cash (GAAP) ETR over the prior five years, moving from the 25th to 75th percentile in *Tax Effectiveness* is associated with about a 9.1

(5.4) percent decrease in future five year cash (GAAP) ETRs.[14] Finding *Tax Effectiveness* is related to lower future GAAP and Cash ETRs indicates that *Tax Effectiveness* is related to the use of both permanent tax planning strategies and temporary tax planning strategies.

Column 5 through 6 of Panel A present the results using *Settlements* as the dependent variable.[15] Column 5 (Column 6) does not control (does control) for a firm's prior five-year cash ETR (measured from *t-4* to *t).* We estimate a negative and significant coefficient on *Tax Effectiveness* ($\beta_1 < 0$) across both specifications. These results are consistent with tax effective firms having lower future settlements and indicate that these firms engage in tax planning strategies that enable them to retain more of the incremental tax savings they generate.[16]

In Table 3, Panel B, we re-estimate equation (3) but scale cash taxes paid and total tax expense from year *t* to year *t+4* by assets in year *t* when constructing *Tax Outcome*. We estimate a negative and significant coefficient on *Tax Effectiveness* across all specifications. These results corroborate the ETR results in Panel A and provide comfort that results are not unduly influenced by firm performance (Henry and Sansing 2017; Schwab et al. 2018), or by earnings management (Guenther et al. 2017).

[Insert Table 3 here.]

In summary, results thus far suggest that *Tax Effectiveness* contains unique information relative to various ETR measures. We find that tax effective firms exhibit lower future ETRs, even after controlling for historical levels of tax avoidance, but do not exhibit higher settlements upon audit.

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[14] 9.1 percent is calculated as -0.071*(0.330)/0.257, where 0.330 is the interquartile range of *Tax Effectiveness* and 0.257 is the average *Cash ETR 5*. 5.4 percent is calculated as -0.050*(0.330)/0.304, where 0.330 is the interquartile range of *Tax Effectiveness* and 0.304 is the average *GAAP ETR 5*.
[15] Due to time FIN 48 has been effective, the regressions using *Settlements* are estimated on a smaller sample.
[16] In untabulated tests, we show that *Tax Efficiency* is positively related to reserves for unrecognized tax benefits (UTBs) scaled by total assets. This finding provides further validation that our tax efficiency measure is related to tax planning strategies.

4.4 Channels of Tax Planning

In this section, we examine the "channels" of tax planning for tax effective firms. Scholes et al. (2014) identify three broad types of income tax planning: conversion, shifting and deferral. Conversion strategies allow taxpayers to modify or change an activity from one that is less tax-advantaged to one that is more tax-advantaged. Shifting strategies allow taxpayers to exploit the fact that tax rates vary across both taxpayers and jurisdictions. Timing strategies allow taxpayers to accelerate deductions or defer income to minimize the net present value of cash tax outflows.

In our setting, we classify *R&D* as a conversion strategy because companies can increase tax benefits by converting unqualified R&D activity (i.e., that which yields only a tax deduction) to qualified R&D activity (i.e., that which yields a tax credit). We consider *PIFO*, *INTAN* and *XINT* to be inputs to a shifting strategy because prior literature shows these factors contribute to tax-motivated income shifting. We consider *CAPX* to be an input to timing strategies. We acknowledge, however, that these variables could be inputs to multiple types of strategies.

To identify the channels of tax planning, we examine firms that are in the top decile of ranked *Tax Effectiveness* (that is, the most tax effective firms in each industry). For these firms, we then examine which inputs with positive values, other than pre-tax domestic income, contribute most to their tax effectiveness score.[17] Recall that one advantage of DEA is that it allows for each of the input variables to be more important for some firms than others. For example, some firms might utilize R&D expenditures more efficiently than capital expenditures for tax planning purposes, and vice versa. We classify the input that has the largest contribution to the firm's tax effectiveness score as their primary channel of tax planning.

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[17] We execute DEA using Frontier Analysis software from Banxia. The variable we use to obtain channels is I/O contributions (*IOCONT*), which shows in-depth information about how each input variable was weighted in calculating optimal output. An input variable with a higher weighting has a larger effect on optimal output and, therefore, on our measure of tax efficiency.

Panel A of Table 4 presents descriptive statistics for firms in the top decile of *Tax Effectiveness* relative to other firms. Firms in the top decile of *Tax Effectiveness* have lower future ETRs (as expected based on results in Table 3), higher *PTROA* and are smaller than other firms. Firms in the top decile of *Tax Effectiveness* also have more R&D, foreign income and net operating losses but fewer intangible assets fewer tax haven operations. Although these results are interesting, we caution against drawing strong inferences from these univariate statistics because there is substantial variation in the channels of tax planning and general firm characteristics among firms classified as tax effective.

[Insert Table 4]

Figure 1 graphs the percentage of firm-year observations in the top decile of *Tax Effectiveness* that use conversion, shifting and timing strategies as their primary form of tax planning. Figures 1 indicates that shifting strategies are the primary channel of tax planning for 57.2 percent of firms in the top decile of *Tax Effectiveness*. Timing strategies are the primary channel for 33.49 percent of firms in the top decile of *Tax Effectiveness,* and conversion strategies are the primary channel of effective tax planning for only 9.3 percent of firms in the top decile of *Tax Effectiveness*.

[Insert Figure 1]

Figure 2 presents a more detailed breakdown based on each of the input variables. Interest expense (XINT) is the most common primary contributor to the *Tax Effectiveness* score for observations in the top decile of tax effectiveness (N=2,707). *CAPX* is a close second (N=2,180). *R&D* (N=605), *PIFO* (N=549) and *INTAN* (N=469) are less common primary contributors to the *Tax Effectiveness* score for observations in the top decile of tax effectiveness.

[Insert Figure 2]

Panel B of Table 4 presents the by industry breakdown of the primary channels of tax planning for observations in the top decile of *Tax Effectiveness.* We find that there is substantial variation in the primary channel within and across-industry classifications, which is consistent with our research design of running DEA *within* each industry and thus comparing firms to other firms in the same industry. For example, we find that almost every industry has at least some firms in the top decile of *Tax Effectiveness* for which each separate channel of tax planning is the primary driver to that firm's score. On average, *XINT* is the most common primary channel.

When examining differences across industries, we find that *R&D* is the primary channel of effective tax planning for 42.6% of firms in the Business Equipment industry, which includes Apple, and for 26.9% of firms in the Healthcare industry. Interest expense *(XINT)* is the primary channel for over 67% of firms in both the Banking and Insurance industry and Utilities.. We find that capital expenditures (*CAPX)* are the primary channel for a majority of the firms in eight capital-intensive industries including Apparel, Consumer Goods, and Retail. *PIFO* is most important for tax effective firms in the Tobacco, and Personal and Business Services Industry. *INTAN* is the primary channel of tax effectiveness for 29.4% of firms in the Beer & Liquor industry and for 26.8% of firms in Textiles. Overall, the descriptive statistics in Table 4 present basic information on the channels of tax planning across industries, and how various types of firms use different strategies for effective tax planning.

Appendix B provides more detailed evidence of the channels of tax planning for specific companies in our sample in Appendix B. Panel A (Panel B) provides values of *Tax Effectiveness* and *Cash ETR* from 2008 through 2016, as well as the primary channel of tax avoidance each year, for Apple (McDonald's). Apple is well-known for its cutting-edge tax planning and has been the subject of both extensive media coverage and regulatory scrutiny (Chen et al. 2017). Not surprisingly, we calculate relatively high *Tax Effectiveness* scores for Apple – scores are in excess of 96% from 2010 through 2012, and find R&D is Apple's primary channel of tax avoidance. Interestingly, the company's effectiveness score begins to decline in 2013 in conjunction with its $17B bond issuance, the proceeds of which went to share repurchases. This pattern suggests the company did not extract as many tax benefits from this debt as possible, resulting in an overall decline in their effectiveness score.

