Tax Avoidance, Uncertainty, and Firm Risk

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January 2019

Abstract: While tax avoidance strategies result in greater after-tax cash flows, they can involve uncertain future outcomes, which can impose significant costs on firms. Thus, the extent to which tax avoidance increases firm risk is unclear. This paper re-examines the relation between tax avoidance and firm risk using latent class mixture models, which identify subsamples of firms with differing relations between variables of interest. We provide evidence that 19 percent of our sample exhibits a *positive* association between tax avoidance and firm risk, 43 percent exhibits a *negative* association, and 38 percent does not exhibit a statistically significant relation. Our analyses suggest striking differences in firm characteristics across the latent classes, including differences in the use of common tax shields such as net operating loss carryforwards, interest expense, and capital expenditures; variation in tax planning as reflected in effective tax rates, settlements with tax authorities, and foreign income; firm size and profitability; operating volatility and information environments; and managerial compensation incentives and stock ownership. Our findings increase our understanding of the circumstances in which tax avoidance is positively, negatively, or not significantly related to firm risk.

Keywords: Tax avoidance, firm risk, stock return volatility, latent class mixture model

*Corresponding author. All authors acknowledge helpful comments from Harold Amberger, Tobias Bornemann, Bill Cready, Eva Eberhartinger, Nathan Goldman, Maria Loumioti, Matthias Petutschnig, Suresh Radhakrishnan, and workshop participants at the University of Texas at Dallas and Vienna University of Economics and Business. The authors gratefully acknowledge funding from the Gies College of Business and the Kelley School of Business. Professor Rego also appreciates research funding provided by the Frumer Professorship.

1. Introduction

This study examines the relation between corporate tax avoidance and firm risk, where we define tax avoidance as all transactions that reduce a firm's explicit tax liability (e.g., Hanlon and Heitzman 2010) and firm risk as uncertainty about future outcomes (e.g., Miller 1977). The relation between tax avoidance and firm risk is important given the significance of income tax expense for a firm's after-tax profits and given the recent, increased scrutiny of corporate tax avoidance by global tax authorities. Tax avoidance increases net cash flows, which can be used to boost corporate investment, fulfill debt obligations, or be distributed to shareholders in the form of dividends or share buybacks. However, while some tax avoidance strategies are highly certain and unlikely to be challenged by tax authorities (e.g., the tax treatment of capital expenditures or municipal bond interest income), others have highly uncertain future outcomes (e.g., cross-border income shifting via intellectual property and transfer pricing schemes). Based on public information it is difficult for corporate stakeholders to disentangle the tax strategies that have a high degree of certainty from those with highly uncertain future outcomes. Thus, the relation between tax avoidance and firm risk is theoretically ambiguous.

Recent research examines many aspects of this relation, but these studies provide little consistent evidence. Goh, Li, Lim, and Shevlin (2016) and Guenther, Matsunaga, and Williams (2017) provide direct evidence that tax avoidance and two measures of firm risk are on average, negatively related. However, other studies find that tax avoidance is associated with higher stock return volatility (e.g., Rego and Wilson 2012), higher costs of debt (e.g., Shevlin, Urcan, and Vasvari 2013; Hasan, Hoi, Wu, and Zhang 2014), and greater "tax uncertainty" (Dyreng, Hanlon, and Maydew 2018).[1] In contrast, Guenther, Wilson, and Wu (2018) find that increases in the rate

[1] Dyreng et al. (2018) define tax uncertainty as the potential loss of tax savings upon challenge by tax authorities and measure it as additions to unrecognized tax benefits related to current year tax positions over a five-year period.

of tax avoidance are *not* related to the rate of tax uncertainty. Taken together, it is difficult to draw broad conclusions from these studies about the relation between tax avoidance and firm risk.

There are a number of potential explanations for the contrasting results in prior research. First, these studies use different proxies for uncertainty about future outcomes and these measures reflect different stakeholders' perspectives, including those of investors, lenders, and financial statement preparers. Second, these studies use different models to examine the relation between corporate tax avoidance and firm risk across a broad sample of firms. Given the varied opportunities for tax planning across industries and national borders, and given the different information environments, managerial incentives, and governance mechanisms across firms, it is unlikely that a single, pooled OLS regression model can adequately evaluate the relation between corporate tax avoidance and firm risk.[2]

We address this limitation in prior research by using an econometric approach uncommon in the accounting literature – a latent class mixture model – to explore economic explanations for the contrasting results. Our approach is similar to that in Larcker and Richardson (2004), which uses the same method to examine the relation between audit fees and accruals.[3] As explained by those authors, latent class mixture models do not impose a fixed relation on the variables of interest. Instead, the model categorizes a population of firms into homogeneous subsamples (i.e., classes) that exhibit similar relations between the variables of interest *within* each subsample, while allowing the relations to differ *across* the subsamples. In our setting this method allows us to identify the subsample(s) of firms in which tax avoidance is positively, negatively, or not related

[2] Inherent in analyses using a pooled OLS regression model is the assumption that the underlying relationship between the dependent and independent variables is similar for the entire sample, and thus a single coefficient representing this relationship is appropriate.

[3] Similar to our research setting, studies published before Larcker and Richardson (2004) provide a confusing array of conflicting evidence as to whether audit fees and accruals are positively, negatively, or not significantly related. Larcker and Richardson use a latent class mixture model to reconcile those conflicting prior research findings.

to firm risk. We then examine how firms vary across the different subsamples to shed light on the potential economic explanations for tax avoidance being positive, negatively, or not related to firm risk.

We use a large sample of firms with requisite data for fiscal years 1991 through 2016 to conduct our primary analyses. Consistent with Dyreng, Hanlon, and Maydew (2008) and many of the studies cited above, we measure corporate tax avoidance as five-year cash effective tax rates (ETRs), multiplied by negative one, so the measure is increasing in tax avoidance. Cash ETRs capture a broad set of tax strategies, including those with highly certain and uncertain outcomes, and is arguably the most frequently used measure of tax avoidance in current tax research. As a result, our findings should be relevant for the broader tax literature. Consistent with Miller (1977) and studies that examine equity risk incentives (i.e., vega), we measure firm risk as the volatility of monthly stock returns in year *t+1*. This measure captures overall firm risk, which has both systematic and idiosyncratic components. Tax avoidance also likely has systematic and idiosyncratic aspects, depending on the types of strategies employed and the pervasiveness of these strategies across all firms. Thus, we use a measure of overall firm risk rather than measures that only capture systematic risk, such as the cost of capital or beta (see also Guenther et al. 2017).

