Taxes and Earnings Uncertainty

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Abstract: We examine how investors' uncertainty about effective tax rates (ETRs) is related to their uncertainty about after-tax earnings. We show that dispersion in ETR forecasts accounts for meaningful variation in after-tax forecast dispersion, and surprisingly, decreases it in approximately half of our sample. A key determinant of how ETR uncertainty impacts after-tax earnings uncertainty is the covariance between pre-tax income and ETR forecasts, as a positive covariance mutes the effect of pre-tax uncertainty and ETR uncertainty. ETR uncertainty is positively related to bid-ask spreads and return volatility, consistent with it affecting perceptions of a firm's overall uncertainty. However, subsample analysis suggests it is not related to spreads and return volatility when pre-tax income and ETR forecasts are positively and significantly correlated, which is the case in one-third of our sample. Our findings highlight the importance of considering how expectations about pre-tax performance and ETRs may covary when evaluating how ETR uncertainty affects earnings uncertainty and a firm's overall uncertainty.

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I. Introduction

It is well established that managers and investors prefer predictable earnings (Graham, Harvey, and Rajgopal 2005). Seventy-eight percent of surveyed CFOs in Graham et al. (2005) admit to sacrificing long-term value in order to smooth earnings. Managers fear that the market will demand a higher risk premium if the firm misses a target or has more volatile earnings. Consistent with this concerns, Affleck-Graves, Callahan, and Chipalkatti (2002) find that firms with less predictable earnings have a higher cost of capital than similar firms with more predictable earnings.

A large component of earnings is taxes. Few other line items on the income statement comprise such a large percentage of earnings (the statutory corporate tax rate has been 21% since 2017 before which it was 35%). Thus, to the extent that there is uncertainty about a firm's tax expense, one might expect for this uncertainty to translate into greater uncertainty about after-tax earnings. A firm's tax expense could be uncertain due to aggressive tax planning (e.g., shifting income to tax havens), the tax benefits of which could later be overturned, or due to inherent difficulty in forecasting tax expense even with minimal risk (e.g., the excess tax benefit from stock-based compensation).

Forecasting tax expense involves forecasting an effective tax rate (ETR). In this paper, we examine the effect of ETR uncertainty on earnings uncertainty. Addressing this question is important because although prior studies examine the impact of *ex post* ETR volatility on overall firm risk (Goh, Lee, Lim, and Shevlin 2016; Guenther, Matsunaga, and Williams 2017), no paper has addressed the more fundamental question of whether ETR uncertainty increases earnings uncertainty.

On the one hand, it may seem obvious that ETR uncertainty will increase after-tax earnings uncertainty regardless of whether or not the ETR uncertainty is the result of risky tax strategies. On the other hand, ETR uncertainty may not increase after-tax earnings uncertainty if expectations about pre-tax performance and ETRs covary in a certain way. If more favorable pre-tax expectations are associated with higher ETR expectations (i.e., a positive covariance), then ETR uncertainty can serve to mute the effect of pre-tax earnings uncertainty. *Ex ante*, it is unclear whether expectations about pre-tax income and ETRs covary in such a way to deflate or inflate after-tax earnings uncertainty. If a positive covariance does exist for some subsample, it is also unclear whether the covariance effect is ever strong enough to completely offset the additional after-tax earnings uncertainty caused by the raw variation in tax expense expectations. The ultimate effect of ETR uncertainty on bottom-line earnings uncertainty is an open empirical question for which we provide evidence both overall and in the cross-section.

We rely upon analyst forecasts to identify expectations of pre-tax income, ETRs, and after-tax income, and then measure uncertainty as the standard deviation of the forecasts scaled by their mean values. For example, we calculate ETR uncertainty as the standard deviation of ETR forecasts scaled by the mean ETR forecast. We find that the standard deviation of ETR forecasts averages 11% of the mean ETR forecast. Thus, there appears to be substantial ETR uncertainty. As expected, a substantial portion of ETR uncertainty is driven by pre-tax uncertainty. However, our measure of ETR uncertainty is also positively related to firm characteristics that one would expect make it more difficult to forecast an ETR. For instance, it is associated with risky types of tax avoidance (such as R&D and the number of tax haven subsidiaries) as well as other firm characteristics that have an association with lower effective tax rates (such as leverage and stock-based compensation). In addition, ETR uncertainty is positively related to net operating loss (NOL)

carryforwards, which can make it difficult to forecast ETRs, especially when the NOLs have valuation allowances attached to them. In summary, our measure of ETR uncertainty varies in the cross-section as we would expect. What interests us more, however, is how ETR uncertainty affects bottom-line earnings uncertainty.

To estimate the effect of ETR uncertainty on earnings uncertainty, we calculate the percentage change in after-tax forecast dispersion that occurs due to variation in analysts' ETR forecasts. We do so by taking the difference between observed after-tax dispersion and a counterfactual after-tax dispersion measure calculated as if all analysts agreed upon the ETR and applied the mean ETR forecast to their pre-tax income forecasts. We then scale the difference between the two dispersion measures by the counterfactual dispersion measure such that it represents a percentage change. In other words, we create a variable that represents the percentage change in earnings uncertainty that occurs because of variation in ETR forecasts. The mean and median of this variable are slightly negative suggesting that variation in ETR forecasts actually serves to *decrease* earnings uncertainty in a little over half of our observations.

There is substantial cross-sectional variation in the extent to which ETR uncertainty impacts earnings uncertainty. Moving from the first quartile to the third quartile, the estimated effect of ETR uncertainty on after-tax uncertainty ranges from -13% to 7%. ETR uncertainty translates into greater after-tax earnings uncertainty for smaller, domestic-only firms with tax loss carryforwards. ETR uncertainty is associated with less after-tax earnings uncertainty for firms that own more intangible assets and firms with higher marginal tax rates. We also observe time-series variation in the extent to which ETR uncertainty maps into after-tax earnings uncertainty. As one might expect, the effect of ETR uncertainty on after-tax uncertainty spiked around the passage of the Tax Cut and Jobs Act of 2017 ("TCJA"), which reduced the corporate tax rate from 35% to

21% as well as implemented many other changes to corporate taxation, and then leveled off. The spike is likely due to analysts being unsure of how the act's provisions would affect firms' tax liabilities.

One potential explanation for why ETR uncertainty surprisingly decreases after-tax uncertainty in over half of our observations is a positive covariance between pre-tax income and ETR forecasts. Indeed, this is what we find. ETR forecasts positively covary with pre-tax income forecasts for 72% of the firm-years in our sample. A positive covariance, or the extent to which ETRs scale with pre-tax income and thus reduce after-tax earnings uncertainty, appears to cancel out the increase in earnings uncertainty that arises from the difficulty of forecasting ETRs for some firms.

So far, we have shown that ETR uncertainty increases after-tax uncertainty but not for as many firms as one might expect, due to the cancelling out effect of the covariance between pre-tax income and ETR forecasts. Next, we examine whether uncertainty related to forecasting a firm's ETR alters investors' perceptions of a firm's overall uncertainty by looking at bid-ask spreads. Prior research documents a positive association between earnings uncertainty and bid-ask spreads (e.g., Affleck-Graves, Callahan, and Chilpalkatti 2002), and we expect to find a similar association. However, it is unclear whether a pre-tax or after-tax earnings uncertainty measure will better explain variation in bid-ask spreads. It is also unclear as to whether ETR uncertainty is positively related to bid-ask spreads and whether it has incremental explanatory power beyond pre-tax earnings uncertainty.

We find that both pre-tax and after-tax earnings uncertainty are positively associated with bid-ask spreads, with pre-tax earnings uncertainty explaining more variation in bid-ask spreads than after-tax earnings uncertainty. The explanatory power of a model that regresses bid-ask spread

on pre-tax uncertainty is 12% higher than that of a model that regresses bid-ask spread on after-tax uncertainty. Moreover, a one-standard-deviation-change in pre-tax uncertainty has a 6% larger effect on bid-ask spreads than a one-standard-deviation-change in after-tax uncertainty. These results suggest that pre-tax forecast dispersion better captures overall firm uncertainty than does after-tax forecast dispersion.

Next, when we regress bid-ask spreads on ETR uncertainty, we find that the two are positively and significantly related; however, this could be due to the underlying correlation between pre-tax earnings and ETR forecasts. To control for this, we include pre-tax uncertainty, ETR uncertainty, and the covariance between pre-tax income and ETR forecasts in the same model. We find that pre-tax uncertainty and ETR uncertainty are both positively and significantly related to bid-ask spreads, suggesting that ETR uncertainty has explanatory power that is incremental to that of pre-tax uncertainty. The covariance between pre-tax income and ETR forecasts, which reduces the effect of ETR uncertainty on after-tax uncertainty, is negatively related to bid-ask spreads. Interestingly, the model that includes pre-tax income uncertainty, ETR uncertainty, and the covariance term exhibits 30% greater explanatory power than the model that only includes after-tax uncertainty. This important finding suggests that an after-tax uncertainty measure may obscure some of the information in the separate components of pre-tax uncertainty and ETR uncertainty.

To extend our finding that the covariance between pre-tax income and ETR forecasts mutes the effect of ETR uncertainty on after-tax income uncertainty, we split our sample into firm-year observations where the covariance is positive and significant and all other observations. Consistent with the covariance effect muting the ETR uncertainty effect, we find that ETR uncertainty is only significantly related to bid-ask spreads in the sub-sample without a positive and significant

covariance, which comprises 67% of our total sample. This result highlights the importance of not focusing on ETR uncertainty without also considering that ETR expectations may covary with expectations about pre-tax income. For a given outcome variable, such as bid-ask spreads, ETR uncertainty may or may not have a significant effect depending on that covariance structure.[1]

Our paper makes a number of contributions. It is the first to quantify what effect ETR uncertainty has on after-tax earnings uncertainty. We show that the impact of ETR uncertainty on after-tax earnings uncertainty is not unidirectional and critically depends on the covariance structure between expectations regarding a firm's pre-tax income and ETR. The fact that variation in ETR forecasts can decrease after-tax earnings uncertainty is a counter-intuitive finding, and sometimes the decrease in after-tax earnings uncertainty can be substantial (e.g., a quarter of our sample has an after-tax forecast dispersion measure that is at least 13% lower relative to a counterfactual with no ETR variation across analysts). When analyzing the uncertainty of a firm's pre-tax earnings, its ETR, and its after-tax earnings, researchers and investors should consider that pre-tax income and ETRs covary as well as how this covariance differs across firms.

Second, we show that the impact of a firm characteristic on ETR uncertainty is not always consistent with its impact on after-tax earnings uncertainty. For example, stock-based compensation is associated with greater ETR uncertainty, but the additional ETR uncertainty does not translate into greater after-tax earnings uncertainty. This is because stock-based compensation is positively associated with the covariance between a firm's pretax income and ETR forecasts.

[1] In addition to examining bid-ask spreads, we also examine future return volatility with the expectation that current earnings uncertainty would manifest in higher future return volatility. We do find that ETR uncertainty is positively associated with future return volatility, and we also find an offsetting covariance effect. The extent to which pre-tax income and ETR expectations covary is negatively associated with future return volatility.

Third, we develop a method for measuring *ex ante* ETR-related earnings uncertainty based on non-GAAP earnings expectations that we argue is much more relevant to managers and investors than a historical measure of tax uncertainty based on the standard deviation of GAAP or cash ETRs.[2]

Lastly, we provide evidence that focusing on an after-tax earnings uncertainty measure can obscure some of the information in the separate components of pre-tax uncertainty and ETR uncertainty. As ETR uncertainty sometimes attenuates pre-tax uncertainty and at other times amplifies it, researchers and investors may want to decompose earnings uncertainty into its pre-tax and tax components depending on the research question and outcome variable.

II. Background

Our paper relates to the growing literature on tax risk (e.g., Guenther et al. 2017; Drake, Lusch, and Stekelberg 2019; Neuman, Omer, and Schmidt 2020; Hutchens, Rego, and Williams 2023). The term "tax risk" generally refers to the heightened probability that the tax authority (e.g., the IRS) will overturn a firm's favorable tax position. A firm's tax risk could increase either because it engages in aggressive tax planning or because it is uncertain what the correct interpretation of the tax law is even when its tax planning is not aggressive. In either case, we would expect tax risk makes it more difficult to predict ETRs.