In contrast, McDonalds maintained a score in excess of 90% from 2008-2016. The company also displays greater variance in its primary channels of tax avoidance. *PIFO* is the most important channel in 2009, perhaps corresponding with the favorable tax ruling the company received from Luxembourg in 2009 (Kanter 2015). *CAPX* becomes increasingly important for the company in 2012, coinciding with global expansion.[18] Another important takeaway from these examples is that equally effective firms can report very different cash ETRs. In 2011, both companies had almost identical *Tax Effectiveness* scores (98.4% for Apple, 98.28% for McDonalds) yet McDonalds reported a *Cash ETR* that was 17.7 percentage points lower.

5. Testing determinants and consequences of effective tax planning

In this section, we use our measure of *Tax Effectiveness* to enrich our understanding of some important determinants and consequences of corporate tax behavior. These analyses not only offer new insights into previously-examined questions, but also validate of our measure by showing that it exhibits expected relations based on theoretical predictions about effective tax planning that arise from the SW framework.

5.1 The Effect of Corporate Governance on Tax Planning

[18] McDonalds expanded its operations in China alone by 50 percent, opening over 200 new locations. See https://www.reuters.com/article/us-china-mcdonalds/mcdonalds-plans-to-expand-franchising-in-china-idUSTRE81R0BC20120228.

First, we examine corporate governance as a determinant of effective tax planning. We focus on governance because current evidence on the relation between various aspects of a firm's corporate governance and tax *avoidance* is mixed. Desai and Dharmapala (2006) provide evidence that increased incentive alignment reduces *overinvestment* in aggressive tax avoidance in poorly governed firms. In contrast, McGuire et al. (2014) provide evidence that firms with more entrenched managers *underinvest* in tax avoidance. This mixed empirical evidence is not entirely surprising, however, because the theoretical link between tax *avoidance* and firm value is ambiguous. Per the SW framework, tax avoidance in isolation does not necessarily increase firm value because it may substantially increase non-tax costs. Consistent with the notion that the relation between tax avoidance and corporate governance may not be linear, Armstrong et al. (2015) find little relation between measures of corporate governance and the conditional mean of tax avoidance. Instead, they provide evidence that the relation between governance and tax avoidance is nonlinear, with effective monitoring (i.e., stronger governance) mitigating both over- and underinvest in tax avoidance. In contrast to the link between governance and tax *avoidance*, the theoretical link between effective tax *planning* and corporate governance is clear. Because strong governance is associated with increased firm value (e.g., Gompers et al. 2003), we predict that effective tax planning is positively associated with the strength of a firm's governance.

To test our prediction, we estimate the following regression:

$$Tax\ Effectiveness_{,t,} = \beta_0 + \beta_1 Governance_{it} + Controls + Industry\ FE + Year\ FE + \varepsilon_{it} \qquad (4)$$

We consider four *Governance* proxies. Our first proxy, *Ln(Delta)*, captures the incentive alignment between CEOs and shareholders. *Delta* represents the sensitivity of CEO wealth to changes in stock price (Core and Guay 1999). We predict *Ln(Delta)* is positively associated with effective tax planning, which is a value-maximizing activity.[19] Our second proxy, *Less Entrenched*, is an indicator variable based on the "G" index developed by Gompers, Ishii, and Metrick (2003). The G Index measures the number of anti-takeover provisions in place such that higher values are associated with greater managerial entrenchment. As such, *Less Entrenched* equals one if an observation has a G Index below eight, and zero otherwise.[20] Our final proxies, *% Financial Experts* and *Ln(1+#Financial Experts)*, measure the financial sophistication of the firm's monitors. *% Financial Experts* equals the percentage of directors that are classified as financial experts. *Ln(1+# of Financial Experts)* equals the logarithm of one plus the number of the financial experts on the board or directors. Consistent with Armstrong et al. (2015), we believe a more financially sophisticated board can better monitor encourage effective tax planning. Equation (4) also includes controls for profitability, size, and year and industry fixed effects.

Table 5 presents the results of this analysis. We find a positive and significant coefficient on *Governance* in three of the four specifications. Specifically, we find firms with greater incentive alignment between the CEO and shareholders (*Ln(Delta)*), firms with less entrenched managers (*Less Entrenched*), and firms with a greater proportion of financial experts on the board of directors (*% Financial Experts*) exhibit higher levels of effective tax planning. In the fourth specification when governance is based on the number of financial experts on the board (*Log(1+# of Financial Experts)*, the coefficient is positive but not significant.

[Insert Table 5]

The positive relation between governance and *Tax Effectiveness* is consistent with the SW

[19] We do not consider the effects of CEO equity risk incentives (*Vega*) because the predicted relation is unclear; effective tax planning does not necessarily require more risky tax positions.

[20] Seidman and Stomberg (2017) highlight limitations of the G Index as a measure of governance in tax avoidance studies because anti-takeover provisions (and therefore values of the G Index) tend to cluster within certain industries (Johnson, Moorman and Sorescu 2009). Thus, it can be difficult to disentangle the effects of these provisions from other industry-specific tax planning opportunities. Because we measure tax efficiency within industry, we believe this issue is less of a concern.

view that effective tax planning focuses not on tax minimization, but instead on maximizing after-tax wealth. These results highlight the benefits of our measure when addressing questions about effective tax planning, which may not necessarily be properly measured with ETRs.

5.2 The Effect of Tax Planning on Precautionary Cash Holdings

Next, we focus on precautionary cash holdings as a potential non-tax cost of tax planning. Hanlon et al. (2017) predict that firms reporting higher levels of uncertain tax benefits increase their "precautionary" cash holdings to cover potential future repayments of tax benefits to the tax authority upon audit. They find evidence consistent with their predictions. Such behavior can be costly if it prevents or delays investment in positive net present value projects.

Because the results in Table 3 reveal that tax effective firms sustain a greater proportion of their UTBs, we expect cross-sectional variation in the relation between UTBs and precautionary cash holdings. Specifically, holding UTBs constant, we predict tax effective firms hold less precautionary cash. To test this prediction, we estimate the following regression:

$$ExcessCash_{it,} = \beta_0 + \beta_1 Tax\ Effectiveness_{it} * UTB_{it} + \beta_2\ Tax\ Effectiveness_{\ it} + \beta_3\ UTB_{it} + \qquad (5)$$
$$Controls + Industry\ FE + Year\ FE + \varepsilon_{it}$$

Because tax effective firms likely have more total cash (due to lower tax payments), we use a measure of *excess* cash holdings as the dependent variable (Fresard and Salva 2010). We are interested in the interaction of *Tax Effectiveness* and uncertain tax avoidance, which we measure using the ratio of unrecognized tax benefits to lagged total assets (*UTB*). For ease of interpretation we also consider two discrete measures of tax effectiveness and uncertain tax avoidance. *High Tax Effectiveness* and *High UTB* equal one if an observation has an above median value of *Tax Effectiveness* or *UTB*, respectively, and zero otherwise. A negative and significant coefficient on the interaction between our measures of tax effectiveness and uncertain tax avoidance would suggest that, relative to less tax effective firms, tax uncertainty is associated with lower levels of precautionary cash holdings for tax effective firms. Or in other words, for a given level of tax uncertainty, firms with higher levels of *Tax Effectiveness* hold less precautionary cash.

Table 6 presents the results of our analysis. Consistent with expectations, we estimate a negative and significant coefficient on the *Tax Effectiveness* and *UTB* interactions across all specifications. These results are consistent with our earlier finding that tax effective firms have lower settlements with tax authorities, and suggest that managers of these firms recognize this ability and hold less precautionary cash. Moreover, these results provide one explanation for the variation in UTB settlements documented in Robinson et al. (2016). These results are also consistent with the definition of effective tax planning in the SW paradigm that requires the consideration of both tax and non-tax costs. Our evidence suggests that tax effective firms not only reduce their explicit tax liabilities but also reduce non-tax costs, such as the agency costs and opportunity costs of holding higher levels of excess cash.