We expect some firms to exhibit a positive relation between tax avoidance and firm risk while others exhibit either a negative or insignificant relation, depending on the types of tax planning strategies employed. Firms undertaking tax strategies that have less (more) certain outcomes with tax authorities should exhibit a positive (negative) association between tax avoidance and firm risk because forecasting future cash flows should be more (less) difficult for firms that adopt tax strategies with less (more) certain outcomes. Further, when it is more (less) difficult to forecast future cash flows, there should be more (less) disagreement between investors about firm value and thus, higher (lower) stock return volatility (Miller 1977). Compared to tax strategies that have more certain outcomes with tax authorities, strategies with *less certain* outcomes should *have more volatile future cash flows* as outcomes are realized with tax authorities, leading to higher stock return volatility. Our research method – a latent class mixture model – allows us to identify the homogeneous subsamples of firms for which the relations between tax avoidance and firm risk differ, both statistically and economically.

We first use pooled, OLS regressions to document that tax avoidance and firm risk are significantly negatively related in a model without control variables, but not statistically related after controlling for pretax profitability and firm size. These OLS results are consistent with those in Guenther et al. (2017), which finds both negative and insignificant relations depending on how tax avoidance is measured. We then use a latent class mixture model to estimate the relation between firm risk and tax avoidance and find that 43 percent of firm-year observations exhibit a significant and *negative* relation, while 19 percent exhibit a significant and *positive* association. For the remaining 38 percent of the sample, there is *no significant association* between the variables of interest. These findings indicate that the relation between tax avoidance and firm risk is more complex than suggested by conclusions in prior studies.

Having identified the firm-year observations in each latent class, we next examine the economic explanations that underlie the varying relations between tax avoidance and firm risk. Specifically, we compare firms in each latent class based on proxies for the following attributes: (i) tax rates, tax planning, and tax shields, (ii) general and risk-taking characteristics of the firm and its information environment, and (iii) managerial incentives and ownership. Throughout our discussion, we refer to firms in latent classes that exhibit a significant and positive (negative) association between tax avoidance and firm risk as "*positive* (*negative*) *latent class*" firms.

Results from our primary analyses reveal that "*positive latent class*" firms have lower stock return volatility but avoid more taxes than firms in the other latent classes. Nonetheless, within this subsample of firms, the relation between tax avoidance and firm risk is *positive* and significant. Compared to *negative latent class* firms, *positive latent class* firms rely on fewer common tax shields such as interest expense, R&D and capital expenditures, and NOL carryforwards, but report greater foreign income, intangible assets, and tax haven usage. These firms are also larger, older firms, with higher return on assets, but lower sales growth, less operating volatility, and lower abnormal returns and costs of capital than *negative latent class* firms. They firms also have stronger information environments, with greater analyst following, less analyst forecast dispersion, and lower bid-ask spreads. *Positive latent class* firms have CEO compensation plans with greater delta and vega, consistent with these managers being incentivized to increase stock price and firm risk. *Positive latent class* firms also have higher institutional ownership but less inside stock ownership by the top five paid executives, compared to *negative latent class* firms.

Collectively, this evidence is consistent with tax avoidance being *positively* associated with firm risk when mature firms use strategies with more uncertain outcomes to avoid income taxes. In contrast, *negative latent class* firms exhibit higher levels of overall risk, but this risk is related to business operations not tax avoidance, given the negative relation between tax avoidance and stock return volatility. This conclusion is further supported by the fact that negative latent class firms benefit from many common tax shields (such as interest expense), which have highly certain outcomes with tax authorities. Lastly, the latent class of firms with an insignificant association between tax avoidance and firm risk (i.e., "*no relation latent class*" firms) have attributes with mean values that are generally in between those for the positive and negative latent class firms. Taken together, our results suggest that it would be incorrect to claim that a single, fixed relation adequately describes the link between tax avoidance and firm risk for a broad set of firms.

We estimate several additional latent class models to further enhance our understanding of the relation between tax avoidance and firm risk. We first separately estimate the association between tax avoidance and firm risk for U.S. domestic-only and U.S. multinational firms, since these firms have different tax planning opportunities. For U.S. domestic-only firms we observe patterns in the latent classes that are generally consistent with our full sample analysis. Specifically, we find that 23 percent (34 percent) of the firms in the U.S. domestic-only sample exhibit a *positive* (*negative*) and significant relation between tax avoidance and firm risk. In contrast, among U.S. multinational corporations, there are two latent classes (comprising 45 percent of this subsample) that exhibit a *negative* and significant relation between tax avoidance and firm risk, while the other latent classes of U.S. multinational firms do not exhibit statistically significant relations. Together these findings are consistent with most U.S. multinational corporations avoiding income taxes without significantly increasing firm risk. In contrast, a non-trivial proportion of U.S. domestic-only firms appear to engage in tax avoidance strategies that are associated with higher firm risk. In supplemental analyses we provide evidence that our primary results are robust to latent class mixture models that control for operating volatility and estimating separate OLS regressions for each latent class while controlling for numerous firm attributes.

Our study makes several contributions to the accounting literature. First, we employ a latent class mixture model to re-evaluate the relation between tax avoidance and firm risk. While this relation has received significant attention in the literature, much of the empirical evidence is mixed. Our research approach highlights the nuanced nature of the relation between tax avoidance and firm risk and complements existing research in this area. Second, use of the latent class mixture model allows us to evaluate the unique characteristics of the firms within each class. Our results indicate that tax avoidance is associated with *higher* risk for firms that (i) rely on fewer common tax shields such as interest, R&D and capital expenditures, and NOL carryforwards; (ii) are larger, older firms with higher levels of profitability but lower sales growth; (iii) have high analyst following and lower bid-ask spreads; and (iv) have stronger managerial compensation incentives and greater institutional ownership. Collectively, this evidence is consistent with tax avoidance being positively associated with firm risk when mature firms seek new and possibly more uncertain methods of reducing tax payments. These findings contrast those in Goh et al. (2016) and Guenther et al. (2017), which find a significant and *negative* relation between tax avoidance and firm risk when examining the average relation for a broad sample of firms. Importantly, our results suggest a negative relation exists *only* for subsamples of firms that exhibit *higher* firm risk and *less* tax avoidance. Our findings should be of interest to analysts, investors, and lenders evaluating the costs and benefits of tax avoidance. They increase our understanding of the types of firms for which tax avoidance is associated with higher versus lower uncertainty about future outcomes, an important factor for market expectations and the costs of debt and equity capital.