Prior studies link tax risk with overall firm risk. Guenther et al. (2017) find that tax risk, measured as the standard deviation of a firm's historical cash ETR over the prior five years,

[2] The standard deviation of ETRs requires five years of historical data to measure typically, and earlier years of the measurement period are often stale such that they may no longer reflect the tax uncertainty faced when forecasting the firm's earnings for the upcoming year. GAAP ETRs can also be contaminated by one-time items which increase volatility (e.g., valuation allowance changes, settlements with tax authorities) but should not impact the task of forecasting current period's ETR. Further in support of using an analyst-based measure of earnings expectations, non-GAAP earnings are generally more persistent and a more significant predictor of stock prices than GAAP earnings (Bradshaw and Sloan 2002; Bhattacharya, Black, Christensen, and Larson 2003).

increases firm risk, measured as the volatility of future returns. Also using the standard deviation of historical cash ETRs to proxy for aggressive tax planning, Goh et al. (2016) find that tax risk increases a firm's cost of capital. Balakrishnan, Blouin, and Guay (2019) find that aggressive tax planning, which they proxy for with an unusually low ETR relative to a firm's size and industry peers, reduces a firm's financial transparency, resulting in larger analysts' forecast errors, greater forecast dispersion, and a higher level of information asymmetry.

These three papers motivate us to ask the following research question: What effect does uncertainty regarding a firm's future ETR have on the uncertainty related to its future earnings? We are interested in ETR uncertainty that could arise due to aggressive tax planning, but we are also interested in uncertainty that arises due to the complexity in calculating tax expense even when the underlying tax planning is not aggressive (e.g., excess tax benefit from stock options). Unlike the prior studies, we focus on how future ETR uncertainty, rather than past tax avoidance/aggressiveness, affects future earnings uncertainty.

When considering the effect of ETR uncertainty on after-tax uncertainty, on the one hand, it seems reasonable to expect that uncertainty about the calculation of tax expense, which comprises a large percentage of earnings, would increase the uncertainty related to earnings. On the other hand, to the extent that expectations about ETRs positively covary with expectations about pretax income, greater ETR uncertainty could mask any uncertainty about pretax income, thereby muting the effect of pretax income uncertainty on after-tax income uncertainty. We believe providing general evidence on the covariance structure between pretax income expectations and ETR expectations is helpful, and we think it is important for practitioners and researchers to understand how the effect of ETR uncertainty on after-tax uncertainty varies in the cross-section.

In order to answer our research question, we develop a measure of ETR uncertainty that is forward-looking and appropriate for the analysis of how ETR uncertainty affects after-tax earnings uncertainty. As explained above, tax risk is often operationalized through a statistical lens where researchers use the standard deviation of ETRs over some pre-determined period (e.g., Goh et al. 2016; Guenther et al. 2017; Drake et al. 2019). While historical ETR volatility may be an appropriate measure of tax risk for some settings, we argue that it is a poor *ex ante* measure of tax-related earnings uncertainty.[3] If managers worry about negative earnings surprises and are so focused on short-term earnings targets, which survey evidence suggests is the case (Graham et al. 2005), we argue that an *ex ante* measure of tax uncertainty is needed when examining tax uncertainty in the context of earnings uncertainty. In further support against a historical ETR volatility measure, Donelson, Koutney, and Mills (2022) find that nonrecurring income taxes (Compustat data item NRTAX) have little predictive power for future earnings, nor do they appear to be opportunistic. Donelson et al. (2022) recommend researchers consider removing the effect of nonrecurring income taxes when using ETR levels or volatility. Our measure of tax-related earnings uncertainty relies upon forward-looking forecasts and thus does not require any removal of nonrecurring income taxes.

Other studies employ the total or current additions to a firm's unrecognized tax benefit (UTB) or tax reserve as a measure of tax uncertainty. For example, Dyreng, Hanlon, and Maydew (2019) use the amount of UTBs recorded during a time period to examine whether tax avoidance is associated with tax uncertainty. While firms with higher levels of UTBs likely face more tax

[3] First, prior studies use GAAP or cash ETRs while management and analysts are more likely to be focused on non-GAAP earnings measures. Second, as mentioned previously, calculating the standard deviation of ETRs requires a fairly long string of firm-year observations such that the measure is likely to be stale for assessing current year tax-related earnings uncertainty. Third, changes in statutory tax rates can increase ETR volatility without necessarily increasing tax risk (e.g., the decrease in corporate tax rates from 35% to 21% with the Tax Cut and Jobs Act).

uncertainty, more UTBs do not necessarily translate into more uncertain earnings. For example, De Simone, Robinson, and Stomberg (2014) find that firms exhibit widely disparate accounting treatments for the same underlying uncertain tax position, and Savoy (2017) finds that acquirers make large changes to target UTB reserves and tend to increase UTB reserves through purchase accounting. Both studies suggest that larger UTB balances could act as "cookie jar" reserves that management could use to smooth earnings and reduce earnings uncertainty.

To provide a framework for thinking about how ETRs shape the distribution of earnings expectations, we decompose the variance of net income expectations into three components: the variance of pre-tax earnings expectations, the variance of tax expense expectations, and the covariance of the two. The variance of the difference between two completely independent random variables, x and y, equals the variance of x plus the variance of y. However, if x and y potentially covary, and tax expense most certainly covaries with pre-tax income, the variance of the difference also includes an additional term equal to negative two times the covariance of pre-tax income and tax expense expectations. Applying this decomposition to the variance of earnings expectations suggests the variance of net income can be thought of as: $var(net) = var(pre) + var(txt) - 2*cov(pre,txt)$.

We first consider the simplest tax system possible where there is only one jurisdiction with a proportional tax rate, r, and the tax system has no tax preferences (e.g., no credits for certain activities). In such a simple tax system, the variance of net income forecasts will simplify to $(1 - r)^2 * var(pre)$. After the standard deviation is taken to calculate dispersion and the result is scaled by the mean forecast, one can see that after-tax forecast dispersion equals pre-tax forecast dispersion for this simplest of tax systems with complete tax certainty.

$$After-tax\ Dispersion = \frac{\sqrt{(1-r)^2 * var(pre)}}{mean(pre) * (1-r)} = \frac{(1-r) * stddev(pre)}{mean(pre) * (1-r)} = \frac{stddev(pre)}{mean(pre)}$$

The tax system that U.S. corporations face is of course much more complex and complicated than the simple tax system described above. As a result, we would expect the variance of tax expense expectations to be much larger than in the simple tax system (i.e., ETR uncertainty is non-zero). Now if variation in ETR forecasts was purely noise and uncorrelated with pre-tax expectations, then the additional variation in tax expense would have to increase after-tax earnings uncertainty. However, it is unclear whether ETR forecasts covary with pre-tax expectations. If the covariance is positive and strong enough, ETR uncertainty could decrease after-tax earnings uncertainty. Because we are the first to study this construct and do not have a good idea as to what the typical covariance structure is between pre-tax income and ETR forecasts, we do not develop a formal hypothesis as to whether ETR uncertainty increases or decreases after-tax earnings uncertainty. The above discussion illustrates, however, that the covariance structure between pre-tax income and ETR forecasts will play a role in the answer to that question.

Figure 1 provides a visualization of the decomposition of bottom line-earnings uncertainty. Both pre-tax income uncertainty and tax expense uncertainty increase bottom-line earnings uncertainty. Because tax expense uncertainty is increasing in ETR forecast dispersion, ETR forecast dispersion will be positively associated with bottom-line earnings uncertainty. The covariance term, on the other hand, decreases bottom-line earnings uncertainty, and the covariance term is influenced by both the mean ETR forecast and the covariance between pre-tax income and ETR forecasts for that firm year. A higher mean ETR forecast and a stronger covariance between pre-tax income and ETR forecasts reduces bottom-line earnings uncertainty.

We acknowledge that analysts forecast an ETR to apply to pre-tax income as opposed to independently forecasting tax expense without any regard to pre-tax income. In addition, tax expense variance will be contaminated by both pre-tax income uncertainty and ETR uncertainty. For these reasons and tractability purposes, we believe it is much easier to focus on ETR uncertainty and the covariance of analysts' pre-tax income forecasts and their ETR forecasts. In the following section, we describe how we estimate pre-tax, after-tax, and ETR uncertainty, and outline a methodology to isolate the change in after-tax earnings uncertainty that stems from ETR uncertainty.

III. Research Design and Sample Construction

Identification of tax-related earnings uncertainty requires a measure of expectations about tax expense. Prior research has used analyst forecasts of pre-tax and after-tax earnings to measure implicit ETR forecasts (e.g., Bratten, Gleason, Mills, and Larocque 2017; Brushwood, Johnston, Kutcher, and Stekelberg 2019; Mauler 2019), and we use a similar approach to identify tax-related earnings uncertainty.[4] An alternative to using analyst forecasts to capture ETR uncertainty would be to use the standard deviation of annual ETRs over a prior multi-year period. In Section 2, we provide several reasons why we believe a forward-looking measure based on analysts' forecasts is superior to a historical-based measure for purposes of our research objective. Nonetheless, we perform additional analyses using the standard deviation of annual ETRs in Section 5.

We focus on annual earnings forecasts made between the prior year earnings announcement and the first quarter earnings announcement for two primary reasons. First, most

[4] Several prior studies document that analysts have difficulty forecasting tax expense (e.g., Plumlee 2003; Weber 2009; Bratten et al. 2017; Kim, Schmidt, and Wentland 2020). We take analysts' ETR forecasts as given and treat them as a reasonable proxy for investors' expectations of tax expense.

analysts who cover a given firm revise their current year earnings forecasts immediately after the firm announces prior year earnings ensuring that the forecasts are not stale. In addition, the large number of revisions in the period after an annual earnings announcement allow for an ample number of forecasts to calculate a dispersion measure. Observing the prior year ETR also gives analysts an opportunity to anchor their current year ETR forecasts. Second, standards for interim financial reporting require managers to forecast their annual ETR at each quarterly reporting date to calculate tax expense, and Bratten et al. (2017) show that reported quarterly ETRs affect the dispersion of analysts' annual forecasts. To maximize the salience of tax-related earnings uncertainty, we focus on forecasts made before management has reported the first quarter ETR.

We include both calendar year-end and non-calendar year-end firms in the sample. For the typical calendar year-end firm, our sample construction process implies we concentrate on earnings forecasts made from approximately mid-February through mid-April. If a particular analyst issues two forecasts for a given firm in that period, we include only the earlier forecast in our sample. An earnings forecast must be accompanied by a pre-tax income forecast made on the same day for it to be included in our sample (I/B/E/S data item anndats), and the vast majority of EPS forecasts are accompanied by pre-tax income forecasts.[5] We compute the implied tax expense forecast and ETR forecast as follows:

$$\textit{Tax Expense Forecast} = \textit{Pre-tax Earnings Forecast} - \textit{After-tax Earnings Forecast} \quad (1)$$

$$\textit{ETR Forecast} = \textit{Tax Expense Forecast} / \textit{Pre-tax Earnings Forecast} \quad (2)$$

[5] Brushwood et al. (2019) finds over 85% of analysts that issue an EPS forecast in their sample also issue a pre-tax income forecast on the same day. Note that the analyst is not technically issuing two separate forecasts. An EPS forecast is just one piece of information in an analyst report, and the pre-tax income forecast would be included in the same analyst report. It is unclear if EPS forecasts that are unaccompanied by a pre-tax forecast are due to the analyst not providing a pre-tax forecast or a data collection issue on the part of I/B/E/S.

We exclude loss forecasts because ETRs with a pre-tax loss are difficult to interpret. We also remove observations where the analyst forecasts a tax benefit on a pre-tax profit because these could be data entry errors on the part of IBES.

In Section 2, we decompose bottom-line earnings. Figure 1 provides a visualization of the decomposition. Throughout our empirical analysis, we use the standard deviation of forecasts to measure earnings uncertainty to be consistent with prior research and also align with how I/B/E/S-provided summary statistics for dispersion are calculated.