[Insert Table 6]

6. DEA by Year

In our primary analysis, we conduct DEA comparing each firm-year observation to other firm-year observations in the same industry. We choose to run our analysis by industry because tax planning opportunities are often industry specific. However, Demerjian (2017) notes that estimating DEA by industry may potentially lead to issues in creating a comparable efficiency score, especially when the efficient frontier is changing over time or when industry subgroups have substantially different sample sizes. The issues relating to the efficient frontier changing over time may be particularly relevant to our study because recent research documents a decrease in corporate tax payments as a percentage of income over time (Dyreng et al. 2017). It is possible that this decrease may have also influenced after-tax returns. Demerjian (2017) illustrates that DEA also works well when comparing each firm to other firms in the same *year* and suggests researchers consider estimating DEA by year, rather than by industry, to address these issues. Researchers can then subsequently control for industry differences using industry fixed effects in regressions that use the efficiency score.

To address the concerns with estimating DEA by industry, we follow the suggestion in Demerjian (2017) and instead generate our tax effectiveness measure based on DEA that is estimated by year. We compare the measures of tax effectiveness estimated under the two approaches and find a correlation between the scores of 0.755 (untabulated). Thus, although the scores are related, they are not identical. To assure that our results are robust to estimating DEA by year, we re-estimate all of our analysis using the tax effectiveness score estimated by year. Overall, we find that our results are similar in terms of both economic magnitude and statistical significance when using this measure. Across all of our regression estimations, the only result that is not similar when estimating DEA by industry is associated with analyses presented in Table 5. Specifically, we find that *% Financial Experts* is no longer significant.

One additional advantage of estimating DEA by year is that it allows for cross-industry comparisons. As noted in Demerjian (2017), efficiency scores are inversely related to group size, which makes cross-industry comparisons difficult when conducting DEA by industry. Although sample sizes also vary by year, this variation is much smaller. We exploit this advantage of estimating DEA by year to compare tax effectiveness across industries. We find that Banking and Insurance, and Petroleum and Natural Gas have the highest tax effectiveness scores (0.619 and 0.602, respectively), while Textiles and Business Supplies have the lowest tax effectiveness scores (0.435 and 0.441, respectively).

7. Conclusion

We use data envelopment analysis (DEA) to develop a firm-level measure of tax effectiveness based on Scholes-Wolfson framework. Our measure is intended to capture how effectively firms maximize their after-tax returns, defined as firms' pre-tax income less cash taxes paid scaled by owner's equity, given their level of pre-tax foreign and domestic income, research and development expenditures, intangible assets, leverage, and capital intensity. Our study is important given broad interest in the determinants and consequences of tax planning across multiple literatures. We believe this approach will be useful to future research.

We validate the measure by showing it predicts economically significant reductions in future cash taxes paid and tax expense. Specifically, we estimate that moving from the 25th to 75th percentile of tax effectiveness corresponds with about a nine (five) percent reduction in five-year-ahead cash (GAAP) ETRs. We also find that our measure is associated with lower future settlements with tax authorities. Taken together, we conclude that more tax effective firms reduce their taxes paid and retain these savings upon tax authority audit.

Our analysis also allows us to identify tax effective firms' primary channels of tax planning. On average, we find shifting strategies are most common, followed by timing strategies and conversion strategies. We document substantial variation in the primary channel of tax avoidance across tax effective firms. We also document that on average, tax effective firms in different industries utilize different channels of tax planning, as expected.

Finally, we use our measure to provide new evidence on the determinants and consequences of effective tax *planning*. We first examine corporate governance as a determinant of effective tax planning. Unlike prior studies that provide mixed evidence on the relation between corporate governance and tax *avoidance*, we find that governance is positively associated with effective tax planning. These different results are not entirely surprising because the theoretical link between governance and tax avoidance is ambiguous whereas the link between governance and effective tax planning is clear. We then examine firms' precautionary cash holdings as a potential non-tax cost of tax planning. Hanlon et al. (2017) provide the first evidence that firms reporting higher levels of uncertain tax benefits increase their "precautionary" cash holdings to cover potential repayments of tax benefits the tax authority upon audit. We build upon their result and provide evidence that the relation between uncertain tax benefits and precautionary cash holdings is less positive for more tax effective firms. Or in other words, for a given level of tax uncertainty, tax effective firms hold less precautionary cash. Collectively, these results suggest that tax effective firms not only reduce their explicit tax liabilities but also reduce non-tax costs, such as the agency and opportunity costs of holding higher levels of excess cash.

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Appendix A: Variable Definitions

Variable	**Definition –** All variables from Compustat unless otherwise noted.
DEA variables	
After-Tax Return	= pre-tax income (PI) less cash taxes paid (TXPD), scaled by beginning owner's equity (CEQ)
Pre-tax Domestic Income	= pre-tax domestic income (PIDOM); reset to total pre-tax income (PI) if PIFO missing. Scaled by beginning owner's equity (CEQ).
Pre-tax Foreign Income	= pre-tax foreign income (PIFO); reset to zero if missing. Scaled by beginning owner's equity (CEQ)
R&D	= research and development expenditures (XRD); reset to zero if missing. Scaled by beginning owner's equity (CEQ)
Intangible Assets	= intangible assets (INTAN); reset to zero if missing. Scaled by beginning owner's equity (CEQ)
Interest Expense	= total interest expense (XINT); reset to zero if missing. Scaled by beginning owner's equity (CEQ)
Capital Expenditures	= capital expenditures (CAPX); reset to zero if missing. Scaled by beginning owner's equity (CEQ)
Tax Effectiveness	= firm-level tax effectiveness from DEA. Scores range from zero to one and are increasing in tax effectiveness.
Revenue Efficiency	= firm-level efficiency measure from Demerjian et al. (2012). Scores range from zero to one and are increasing in the firm's efficiency in converting various inputs to revenue. Accessed from Peter Demerjian's website.
Other tax measures	
Cash ETR	= cash taxes paid (TXPD) scaled by pre-tax income (PI), measured over one, three or five years. We reset ETRs greater than one to one and reset ETRs less than zero to zero.
GAAP ETR	= tax expense (TXT) scaled by pre-tax income (PI), measured over one, three or five years. We reset ETRs greater than one to one and reset ETRs less than zero to zero.
Ind. Adj. GAAP ETR	= industry adjusted GAAP ETR calculated as *GAAP ETR* for firm *i* less the average *GAAP ETR* in industry *j*. Tax avoidance is decreasing in *IndAdj GAAP ETR*
Ind. Adj. Cash ETR	= industry adjusted Cash ETR calculated as *Cash ETR* for firm *i* less the average *Cash ETR* in industry *j*. Tax avoidance is decreasing in *IndAdj Cash ETR*
Settlements	= following Robinson et al. (2016), the firm's settlements with tax authorities as reported in the FIN 48 rollforward (TXTUBSETTLE) from *t+1* through *t+5* as a proportion of the firm's total unrecognized tax benefits at year *t* (TXTUBEND).
5YR Cash Taxes Paid/Assets	= the sum of cash taxes paid (TXPD) from years *t+1 to t+5*, scaled by assets (AT) in year *t*.
5YR Tax Expense/Assets	= the sum of total tax expense (TXT) from years *t+1 to t+5*, scaled by assets (AT) in year *t*.