2. Prior Research Examining Firm Risk and Tax Avoidance

2.1 Firm Risk

For purposes of this study we define firm risk as uncertainty about future firm outcomes. While Knight (1921) separates the concepts of risk and uncertainty, our definition and measurement of risk more closely follows Miller (1977), who notes that in practice, uncertainty, divergence of opinion, and risk are inextricably linked. He also explains that uncertainty usually implies a divergence of opinions, which leads to greater variability in stock prices. This definition of firm risk is also adopted by studies in finance that examine the impact of firm risk on managers' preferences, e.g., Smith and Stulz (1985), Lambert, Larcker, and Verrecchia (1991) Guay (1999), Rajgopal and Shevlin (2002), and Coles, Daniel, and Naveen (2006). In these studies, the "wealth effect" describes increases in firm risk that *increase* the wealth of managers that own securities with convex payoffs (e.g., stock options). In contrast, the "risk aversion effect" describes increases in firm risk that *decrease* the utility of managers that are risk-averse or poorly diversified with respect to firm-specific wealth. All of the studies cited above measure firm risk – analytically or empirically – as stock return volatility.

As noted in Guenther et al. (2017) among others, stock return volatility is a measure of overall firm risk, which has systematic and idiosyncratic components. Tax avoidance also likely has systematic and idiosyncratic aspects, depending on the types of strategies employed and the pervasiveness of these strategies across all firms. In some research settings idiosyncratic risk is considered irrelevant, since investors can eliminate idiosyncratic risk through portfolio diversification. However, we view idiosyncratic risk as relevant in our setting, as some tax strategies increase idiosyncratic firm risk and managers that own securities with convex payoffs (e.g., stock options) are incentivized to increase total firm risk as captured by stock return volatility (Rego and Wilson 2012). Thus, we use a measure of overall firm risk in our empirical tests, rather than measures that only capture systematic risk, such as the cost of equity capital or beta. Nonetheless, we include descriptive evidence by latent class for other measures of firm risk – including the cost of equity capital – in our tabulated analyses.

2.2 Tax Avoidance

Corporate tax avoidance can generate significant financial and tax reporting benefits but also imposes both tax and non-tax costs on firms. The benefits of corporate tax avoidance are straightforward. Tax avoidance generates cash tax savings (and thus higher net after-tax cash flows) and "permanent tax" avoidance provides financial reporting benefits via lower GAAP effective tax rates (ETRs).[4] However, corporate tax avoidance can also impose significant costs on firms and those costs are generally increasing in the uncertainty of the underlying tax positions. Tax avoidance can involve unusual transactions that are costly to implement, given complexities in the application of tax law and in understanding company facts, e.g., costs associated with internal tax staff, external tax service providers, and/or coordination with other functional units within the firm. Tax avoidance can impose additional costs if the firm is audited by the Internal Revenue Service or other tax authorities, in which case the firm can experience significant costs in complying with the audit and paying additional taxes, interest, and penalties.

In this study, we seek to provide evidence on one potential cost of tax avoidance: increased firm risk. Prior research examining the relation between tax avoidance and firm risk offers mixed evidence. Guenther et al. (2017) find that stock return volatility is negatively related to tax avoidance as measured by three-year (but not five-year) cash and GAAP ETRs, while Goh et al. (2016) provide evidence that the cost of equity capital is lower for tax-avoiding firms. Based on the theoretical model in Lambert, Leuz, and Verrecchia (2007), the Goh et al. results are consistent with tax avoidance either *increasing* a firm's expected future cash flows or *decreasing* the variance of the firm's cash flows – or the covariance of the firm's cash flows – with the sum of all cash flows in the market. Goh et al. (2016) do not empirically test the mechanism for the negative relation between tax avoidance and the cost of equity.

Sikes and Verrecchia (2016) develop a theoretical model to examine the relation between aggregate tax avoidance and the cost of equity capital. The model demonstrates that as firms avoid more taxes in aggregate, the variance of the market's after-tax cash flows increases. As a result,

[4] We define permanent tax avoidance as tax strategies that generate statutory reconciliation items in a firm's tax footnote (often referred to as "permanent" book-tax differences) and thus, decrease effective tax rates.

the covariance between market cash flows and a particular firm's cash flows is larger – and the cost of equity capital *higher* – when a meaningful proportion of firms avoid income taxes. The results from their empirical analyses are consistent with the model's predictions, but contrast those in Goh et al. (2016). Cook, Moser, and Omer (2017) also provide evidence that tax avoidance is associated with *higher* costs of equity capital, but only when tax avoidance is above *or* below investors' expectations. Turning to debt holders—who are exposed to the potential costs of tax avoidance but not necessarily the benefits—recent evidence suggests that firms avoiding more income taxes exhibit higher spreads on bank loans and public bonds and thus, higher costs of debt (Shevlin et al. 2013; Hasan et al. 2014; Saavedra 2018). Lastly, in supplemental analyses Rego and Wilson (2012) provide some evidence that tax avoidance is positively associated with stock return volatility, although their sample is limited to S&P 1500 firms. Taken together, recent research provides a puzzling collection of results about the relation between tax avoidance and firm risk.[5]

2.3 Expectations for the Relation between Tax Avoidance and Firm Risk

We expect some firms to exhibit a positive relation between tax avoidance and firm risk while others exhibit either a negative or insignificant relation, depending on the types of tax planning strategies employed. Firms undertaking tax strategies that have less (more) certain outcomes with tax authorities should exhibit a positive (negative) association between tax avoidance and firm risk because forecasting future cash flows should be more (less) difficult for firms that adopt tax strategies with less (more) certain outcomes. When it is more (less) difficult to forecast future cash flows, there should be more (less) disagreement between investors about firm value and thus, higher (lower) stock return volatility (Miller 1977). Additionally, compared

[5] We acknowledge the empirical proxies for tax avoidance and firm risk vary across some of these studies, as do the sample compositions and time periods examined.

to tax strategies that have more certain outcomes with tax authorities, strategies with *less certain* outcomes should *have more volatile future cash flows* (as outcomes are realized with tax authorities), leading to higher stock return volatility. Thus, realizations of past tax strategies and the ease (or difficulty) of forecasting future outcomes of ongoing tax strategies should jointly affect variation in monthly stock returns.

Examples of tax planning strategies that have *less certain* outcomes with tax authorities include claiming R&D tax credits that are inflated by expense re-classifications and cross-border income shifting strategies that rely on aggressive transfer pricing schemes. Tax strategies with *more certain* outcomes with tax authorities include the use of debt to finance business operations, the acquisition of depreciable property eligible for accelerated depreciation, and the use of NOL carryforwards. Importantly, our research method – a latent class mixture model – allows us to identify the homogeneous subsamples of firms for which the relations between tax avoidance and firm risk differ, both statistically and economically.