We next discuss our methodology to isolate some of the aforementioned components of earnings uncertainty. To measure earnings uncertainty at the pre-tax and after-tax levels, we take the standard deviation of analysts' forecasts and scale by the mean forecast. We employ a similar approach to measure ETR uncertainty. To measure the covariance term, we calculate the covariance of pre-tax income and ETR forecasts for each firm-year and scale by shares outstanding. Because dispersion measures are likely to be noisier with fewer observations, we require a minimum of 10 forecasts for a firm-year to be included in our final sample. This methodology produces the following earnings uncertainty variables, which are also defined in Appendix A:

PTDisp: the standard deviation of analysts' pre-tax income forecasts scaled by the mean pre-tax income forecast

ATDisp: the standard deviation of analysts' net income forecasts scaled by the mean net income forecast

ETRDisp: the standard deviation of implicit ETR forecasts scaled by the mean ETR forecast

ETRCovariance: the covariance of pre-tax income forecasts and ETR forecasts scaled by shares outstanding

Given that ETR uncertainty is one of the key constructs of interest in our study, we believe it is helpful to look at cross-sectional variation in *ETRDisp* for one particular industry-year to understand how it captures ETR uncertainty on a forward-looking basis. To perform a quick case study analysis, we select observations with low and high values of *ETRDisp* within a particular industry-year and then collect the ETR reconciliation tables from the prior year's financial statements (e.g., the 2015 10-K when the forecasts are for 2016). Appendix B displays the ETR reconciliation tables for the low and high ETR uncertainty observations from the 2016 forecast year for the SIC 2-digit industry representing Industrial and Commercial Machinery and Computer Equipment.

A few key patterns emerge from examining the ETR reconciliation tables of the high and low *ETRDisp* observations. All the firms have ETR reconciling items related to foreign income taxed at non-U.S. rates, and that line item happens to be very large in magnitude for two of the low *ETRDisp* observations, Cisco Systems and Brocade Communication Systems. Thus, it appears that a large foreign rate reconciling line item does not necessarily lead to ETR uncertainty. Instead, the lack of year-over-year stability in that line item seems to drive ETR uncertainty for the high *ETRDisp* observations (e.g., see Lam Research and Palo Alto Networks).

However, it is important to note that ETR volatility does not always result in ETR uncertainty. Both Cisco Systems and Brocade Communication Systems have large one-off ETR reconciling items that substantially increase their ETR volatility yet do not appear to result in ETR uncertainty. We suspect this is because some large one-time ETR reconciling items are not something that analysts would attempt to forecast. For example, Cisco Systems had a tax audit settlement in FY2013 while Brocade Communication Systems had a goodwill impairment in FY2014 and recorded a valuation allowance and released reserves for uncertain tax positions in

FY2013. These one-time transactions most certainly increased historical ETR volatility, but we do not expect them to affect analyst ETR forecasts and ETR uncertainty on a go-forward basis.

Ultimately, we would like to compare observed after-tax forecast dispersion to a counterfactual in which there is no ETR uncertainty. To do this, we create a pseudo after-tax dispersion measure where we allow pre-tax income forecasts to vary across analysts but apply a constant ETR. The dispersion of these pseudo after-tax forecasts can then be compared to observed forecast dispersion for a given firm-year. Applying this logic, we calculate the following variables where *i* denotes firm, *t* denotes year, and *j* denotes analyst:

$Pseudo\ AT\ Forecast_{i,t,j} = Pre\text{-}tax\ Earnings\ Forecast_{i,t,j} * (1 - Mean\ ETR\ Forecast_{i,t})$

$PseudoATDisp_{i,t}$: the standard deviation of the pseudo after-tax forecasts scaled by the mean pseudo after-tax forecast

$ETR\Delta ATDisp_{i,t}$: the difference between *ATDisp* and *PseudoATDisp* scaled by *PseudoATDisp*

Because *PseudoATDisp* employs the same pre-tax forecasts as *ATDisp,* we essentially hold pre-tax earnings uncertainty constant. We are also holding the mean ETR forecast constant because *PseudoATDisp* applies the mean ETR forecast to the pre-tax income forecasts in calculating the pseudo after-tax forecasts. Thus, our methodology allows us to examine the net impact of the bolded effects at the bottom of Figure 1, namely ETR uncertainty and the covariance effect. In terms of interpretation, *ETRΔATDisp* can be thought of as the percentage change in after-tax earnings uncertainty that occurs because of variation in ETR forecasts.

When we examine the determinants of ETR uncertainty, we perform the following regression:

$$Uncertainty\ Measure_{i,t} = \alpha + \sum \beta * Determinants_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where we include determinants that are related to the quality of a firm's information environment or to its ETR because these variables could potentially impact tax-related earnings uncertainty. We include the natural log of assets (*Size*) because larger firms are presumed to have better information environments and there are economics of scale to tax planning (Rego 2003). We include the ratio of debt to total assets (*Leverage*) as leverage may impact earnings uncertainty and is likely to be associated with marginal tax rates. Capital expenditures may impact earnings uncertainty and ETRs, so we include property, plant, and equipment scaled by total assets (*PP&E*). Research and development activity likely impacts earnings uncertainty and may be eligible for tax credits, so we include R&D expense scaled by sales (*R&D*). We control for whether a firm has foreign operations (*MNE*) and intangible assets (*Intangible Assets*) because multinational firms may have lower ETRs due to different tax planning opportunities such as income shifting (e.g., Rego 2003; Chen, Chen, Cheng, and Shevlin 2010). We also control for the number of tax haven subsidiaries (*LnHavenSubs*) that are disclosed in Exhibit 21 as tax haven subsidiaries are associated with lower ETRs (Dyreng and Lindsey 2009). As prior research suggests that tax loss carryforwards and particularly valuation allowances complicate the task of forecasting taxes (Amir and Sougiannis 1999; Guenther, Peterson, Searcy, and Williams 2023), we control for tax loss carryforwards (*NOL).* Lastly, we include marginal tax rates (*MTR)* as higher marginal tax rates should compress the distribution of after-tax earnings expectations.

When analyzing the cross-sectional variation in the effect of ETR uncertainty on after-tax earnings uncertainty (i.e., *ETRΔATDisp*), it is helpful to consider both the determinant's impact on ETR uncertainty and the determinant's impact on the covariance of pre-tax forecasts and ETR forecasts. Thus, we estimate equation (3) with each of the following dependent variables: *ETRDisp*, *ETRΔATDisp*, and *ETRCovariance*. We would expect that significant predictors of

ETRs would also increase ETR uncertainty.[6] Predictions for how a determinant affects the covariance of pre-tax income and ETR forecasts are much more difficult to develop *ex ante*. One would have to consider why a determinant drives ETRs and the nature of a firm's rate-reconciling items. Some permanent book-tax differences are favorable (i.e., decrease ETRs) while others are unfavorable (i.e., increase ETRs), and more importantly, they do not all scale proportionally with pre-tax income. If a favorable permanent difference is somewhat fixed and does not scale proportionally with pre-tax income (e.g., R&D tax credit, excess tax benefit on stock compensation), then ETRs will increase as pre-tax income grows, leading to a higher covariance between pre-tax forecasts and ETR forecasts. If an unfavorable permanent difference is somewhat fixed and does not scale proportionally with pre-tax income (e.g., no tax deduction on excessive executive compensation), then ETRs will decrease as pre-tax income grows, leading to a lower covariance between pre-tax forecasts and ETR forecasts. We consider this issue of scalability when we evaluate the results of analyzing the determinants of the ETR-related change in after-tax earnings uncertainty.

Unless otherwise noted, we measure each control variable as of the end of year *t-1*. Appendix A provides detailed definitions for each variable. We cluster standard errors by firm and year (Gow, Ormzabal, and Taylor 2010; Petersen 2009).

IV. Results

Table 1 Panel A presents our sample composition by year. I/B/E/S coverage of pre-tax income forecasts is sparse prior to 2004 so our sample begins with forecasts for fiscal year 2004 and runs through fiscal year 2022. The number of observations per year is relatively lower in the

[6] For example, if research and development expenditures are a determinant of ETRs due to R&D tax credits, it is reasonable to expect that research and develop expenditures would also increase ETR uncertainty.

earlier years of our sample but picks up as I/B/E/S coverage of pre-tax forecasts increases. The number of observations per year is fairly consistent over the latter half of our sample period. Table 1 Panel B presents the descriptive statistics for our sample. When pre-tax and after-tax forecast dispersion are unscaled, one can see that taxes compress the standard deviation of earnings forecasts. The mean standard deviation of after-tax forecasts is approximately 32.5% lower than the mean standard deviation of pre-tax forecasts. However, when the standard deviation of pre-tax and after-tax forecasts are scaled by the mean forecast, pre-tax and after-tax forecast dispersion are extremely similar in magnitude as evidenced by the means of *PTDisp* and *ATDisp*.[7] The standard deviation of both pre-tax and after-tax forecasts average approximately 7.7% of their means. The variation in *PTDisp* and *ATDisp* is also similar in magnitude as can be seen in their inter-quartile ranges and standard deviations.

The similarity in magnitudes for pre-tax earnings uncertainty and after-tax earnings uncertainty is not prima facie evidence that ETR expectations have little to no impact on bottom-line earnings uncertainty. We believe the most interesting descriptive statistics relate to *ETRΔATDisp,* which represents the percentage change in after-tax dispersion that occurs because of variation in analysts' ETR forecasts. The mean and median are slightly negative suggesting that variation in ETR forecasts actually serves to decrease earnings uncertainty in a little over half of our observations. More importantly, there is substantial cross-sectional variation in the extent to which ETR forecast variation impacts earnings uncertainty as evidenced by the standard deviation of *ETRΔATDisp* (41.7%). We will explore the cross-sectional variation in *ETRΔATDisp* in more detail in Figure 2.

[7] A stock with a mean EPS forecast of $1 should have a lower standard deviation of EPS forecasts than a stock with a mean EPS forecast of $10 all else equal. Scaling by the mean forecast also serves to neutralize the mechanical effect of taxes. If a firm's mean pre-tax forecast is $1 and mean after-tax forecast is $0.65, scaling by those means creates a standardized uncertainty measure.

Turning to ETR uncertainty, the mean of *ETRDisp* indicates that the standard deviation of ETR forecasts averages 11% of the mean ETR forecast. Thus, there appears to be substantial ETR uncertainty, yet variation in ETR forecasts does not often result in additional bottom-line earnings uncertainty. The mean value of *ETRCovariance* provides a potential explanation. For the average firm-year, ETR forecasts positively covary with pre-tax income forecasts. Approximately 72% of the sample show a positive covariance as opposed to a negative covariance (untabulated).[8] A positive covariance can dominate any increase in earnings uncertainty that arises from the difficulty of forecasting ETRs. Given we require sufficient analyst coverage to calculate the earnings uncertainty measures, our sample skews towards large, multinational firms. The median observation has over $8 billion in total assets, and over 87% of the firm-years have foreign operations.

Table 1 Panel C compares the descriptive statistics of our sample to the broader Compustat population over the same time period. Given I/B/E/S only covers select firms, many of the differences between our sample and the broader Compustat sample are to be expected. For example, our sample firms are much larger and more profitable. Our sample firms are also more likely to have foreign operations and tax haven subsidiaries. When requiring the Compustat population to have positive pre-tax income and tax expense, our sample begins to look more similar

[8] Edwards, Kubata, and Shevlin (2021) develop a linear tax function where cash taxes paid are regressed on an intercept and pre-tax income, and they show that cash ETRs are a convex function of pre-tax income if the intercept is positive. Using Compustat data, they find large sample evidence that is consistent with this ETR convexity. One might expect more of our firm-years to have a negative covariance based on the findings in Edwards et al. (2021), but we believe there is one important distinction to be made. We examine *ex ante* expectations of non-GAAP ETRs whereas they examine *ex post* realizations of cash ETRs. Cash ETRs are impacted by temporary book-tax differences that can cause high ETRs for firm-years with low pre-tax income (e.g., one of the 29 portfolios they form has a mean ETR above one). Edwards et al. (2021) find that ETR convexity is much less notable when ETRs above one are truncated. We would not expect many analysts to forecast an ETR above one. Thus, we do not expect for the ETR convexity in Edwards et al. (2021) to be as present in our sample.

across some variables such as *PTRoa* and *NOL*, but our sample is still skewed towards very large firms as they have an average market value of equity of $35 billion.