Other variables	
PTROA	= pre-tax income (PI) scaled by lagged assets (AT)
Log(Assets)	= log of total assets (AT)
Leverage	= long-term debt (DLTT) plus short term debt (DLC) scaled by lagged assets (AT); reset to zero if missing.
CapEx_Assets	= capital expenditures (CAPX) scaled by lagged assets (AT); reset to zero if missing.
RD_Assets	= research and development expenditures (XRD) scaled by lagged assets (AT); reset to zero if missing.
Intan_Assets	= intangible assets (INTAN) scaled by lagged assets (AT); reset to zero if missing.
Foreign Income %	= absolute value of pre-tax foreign income (PIFO) scaled by absolute value of total pre-tax income (PI). Absolute value of pre-tax foreign income is reset to zero if missing.
Haven	= an indicator variable equal to one if the firm has operations in a tax haven in any year as identified by the exhibit 21 data from Scott Dyreng's website.
NOL	= an indicator variable equal to one if the firm has a net operating loss carryforward (TLCF) and zero otherwise.
Ln(Delta)	= the natural log of Delta, where Delta is defined as the dollar change in the CEO's equity portfolio value for a 1% change in the firm's stock price (Core and Guay, 2002).
Less Entrenched	= following Armstrong et al. (2015), an indicator variable equal to one if the firm has a Gompers et al. (2003) governance score less than 8, and zero otherwise
% Financial Experts	= the percent of the board of directors that are financial experts
Log(1+# of Financial Experts)	= the logarithm of one plus the number of financial experts on the board of directors.
Excess Cash	= Following Fresard and Salva (2010) the error term from the regression of: Ln (Cash / Total Assets) = B_0 + B_1Ln (Total Assets) + B_2(Net Working Capital / Total Assets) + B_3(R&D / Total Assets) + B_4(Market Value / Total Assets) + B_5(Capital Expenditures / Total Assets) + B_6(Total Dividends Paid / Total Assets) + B_7(Total Debt / Total Assets) + Industry Effects + Year Effects + e

Appendix B: Tax Effectiveness and Channels for Sample Companies

This appendix provides *Tax Effectiveness* values for Apple and McDonald's, two sample firms, from 2008 through 2016. We also identify the primary and secondary channels that contribute most to these companies' efficient tax planning. Finally, we present descriptive statistics for the inputs to DEA.

Panel A: Apple

Year	*Tax Effectiveness*	*Primary Channel*	*Secondary Channel*	*Cash ETR*	*Foreign Income %*	*RD_Assets*	*Leverage*	*Intan_ Assets*	*Capx_Assets*
2008	74.4%	*R&D*	*Pre-tax Foreign*	0.184	0.508	0.044	0.000	0.022	0.043
2009	84.3%	*R&D*	*Intangible Assets*	0.248	0.547	0.034	0.000	0.014	0.029
2010	96.2%	*R&D*	*Intangible Assets*	0.145	0.701	0.038	0.000	0.023	0.042
2011	98.4%	*R&D*	*Capital Expenditures*	0.098	0.702	0.032	0.000	0.059	0.057
2012	99.2%	*R&D*	*Intangible Assets*	0.138	0.660	0.029	0.000	0.046	0.071
2013	86.0%	*R&D*	*Pre-tax Foreign*	0.182	0.608	0.025	0.096	0.033	0.046
2014	79.5%	*PIFO*	*R&D*	0.187	0.628	0.029	0.171	0.042	0.046
2015	85.5%	*R&D*	*Intangible Assets*	0.183	0.656	0.035	0.278	0.039	0.049
2016	70.84%	*R&D*	*Pre-tax Foreign*	0.170	0.670	0.035	0.300	0.030	0.044

Panel B: McDonald's

Year	*Tax Effectiveness*	*Primary Channel*	*Secondary Channel*	*Cash ETR*	*Foreign Income %*	*RD_Assets*	*Leverage*	*Intan_ Assets*	*Capx_Assets*
2008	92.1%	*Pre-tax Foreign*	*Intangible Assets*	0.210	0.550	0.000	0.348	0.076	0.073
2009	91.9%	*Capital Expenditures*	*Intangible Assets*	0.260	0.584	0.000	0.372	0.085	0.069
2010	100%	*Pre-tax Foreign*	*Intangible Assets*	0.244	0.605	0.000	0.381	0.086	0.071
2011	98.2%	*Intangible Assets*	*Capital Expenditures*	0.257	0.600	0.000	0.391	0.083	0.085
2012	93.8%	*Interest Expense*	*Capital Expenditures*	0.303	0.644	0.000	0.413	0.085	0.092
2013	93.5%	*Interest Expense*	*Capital Expenditures*	0.310	0.645	0.000	0.399	0.081	0.080
2014	90.2%	*Interest Expense*	*Capital Expenditures*	0.324	0.636	0.000	0.409	0.075	0.071
2015	91.3%	*Capital Expenditures*	*Interest Expense*	0.303	0.604	0.000	0.704	0.073	0.053
2016	98.3%	*Intangible Assets*	*Pre-tax Foreign*	0.348	0.700	0.000	0.684	0.062	0.048

Appendix C:

Comparing *Tax Effectiveness* and *Revenue Efficiency* (Demerjian, Lev, and McVay 2012)

Demerjian et al. (2012) develop a measure of firms' ability to convert inputs into revenue. Although we do not believe *Tax Effectiveness* should be highly correlated with this DLM measure, we believe it is important to empirically differentiate the measures. In this appendix, we compare our measure to the firm-level revenue efficiency measure from Demerjian, Lev, and McVay (2012), and examine both measures' association with future tax outcomes.

Panel A presents the results of analyzing the correlations between *Tax Effectiveness* and *Revenue Efficiency*. Panel A indicates that these measures are not highly correlated, with a Pearson (Spearman) correlation of 0.010 (0.009). Panel B presents an overlapping quintile analysis. The majority of cells hold 5% of observations, consistent with a random assignment of observations among the cells. Overall, the evidence in Table C1 suggests that *Tax Effectiveness* is distinct from *Revenue Efficiency*. Moreover, these low correlations provide further validation that our tax effectiveness measure does not predominantly capture how efficiently a firm converts its inputs into pre-tax income. Rather our measure is uniquely related to maximizing after-tax returns given the levels of pre-tax income and other inputs associated with tax planning opportunities.

Panel A: Correlations

Variable	Pearson Correlations with *Revenue Efficiency*	Spearman Correlations with *Revenue Efficiency*
Tax Effectiveness	**0.010**	**0.009**

Panel A presents Pearson and Spearman correlations between *Tax Effectiveness* and *Revenue Efficiency*. *Tax Effectiveness* is the firm-level tax effectiveness estimated using DEA. *Revenue Efficiency* is the firm-level efficiency measure estimated using DEA and based on maximizing revenues from Demerjian et al. (2012). Scores range from zero to one and are increasing in firm efficiency. Correlations that are significant at the 10% level or better are bold.

Appendix C (continued):

Panel B: Overlapping Quintiles

		Revenue Efficiency				
		Q1 (Low)	**Q2**	**Q3**	**Q4**	**Q5 (High)**
Tax Effectiveness	**Q1 (Low)**	5%	4%	4%	4%	3%
	Q2	4%	4%	4%	4%	4%
	Q3	3%	4%	4%	4%	4%
	Q4	4%	4%	4%	4%	4%
	Q5 (High)	5%	4%	4%	4%	4%

Panel B presents the two-way distribution of observations among quintile of *Revenue Efficiency* and *Tax Effectiveness.* Observations along the diagonal are ranked in the same quintile of both measures. Observations in the off-diagonals are ranked in different quintiles of the two measures. Random probability would assign 4% of firm-years in each cell. Perfect correlation would assign 20% of observations along the diagonal, and zero elsewhere.

Panel C presents the results of a horserace between *Tax Effectiveness* and *Revenue Efficiency* for predicting *Cash ETR 5, GAAP ETR 5* and *Settlements.* We note two findings. First, the significant associations between *Tax Effectiveness* and future tax outcomes are robust to controlling for *Revenue Efficiency.* Thus, the effect of tax effectiveness on future tax outcomes is incremental to any effect of revenue efficiency. These results are robust to scaling tax expense and taxes paid by assets instead of pre-tax income. Second, we estimate opposite effects between the two efficiency measures and future tax outcomes. *Revenue Efficiency* is associated with *higher* future GAAP and cash ETRs and has no significant effect on *Settlements.*

We conclude that *Tax Effectiveness* is distinct from the revenue efficiency measure developed by DLM. These analyses and conclusions are not criticisms of the DLM efficiency measure, which was not designed to predict future tax outcomes. We intend these analyses only to demonstrate that our construct of tax effectiveness is unique from an established firm-level measure of efficiency in an area of operations largely unrelated to taxes.