3. Methodological Approach

3.1 Sample Selection

Our initial sample includes all Compustat firms that are incorporated in the United States with financial data available for fiscal years 1987 through 2016. Following prior research, we remove observations categorized as real estate investment trusts, financial institutions, or utilities since regulations in these industries likely affect both overall firm risk and tax avoidance opportunities. Because we require five years of data for cash taxes paid, the first observations for which we have five years of data begin in 1991. Our initial sample includes 78,150 firm-year observations (8,884 firms). We require firms to report cumulative, positive pretax income adjusted for special items for years *t-4* through year *t*, since loss firms have fewer incentives to tax plan. Additionally, losses distort income tax expense as reported on financial statements and ETR-based tax measures. This requirement eliminates 20,857 firm-years (2,316 firms). We next remove 10,156 firm-years (1,136 firms) that have insufficient monthly data to calculate stock return volatility for year *t+1*. These data requirements generate a sample of 47,137 firm-years (5,432 unique firms) to estimate our latent class mixture model. After identifying the latent classes for our sample of firm-years, we then calculate mean values for a broad set of firm attributes (e.g., tax planning and tax shield variables, general firm characteristics, etc.) for each latent class. Because we do not require that all observations have requisite data to calculate all variables, the number of observations with which we calculate mean value varies across the firm attributes. For example, all 47,137 firm-year observations have requisite data to calculate stock return volatility (*RET_VOL*), tax avoidance (*TAXAVOID*), and profitability (*PTROA*), but significantly fewer observations have requisite data to calculate loan spread (*COST_DEBT*), delta [*DELTA*], and settlements with tax authorities (*SETTLEMENT*).

3.2 Measurement of Tax Avoidance and Firm Risk

Our primary measure of tax avoidance is long-run cash ETR (*TAXAVOID*), measured as the sum of cash taxes paid over the five-year period from year *t-4* through year *t*, divided by the sum of pre-tax book income adjusted for special items over the same five year period, multiplied by negative one (Dyreng et al. 2008). We multiply by negative one for ease of interpretation, as this adjustment allows the measure to be increasing in tax avoidance. We winsorize ETRs to range between zero and one.

As previously discussed, we measure firm risk as the volatility of monthly stock returns, which captures both systematic and idiosyncratic risk and imposes minimal data restrictions. We calculate stock return volatility (*RET_VOL*) as the standard deviation of the 12 monthly stock returns during year *t+1* for two reasons. First, we expect some of the uncertain tax positions captured by five-year cash ETRs to be resolved and reflected in monthly stock return volatility during year *t+1*. Second, as the Form 10-K for year *t* is filed early in year *t+1*, stock return volatility during year *t+1* also captures changes in investor beliefs that occur after the Form 10-K filing, including any information about income taxes that is incorporated in stock prices. In supplemental analyses, we evaluate the robustness of our results to an alternative measure of firm risk, the implied cost of equity capital (*R_PEG*) as calculated in Easton (2004).

Because tax avoidance opportunities and firm risk both vary systematically across industries and through time, we include industry and year fixed effects in all of our analyses. Unless otherwise specified, we winsorize all continuous variables at the 1^{st} and 99^{th} percentiles.

3.3 Latent Class Mixture Model Approach

We employ an alternative econometric technique to improve our understanding of the circumstances in which tax avoidance is positively, negatively, or not significantly associated with firm risk. Research across numerous disciplines has employed latent class mixture models to identify latent classes (i.e., subsamples) of observations that exhibit a similar relation between the variables of interest. However, this technique is underutilized in the accounting literature; we are aware of only one other accounting study that employs a latent class mixture model, Larker and Richardson (2004). In their study, Larcker and Richardson (2004) use a latent class mixture model to evaluate the association between abnormal audit fees and discretionary accruals.

Latent class mixture modeling can be helpful in instances where the relation of interest, depicted in the baseline model, behaves differently for different observations (as might be expected for the relation between tax avoidance and firm risk). Latent class mixture modeling focuses on the similarities or differences among observations to identify homogeneous subgroups (Muthén and Muthén 1998). While ordinary least squares (OLS) regression has many advantages, one disadvantage is that it imposes a linear relation on an entire sample. Given the varied opportunities for tax planning across industries and national borders in our research setting, and given differing information environments, managerial incentives, and governance mechanisms across firms, it is unlikely that a single, pooled OLS regression model can adequately evaluate the relation between corporate tax avoidance and firm risk. In this case, estimating OLS regressions could mask any contrasting results for subsamples of the population. Latent class mixture models allow the relation between variables of interest to vary across subsamples, potentially enhancing our understanding of the relation between tax avoidance and firm risk.

We estimate the baseline model using a latent class mixture procedure in STATA:

$$RET\_VOL = \beta_1\ TAXAVOID + \text{Industry FE} + \text{Year FE} + \varepsilon \qquad (1)$$

We do not include any control variables in our latent class mixture model, except industry and year fixed effects, because we do *not* want to hold any firm attributes constant across the latent classes. Instead, our approach allows the "data to speak" without constraint, consistent with Larcker and Richardon (2004). However, we do include industry and year fixed effects because both tax avoidance and firm risk vary substantially across industries and through time. We note, however, our results are substantially similar if we exclude fixed effects from our latent class mixture model.

The latent class mixture estimation procedure categorizes our full sample of observations into a fixed number of subgroups, i.e., latent classes. The number of subgroups is an important input for estimating latent class mixture models. We determine the appropriate number of subgroups in our analyses based on the logarithm of the likelihood function (Larcker and Richardson 2004). Specifically, we choose the number of subgroups (K) that minimizes the

Bayesian information criterion (Nylund, Asparouhov, and Muthen 2007). The Bayesian information criterion is defined as [-2×ln(L) + K×(ln(N)], where L is the maximum likelihood for the K cluster solution and N is the sample size.[6]

We estimate the baseline mixture model using the "fmm" command available in STATA 15. We adopt a stepwise approach where we first estimate a two-latent class mixture model with the command, "fmm 2". STATA generates the Bayesian information criterion (BIC) for this specification, which we store using the "estimates stats" command. We then estimate a three-latent class mixture model, "fmm 3," and again save the BIC as calculated by STATA for this specification. We estimate two more latent class mixture models, assigning four ("fmm 4") and five latent classes ("fmm 5"), respectively, and also storing the BIC estimates for each procedure. We then compare all four BICs generated by STATA and choose the latent class specification that minimizes the Bayesian Information Criterion.