Figure 2 plots the annual median, interquartile range, as well as the tenth and ninetieth percentile for *ETRΔATDisp* over our sample period to give an idea of the time-series and cross-sectional variation in the extent to which variation in ETR expectations impacts after-tax earnings uncertainty. The median of *ETRΔATDisp* is essentially zero across the sample period, yet there is substantial variation in *ETRΔATDisp* as evidenced by the interquartile range. Moving from the 25th to 75th percentiles, *ETRΔATDisp* ranges from -13% to 7%. Stated differently, a quarter of the observations have earnings uncertainty that is at least 13% lower than what it would have been if all analysts used the same ETR while another quarter of the observations have earnings uncertainty that is at least 7% higher than the ETR certainty counterfactual. If one were to look at the 10th (90th) percentile for the full sample, one tenth of the sample has earnings uncertainty that is at least 37% lower (26% higher) than a counterfactual with ETR certainty. As far as time-series variation is concerned, one notable pattern to emerge from Figure 2 is an increase in the absolute magnitude of *ETRΔATDisp* in 2018 after the Tax Cut and Jobs Act. The 10th, 25th, 75th, and 90th percentiles all increase in absolute magnitude in 2018 and then appear to return to more normal levels in the years after. We explore the determinants of *ETRΔATDisp* in Table 2.

Table 2 presents the results of the determinants regressions when ETR uncertainty (*ETRDisp)* and the ETR-induced change in after-tax earnings uncertainty (*ETRΔATDisp*) serve as dependent variables. The results in Column 1 indicate that ETR uncertainty is positively associated with pre-tax uncertainty, and *PTDisp* is the independent variable with the largest effect size. A one standard deviation increase in *PTDisp* is associated with a 0.39 standard deviation increase in *ETRDisp*. Furthermore, pre-tax uncertainty contributes substantially to the explanatory power of

the model as the r-squared would drop from 37.3% to 23.6% if *PTDisp* were removed from the model (untabulated).

Turning to the coefficients on the other independent variables in Column 1, several variables related to permanent book-tax differences, which we would expect to increase the difficulty of forecasting ETRs, are positively associated with *ETRDisp*. Examples include *R&D, LnHavenSubs, Leverage, Stock Comp,* and *NOL.* The variables are linked to permanent book-tax differences as follows: R&D generates tax credits, tax haven subsidiaries facilitate income shifting, leverage may produce non-deductible interest, stock-based compensation can create excess tax benefits, and tax loss carryforwards can result in the recording and release of valuation allowances. Two independent variables, *MTR* and *PP&E,* are negatively associated with ETR uncertainty. A firm with a higher MTR likely engages in less tax planning and thus there may be less variation in ETR forecasts across analysts to the extent that tax planning drives ETR uncertainty. As far as the negative coefficient on *PP&E*, the tax treatment of fixed assets is not particularly complicated (e.g., tax depreciation typically does not create permanent book-tax differences) which may explain why fixed asset intensity is associated with less ETR uncertainty.

A key pattern emerges in the Column 2 results when *ETRΔATDisp* is the dependent variable. Six of the eight variables (*R&D, PP&E, LnHavenSubs, Leverage, Stock Comp,* and *PTDisp*) that were significant determinants of *ETRDisp* are not significant determinants of *ETRΔATDisp.* Only *NOL* and *MTR* are significant with the same sign in both columns. If a variable is positive and significant in Column 1 but insignificant in Column 2, it suggests that the additional ETR uncertainty associated with that variable does not translate into additional bottom-line earnings uncertainty. Consider the case of R&D. A one standard deviation increase in *R&D* is associated with a 0.12 standard deviation increase in *ETRDisp*, but the additional ETR uncertainty

does not significantly change after-tax earnings uncertainty relative to a counterfactual with ETR certainty. The differences across Column 1 and Column 2 highlight a very important feature of tax uncertainty that has been overlooked in prior literature. All tax uncertainty is not the same, and some tax uncertainty may not translate into uncertainty in bottom-line earnings. Most tax researchers would expect that R&D is associated with ETR uncertainty, and they would probably assume the ETR uncertainty manifests in additional bottom-line uncertainty while we find that is not necessarily the case.

In addition, some variables that were not significant predictors of *ETRDisp* are significant predictors of *ETRΔATDisp* (e.g., *Size, Intangible Assets,* and *MNE*). The differences between Column 1 and Column 2 lead to some questions. How can a variable be associated with additional ETR uncertainty, yet the additional ETR uncertainty does not manifest in more after-tax earnings uncertainty? How can a variable not be associated with ETR uncertainty but seemingly impact variation in ETR forecasts enough to reduce after-tax earnings uncertainty? Our earlier decomposition of earnings uncertainty implies the covariance between pre-tax income and ETR forecasts likely plays a role as a positive covariance could offset the effects of ETR uncertainty. We explore the determinants of the covariance between pre-tax income and ETR forecasts in our next analysis.

We next examine the extent to which pre-tax income forecasts covary with implicit ETR forecasts. To provide a basis for understanding how a particular determinant can impact that covariance term, we consider how permanent book-tax differences affect ETRs. Favorable permanent differences decrease ETRs while unfavorable permanent differences increase ETRs for profitable firms. The covariance between pre-tax income and ETRs will depend on the extent to which permanent differences scale with pre-tax income. If a favorable (unfavorable) permanent

difference does not scale with pre-tax income, it will increase (decrease) the covariance between pre-tax income forecasts and ETR forecasts.

We find in Table 3 that six of the eleven independent variables are significantly associated with *ETRCovariance*. The three variables with largest effect sizes are *Size*, *PTDisp*, and *Stock Comp,* and their positive associations with *ETRCovariance* help explain the conflicting results across the *ETRDisp* and *ETRΔATDisp* regression results in Table 2. Those three variables load significantly in one column but not both, and their positive association with *ETRCovariance* helps explain why. In the case of *PTDisp* and *Stock Comp,* both variables are positively associated with *ETRDisp* but are not associated with *ETRΔATDisp*, suggesting the covariance effect related to those determinants "offsets" the ETR uncertainty effect. In the case of *Size,* it is not associated with *ETRDisp* but is negatively associated with *ETRΔATDisp*, suggesting that the covariance effects "mutes" pre-tax uncertainty relative to a counter-factual where every analyst applies the same ETR to their pre-tax income forecast. We next offer potential explanations for why some determinants are significantly associated with *ETRCovariance.*

The coefficient on *Stock Comp* is positive and significant, which we suspect is due to the excess tax benefit on stock-based compensation. The actual tax benefit on stock-based compensation often vastly exceeds the original tax benefit recorded on the GAAP-based stock compensation expense. The excess tax benefit results in a favorable permanent book-tax difference which is unlikely to scale with pre-tax income.[9] The coefficient on *MTR* is positive and significant

[9] The amount of shares exercised in any given period, which will determine the excess tax benefit, is completely out of the hands of management and arguably unrelated to current period pre-tax income. Most employees exercise their options immediately upon vesting to diversify their risk. As pre-tax income grows, the excess tax benefit on stock-based compensation is unlikely to grow proportionally. We do note that the excess tax benefit on stock-based compensation was not recorded in income during the earlier portion of our sample. Prior to ASU 2016-19, the excess tax benefit was recorded to additional paid in capital as opposed to directly to the income statement.

which makes sense as the covariance between pre-tax income and ETR forecasts should be stronger if marginal dollars are expected to be taxed at a higher rate. Firm size might be related to the covariance term due to larger firms being less able to avoid taxes on their marginal dollars of income. The negative coefficient on *NOL* suggests that analysts do not expect firms with tax loss carryforwards to have ETRs that increase at the same rate (i.e., a weaker covariance) with profitability as firms without tax loss carryforwards.[10]

The coefficient on *PTDisp* indicates that pre-tax uncertainty is positively associated with the covariance of pre-tax income forecasts and ETR forecasts. Perhaps analysts are more likely to use an implicit ETR forecast that brings their after-tax forecast closer to the consensus when faced with lots of pre-tax or operational uncertainty. We leave it to future research to examine whether strategic behavior on the part of analysts plays a role in why pre-tax uncertainty is associated with a stronger covariance between pre-tax income forecasts and ETR forecasts.

As discussed in Section 2, Guenther et al. (2017) and Balakrishnan et al. (2019) examine whether tax uncertainty increases investors' overall uncertainty about a firm. We surmise that ETR uncertainty has less of an effect on investors' perceptions of overall firm uncertainty when there is a greater covariance between expectations of a firm's pretax income and its ETR. Our next tests address this question and examine the effect of after-tax uncertainty, pre-tax uncertainty, ETR uncertainty, and the covariance of pre-tax income and ETR forecasts on bid-ask spreads.

Prior research has shown a positive association between earnings uncertainty and bid-ask spreads (e.g., Affleck-Graves, Callahan, and Chilpalkatti 2002), and we expect our earnings

[10] This finding makes sense to the extent a tax benefit has not yet been realized for any of the tax loss carryforwards (i.e., a partial or full valuation allowance was recorded). Note that the Compustat data item tlcf reflects the gross amount of tax loss carryforwards disclosed in the tax footnote, which is before any valuation allowance.

uncertainty measures to load positively and significantly in a regression of bid-ask spreads. However, it is less clear whether a pre-tax or after-tax earnings uncertainty measure would better explain variation in bid-ask spreads. It is also unclear as to whether ETR uncertainty is positively associated with bid-ask spreads and whether it has incremental explanatory power beyond pre-tax earnings uncertainty. We explore these questions in Table 4 Panel A where we regress bid-ask spreads on the various uncertainty measures. Columns (1)-(5) report the results without the inclusion of additional control variables and columns (6)-(10) with the inclusion of *LnMVE*, *Size*, and *Following*. *Size* is calculated as previously described. *LnMVE* is the natural log of market value of equity while *Following* is the number of analysts following the firm who provided forecasts included in our dispersion measures for that particular year.

As expected, both pre-tax and after-tax earnings uncertainty are positively associated with bid-ask spreads as evidenced by the coefficients on *PTDisp* and *ATDisp.* However, more interesting is the fact that pre-tax earnings uncertainty explains more variation in bid-ask spreads than after-tax earnings uncertainty. The explanatory power of the model is 12% higher in Column 2 than in Column 1, and a one-standard-deviation-change in *PTDisp* has a 6% larger effect on bid-ask spreads than a one-standard-deviation-change in *ATDisp* (untabulated).[11] These results suggest that after-tax dispersion measures may obscure variation in uncertainty relative to pre-tax dispersion measures. In Column 3, *ETRDisp* loads positively and significantly suggesting ETR uncertainty is associated with bid-asks spreads. This finding could be due to the strong underlying correlation between ETR uncertainty and pre-tax uncertainty, which we address below. *ETRCovariance* is insignificant when included by itself in Column 4.

[11] Inferences are similar in Columns 6 and 7 when additional controls are included. The incremental explanatory power of the model with pre-tax uncertainty is slightly more modest with the inclusion of additional controls, only 4% higher, but the coefficient sizes in Columns 6 and 7 suggest a one-standard-deviation-change in *PTDisp* has a 14% larger effect on bid-ask spreads than a one-standard-deviation-change in *ATDisp* (untabulated).

When *PTDisp*, *ETRDisp*, and *ETRCovariance* are included together in Column 5, they each load in the direction we would expect. *PTDisp* and *ETRDisp* are positively associated with bid-ask spreads, suggesting the association between ETR uncertainty and bid-ask spreads holds after controlling for pre-tax uncertainty. *ETRCovariance* reduces after-tax earnings uncertainty and is negatively associated with bid-ask spreads. The model in Column 5 with *PTDisp, ETRDisp,* and *ETRCovariance* also has 30% more explanatory power than the model in Column 1 with only *ATDisp.* A model with only after-tax earnings uncertainty performs much worse in explaining bid-asks spreads than a model with pre-tax earnings uncertainty, ETR uncertainty, and the extent to which the forecasts covary.

The findings in Table 4 Panel A suggest that the effects of pre-tax earnings uncertainty and ETR uncertainty on bid-asks spreads are additive. Both pre-tax uncertainty and ETR uncertainty are associated with higher bid-asks spreads controlling for the other. However, the extent to which pre-tax income expectations and ETR forecasts covary can offset the positive effects that ETR uncertainty has on bid-ask spreads. If the covariance between pre-tax income and ETR forecasts is strong enough, ETR uncertainty may not be significantly associated with bid-ask spreads. We explore this notion in a subsample analysis presented in Table 4 Panel B.

First, we separate firm-years into two groups based on the correlation between the pre-tax income and ETR forecasts for that firm-year. Those observations with a positive and significant correlation are placed into one group, and all others are placed into the second group. We expect that the positive association between ETR uncertainty and bid-ask spreads will be muted or not exist at all in the firm-years with a positive and significant correlation between pre-tax income and ETR forecasts. The results reported in Column 1 repeat one of the key findings from Panel A, mainly that both *PTDisp* and *ETRDisp* are positively associated with bid-ask spreads in the full

sample. However, when focusing on the subsample of firms with (without) a positive and significant correlation between pre-tax income and ETR forecasts in Column 2 (3), *ETRDisp* is not significant (significant). This finding suggests that ETR uncertainty is not associated with bid-ask spreads for a substantial portion of our sample firms, and the covariance between pre-tax income expectations and ETR forecasts impacts the relationship between ETR uncertainty and bid-ask spreads.