Appendix C (continued):

Panel C: Predicting Future Five-Year *ETRs* and *Settlements*

	Y = *Cash ETR*$_{t+1,t+5}$		Y = *GAAP ETR*$_{t+1,t+5}$		Y = Settlements$_{t+1,t+5}$	
VARIABLES	1	2	3	4	5	6
Tax Effectiveness	-0.096***	-0.061***	-0.042***	-0.031***	-0.119*	-0.128*
	(-13.02)	(-7.80)	(-6.77)	(-5.20)	(-1.69)	(-1.72)
Revenue Efficiency	0.035***	0.024**	0.016**	0.014*	0.131	0.147
	(3.54)	(2.41)	(2.01)	(1.92)	(1.27)	(1.37)
PTROA	0.282***	0.237***	0.134***	0.110***	0.661***	0.608**
	(13.99)	(10.80)	(8.50)	(6.99)	(2.62)	(2.18)
Log(Assets)	-0.005***	-0.004***	0.001	-0.000	0.029*	0.027
	(-3.42)	(-3.34)	(1.23)	(-0.01)	(1.80)	(1.63)
Leverage	-0.055***	-0.047***	-0.008	-0.008	-0.087	-0.150
	(-5.84)	(-4.65)	(-0.99)	(-0.90)	(-0.74)	(-1.29)
CapEx_Assets	-0.211***	-0.192***	0.049**	0.039*	-0.471	-0.220
	(-8.35)	(-6.99)	(2.32)	(1.73)	(-1.12)	(-0.49)
RD_Assets	-0.421***	-0.378***	-0.294***	-0.281***	-0.549	-0.072
	(-8.28)	(-6.85)	(-6.51)	(-5.91)	(-1.48)	(-0.18)
Intan_Assets	-0.013	-0.001	0.010	0.005	-0.026	0.015
	(-1.09)	(-0.09)	(0.95)	(0.51)	(-0.28)	(0.16)
Foreign Income %	0.019*	0.013	-0.058***	-0.054***	0.031	0.031
	(1.91)	(1.36)	(-6.95)	(-6.98)	(0.38)	(0.39)
NOL	-0.023***	-0.015***	-0.007**	-0.007**	-0.050	-0.033
	(-5.37)	(-3.52)	(-2.09)	(-1.98)	(-1.32)	(-0.85)
Haven	-0.000	-0.002	-0.003	-0.002	-0.025	-0.021
	(-0.00)	(-0.34)	(-0.62)	(-0.50)	(-0.55)	(-0.47)
Cash ETR 5		0.174***				0.281**
		(12.76)				(2.18)
GAAP ETR 5				0.165***		
				(10.82)		
Intercept	0.353***	0.288***	0.341***	0.293***	3.028***	3.056***
	(26.08)	(20.53)	(29.34)	(25.08)	(12.41)	(13.43)
Industry and Year FE?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,773	15,275	17,957	16,233	3,685	3,419
R-squared	0.104	0.130	0.078	0.111	0.036	0.040

This panel presents results of estimating future tax outcomes as a function of *Tax Effectiveness* and controls. Tax outcomes are measured using five-year future GAAP and cash ETR measured from *t+1* through *t+5*, and *Settlements*, which are measured following Robinson et al. (2016) as the sum of settlements from the UTB roll forward (TXTUBSETTLE) from *t+1* through *t+5* scaled by total UTBs in *t*. All variables are defined in Appendix A. Robust t-statistics in parenthesis calculated based on standard errors clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Tax Planning Strategies for Firms in top decile of *Tax Effectiveness*

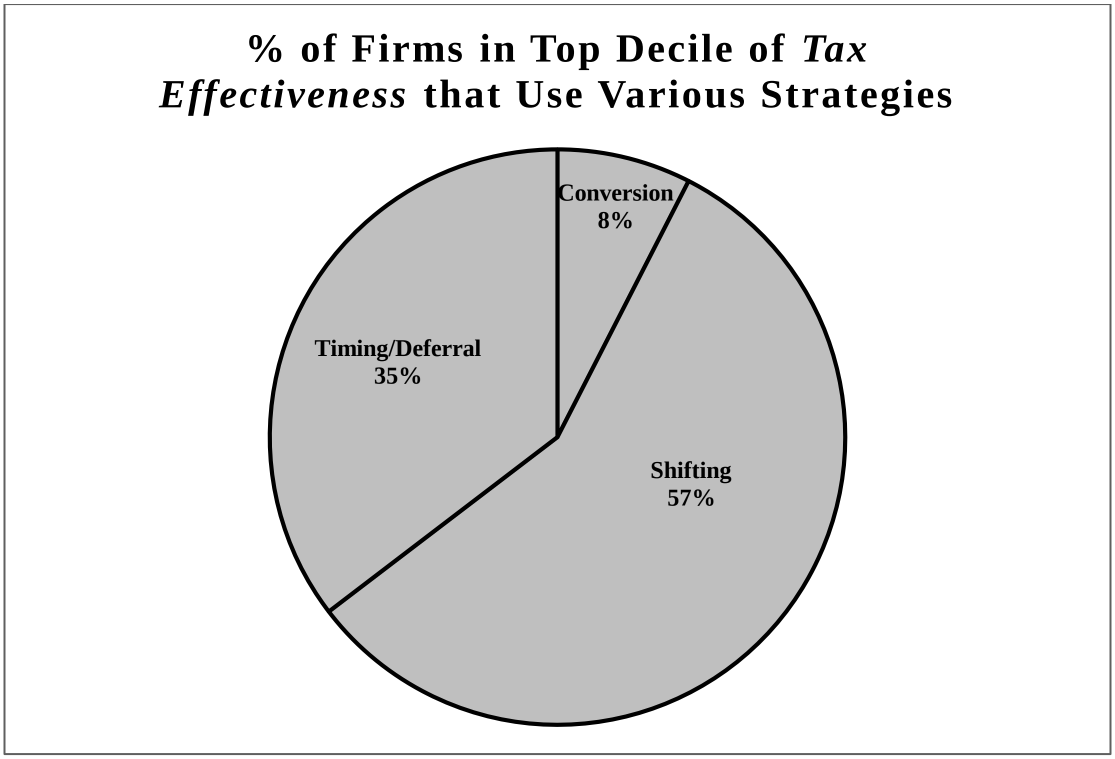

Figure 1 shows the percentage of firms in the top decile of *Tax Effectiveness* that use various channels of tax planning as their primary channel. We categorize channels using the classification scheme from Scholes et al. (2014). Conversion strategies exploit the fact that some activities are tax-favored. For example, we classify *R&D* as a conversion activity because companies can increase tax benefits by converting unqualified R&D activity (i.e., that which yields only a tax deduction) to qualified R&D activity (i.e., that which yields a tax credit). Shifting strategies allow taxpayers to take advantage of the fact that income is subject to different tax rates in different jurisdictions. We consider *PIFO*, *INTAN* and *XINT* to be inputs to shifting strategies. Timing or deferral strategies take advantage of accelerating expense deduction or deferring income recognition to minimize the NPV of tax cash payments. We consider *CAPX* to be an input to timing strategies. We acknowledge, however, that these variables could be inputs to multiple types of strategies.