Because a mixture model estimates the observations in each latent class probabilistically across an entire sample, the assignment of a single observation to a specific class requires some judgement. We follow prior research in assigning observations based on their *most probable* latent class. For example, let us assume the mixture model identifies three latent classes, and assume the posterior probabilities of assignment to each class for the *full sample* is: 25 percent to class one, 60 percent to class two, and 15 percent to class three. However, if we were to examine a *single* observation, that observation could have a 10 percent probability of belonging to class one, a 70 percent probability of belonging to class two, and a 20 percent probability of belonging to class three. We would assign this observation to class two based on its *most probable* class assignment. The "fmm" command in STATA does not automatically generate the estimated percentage of

[6] We refer readers interested in additional details regarding the econometric approach to Larker and Richardson (2004); DeSarbo and Cron (1988); Wedel and DeSarbo (1995).

observations that belong in each latent class. To identify these probabilities we execute the "predict, classposteriorpr" command after the basic mixture model command ("fmm"). We then assign the observation to the latent class with the highest posterior probability.[7]

While identifying distinct, latent classes is an important first step, we are also interested in investigating whether there are significant differences across the latent classes with respect to: (i) tax rates, tax planning, and tax shields, (ii) general and risk-taking characteristics of the firm and its information environment, and (iii) managerial incentives and stock ownership. Importantly these variables are *not* included in the latent class mixture model. If these variables were included in the baseline model, they would influence which firms are included in each latent class (Clark and Muthén 2009). To illustrate this point, take for example the variable "size." If we control for firm size in the latent class mixture model, we would find that size varies little across the subgroups. However, if we exclude size from the variables used to predict the relation between tax avoidance and firm risk, we can evaluate the extent to which firm size varies between the latent classes that exhibit different relations between tax avoidance and firm risk. Importantly, by not controlling for firm characteristics that moderate the relation between tax avoidance and firm risk, we are able to shed light on the types of firms for which tax avoidance and firm risk are positively, negatively, or not statistically related. These analyses should be useful to investors, analysts, and

[7] This example further illustrates differences between the posterior probabilistic class assignments for an entire sample as compared to the classification of a single observation to a specific latent class. Please note this example is contrived and not based on actual data. Assume we have data for firms that are headquartered in two States: Alaska and Florida. We do not know where each firm is headquartered. Instead we only know the temperature of the location in which headquarters are located, on a single, random day of the year. Assume we estimate the mixture model based on the entire sample and we identify two latent classes (i.e., Alaska and Florida). The model estimates that 20 percent of the sample observations are from Alaska and 80 percent are from Florida. However, the only information we have for a given observation is the temperature of the location in which headquarters is located on a single, random day of the year. If an observation has a temperature of 20 degrees, the mixture model may assign it a 90 percent probability of being headquartered in Alaska, and a 10 percent probability of being headquartered in Florida. We would then classify this firm's most likely headquarters location as Alaska. In contrast, an observation with a temperature of 55 degrees may have a 60 (40) percent probability of being headquartered in Florida (Alaska). We would once again use the highest probability and classify this particular observation as a Florida firm.

lenders evaluating whether a particular firm's tax strategies increase uncertainty about the firm's future cash flows. Thus, we estimate our latent class mixture model focusing on the basic relation between tax avoidance and firm risk. We then examine the extent to which various firm attributes differ between the latent classes, by comparing descriptive statistics across the latent classes.

3.4 Evaluation of Firm Attributes Across Latent Classes

Following the identification of latent classes with differing relations between tax avoidance and firm risk, we analyze the firms in each latent class along three key dimensions including: (i) tax rates, tax planning, and tax shields, (ii) general and risk-taking characteristics of the firm and its information environment, and (iii) managerial incentives and ownership variables. We perform our analyses by separately calculating the mean values for numerous firm characteristics based on the observations assigned to each latent class. First, with regard to tax rates, we compare five-year, average GAAP and cash ETRs (*GAAP_ETR5* and *CASH_ETR5*) across the latent classes. Given the findings in Guenther et al. (2017), i.e., that cash ETR volatility is positively associated with firm risk, we also evaluate variation in the volatility of five-year cash ETRs (*CASHETR_VOL5*) across the latent classes. With respect to tax planning and tax uncertainty, we examine variation in the ending balance of unrecognized tax benefits (*UTB_END*), settlements with tax authorities (*SETTLEMENTS*), and proxies for cross-border income shifting including the percentage of income from non-domestic sources (*FOR_INC%*), an indicator for the use of tax havens (*HAVEN*), and scaled intangible assets (*INTANG*). Additionally, to understand variation in tax shields employed by firms in each latent class, we evaluate differences in NOL carryforwards (*NOL* and Δ*NOL*), research and development expenditures (*R&D*), capital expenditures (*CAPEX*), and interest expense (*INT_EXP).* We seek to understand if firms that exhibit positive versus negative associations between tax avoidance and firm risk also exhibit systematic differences in tax rates, tax planning, and use of common tax shields.

We also evaluate variation in general and risk-taking characteristics and information environments for firms across the latent classes. Specifically, we examine variation in firm age (*AGE*), size (*ASSETS*), membership in the S&P 500 (S&P_500), profitability (*PTROA*), abnormal returns in year *t* and *t+1* (ABN_RETURN_t, ABN_RETURN_{t+1}), sales growth (*SALES_GROWTH*), and the market-to-book ratio (*MTB*) across the latent classes. We also evaluate variation in financial constraints (*WW_INDEX*) and the life cycle of the firm, where higher *LIFE_CYCLE* values indicate later firm life cycles, which range from introduction (1), growth (2), mature (3), shake-out (4), and decline (5) (see Dickinson 2011). We also examine a broad set of measures that capture corporate risk-taking, including stock return volatility in year *t+1* (*RET_VOL*), volatility of pretax ROA over years *t-1* through *t* (*PTROA_VOL5*), the implied cost of equity capital (*COST_EQUITY*) and the cost of debt (*COST_DEBT*). Given recent evidence that tax avoidance is associated with reduced transparency in a firm's information environment (Balakrishnan, Blouin, and Guay 2018), we also evaluate variation across latent classes in analyst following (*ANALYST_FOL*), dispersion in analyst earnings forecasts (*ANALYST_DISP*), and bid-ask spreads (*BIDASK_SPREAD*). Prior research uses many of these variables as controls in analyses evaluating the association between tax avoidance and firm risk. However, with the latent class mixture model, we first determine the homogeneous subsamples that exhibit distinct relations between tax avoidance and firm risk, and then examine whether the subsamples differ systematically based on mean values of these important firm attributes.

Lastly, we evaluate whether the latent classes differ with respect to CEO compensation and ownership attributes, both of which influence managerial risk-taking. Specifically, we examine the variation in CEO pay-for-performance sensitivity (*DELTA*) and equity risk incentives (*VEGA*) across the latent classes, since Rego and Wilson (2012) provide evidence that CEO compensation incentives and corporate tax avoidance are positively related. Additionally, we evaluate whether institutional stock ownership (*INSTITUT_OWN%*) and the proportion of stock owned by the top five paid executives (*INSIDE_OWN%*) varies across the latent classes, since institutional investors serve as outside monitors and inside stock ownership captures managerial incentive alignment and risk aversion. All variables are defined in Appendix A.