We repeat this analysis with return volatility as the outcome variable of interest. More specifically, we measure the standard deviation of raw returns (*RetVol)* over the twelve months following the measurement of our dispersion measures with the expectation that earnings uncertainty should be positively associated with future return volatility. Table 4 Panels C and D present the results of these analyses. The key result in Panel C is that the coefficient on *ETRDisp* is positive and significant while the coefficient on *ETRCovariance* is negative and significant suggesting that ETR uncertainty is associated with future return volatility but a positive covariance between pre-tax income and ETR expectations can offset that association. We do note the incremental explanatory power of these two variables, *ETRDisp* and *ETRCovariance,* is much more modest in Panel C than in Panel A.

Turning to the subsample analysis in Panel D, we find that *PTDisp* is positively and significantly related to *RetVol* at the 1% level while *ETRDisp* is positively and significantly related to *RetVol* at the 10% level in Column 1. The association between *ETRDisp* and *RetVol* appears to be only marginally significant in Column 1 because some firm-years have a positive covariance between pre-tax income and ETR expectations while others have a negative covariance. When focusing on the subsample of firms without a positive and significant correlation between pre-tax income and ETR forecasts in Column 3, *ETRDisp* is significant suggesting that ETR uncertainty

is associated with return volatility for about two-thirds of our sample firms. However, that is not the case for the other one-third of our sample with a positive and significant correlation between pre-tax income and ETR forecasts in Column 2.

Taking a step back, the findings in Table 4 highlight that focusing only on ETR uncertainty does not paint a full picture. Instead, it is important to also consider that expectations about ETRs may covary with expectations about pre-tax income. For a given outcome variable, such as bid-ask spreads or return volatility, ETR uncertainty may or may not have a significant effect depending on that covariance structure.

V. Additional Analyses

Prior studies measure ETR uncertainty with the standard deviation of actual realized ETRs. Next, we compute the correlation between our measure and the standard deviation of realized ETRs. Table 5 Panel A presents the correlations of *ETRDisp*, non-GAAP ETR volatility, GAAP ETR volatility, and cash ETR volatility. We measure non-GAAP ETR volatility as the standard deviation of a firm's non-GAAP ETR over the prior five years where non-GAAP ETRs are measured using I/B/E/S actuals. To be consistent with how prior studies construct ETR volatility measures (e.g., Guenther, Matsunaga, Williams 2019), we restrict this analysis to observations where the firm was profitable and reported positive tax expense and cash taxes paid in each of the prior five years; thus, the number of observations is reduced for this analysis. A key takeaway emerges. Although *ETRDisp* is significantly correlated with all three ETR volatility measures at the 1% level, the correlations are not particularly strong suggesting they capture distinct constructs. The Pearson (Spearman) correlation coefficient between *ETRDisp* and *NonGAAPETRVol* is 0.226 (0.317) while it is 0.203 (0.332) between *ETRDisp* and *GAAPETRVol*. The Pearson (Spearman) correlation coefficient is only 0.060 (0.110) for *CashETRVol,* suggesting that historical cash ETR

volatility is not the best measure to use if researchers want to capture forward looking tax-related uncertainty.

We also re-estimate Equation 3 adding the ETR volatility measures as additional independent variables to explain variation in *ETRDisp*. Table 5 Panel B presents the results of this analysis. Neither non-GAAP nor GAAP ETR volatility load significantly, and the inferences regarding the other determinants remain qualitatively similar. The coefficient on *CashETRVol* is negative and significant at the 10% level, which is contrary to what one would expect. This analysis highlights the notion that historical ETR volatility is not the best proxy for ETR predictability and further reinforces the notion that past earnings volatility captures two different constructs: time-series volatility and earnings predictability (Donelson and Resutek 2015). When available, we believe using analyst forecasts is the more appropriate means to identify ETR-related earnings uncertainty than using historical ETR volatility.

Throughout the paper, we have focused on dispersion measures where the standard deviations of forecasts are scaled by their means, and as a result, the pre-tax and after-tax dispersion measures are very similar in magnitude as described when discussing the descriptive statistics. However, we did briefly discuss that the raw standard deviation of after-tax forecasts is around 30% lower than the raw standard deviation of pre-tax forecasts. This reduction in the raw standard deviations is almost mechanical in the sense that taxes reduce earnings and should compress the distribution of after-tax forecasts. However, it is not always the case that the standard deviations are lower for after-tax forecasts than they are for pre-tax forecasts. Approximately 7% of the sample firm-years have net income forecasts with a greater standard deviation than the matched pre-tax income forecasts (*Higher*=1). We next explore what is different about these firm-years.

Table 6 presents the descriptive statistics for the two groups along with a test of whether the difference in means across the two groups is statistically significant. We first focus on the tax-related variables. Firm-years with *Higher*=1 have significantly lower expected ETRs and lower marginal tax rates suggesting they may engage in more aggressive tax avoidance. These observations have much greater ETR uncertainty as the standard deviation of ETR forecasts averages 29.0% of their mean compared to 9.5% for the other group. Also noteworthy, observations with *Higher*=1 have a mean *negative* covariance between pre-tax income forecasts and ETR forecasts. The significantly greater dispersion of ETR forecasts coupled with the negative covariance between pre-tax income and ETR forecasts explains why unscaled after-tax forecast dispersion is greater than unscaled pre-tax forecast dispersion for these observations. Turning to firm characteristics, firm-years with *Higher*=1 have significantly less fixed asset intensity, are more R&D intensive, and have substantially more tax loss carryforwards. Firm-years with *Higher*=1 are also less profitable and more highly levered although the differences are marginally significant.

VI. Conclusion

Our paper connects the literatures on earnings uncertainty and tax uncertainty by providing evidence on how expected tax expense shapes the distribution of earnings expectations. We develop a method that uses analysts' forecasts of pre-tax and net income to separately measure: (i) pre-tax uncertainty, (ii) ETR uncertainty, and (iii) the extent to which ETR forecasts covary with pre-tax income forecasts and thus compress the distribution of earnings expectations.

We make a number of contributions. First, we show that ETR uncertainty does not have a unidirectional effect on after-tax earnings uncertainty. Interestingly, ETR uncertainty serves to decrease earnings uncertainty in a little over half of our observations, and we show that the

covariance between pre-tax income and ETR forecasts plays a major role in why ETR uncertainty decreases earnings uncertainty for those firm-years. Second, we find that certain firm characteristics increase ETR uncertainty, but the additional ETR uncertainty does not always translate into additional after-tax earnings uncertainty. We also find that a firm characteristic can have no significant relationship with ETR uncertainty yet still have a significant effect on the extent to which variation in ETR forecasts changes after-tax earnings uncertainty. These findings highlight the importance of not examining ETR uncertainty in isolation; instead, any examination of ETR uncertainty should consider the covariance structure between pre-tax income and ETRs. If investors care more about the uncertainty related to a firm's operations, our results suggest that when a firm's pre-tax income is positively correlated with its ETR, investors should focus on analysts' forecasts of pre-tax earnings as opposed to after-tax earnings because analysts' ETR uncertainty could mask the uncertainty related to pre-tax earnings in these cases.

Third, we provide evidence that an after-tax earnings uncertainty measure may obscure some of the information in the separate components of pre-tax uncertainty and ETR uncertainty. For example, pre-tax forecast dispersion explains substantially more variation in bid-ask spreads than after-tax forecast dispersion. This finding suggests that researchers may want to decompose earnings uncertainty into its pre-tax and tax components depending on the research question and the outcome variable of interest. Fourth, we find that ETR uncertainty does not have a substantial association with bid-ask spreads or return volatility for a subsample of firm-years that show a positive correlation between pre-tax expectations and ETR forecasts. This important finding suggests that ETR uncertainty is not nearly as relevant or important if a positive covariance structure exists between pre-tax income and ETRs.

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Appendix A: Variable Definitions

Uncertainty Measures	
PTDisp	Standard deviation of analysts' pre-tax income forecasts scaled by the mean pre-tax income forecast
ATDisp	Standard deviation of analysts' net income forecasts scaled by the mean net income forecast
ETRDisp	Standard deviation of analysts' ETR forecasts scaled by the mean ETR forecast
ETRCovariance	The covariance of analysts' pre-tax income forecasts and their ETR forecasts scaled by shares outstanding
ETRΔATDisp	The difference between *ATDisp* and a counterfactual dispersion measure calculated as if there were no ETR uncertainty. The difference is then scaled by the counterfactual dispersion measure such that this variable represents the percentage change in dispersion that results from variation in ETR forecasts. The counterfactual dispersion measure is calculated by taking the standard deviation of pseudo forecasts assuming all analysts applied the mean ETR for that firm-year to their pre-tax income forecasts.
NonGAAPETRVol	The standard deviation of a firm's non-GAAP ETR over the prior five years where non-GAAP ETRs are measured using I/B/E/S actuals
GAAPETRVol	The standard deviation of a firm's GAAP ETR over the prior five years
CashETRVol	The standard deviation of a firm's cash ETR over the prior five years
Higher	Indicator variable equal to one if the unscaled standard deviation of net income forecasts is greater than the unscaled standard deviation of pre-tax income forecasts; otherwise, zero
Determinants / Controls	
Size	Natural log of total assets
Leverage	Total debt scaled by total assets
PP&E	Total property, plant, and equipment scaled by total assets
Intangible Assets	Intangible assets scaled by total assets
R&D	R&D expense scaled by total revenue; missing values of R&D are set to zero
Stock Comp	Stock compensation expense accumulated over the prior five years scaled by total assets; missing values in a given year are set to zero
MNE	Indicator variable equal to one if either pre-tax foreign income or foreign tax expense is non-zero
LnHavenSubs	Natural log of one plus the number of tax haven subsidiaries as disclosed in Exhibit 21. The country-level data on subsidiaries was first described and used in Dyreng and Lyndsey (2009).
NOL	Tax loss carryforward scaled by total assets; missing values are set to zero
MTR	When available, *MTR* is set equal to the marginal tax rate data provided by WRDS. This marginal tax rate data is estimated using non-parametric techniques as developed in Blouin, Core, and Guay (2010). In the post-TCJA years when that data is not available, *MTR* is set equal to the corporate statutory rate of 21%.
MVE	The market value of equity is calculated by multiplying common shares outstanding by price. When comparing our sample to the broad Compustat population, market value of equity is measured using Compustat data. When

	performing the bid-ask spread analysis, market value of equity is measured contemporaneously with bid-ask spreads using CRSP data.
Following	The number of analysts following the firm that provided a forecast used in calculating our dispersion measures
Consequences	
Spreads	The difference between the bid and ask prices scaled by the midpoint and then multiplied by 100 for ease of interpretation. Bid and ask prices are measured at the end of the month during which most of the analysts' forecasts were made for the measurement of the dispersion measures.
RetVol	The standard deviation of returns measured over the 12 months following the measurement of the forecast dispersion variables.
*All continuous variables are winsorized at the 1st and 99th percentile. **When necessary, shares outstanding is obtained from the CRSP monthly database as of the month when most of our sample forecasts are made for each firm-year observation (i.e., January or February for most calendar year-end firms).	