Figure 2: Tax Planning Strategies for Firms in top decile of *Tax Effectiveness*, by Particular Input's Contribution to Tax Effectiveness

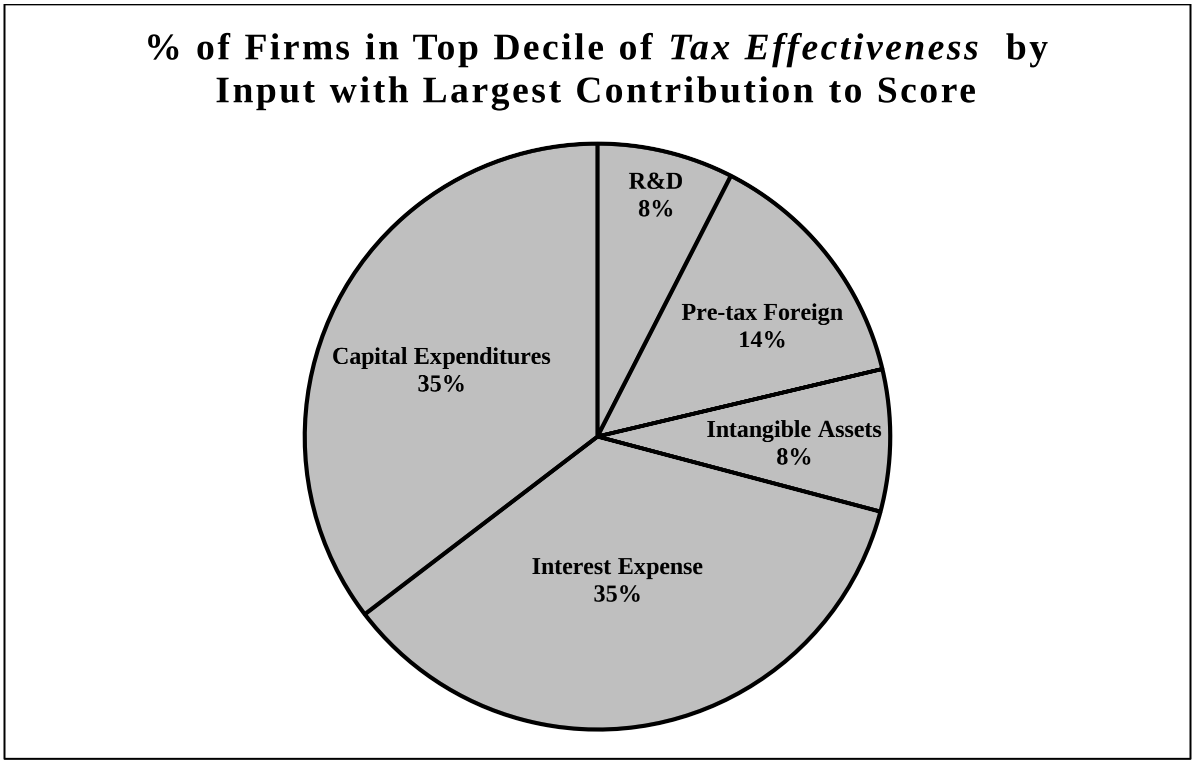

Table 1: Descriptive Statistics

Panel A: Firm-level tax effectiveness measure

Variable	*No Obs.*	*Mean*	*Std. Dev*	*P25*	*P50*	*P75*
Tax Effectiveness	65,317	0.494	0.230	0.316	0.471	0.646
DEA Output and Inputs						
After-tax returns	65,317	0.240	0.358	0.090	0.151	0.247
Pre-tax Domestic Income	65,317	0.279	0.403	0.099	0.178	0.296
Pre-tax Foreign Income	65,317	0.024	0.063	0.000	0.000	0.004
R&D	65,317	0.041	0.101	0.000	0.000	0.024
Intangible Assets	65,317	0.413	0.847	0.000	0.084	0.452
Interest Expense	65,317	0.077	0.177	0.001	0.025	0.073
Capital Expenditures	65,317	0.174	0.295	0.027	0.082	0.195
Variables used in additional analyses						
GAAP ETR 1	65,317	0.301	0.151	0.250	0.344	0.384
GAAP ETR 5	56,475	0.304	0.173	0.240	0.341	0.383
Cash ETR 1	65,317	0.232	0.185	0.062	0.229	0.348
Cash ETR 5	51,483	0.257	0.192	0.117	0.264	0.353
PTROA	65,317	0.113	0.115	0.037	0.079	0.149
Log(Assets)	65,317	6.346	2.191	4.866	6.376	7.798
CapEx_Assets	65,317	0.060	0.079	0.010	0.036	0.075
Leverage	65,317	0.262	0.264	0.044	0.206	0.385
R&D_Assets	65,317	0.021	0.050	0.000	0.000	0.011
Intan_Assets	65,317	0.136	0.215	0.000	0.027	0.190
Foreign Income %	65,317	0.091	0.206	0.000	0.000	0.021
NOL	65,317	0.276	0.447	0.000	0.000	1.000

This panel presents descriptive statistics for *Tax Effectiveness* as well as other variables used in subsequent analysis. All variables are defined in Appendix A. The sample is 65,317 firm-year observations from 1994-2016 from Compustat. We require firms to be incorporated in the US (FIC=USA) and require all observations to report positive pre-tax income (PI) and positive pre-tax income less cash taxes paid (PI-TXPD). All continuous variables other than ETRs are winsorized at one and 99 percent. We reset ETRs greater than one to one and reset ETRs less than zero to zero.

Table 1 (continued): Descriptive Statistics

Panel B: Firm-level tax effectiveness by industry

Industry	No Obs.	Mean	Std. Dev	P25	P50	P75
Aircraft, ships, and Equipment	544	0.741	0.183	0.622	0.738	0.889
Apparel	955	0.570	0.199	0.451	0.563	0.673
Automobiles	887	0.604	0.241	0.430	0.599	0.790
Banking, Insurance	14,086	0.443	0.204	0.296	0.412	0.573
Beer & Liquor	229	0.784	0.210	0.635	0.822	1.000
Business Equipment	5,681	0.464	0.222	0.300	0.432	0.608
Business Supplies	856	0.565	0.222	0.418	0.539	0.698
Chemicals	1,181	0.568	0.215	0.417	0.533	0.698
Coal	122	0.812	0.205	0.686	0.852	1.000
Communication	1,502	0.603	0.199	0.485	0.591	0.715
Construction and Const. Materials	2,073	0.502	0.206	0.348	0.495	0.617
Consumer Goods	919	0.606	0.230	0.430	0.585	0.757
Electrical Equip	786	0.726	0.182	0.611	0.712	0.865
Fabricated Products	2,216	0.612	0.203	0.484	0.590	0.740
Food Products	1,403	0.573	0.207	0.431	0.543	0.692
Healthcare, Medical Equipment, and Pharmaceuticals	4,150	0.484	0.213	0.332	0.439	0.612
Personal and Business Services	6,631	0.458	0.227	0.285	0.402	0.607
Petroleum and Natural Gas	2,065	0.624	0.210	0.468	0.641	0.787
Precious Metals,	220	0.706	0.234	0.558	0.741	0.901
Printing and Publishing	566	0.569	0.229	0.419	0.543	0.714
Recreation	1,238	0.617	0.209	0.475	0.608	0.753
Restaurants, Hotels and Motels	1,251	0.601	0.225	0.452	0.617	0.751
Retail	3,477	0.505	0.191	0.385	0.496	0.613
Steel Works Etc	773	0.600	0.189	0.481	0.578	0.690
Textiles	243	0.695	0.237	0.543	0.671	0.927
Tobacco Products	70	0.921	0.113	0.862	1.000	1.000
Transportation	1,667	0.590	0.192	0.468	0.585	0.697
Utilities	4,993	0.261	0.134	0.186	0.233	0.301
Wholesale	2,543	0.414	0.211	0.260	0.377	0.534
Everything Else	1,990	0.562	0.231	0.401	0.542	0.725
Average	2,177	0.593	0.206	0.454	0.583	0.731

This panel presents descriptive statistics for *Tax Effectiveness* by Fama-French 30 industry classification.

Table 2: Relation between *Tax Effectiveness* and Effective Tax Rates

Panel A: Correlations

Variable	Pearson Correlations	Spearman Correlations
Cash ETR 1	**-0.433**	**-0.382**
Cash ETR 5	**-0.208**	**-0.219**
GAAP ETR 1	**-0.201**	**-0.161**
GAAP ETR 5	**-0.142**	**-0.144**
Ind. Adj Cash ETR 1	**-0.457**	**-0.412**
Ind. Adj Cash ETR 5	**-0.237**	**-0.261**
Ind. Adj GAAP ETR 1	**-0.213**	**-0.180**
Ind. Adj GAAP ETR 5	**-0.147**	**-0.151**

Relations that are significant at the 10% level or better are bold.