4. Results

4.1 Latent Class Mixture Model

We begin by estimating equation (1) above as a pooled, OLS regression, including industry and year fixed effects. Recall that we measure firm risk as the standard deviation of monthly stock returns in year *t+1* (*RET_VOL*), and tax avoidance as five-year, cash ETRs (*TAXAVOID*), which we multiply by negative one, so the measure is increasing in tax avoidance. In these analyses we estimate equation (1) twice. The first estimation includes industry and year fixed effects but no additional control variables. In the second estimation, we also include controls for firm size and pretax profitability. Table 1 presents the results for these estimations. Column 1 (industry and year fixed effects only) indicates that tax avoidance and firm risk are significantly and negatively related, while column 2 (includes controls for firm size and pretax profitability) indicate no significant relation. These results are consistent with those in Guenther et al. (2017), which provides evidence of a sometimes negative and sometimes insignificant relation between ETRs and stock return volatility.

[INSERT TABLE 1 HERE]

4.2 Full Sample Latent Class Mixture Model Results

Turning to the primary latent class mixture model, presented in Table 2, Panel A, we first determine for the full sample of observations, the number of latent classes that minimizes the Bayesian information criterion is four. Class I, representing 19 percent of the population, exhibits a significant *positive* association between tax avoidance and firm risk (coefficient on *TAXAVOID* = 0.006). Two classes exhibit a significant *negative* association between tax avoidance and firm risk, one representing 11 percent of the population (Class IV, coefficient on *TAXAVOID* = -0.042) and the other representing 32 percent of the population (Class III, coefficient on *TAXAVOID* = -0.019). Finally, the largest class (Class II), representing 38 percent of the sample, does not exhibit a significant association between tax avoidance and firm risk (coefficient on *TAXAVOID* = 0.002). Of particular interest, the firms in the latent class exhibiting a *positive* association between tax avoidance and firm risk (Class I) have less overall firm risk, as evidence by lower stock return volatility. In contrast, the firms in the latent class with the strongest *negative* association between tax avoidance and firm risk (Class IV) have higher levels of overall firm risk.

[INSERT TABLE 2 HERE]

Figure 1 provides graphical representations of the relations between tax avoidance and firm risk, as a percentage of total firm risk, for each latent class presented in Table 2, Panel A. The red and yellow lines representing Classes III and IV are relatively steep, downward sloping lines, while the blue line – representing Class I – is relatively steep but upward sloping. Finally, the gray line represents the relation between tax avoidance and firm risk for observations in Class II, where the slope is not statistically different from zero. Based on this figure, it is clear the relation between tax avoidance and firm risk differs substantially across the latent classes.

[INSERT FIGURE 1 HERE]

We now evaluate the extent to which firms differ across the latent classes, by comparing the mean values of important firm attributes that are separately calculated based on the observations assigned to each latent class. Table 2 provides evidence on variation in tax rates, tax planning, and tax shields (Panels B and C), firm characteristics and information environment variables (Panel D and E), and managerial incentive and ownership variables (Panel E), across the four latent classes. Results from ANOVA f-tests indicate the mean values of every variable in Panels B-F are statistically different across the four latent classes. Additionally, t-tests of differences in mean values indicate that firms in the latent class exhibiting a *positive* association between tax avoidance and firm risk (Class I) are statistically different from the firms exhibiting *negative* associations (Classes III and IV), at the ten percent level or better.

The firms in the latent class exhibiting a *positive* association between tax avoidance and firm risk (Class I) have mean values of raw ETRs (*CASH_ETR5*, *GAAP_ETR5*) and ETR volatility (*CASHETR_VOL5*) that are statistically lower than those in Classes III and IV, and settlements with tax authorities (*SETTLEMENT*), foreign income (*FOR_INC%*), and tax haven usage (*HAVEN*) that are statistically higher. These results uniformly indicate that *positive latent class* firms avoid more taxes than *negative latent class* firms, and their tax strategies likely include cross-border income shifting. Positive latent class firms also report lower levels of NOL carryforwards (*NOL*), capital expenditures (*CAPEX*), R&D expenditures *(R&D)*, and interest expense (*INT_EXP*), consistent with these firms using fewer common tax shields. This class of firms is also larger (*ASSETS*), older (*AGE*), and has fewer financial constraints (*WW_INDEX*). They are highly profitable (*PTROA*) and experience lower abnormal stocks returns (*ABN_RETURN*) and lower costs of capital (*COST_EQUITY*, *COST_DEBT*). They also appear to have stronger information environments, with higher analyst following (*ANALYST_FOL*), lower analyst forecast dispersion (*ANALYST_DISP*), and lower bid-ask spreads (*BIDASK_SPREAD*). Finally, these firms have higher *DELTA* and *VEGA*, consistent with the managers at these firms being incentivized to increase firm profits and risk. Collectively, this evidence is consistent with tax avoidance and firm risk being positively related when mature firms seek new ways to reduce tax payments.

Two latent classes, totaling 43 percent of the population, exhibit a significant *negative* relation between tax avoidance and firm risk. Class IV, which represents 11 percent of the population, exhibits the strongest negative association between tax avoidance and firm risk. Compared to Class I firms, Class IV firms experience significantly higher stock return volatility (*RET_VOL*) and pre-tax ROA volatility (*PTROA_VOL5*), consistent with higher overall risk related to business operations. However, tax avoidance does not appear to contribute to that risk (given the negative relation between firm risk and tax avoidance), perhaps because these firms have larger common tax shields such as NOL carryforwards (*NOL*), R&D expenditures (*R&D*) and interest expense (*IND_EXP*). Additionally, the firms in Class IV are younger (*AGE*), smaller (*ASSETS*), less profitable (*PTROA*), and experience higher abnormal returns (*ABN_RETURN*) and costs of capital (*COST_EQUITY*, *COST_DEBT*). They also have relatively weak information environments, as evidenced by lower analyst following (*ANALYST_FOL*), higher analyst forecast dispersion (*ANALYST_DISP*), and higher bid-ask spread (*BIDASK_SPREAD*). The firms in Class IV also have less institutional ownership (*INSTITUT_OWN%*) and lower managerial incentives (*DELTA*, *VEGA*). In short, the Class IV firms differ substantially from Class I firms in every measured firm attribute.

The Class III firms also exhibit a significant and *negative* association between tax avoidance and firm risk and constitute 32 percent of the population. However, the coefficient on *TAXAVOID* in Panel A is much smaller for Class III firms (-0.019) than the coefficient for Class IV firms (-0.042). Nonetheless, Class III firms have characteristics that are generally similar to those for firms in Class IV, including higher interest expense, R&D, and capital expenditures, and larger NOL carryforwards. Additionally, the firms in Class III are smaller, less profitable, exhibit higher abnormal returns and costs of capital, and weaker information environments. In sum, the firms in Class III and Class IV appear to experience greater risk from their business operations, but given the negative relation between firm risk and tax avoidance (and their use of common tax shields), they do not appear to engage in tax avoidance with more uncertain outcomes.