Appendix B
High and Low ETR Uncertainty Examples with ETR Reconciliation Tables

SIC 2-digit industry: 35
SIC industry description: Industrial and Commercial Machinery and Computer Equipment
Forecast Period Year: 2016
Financial Statement Data Year: 2015

IBES Ticker	Company Name	Forecast Period	Compustat Datadate	Analyst Following	Mean ETR Forecast	σ(ETR Forecasts)	*ETRDisp*
OTRK	OSHKOSH CORP	30-Sep-16	30-Sep-15	12	0.335	0.007	0.022
CSCO	CISCO SYSTEMS INC	31-Jul-16	31-Jul-15	19	0.227	0.006	0.024
BRCD	BROCADE COMMUNICATIONS SYS	31-Oct-16	31-Oct-15	17	0.232	0.010	0.042
SWK	STANLEY BLACK & DECKER INC	31-Dec-16	31-Dec-15	12	0.219	0.015	0.069
CUM	CUMMINS INC	31-Dec-16	31-Dec-15	14	0.327	0.025	0.075
MANT	MANITOWOC CO	31-Dec-16	31-Dec-15	10	0.285	0.023	0.081
NTAP	NETAPP INC	30-Apr-16	30-Apr-15	26	0.162	0.017	0.104
FNSR	FINISAR CORP	30-Apr-16	30-Apr-15	10	0.065	0.009	0.135
JOYG	JOY GLOBAL INC	31-Oct-16	31-Oct-15	13	0.353	0.051	0.144
JNPR	JUNIPER NETWORKS INC	31-Dec-16	31-Dec-15	20	0.252	0.036	0.144
AMAT	APPLIED MATERIALS INC	31-Oct-16	31-Oct-15	14	0.175	0.034	0.192
PLLO	PALO ALTO NETWORKS INC	31-Jul-16	31-Jul-15	22	0.371	0.073	0.196
LRCX	LAM RESEARCH CORP	30-Jun-16	30-Jun-15	13	0.144	0.042	0.292
WDC	WESTERN DIGITAL CORP	30-Jun-16	30-Jun-15	18	0.073	0.022	0.294
CAT	CATERPILLAR INC	31-Dec-16	31-Dec-15	12	0.230	0.084	0.367

ETR Reconciliation Tables for the High *ETRDisp* Observations

- From Caterpillar's 10-K for the fiscal year ended December 31, 2015

Reconciliation of the U.S. federal statutory rate to effective rate:

	Years ended December 31,					
(Millions of dollars)	**2015**		2014		2013	
Taxes at U.S. statutory rate	**$ 999**	**35.0 %**	$ 1,779	35.0 %	$ 1,795	35.0 %
(Decreases) increases resulting from:						
Non-U.S. subsidiaries taxed at other than 35%	**(198)**	**(6.9)%**	(249)	(4.9)%	(268)	(5.2)%
State and local taxes, net of federal	**16**	**0.5 %**	17	0.3 %	23	0.4 %
Interest and penalties, net of tax	**12**	**0.4 %**	12	0.2 %	4	0.1 %
U.S. research and production incentives	**(95)**	**(3.3)%**	(125)	(2.4)%	(91)	(1.8)%
Other—net	**(34)**	**(1.2)%**	(10)	(0.2)%	(2)	— %
	700	**24.5 %**	1,424	28.0 %	1,461	28.5 %
Prior year tax and interest adjustments	**42**	**1.5 %**	(21)	(0.4)%	(55)	(1.1)%
Release of valuation allowances	**—**	**— %**	(23)	(0.5)%	—	— %
Tax law changes	**—**	**— %**	—	— %	(87)	(1.7)%
Provision (benefit) for income taxes	**$ 742**	**26.0 %**	$ 1,380	27.1 %	$ 1,319	25.7 %

- From Lam Research's 10-K for the fiscal year ended June 28, 2015

	June 28, 2015	June 29, 2014	June 30, 2013
		(in thousands)	
Income tax expense computed at federal statutory rate	$ 259,297	$ 253,177	$ 23,332
State income taxes, net of federal tax benefit	(8,611)	1,884	(13,588)
Foreign income taxed at different rates	(175,581)	(164,130)	(40,255)
Tax credits	(24,416)	(15,650)	(42,593)
State valuation allowance, net of federal tax benefit	8,594	(1,707)	11,538
Equity-based compensation	28,845	23,167	20,318
Other permanent differences and miscellaneous items	(2,855)	(5,667)	(5,973)
	$ 85,273	$ 91,074	$(47,221)

- From Palo Alto Network's 10-K for the fiscal year ended July 31, 2015

	Year Ended July 31,		
	2015	2014	2013
Federal statutory rate	35.0 %	35.0 %	35.0 %
Effect of:			
State taxes, net of federal tax benefit	3.6	1.3	1.0
Foreign income at other than U.S. rates	(6.5)	(12.1)	(62.4)
Change in valuation allowance	(28.5)	(21.3)	(32.5)
Share-based compensation	(10.2)	(3.2)	(16.1)
Meals and entertainment	(0.6)	(0.3)	(2.0)
Amortization of deferred tax charges	(2.2)	—	—
Research credits	6.7	1.3	25.2
Other, net	(3.3)	(2.6)	(5.0)
Total	(6.0)%	(1.9)%	(56.8)%

ETR Reconciliation Tables for the Low *ETRDisp* Observations

- From OshKosh's 10-K for the fiscal year ended September 30, 2015

	Fiscal Year Ended September 30,		
	2015	2014	2013
Effective Rate Reconciliation			
U.S. federal tax rate	35.0 %	35.0 %	35.0 %
State income taxes, net	2.5	2.1	0.8
Foreign taxes	(2.4)	(1.4)	(0.3)
Tax audit settlements	(2.6)	(2.3)	0.3
European tax incentive	—	—	(0.6)
Valuation allowance	0.4	(2.4)	(0.7)
Domestic tax credits	(1.3)	(0.4)	(1.3)
Manufacturing deduction	(2.8)	(2.2)	(3.8)
Other, net	1.6	0.6	0.2
	30.4 %	29.0 %	29.6 %

- From Cisco Systems' 10-K for the fiscal year ended July 25, 2015

Years Ended	July 25, 2015	July 26, 2014	July 27, 2013
Federal statutory rate	**35.0%**	35.0%	35.0%
Effect of:			
State taxes, net of federal tax benefit	**0.8**	0.5	0.8
Foreign income at other than U.S. rates	**(15.2)**	(16.4)	(16.4)
Tax credits	**(1.2)**	(0.7)	(1.6)
Domestic manufacturing deduction	**(0.7)**	(0.9)	(1.0)
Nondeductible compensation	**2.0**	3.3	1.3
Tax audit settlement	**—**	—	(7.1)
Other, net	**(0.9)**	(1.6)	0.1
Total	**19.8%**	19.2%	11.1%

- From Brocade Communication Systems' 10-K for the fiscal year ended October 31, 2015

	Fiscal Year Ended		
	October 31, 2015	November 1, 2014	October 26, 2013
U.S. federal statutory tax rate	35.0%	35.0%	35.0%
State taxes, net of federal tax benefit	0.2	3.1	4.1
Foreign income taxed at other than U.S. rates	(14.5)	(16.9)	(17.6)
Stock-based compensation expense	1.9	2.3	1.9
Research and development credit	(0.9)	(3.1)	(5.6)
Permanent items	0.3	0.3	0.3
Change in liabilities for uncertain tax positions	0.5	0.5	(5.1)
Goodwill impairment charge	—	8.3	—
Audit settlement and reinstated tax credit	—	0.1	1.3
Change in valuation allowance	1.3	1.6	23.7
Other	(1.3)	1.5	(1.1)
Effective tax rate	22.5%	32.7%	36.9%

Figure 1
Decomposition of Earnings Uncertainty Components and Predictions

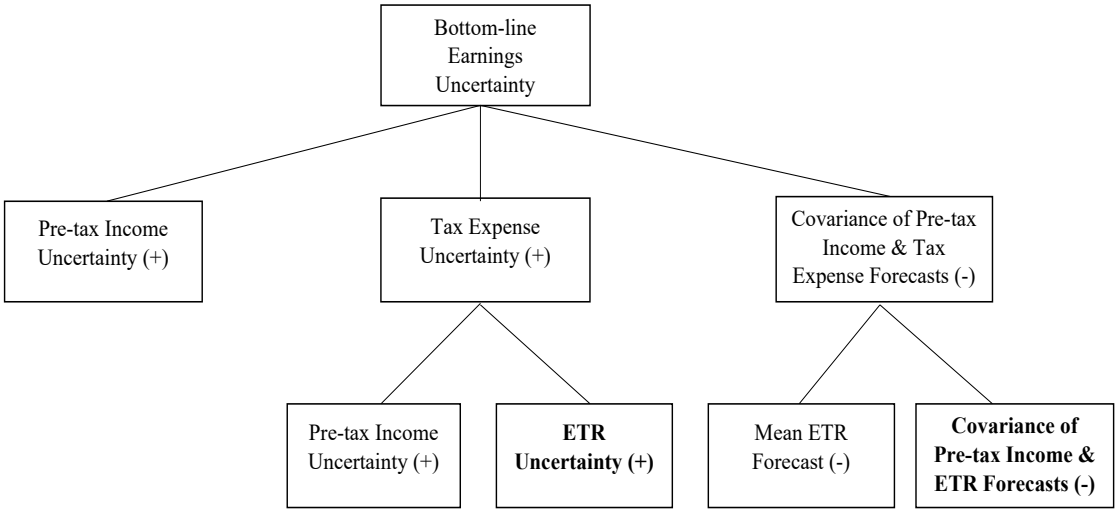

Figure 1 shows the decomposition of bottom-line earnings uncertainty into the three components we focus on: (i) pre-tax income uncertainty, (ii) ETR uncertainty, and (iii) the covariance between pre-tax income forecasts and ETR forecasts. Pre-tax income uncertainty and ETR uncertainty are expected to increase bottom-line earnings uncertainty. The covariance term, on the other hand, is expected to decrease bottom-line earnings uncertainty as more favorable pre-tax income forecasts will be "offset" by higher ETR forecasts. In other words, a strong, positive covariance between pre-tax income forecasts and ETR forecasts can reduce the amount of pre-tax earnings uncertainty that manifests in bottom-line earnings uncertainty. The directional prediction in parentheses is each component's predictive effect on bottom-line earnings uncertainty.

Figure 2

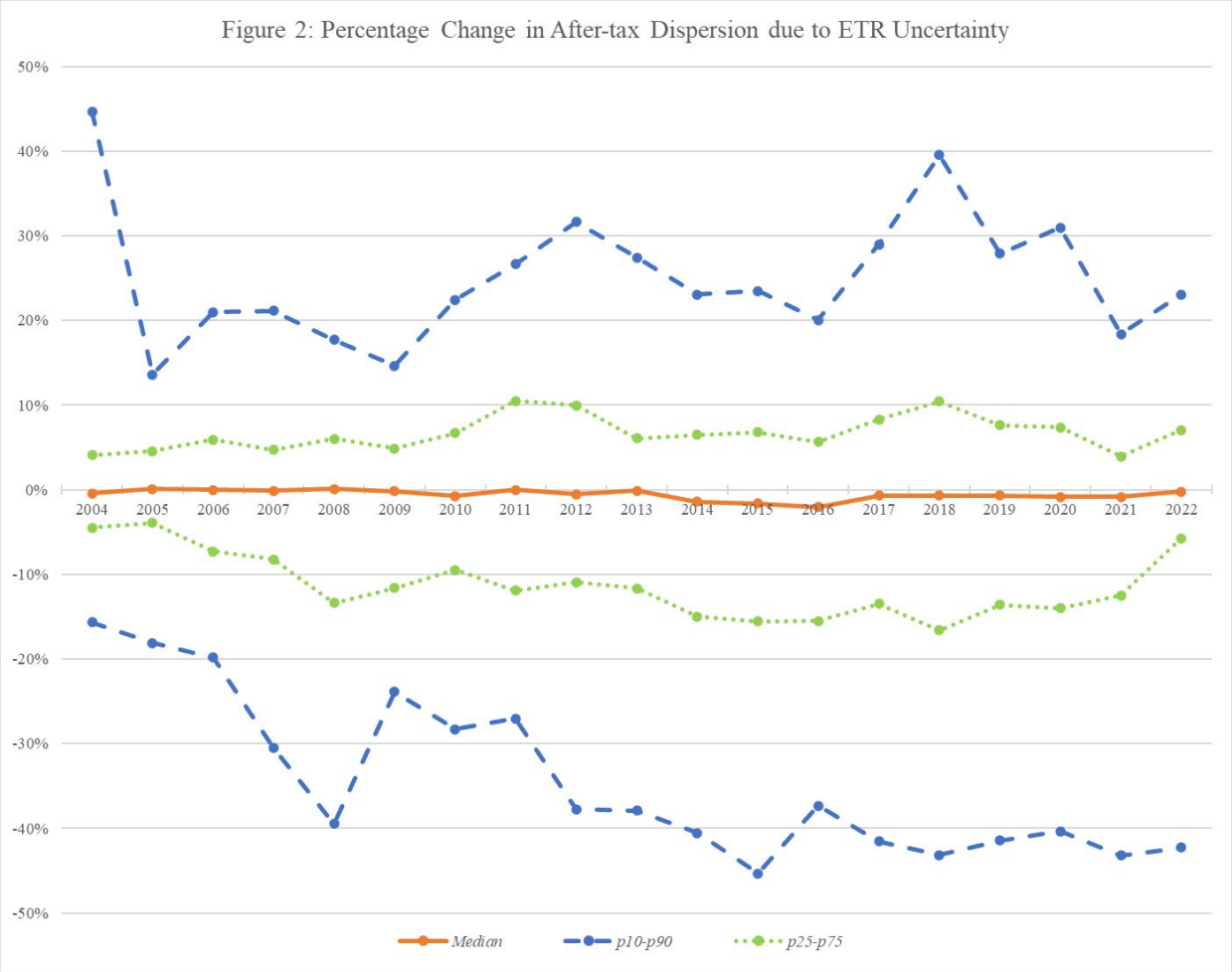

Figure 2 plots the descriptive statistics for *ETRΔATDisp* by year over the sample period. *ETRΔATDisp* represents the percentage change in after-tax earnings uncertainty that is induced by variation in beliefs about ETRs across analysts. To calculate *ETRΔATDisp*, observed after-tax forecast dispersion is compared to a counterfactual dispersion measure calculated as if all analysts applied the same ETR to their pre-tax income forecasts. Please see Appendix A for more detailed variable definitions.