Panel B: Overlapping *Cash ETR 1* Quintiles

		Cash ETR 1				
		Q5 (High)	**Q4**	**Q3**	**Q2**	**Q1 (Low)**
Tax Effectiveness	**Q1 (Low)**	10%	4%	3%	2%	1%
	Q2	4%	5%	5%	4%	2%
	Q3	3%	5%	5%	4%	3%
	Q4	2%	4%	5%	5%	4%
	Q5 (High)	1%	1%	3%	5%	10%

Random probability would assign 4% of firm-years to each cell. Perfect correlation would assign 20% of observations along the diagonal, and zero elsewhere.

Panel C: Overlapping *Ind. Adj. Cash ETR 1* Quintiles

		Ind Adj. Cash ETR 1				
		Q5 (High)	**Q4**	**Q3**	**Q2**	**Q1 (Low)**
Tax Effectiveness	**Q1 (Low)**	10%	4%	2%	2%	1%
	Q2	4%	5%	5%	4%	2%
	Q3	3%	5%	5%	4%	3%
	Q4	2%	4%	5%	5%	4%
	Q5 (High)	1%	1%	3%	5%	10%

Random probability would assign 4% of firm-years to each cell. Perfect correlation would assign 20% of observations along the diagonal, and zero elsewhere.

Panel A presents Pearson and Spearman correlations between *Tax Effectiveness* and various firm-year measures of tax avoidance. *Tax Effectiveness* is the firm-level measure of tax effectiveness from DEA analysis. All other variables are defined in Appendix A. Panel B presents the two-way distribution of observations among quintiles of *Cash ETR 1* and *Tax Effectiveness*, and Panel C presents the two-way distribution for *Ind. Adj Cash ETR 1* and *Tax Effectiveness.* Observations along the diagonal are ranked in the same quintile of both measures. Observations in the off-diagonals are ranked in different quintiles of the two measures. Percentages shown in the cells may not sum to 100% due to rounding.

Table 3: Predictive Power of *Firm Tax Effectiveness* for Future Tax Outcomes

Panel A: Future Five-Year *ETRs* and *Settlements*

	Y = *Cash ETR*$_{t+1,t+5}$		Y = *GAAP ETR*$_{t+1,t+5}$		Y = Settlements$_{t+1,t+5}$	
VARIABLES	1	2	3	4	5	6
Tax Effectiveness	-0.126***	-0.071***	-0.083***	-0.050***	-0.143**	-0.137*
	(-19.38)	(-10.40)	(-14.08)	(-9.70)	(-2.16)	(-1.91)
PTROA	0.308***	0.264***	0.174***	0.119***	0.700***	0.677***
	(14.02)	(10.60)	(9.89)	(6.84)	(3.16)	(2.71)
Log(Assets)	-0.001	-0.002	0.003***	0.001	0.029**	0.029**
	(-0.86)	(-1.63)	(3.27)	(1.31)	(2.14)	(2.12)
Leverage	-0.089***	-0.061***	-0.056***	-0.041***	-0.031	-0.076
	(-10.32)	(-6.76)	(-6.80)	(-5.37)	(-0.28)	(-0.65)
CapEx_Assets	-0.210***	-0.203***	0.120***	0.087***	-0.322	-0.134
	(-8.48)	(-7.60)	(5.63)	(4.10)	(-0.81)	(-0.31)
RD_Assets	-0.393***	-0.354***	-0.273***	-0.232***	-0.434	0.025
	(-7.88)	(-6.59)	(-6.23)	(-5.14)	(-1.25)	(0.07)
Intan_Assets	0.001	0.014	0.043***	0.029***	-0.037	-0.008
	(0.12)	(1.31)	(4.48)	(3.30)	(-0.43)	(-0.09)
Foreign Income %	0.023**	0.019**	-0.058***	-0.055***	0.050	0.029
	(2.40)	(2.05)	(-6.97)	(-7.38)	(0.67)	(0.39)
NOL	-0.018***	-0.005	-0.002	-0.002	-0.029	-0.012
	(-4.39)	(-1.34)	(-0.59)	(-0.53)	(-0.80)	(-0.34)
Haven	-0.005	-0.002	0.002	0.002	-0.009	-0.007
	(-1.08)	(-0.57)	(0.56)	(0.59)	(-0.21)	(-0.15)
Cash ETR 5		0.215***				0.232**
		(17.70)				(2.05)
GAAP ETR 5				0.256***		
				(18.39)		
Intercept	0.372***	0.289***	0.350***	0.272***	3.122***	3.098***
	(29.31)	(22.36)	(31.78)	(26.44)	(14.76)	(14.94)
Industry and Year FE?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,953	21,554	26,284	23,588	4,188	3,870
R-squared	0.122	0.175	0.131	0.192	0.029	0.032

This panel presents results of estimating future tax outcomes as a function of *Tax Effectiveness* and controls. Tax outcomes are measured using five-year future GAAP and cash ETR measured from *t+1* through *t+5,* and *Settlements,* which are measured following Robinson et al. (2016) as the sum of settlements from the UTB roll forward (TXTUBSETTLE) from *t+1* through *t+5* scaled by total UTBs in *t.* All variables are defined in Appendix A. Robust t-statistics in parenthesis calculated based on standard errors clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

Table 3 (continued): Predictive Power of *Tax Effectiveness* for Future Tax Outcomes

Panel B: Future Five-Year *Cash Taxes Paid/Assets* and Five-Year *Settlements*

	Y = *Cash Taxes Paid*$_{t+1,t+5}$/*Assets*$_t$		Y = *Tax Expense*$_{+1,t+5}$/*Assets*$_t$	
VARIABLES	1	2	3	4
Tax Effectiveness	-0.060***	-0.031***	-0.034***	-0.021***
	(-10.72)	(-4.15)	(-5.16)	(-2.62)
PTROA	1.067***	0.945***	1.090***	0.984***
	(28.60)	(12.82)	(25.59)	(11.67)
Log(Assets)	-0.007***	-0.005***	-0.002	-0.005***
	(-5.68)	(-3.94)	(-1.16)	(-3.02)
Leverage	-0.089***	-0.072***	-0.105***	-0.088***
	(-12.74)	(-7.95)	(-12.77)	(-8.40)
CapEx_Assets	-0.156***	-0.168***	0.039	-0.002
	(-4.98)	(-3.13)	(1.02)	(-0.03)
RD_Assets	-0.415***	-0.408***	-0.174**	-0.323***
	(-6.29)	(-4.47)	(-2.11)	(-3.25)
Intan_Assets	-0.015	-0.030**	0.007	-0.004
	(-1.54)	(-2.28)	(0.59)	(-0.23)
Foreign Income %	0.030***	0.015	0.003	-0.004
	(3.14)	(1.49)	(0.25)	(-0.33)
NOL	-0.017***	-0.011***	-0.011**	-0.009*
	(-4.34)	(-2.69)	(-2.30)	(-1.79)
Haven	0.000	-0.001	-0.006	-0.004
	(0.10)	(-0.16)	(-1.21)	(-0.75)
Cash Taxes Paid$_{t-4,t}$/*Assets*$_{t-5}$		0.135***		
		(6.18)		
Tax Expense$_{t-4,t}$/*Assets*$_{t-5}$				0.106***
				(5.15)
Intercept	0.246***	0.147***	0.221***	0.175***
	(12.18)	(6.10)	(9.01)	(6.03)
Industry and Year FE?	Yes	Yes	Yes	Yes
Observations	30,581	14,671	31,399	15,096
R-squared	0.399	0.483	0.336	0.424

This panel presents results of estimating future tax outcomes as a function of *Tax Effectiveness* and controls. Tax outcomes are measured using *Cash Taxes Paid*$_{t+1,t+5}$/*Assets*$_t$, and *Tax Expense*$_{+1,t+5}$/*Assets*$_t$, which are measured following using the sum of cash taxes paid or tax expense, respectively from *t+1* through *t+5* scaled by assets in year *t*. All other variables are defined in Appendix A. Robust t-statistics in parenthesis calculated based on standard errors clustered by firm. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Channels of Tax Planning

Panel A: Descriptive Statistics for Firms in Top Decile of *Tax Effectiveness* Relative to Other Firms

	Firms in Top 10% of *Tax Effectiveness*	Firms Not in Top 10% of *Tax Effectiveness*	Difference
	N=6,531	N=58,786	
Cash ETR 5	0.155	0.266	-0.111***
GAAP ETR 5	0.228	0.311	-0.083***
PTROA	0.193	0.104	0.089***
Log(Assets)	5.394	6.451	-1.057***
Leverage	0.256	0.262	-0.006
CapEx_Assets	0.059	0.060	-0.001
R&D_Assets	0.027	0.020	0.007***
Intan_Assets	0.081	0.142	-0.061***
Foreign Income %	0.112	0.089	0.023***
NOL	0.298	0.273	0.025***
Haven	0.106	0.145	-0.039***

This table presents descriptive statistics for firms based on their *Tax Effectiveness* scores and the variables that contribute to those scores. Panel A presents descriptive statistics for firms in the top decile of *Tax Effectiveness* relative to other firms.