Finally, and perhaps unsurprisingly, the firms in the latent class exhibiting no association between tax avoidance and firm risk (Class II) have attributes with mean values that are in between those of the other latent classes. Overall, the results in Table 2 indicate the relation between tax avoidance and firm risk varies substantially across the latent classes. Additionally, it is apparent that the firms in each latent class are fundamentally different across a number of key dimensions including use of common tax shields, general and risk-taking attributes, information environment, and managerial incentive and ownership characteristics.

To illustrate key fundamental differences across the latent classes, Figure 2, Panels A-C present the interquartile distributions of NOL carryforwards, R&D expenditures, and interest expense for firms in each of the four latent classes. While the middle vertical line in each bar represents the median value for a variable in a specific latent class, the start and end points reflect the 25th and 75th percentile values for that variable, respectively. Statistical tests confirm that the mean values of these variables are significantly different across the latent classes, at the 1 percent significance level. Further, the bar charts illustrate visually striking differences in the interquartile distributions of these common tax shields. Panels D-F present the interquartile distributions of firm age, analyst following, and equity risk incentives (i.e., vega). In addition to differences in the mean values of age across all latent classes, Panel D illustrates that in Classes III and IV the firm in the

75th percentile for age is younger than the median firm in Class I. In Panel E we observe that the 75th percentile of analyst following for Class IV is five analysts, whereas the median firm in Class I is followed by five analysts. Panel F demonstrates that the 25th percentile of vega for Class I firms is close to the median value for Class IV firms.

[INSERT FIGURE 2 HERE]

Taken together, the results in Table 2 and Figures 1 and 2 suggest the following. The Class I firms, which exhibit a significant and *positive* association between firm risk and tax avoidance, are generally mature, strong information environment firms that exhibit *lower* operational volatility. In contrast, the Class III and IV firms, which exhibit significant and *negative* associations between firm risk and avoidance, are generally younger, less profitable firms that benefit from common tax shields and exhibit *higher* operational volatility. Importantly, these latent classes experience fundamentally different relations between firm risk and tax avoidance.

4.3 U.S. Domestic-Only vs. U.S. Multinational Latent Class Mixture Model Results

Next, we separately estimate latent class mixture models for U.S. domestic-only firms and U.S. multinational firms. We partition the full sample based on cross-border activities because U.S. multinational firms have more tax planning opportunities than U.S. domestic-only firms, and many observers perceive cross-border tax avoidance as having more uncertain outcomes with tax authorities. Similar to the results based on the full sample, Table 3 reveals that the latent class mixture model generates four latent classes of U.S. domestic-only firms, one that exhibits a significant and *positive* relation between firm risk and tax avoidance (Class I accounts for 23 percent), and two that exhibit significant and *negative* associations (Class III and IV jointly account for 34 percent). Compared to the *negative latent class* firms, the *positive latent class* U.S.-only firms (in Class I) exhibit lower levels of NOL carryforwards, R&D expenditures, and interest expense, consistent with these firms having fewer opportunities to utilize common tax shields. Additionally, they are older, larger, more profitable firms with stronger information environments, as evidenced by higher analyst following, lower analyst earnings forecast dispersion, and lower bid-ask spreads. The *positive latent class* U.S.-only firms also experience lower operating volatility, smaller abnormal stock returns, and lower costs of capital than *negative latent class* U.S.-only firms. Further, they rely on greater managerial incentives and have more institutional ownership. In sum, the results for U.S.-only firms in Table 3 are similar to those for the full sample in Table 2, where *positive latent class* firms are mature firms with lower levels of overall firm risk, while *negative latent class* firms exhibit relatively high levels of risk related to business operations, but do not appear to engage in more uncertain tax avoidance (given the negative relation between tax avoidance and firm risk).

[INSERT TABLE 3 HERE]

Table 4 presents the latent class mixture model results for the subsample of multinational firms. The estimation procedures again produce four latent classes of firms. Although Class I firms (representing 18 percent of the subsample) exhibit a *positive* association between tax avoidance and firm risk, the relation is not statistically significant at conventional levels (t-statistic = 1.26). The remaining three latent classes exhibit negative associations between tax avoidance and firm risk; however, the relations are statistically significant only for multinational firms in Classes III (33 percent) and IV (12 percent). The characteristics of Class I multinational firms are largely similar to the Class I firms in Tables 2 and 3 that exhibit positive associations between tax avoidance and firm risk. Additionally, the characteristics of Class III and IV multinational firms are largely similar to the Class III and IV firms in Tables 2 and 3. For example, compared to *negative latent class* multinational firms (Classes III and IV), the *positive latent class* multinational firms (Class I) use common tax shields (e.g., interest and NOLs) at a lower rate, are larger, older firms with higher profitability but lower sales growth. They rely on greater managerial incentives and have more institutional ownership. The *positive latent class* multinational firms also exhibit lower operating volatility, lower costs of capital, and stronger information environments than *negative latent class* multinational firms. Taken together, the latent classes presented in Tables 2, 3, and 4 reveal a surprisingly consistent picture of two distinct types of firms, i.e., mature firms that exhibit a significant and *positive* association between tax avoidance and firm risk, and younger firms that benefit from common tax shields and exhibit a significant and *negative* relation between avoidance and risk.

[INSERT TABLE 4 HERE]

4.4 Results for Alternative Dependent Variable – Adjusted Stock Return Volatility

For all primary analyses, our dependent variable is unadjusted monthly stock return volatility during year *t+1*. This measure imposes minimal data restrictions and aligns with our construct of firm risk, i.e., uncertainty about future outcomes. However, one concern with this approach is that our latent class mixture model may be capturing variation in operational volatility and thus, not adequately modelling the relation between tax avoidance and firm risk. To address this concern, we employ an alternative dependent variable: stock return volatility orthogonalized to firm size, profitability, and operating volatility. More precisely, adjusted stock return volatility (*ADJ_RET_VOL*) is the residual from the OLS regression of unadjusted stock return volatility (*RET_VOL*) on the natural log of total assets (*SIZE*), pretax return on assets (*PTROA*), and the volatility of annual *PTROA* measured over the five-year period from *t-4* to *t* (*PTROA_VOL5*), while including industry and year fixed effects. Although we prefer to "let the data speak" in our primary analyses, these supplemental analyses evaluate whether our main findings are driven by variation in firm size, profitability, and operating volatility across the latest classes.