Table 1: Sample Composition and Descriptive Statistics

Panel A: Sample Composition by Year

Fiscal Year	N	%	Fiscal Year	N	%
FY2004	30	0.9%	FY2014	257	7.4%
FY2005	64	1.8%	FY2015	282	8.1%
FY2006	91	2.6%	FY2016	253	7.3%
FY2007	124	3.6%	FY2017	234	6.8%
FY2008	117	3.4%	FY2018	235	6.8%
FY2009	111	3.2%	FY2019	261	7.5%
FY2010	167	4.8%	FY2020	187	5.4%
FY2011	255	7.4%	FY2021	213	6.1%
FY2012	309	8.9%	FY2022	39	1.1%
FY2013	235	6.8%			
			Totals	**3,464**	**100%**

Panel B: Descriptive Statistics

Dispersion/Uncertainty Measures	N	Mean	Std Dev	25%	Median	75%
PTDisp (unscaled)	3,464	0.326	0.493	0.096	0.179	0.347
ATDisp (unscaled)	3,464	0.220	0.336	0.061	0.118	0.237
PTDisp	3,464	0.077	0.092	0.023	0.045	0.090
ATDisp	3,464	0.077	0.103	0.020	0.041	0.086
ETRΔATDisp	3,464	-0.3%	41.7%	-12.8%	-0.6%	7.0%
ETRDisp	3,464	0.110	0.152	0.016	0.047	0.144
ETRCovariance	3,464	0.004	0.017	0.000	0.000	0.002
Determinants/Controls						
PTRoa	3,464	0.116	0.107	0.051	0.103	0.169
Size (in millions)	3,464	44,738	193,265	3,047	8,117	24,836
MVE (in millions)	3,464	35,022	70,231	4,607	12,412	33,968
Leverage	3,464	0.247	0.210	0.086	0.220	0.361
PP&E	3,464	0.228	0.214	0.071	0.148	0.336
Intangible Assets	3,464	0.230	0.205	0.046	0.182	0.376
R&D	3,464	0.064	0.093	0.000	0.012	0.121
Stock Comp	3,464	0.052	0.068	0.015	0.030	0.063
MNE	3,464	0.875	0.330	1.000	1.000	1.000
Haven Subsidiaries	3,464	10.559	19.147	1.000	4.000	12.000
NOL	3,464	0.073	0.204	0.000	0.008	0.046
MTR	3,464	0.293	0.071	0.210	0.335	0.347

Panel A presents our sample composition by year. For a firm-year to be included in our sample, it must have 10 analyst ETR forecasts in I/B/E/S, and we exclude forecasts of pre-tax losses and tax benefits. Futhermore, we require Compustat and tax haven data to include a firm-year in our final sample.

Panel B presents the descriptive statistics of our sample. *PTDisp (ATDisp)* is calculated as the standard deviation of analysts' pre-tax (net) income forecasts scaled by the mean forecast. *ETRΔATDisp* is the difference between observed after-tax forecast dispersion and a pseudo dispersion measure where all analysts apply the same ETR to their pre-tax income forecasts. That difference is then scaled by the pseudo dispersion measure such that it represents the percentage change in after-tax forecast dispersion that results from variation in ETR forecasts. *ETRDisp* is the standard deviation of analysts' ETR forecasts scaled by the mean forecast. *ETRCovariance* is the covariance between analysts' pre-tax income and ETR forecasts scaled by shares outstanding. *PTRoa* is pre-tax return on assets measured in the fiscal year prior to the forecast period. *Size* is total assets. *Leverage* is total debt scaled by total assets. *PP&E* is property, plant, and equipment scaled by total assets. *Intangible Assets* is intangible assets scaled by total assets. *R&D* is research and development expense scaled by total revenue. *Stock Comp* is the sum of stock compensation expense over the prior five years scaled by total assets. *MNE* is an indicator variable equal to one if either pre-tax foreign income or foreign tax expense is non-zero. *Haven Subisidaries* is the raw number of tax haven subsidiaries disclosed in Exhibit 21. *NOL* is the amount of any tax loss carry forward scaled by total assets. *MTR* is a firm's marginal tax rate. Please see Appendix A for more detailed variable definitions.

Table 1: Sample Composition and Descriptive Statistics (cont.)

Panel C: Our Sample Compared to Broader Compustat Population

	Our Sample			Compustat with Share Price > $1			Addl. Restriction of Positive PI, TXT, and NI		
	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.
PTRoa	3,464	0.116	0.103	81,675	-0.026	0.023	48,920	0.097	0.066
Size (in millions)	3,464	44,738	8,117	81,675	5,917	760	48,920	8,619	1,240
MVE (in millions)	3,464	35,022	12,412	81,585	4,286	510	48,867	6,485	882
Leverage	3,464	0.247	0.220	81,675	0.254	0.173	48,920	0.213	0.159
PP&E	3,464	0.228	0.148	81,675	0.194	0.092	48,920	0.196	0.100
Intangible Assets	3,464	0.230	0.182	81,675	0.146	0.043	48,920	0.152	0.051
R&D	3,464	0.064	0.012	81,675	0.445	0.000	48,920	0.021	0.000
Stock Comp	3,464	0.052	0.030	81,675	0.053	0.015	48,920	0.024	0.010
MNE	3,464	0.875	1.000	81,675	0.440	0.000	48,920	0.463	0.000
Haven Subsidiaries	3,464	10.559	4.000	37,221	4.950	1.000	24,137	5.824	1.500
NOL	3,464	0.073	0.008	81,675	0.438	0.000	48,920	0.061	0.000
MTR	3,464	0.293	0.335	61,283	0.234	0.210	36,577	0.273	0.300

Panel C compares the descriptives statistics of our sample to the broaded Compustat population. We display the descriptive statistics for the Compustat firms with a share price greater than $1 over the sample period 2004-2021. We further constrain the Compustat sample to firm-years with positve pre-tax income, tax expense, and net income (i.e., pre-tax profits and an ETR between 0 and 1). Please see Appendix A for more detailed variable definitions.

Table 2: Determinants of ETR Uncertainty and its Impact on Forecast Dispersion

Dependent Variable:	*ETRDisp*	*ETRΔATDisp*	Effect Sizes for:	
	(1)	(2)	Col. 1	Col. 2
Variable	Coeff. (Std Err)	Coeff. (Std Err)	Std. Dev. Change in *ETRDisp*	*ETRΔATDisp* as a Percent
Size	0.003	-0.017***		-2.7%
	(0.003)	(0.007)		
R&D	0.205***	-0.037	0.13	
	(0.064)	(0.095)		
PP&E	-0.043***	0.001	-0.09	
	(0.015)	(0.039)		
Intangible Assets	0.009	-0.128***		-2.6%
	(0.015)	(0.044)		
MNE	-0.005	-0.052**		-5.2%
	(0.007)	(0.026)		
LnHavenSubs	0.007***	-0.005	0.06	
	(0.003)	(0.010)		
Leverage	0.055***	0.055	0.08	
	(0.018)	(0.034)		
Stock Comp	0.230**	-0.182	0.10	
	(0.090)	(0.145)		
NOL	0.143***	0.106**	0.19	2.2%
	(0.028)	(0.041)		
MTR	-0.244***	-0.375**	-0.11	-2.7%
	(0.066)	(0.152)		
PTDisp	0.647***	-0.117	0.39	
	(0.054)	(0.081)		
Number of Observations	3,464	3,464		
R^2	0.373	0.020		

ETRDisp is calculated as the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRΔATDisp* is the difference between observed after-tax forecast dispersion and a pseudo dispersion measure where we assume all analysts apply the same ETR to their pre-tax income forecasts. That difference is then scaled by the pseudo dispersion measure such that it represents the percentage change in after-tax forecast dispersion that results from ETR uncertainty. *Size* is the natural log of total assets. *Leverage* is total debt scaled by total assets. *PP&E* is property, plant, and equipment scaled by total assets. *Intangible Assets* is intangible assets scaled by total assets. *R&D* is research and development expense scaled by total revenue. *Stock Comp* is the sum of stock compensation expense over the prior five years scaled by total assets. *MNE* is an indicator variable equal to one if either pre-tax foreign income or foreign tax expense is non-zero. *LnHavenSubs* is the natural log of one plus the number of tax haven subsidiaries. *NOL* is the amount of any tax loss carryforward scaled by total assets. *MTR* is a firm's marginal tax rate. *PTDisp* is the standard deviation of analysts' pre-tax income forecasts scaled by the mean forecast. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the $p < 0.10$, 0.05, and 0.01 levels, respectively.

For column 1, effect sizes are calculated as the standard deviation of the determinant times the coefficient in column 1 divided by the standard deviation of *ETRDisp* . Thus, the effect size for column 1 can be interpreted as the standard deviation change in *ETRDisp* for a one standard deviation increase in the determinant. For column 2, effect sizes are calculated as the standard deviation of the determinant times the coefficient in column 2. As *ETRΔATDisp* is expressed in percentage terms, the effect size in column 2 can be interpreted as the percentage change in after-tax forecast dispersion that results from a one standard deviation increase in the determinant. Effect sizes are only presented when the coefficient is significant.

Table 3: Determinants of the Covariance between Pre-tax Income Forecasts and ETR Forecasts

	Dependent Variable: *ETRCovariance*	
Variable	**(1) Coeff. (Std Err)**	**Effect Size for One Std. Dev. Change**
Size	0.002***	0.185
	(0.000)	
R&D	-0.005	
	(0.005)	
PP&E	-0.005	
	(0.003)	
Intangible Assets	0.001	
	(0.003)	
MNE	0.000	
	(0.001)	
LnHavenSubs	-0.001**	-0.071
	(0.000)	
Leverage	0.004	
	(0.003)	
Stock Comp	0.032***	0.128
	(0.009)	
NOL	-0.006***	-0.071
	(0.002)	
MTR	0.013**	0.054
	(0.005)	
PTDisp	0.032***	0.173
	(0.010)	
Number of Observations	3,464	
R^2	0.059	

ETRCovariance is the covariance between the pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *Size* is the natural log of total assets. *Leverage* is total debt scaled by total assets. *PP&E* is property, plant, and equipment scaled by total assets. *Intangible Assets* is intangible assets scaled by total assets. *R&D* is research and development expense scaled by total revenue. *Stock Comp* is the sum of stock compensation expense over the prior five years scaled by total assets. *MNE* is an indicator variable equal to one if either pre-tax foreign income or foreign tax expense is non-zero. *LnHavenSubs* is the natural log of one plus the number of tax haven subsidiaries. *NOL* is the amount of any tax loss carryforward scaled by total assets. *MTR* is a firm's marginal tax rate. *PTDisp* is the standard deviation of analysts' pre-tax income forecasts scaled by the mean forecast. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the $p < 0.10$, 0.05, and 0.01 levels, respectively.