Table 4 (continued): Channels of Tax Planning
Panel B: Channels of *Tax Effectiveness* by Industry

	R&D	PIFO	INTAN	XINT	CAPX
Aircraft, ships, and Equipment	11.9%	3.4%	10.2%	37.3%	**39.0%**
Apparel	1.0%	9.2%	8.2%	29.6%	**52.0%**
Automobiles	20.9%	11.0%	5.5%	**34.1%**	**34.1%**
Banking, Insurance	0.8%	2.9%	6.4%	**67.2%**	15.5%
Beer & Liquor	0.0%	0.0%	29.4%	17.6%	**52.9%**
Business Equipment	**42.6%**	12.7%	5.6%	25.6%	19.3%
Business Supplies	6.8%	13.6%	10.2%	**44.3%**	34.1%
Chemicals	13.2%	11.3%	3.8%	29.2%	**42.5%**
Coal	0.0%	0.0%	0.0%	33.3%	**66.7%**
Communication	8.4%	6.5%	10.3%	**40.0%**	34.8%
Construction and Const. Materials	3.3%	9.3%	4.2%	**56.1%**	28.5%
Consumer Goods	8.1%	11.1%	13.1%	16.2%	**52.5%**
Electrical Equip	7.8%	17.8%	0.0%	17.8%	**55.6%**
Fabricated Products	20.6%	16.7%	5.3%	29.8%	**33.3%**
Food Products	10.3%	5.5%	8.9%	33.6%	**47.9%**
Healthcare, Medical Equipment, and Pharmaceuticals	26.9%	9.2%	13.4%	25.0%	**27.1%**
Personal and Business Services	10.2%	19.3%	6.3%	14.6%	**54.2%**
Petroleum and Natural Gas	0.5%	3.3%	0.9%	40.3%	**53.6%**
Precious Metals,	0.0%	4.2%	16.7%	**41.7%**	33.3%
Printing and Publishing	0.0%	5.3%	24.6%	31.6%	**36.8%**
Recreation	3.1%	7.0%	12.5%	35.2%	**43.0%**
Restaurants, Hotels and Motels	0.0%	4.8%	12.8%	**51.2%**	32.8%
Retail	0.6%	3.7%	8.6%	29.2%	**57.9%**
Steel Works Etc	1.3%	7.6%	6.3%	39.2%	**44.3%**
Textiles	0.0%	4.9%	26.8%	22.0%	**46.3%**
Tobacco Products	0.0%	**50.0%**	0.0%	0.0%	**50.0%**
Transportation	0.0%	14.6%	4.7%	38.6%	**39.2%**
Utilities	0.0%	0.0%	1.6%	**67.5%**	30.9%
Wholesale	1.5%	14.3%	9.0%	**48.5%**	25.2%
Everything Else	6.1%	6.1%	7.6%	**43.1%**	25.4%
Total	9.3%	8.4%	7.2%	41.4%	33.4%

This panel presents the descriptive statistics for the channels of tax planning by Fama-French 30 industry classification. For firms in the top decile of *Tax Effectiveness* this panel shows the percentage of those firms for which each input represents the primary channel of efficient tax planning. The largest percentage by industry is bold. For example, 67.2% of tax effective firms in the Banking and Insurance industry rely on interest expense as their primary input to tax planning. Channels of tax planning are defined according to the input variable other than pre-tax domestic income with a positive value that provides the greatest contribution to the observations tax effectiveness score.

Table 5: The Effect of Governance on *Tax Effectiveness*

	Y= *Tax Effectiveness*			
VARIABLES	1	2	3	4
Ln(Delta)	0.006**			
	(2.11)			
Less Entrenched		0.024**		
		(2.30)		
% Financial Experts			0.073**	
			(2.08)	
Log(# of Financial Experts)				0.002
				(0.17)
CFO	0.522***	0.566***	0.662***	0.663***
	(8.60)	(15.39)	(9.72)	(9.72)
Log(MVE)	0.102***	0.084***	0.094***	0.093***
	(12.94)	(14.07)	(11.37)	(11.32)
Log(Assets)	-0.111***	-0.094***	-0.089***	-0.089***
	(-13.96)	(-16.60)	(-10.61)	(-10.52)
Constant	0.429***	0.379***	0.265***	0.263***
	(9.66)	(12.06)	(5.67)	(5.67)
Industry and Year Effects?	Yes	Yes	Yes	Yes
Observations	6,586	16,668	9,094	9,094
R-squared	0.217	0.183	0.204	0.203

This table presents results of estimating *Tax Effectiveness* as a function of governance. All variables are measured as of year *t* and are defined in Appendix A. Robust t-statistics in parenthesis calculated based on standard errors clustered by firm. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6: *Tax Effectiveness* and Excess Cash Holdings

Y = *Excess Cash* (Fresard and Salva 2010)

VARIABLES	1	2	3
*High Tax Effectiveness * High UTB*	-0.156***		
	(-2.68)		
*High Tax Effectiveness * UTB*		-6.742***	
		(-3.59)	
*Tax Effectiveness * High UTB*			-0.272***
			(-2.63)
High Tax Effectiveness	0.206***	0.172***	
	(4.00)	(4.37)	
High UTB	0.262***		0.317***
	(5.65)		(5.06)
UTB		9.136***	
		(5.27)	
Tax Effectiveness			0.431***
			(4.55)
PTROA	1.772***	1.806***	1.650***
	(10.47)	(10.64)	(9.34)
Log(Assets)	0.051***	0.059***	0.054***
	(4.31)	(5.08)	(4.49)
Leverage	-0.558***	-0.572***	-0.557***
	(-5.30)	(-5.41)	(-5.31)
CapEx_Assets	-1.943***	-1.979***	-1.909***
	(-5.27)	(-5.40)	(-5.18)
R&D_Assets	3.181***	3.057***	3.187***
	(9.10)	(8.38)	(9.12)
Intan_Assets	-1.207***	-1.211***	-1.189***
	(-12.81)	(-12.80)	(-12.57)
Foreign Inccome %	0.559***	0.572***	0.548***
	(8.70)	(8.83)	(8.48)
NOL	0.040	0.044	0.038
	(1.09)	(1.20)	(1.02)
Haven	0.028	0.026	0.027
	(0.62)	(0.59)	(0.61)
Constant	-0.723***	-0.752***	-0.806***
	(-3.36)	(-3.56)	(-3.66)
Year and Industry FE?	Yes	Yes	Yes
Observations	11,601	11,601	11,601
R-squared	0.240	0.239	0.242

This table presents results of estimating *Excess Cash* as a function of tax effectiveness, tax uncertainty and controls. We measure tax uncertainty using either an indicator variable for observations with above-median values of reserves for unrecognized tax benefits (TXTUBEND) scaled by lagged total assets (*Above Median UTB)* of with the continuous measure of reserves for unrecognized tax benefits scaled by lagged total assets (*UTB/Lagged Assets).* Similarly, *Above Median Effectiveness* is an indicator equal to one for observations with above-median values of *Tax Effectiveness.* All other variables are defined in Appendix A. Robust t-statistics in parenthesis calculated based on standard errors clustered by firm. *** p<0.01, ** p<0.05, * p<0.1.