Table 4: The Association between Bid-Ask Spreads, Return Volatility, and Earnings Uncertainty Measures

Panel A: Bid-Ask Spreads and Full Sample Analysis

	Dependent Variable: *Spread*									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Variable	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)
ATDisp	0.108***					0.069***				
	(0.021)					(0.015)				
PTDisp		0.128***			0.106***		0.088***			0.062***
		(0.028)			(0.028)		(0.022)			(0.022)
ETRDisp			0.059***		0.035***			0.050***		0.034***
			(0.014)		(0.013)			(0.011)		(0.012)
ETRCovariance				-0.027	-0.189**				0.114	-0.030
				(0.093)	(0.088)				(0.109)	(0.101)
LnMVE						-0.012***	-0.012***	-0.014***	-0.015***	-0.013***
						(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Size						0.001	0.001	0.002	0.002	0.001
						(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Following						0.000	-0.000	0.000	0.000	-0.000
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Observations	3,464	3,464	3,464	3,464	3,464	3,464	3,464	3,464	3,464	3,464
R^2	0.033	0.037	0.022	0.000	0.043	0.097	0.101	0.100	0.086	0.106
Incremental explanatory power relative to Col. 1 or Col. 6:		12%			30%		4%			9%

Spread is the difference between the bid and ask prices scaled by the midpoint and then multiplied by 100 for ease of interpreting coefficients. *PTDisp (ATDisp)* is the standard deviation of analysts' pre-tax (net) income forecasts scaled by the mean forecast. *ETRDisp* is the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRCovariance* is the covariance between pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *LnMVE* is the natural log of the market value of equity. *Size* is the natural log of total assets. *Following* is the number of analysts following the firm. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the p < 0.10, 0.05, and 0.01 levels, respectively.

Panel B: Bid-Ask Spreads and Subsample Analysis

	Dependent Variable: *Spread*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Pos. & Sign. Correlation	All Other Firm-years	Full Sample	Pos. & Sign. Correlation	All Other Firm-years
Variable	Coeff. (Std Err)	Coeff. (Std Err)	Coeff. (Std Err)	Coeff. (Std Err)	Coeff. (Std Err)	Coeff. (Std Err)
PTDisp	0.105***	0.138***	0.089***	0.062***	0.101**	0.050**
	(0.028)	(0.053)	(0.026)	(0.023)	(0.048)	(0.021)
ETRDisp	0.029**	0.007	0.043***	0.033***	0.015	0.038***
	(0.013)	(0.019)	(0.015)	(0.012)	(0.019)	(0.014)
LnMVE				-0.013***	-0.008***	-0.014***
				(0.003)	(0.003)	(0.004)
Size				0.001	-0.003	0.003
				(0.003)	(0.003)	(0.003)
Following				-0.000	0.000	-0.000
				(0.000)	(0.000)	(0.000)
Number of Observations	3,464	1,150	2,314	3,464	1,150	2,314
R^2	0.041	0.036	0.045	0.106	0.098	0.111

Spread is the difference between the bid and ask prices scaled by the midpoint and then multiplied by 100 for ease of interpreting coefficients. *PTDisp (ATDisp)* is the standard deviation of analysts' pre-tax (net) income forecasts scaled by the mean forecast. *ETRDisp* is the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRCovariance* is the covariance between pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *LnMVE* is the natural log of the market value of equity. *Size* is the natural log of total assets. *Following* is the number of analysts following the firm. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the p < 0.10, 0.05, and 0.01 levels, respectively.

Panel C: Return Volatility and Full Sample Analysis

	Dependent Variable: *RetVol*									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Variable	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)
ATDisp	0.119***					0.083***				
	(0.008)					(0.007)				
PTDisp		0.130***			0.121***		0.092***			0.081***
		(0.011)			(0.010)		(0.010)			(0.009)
ETRDisp			0.047***		0.018***			0.037***		0.017***
			(0.006)		(0.006)			(0.006)		(0.005)
ETRCovariance				-0.077**	-0.209***				0.048	-0.068**
				(0.037)	(0.047)				(0.034)	(0.032)
LnMVE						-0.011***	-0.011***	-0.014***	-0.014***	-0.011***
						(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Size						0.001	0.001	0.002	0.002	0.001
						(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Following						0.001***	0.001***	0.001***	0.001***	0.001***
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Observations	3,461	3,461	3,461	3,461	3,461	3,461	3,461	3,461	3,461	3,461
R^2	0.097	0.091	0.032	0.001	0.101	0.216	0.215	0.192	0.173	0.218
Incremental explanatory power relative to Col. 1 or Col. 6:		-6%			4%		0%			1%

RetVol is the standard deviation of monthly returns over the twelve months following the measurement of the dispersion measures. *PTDisp (ATDisp)* is the standard deviation of analysts' pre-tax (net) income forecasts scaled by the mean forecast. *ETRDisp* is the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRCovariance* is the covariance between pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *LnMVE* is the natural log of the market value of equity. *Size* is the natural log of total assets. *Following* is the number of analysts following the firm. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the $p < 0.10$, 0.05, and 0.01 levels, respectively.

Panel D: Return Volatility and Subsample Analysis

	Dependent Variable: *RetVol*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Pos. & Sign. Correlation	All Other Firm-years	Full Sample	Pos. & Sign. Correlation	All Other Firm-years
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Variable	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)
PTDisp	0.120***	0.137***	0.107***	0.080***	0.093***	0.073***
	(0.011)	(0.025)	(0.010)	(0.009)	(0.018)	(0.010)
ETRDisp	0.012*	0.004	0.022***	0.015***	0.013	0.018***
	(0.006)	(0.011)	(0.006)	(0.005)	(0.009)	(0.006)
LnMVE				-0.011***	-0.010***	-0.012***
				(0.002)	(0.003)	(0.003)
Size				0.001	-0.001	0.002
				(0.002)	(0.002)	(0.003)
Following				0.001***	0.001***	0.001***
				(0.000)	(0.000)	(0.000)
N	3,461	1,149	2,312	3,461	1,149	2,312
R^2	0.093	0.081	0.098	0.217	0.236	0.203

RetVol is the standard deviation of monthly returns over the twelve months following the measurement of the dispersion measures. *PTDisp* is the standard deviation of analysts' pre-tax income forecasts scaled by the mean forecast. *ETRDisp* is the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRCovariance* is the covariance between pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *LnMVE* is the natural log of the market value of equity. *Size* is the natural log of total assets. *Following* is the number of analysts following the firm. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the $p < 0.10$, 0.05, and 0.01 levels, respectively.

Table 5: Distinction between ETR Uncertainty and Historical ETR Volatility

Panel A: Correlation between ETR Uncertainty and Historical ETR Volatility

	ETRDisp	*NonGAAPETRVol*	*GAAPETRVol*	*CashETRVol*
ETRDisp		**0.226**	**0.203**	**0.060**
		<.0001	<.0001	0.0072
NonGAAPETRVol	**0.317**		**0.377**	**0.238**
	<.0001		<.0001	<.0001
GAAPETRVol	**0.332**	**0.592**		**0.429**
	<.0001	<.0001		<.0001
CashETRVol	**0.110**	**0.281**	**0.367**	
	<.0001	<.0001	<.0001	

ETRDisp is calculated as the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *NonGAAPETRVol* is the standard deviation of a firm's non-GAAP ETR over the prior five years where non-GAAP ETRs are measured using I/B/E/S actuals. *GAAPETRVol* and *CashETRVol* is standard deviation of a firm's GAAP ETR and cash ETR over the prior five years. In order to be included in this analysis, a firm must have a pre-tax profit as well as positive tax expense and cash taxes paid in each of the prior five years. These additional restrictions reduce our main sample for this analysis. ETRs were winsorized at 1 before calculating their historical volatility. Pearson (Spearman) correlations are presented in the upper (lower) triangle for the selected variables. P-values are presented below the correlation coefficients, and correlation coefficients are bolded when they are significant at the 1% level.

Panel B: Historical ETR Volatility as a Determinant of *ETRDisp*

	Dependent Variable: *ETRDisp*				
Variable	(1) Coeff. (Std Err)	(2) Coeff. (Std Err)	(3) Coeff. (Std Err)	(4) Coeff. (Std Err)	(5) Coeff. (Std Err)
NonGAAPETRVol		0.118			
		(0.077)			
GAAPETRVol				0.015	
				(0.049)	
CashETRVol					-0.052*
					(0.030)
Size	0.005*	0.005*	0.008***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
R&D	0.252***	0.250***	0.223***	0.220***	0.230***
	(0.061)	(0.061)	(0.047)	(0.048)	(0.047)
PP&E	-0.057***	-0.054***	-0.065***	-0.064***	-0.063***
	(0.016)	(0.017)	(0.018)	(0.018)	(0.018)
Intangible Assets	0.004	0.005	0.030*	0.030*	0.030*
	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)
MNE	0.007	0.006	0.002	0.002	0.002
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
LnHavenSubs	0.004*	0.004*	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Leverage	0.036**	0.035**	0.028*	0.028*	0.028*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)
Stock Comp	0.105	0.101	0.246**	0.247**	0.242**
	(0.111)	(0.110)	(0.102)	(0.101)	(0.102)
NOL	0.136**	0.135**	0.144**	0.142**	0.146**
	(0.060)	(0.060)	(0.063)	(0.062)	(0.064)
MTR	-0.203***	-0.186***	-0.136*	-0.129	-0.137*
	(0.063)	(0.062)	(0.073)	(0.087)	(0.072)
PTDisp	0.659***	0.641***	0.778***	0.776***	0.787***
	(0.063)	(0.065)	(0.076)	(0.077)	(0.076)
N	2,429	2,429	2,035	2,035	2,035
R^2	0.309	0.311	0.349	0.349	0.350

NonGAAPETRVol is the standard deviation of a firm's non-GAAP ETR over the prior five years where non-GAAP ETRs are measured using I/B/E/S actuals. *GAAPETRVol* is the standard deviation of a firm's GAAP ETR over the prior five years. *CashETRVol* is the standard deviation of a firm's cash ETR over the prior five years. ETRs were winsorized at 1 before calculating their historical volatility. In order to be included in this analysis, the observation must have a pre-tax profit as well as a positive numerator for the ETR measure during the prior five years. These additional restrictions reduce our main sample down to 2,429 observations when non-GAAP ETRs are the focus (Columns 1-2) and 2,035 observations when GAAP and cash ETRs are the focus (Columns 3-5). More observations are lost when GAAP and cash ETRs are the focus as firms are more likely to report a GAAP loss than a non-GAAP loss. Please see Appendix A for the full definition of all variables. *, **, and *** denote significance at the p < 0.10, 0.05, and 0.01 levels, respectively.

Table 6: When is Unscaled After-tax Dispersion Greater than Unscaled Pre-tax Dispersion?

	Higher **=0 (N = 3,210)**	***Higher*** **=1 (N = 254)**	
ETR-related Variables			
Expected ETR	0.285	0.227	***
MTR	0.295	0.262	***
ETRDisp	0.096	0.290	***
ETRCovariance	0.005	-0.002	***
Firm-year Characteristics	**Mean**	**Mean**	
PTRoa	0.139	0.129	*
Size	9.124	8.976	
Leverage	0.245	0.272	*
PP&E	0.231	0.195	***
Intangible Assets	0.229	0.244	
R&D	0.061	0.096	***
MNE	0.878	0.846	
LnHavenSubs	1.687	1.705	
NOL	0.064	0.176	***

This table reports the mean descriptive statistics for firm-years with *Higher* equal to zero and for firms-years with *Higher* equal to one. *Higher* is an indicator variable equal to one if the unscaled standard deviation of after-tax forecasts is greater than the unscaled standard deviation of pre-tax forecasts for that firm-year. *Expected ETR* is the mean implicit ETR forecast for the firm-year. *MTR* is a firm's marginal tax rate. *ETRDisp* is the standard deviation of analysts' implicit ETR forecasts scaled by the mean ETR forecast. *ETRCovariance* is the covariance between pre-tax income forecasts and implicit ETR forecasts for that firm-year scaled by shares outstanding. *PTRoa* is the mean pre-tax income forecast divided by total assets. *Size* is the natural log of total assets. *Leverage* is total debt scaled by total assets. *PP&E* is property, plant, and equipment scaled by total assets. *Intangible Assets* is intangible assets scaled by total assets. *R&D* is research and development expense scaled by total revenue. *Stock Comp* is the sum of stock compensation expense over the prior five years scaled by total assets. *MNE* is an indicator variable equal to one if either pre-tax foreign income or foreign tax expense is non-zero. *LnHavenSubs* is the natural log of one plus the number of tax haven subsidiaries. *NOL* is the amount of any tax loss carry forward scaled by total assets. Please see Appendix A for more detailed variable definitions. The last column in the table reports a test of the difference in means across the two groups. *, **, and *** denote significance at the $p < 0.10$, 0.05, and 0.01 levels, respectively.