We report in Table 5 the results for the latent class mixture model with adjusted stock return volatility as the dependent variable. Broadly speaking the evidence is consistent with our primary analyses, reported in Table 2. We identify four latent classes by minimizing the Bayesian information criterion. The four classes include one (Class I) that exhibits a *positive* association between tax avoidance and adjusted return volatility, two classes (II and III) that exhibit an insignificant relation, and one class (IV) that exhibits a *negative* relation between tax avoidance and adjusted return volatility. However, the percentage of sample firms assigned to each class differs between the two proxies for stock return volatility. *Positive latent class* firms constitute 19 percent of the full sample when *RET_VOL* is the measure of firm risk (Table 2), but 42 percent of the full sample when *ADJ_RET_VOL* is the measure of firm risk (Table 5). *No relation latent class* firms represent 40 percent of the full sample in Table 5 (Classes II and III), compared to 38 percent in Table 2 (only Class II). Lastly, *negative latent class* firms constitute 43 percent of the full sample when *RET_VOL* is the measure of firm risk (Table 2), but 18 percent when *ADJ_RET_VOL* is the measure of firm risk (*ADJ_RET_VOL*). In short, we observe a shift of *negative latent class* firms in Table 2 to *positive latent class* firms in Table 5.

[INSERT TABLE 5 HERE]

While the percentage of firms within each class varies depending on how stock return volatility is measured, our evaluation of the characteristics of *positive* vs. *negative* latent class firms reinforce inferences from the primary analyses. Specifically, compared to *negative latent class* firms, *positive latent class* firms in Table 5 are larger, older firms with lower sales growth and fewer common tax shields, including interest expense, R&D and capital expenditures, and net operating losses. Additionally, *positive latent class* firms in Table 5 experience lower abnormal returns and lower costs of capital, and have greater institutional stock ownership than *negative latent class* firms. We infer that controlling for firm size, profitability, and operating volatility influences the assignment of specific observations across four latent classes, but not our conclusion that the relation between tax avoidance and firm risk varies substantially across different types of firms.

4.5 Results from Separately Estimating OLS Regressions for Each "Most Likely Latent Class"

The results in Table 2 indicate that the relation between tax avoidance and firm risk varies substantially across four latent classes of firms, as do a long list of important firm attributes. Some readers may wonder if we use OLS to separately estimate equation (1) for each latent class of firms presented in Table 2, but include the variables presented in Panels B-F as control variables, would we obtain coefficient estimates that are similar to those on *TAXAVOID* in Panel A? To examine this possibility, we now re-estimate equation (1) separately for each of the "most likely latent classes" presented in Table 2. We report the results for these robustness tests in Table 6. For ease of comparison, Panel A is simply a re-tabulation of the results in Table 2, Panel A. Panel B reports the results of using OLS to re-estimate equation (1) by "most likely latent class," excluding control variables. Inferences from the results in Panel B (based on OLS) are similar to those in Panel A (based on a latent class mixture model). However, we note a slight difference in the proportion of observations assigned to each class in Panel B. The proportions differ somewhat between the two panels because to estimate OLS regressions for each class, we must assign each observation to a specific class, which we do using the *most likely* class. We use these same class assignments to calculate the descriptive statistics in Panels B-F in Tables 2-5.

Table 6, Panel C presents the results of using OLS to re-estimate equation (1), but we now include many of the firm attributes presented in Panels B-F of Tables 2-5 as control variables. Inferences from these OLS regressions that include control variables continue to be similar to those for the latent class mixture model in Panel A. Panel D again uses OLS to re-estimate equation (1) and includes the same control variables as in Panel C, as well as *DELTA* and *VEGA,* to control for managerial incentives. Although the sample sizes for these regressions are much smaller due to the lack of compensation data for many observations, inferences from these regressions are again similar to the results in Panel A.

Overall, we interpret the results in Table 6 as suggesting three important items of note. First, our "most likely" class assignments are reasonably predictive of the posterior probability class assignments from the latent class mixture model. Second, after identifying the latent classes, separately estimating OLS regressions for each latent class produces results that are similar to those from estimating the latent class mixture model for the full sample. Third and most importantly, we interpret the results in Table 6 as suggesting that the basic relation between firm risk and tax avoidance varies across different subsamples of firms, *even after controlling for underlying observable differences between the firms.* These findings illustrate the usefulness of latent class mixture models in studies where the relation between two variables of interest is expected to vary predictably across subgroups of firms, but the identification of the subgroups is difficult a priori.

[INSERT TABLE 6 HERE]

4.6 Results for Alternative Measure of Firm Risk - Cost of Equity Capital

In this study, we follow Guenther et al. (2017) and measure firm risk as the volatility of monthly stock returns in year *t+1*, which captures both systematic and idiosyncratic risk and imposes minimal data restrictions. However, given that prior research has employed numerous proxies for firm risk, we evaluate the robustness of our results to an alternative measure, the implied cost of equity capital (*R_PEG*) as calculated in Easton (2004). When we estimate a latent class mixture model of the relation between tax avoidance (*TAXAVOID*) and *R_PEG* based on Table 2 sample observations with requisite data, the model again produces four latent classes of firms (results untabulated). One class, representing 34 percent of the sample, exhibits a *positive* association between tax avoidance and the implied cost of equity capital, although the relation is not statistically significant. Despite the lack of significance, we do observe that these positive association firms are similar to the positive association firms in Table 2, i.e., they are mature firms that are larger, highly profitable, use fewer common tax shields, and exhibit lower firm risk.

Consistent with the results in Goh et al. (2016), the latent class mixture model based on *R_PEG* produces two classes of firms (representing 33 percent of the sample) that exhibit significant and *negative* associations between tax avoidance and the implied cost of equity capital. These firms are similar to the Class III and IV firms in Table 2, i.e., they are younger, smaller, less profitable firms that rely on common tax shields and exhibit more volatile stock returns and operations. The remaining class, representing 33 percent, exhibits an insignificant and negative association between avoidance and risk. These supplemental analyses based on the cost of equity capital provide comfort that our primary results are not unique to firm risk as measured by stock return volatility, and also suggest that a significant proportion of firms (67 percent) do *not* exhibit a significant and negative relation between tax avoidance and the cost of capital, as found by Goh et al. (2016) on average.

5. Conclusion

While tax avoidance strategies usually generate higher after-tax cash flows, they often involve uncertain future outcomes, which can impose significant costs on the firm. However, the extent to which tax avoidance increases firm risk is unclear, since tax avoidance strategies vary substantially with respect to outcomes with tax authorities, and it can be difficult for investors to differentiate between firms that employ more versus less certain tax avoidance strategies. This paper re-examines the relation between tax avoidance and firm risk using latent class mixture models.

In our primary analyses based on a broad set of firms, we provide evidence that 19 percent of the sample exhibits a *positive* association between tax avoidance and firm risk, while 43 percent exhibits a *negative* association. The remaining class, representing 38 percent of the sample, exhibits no significant association between tax avoidance and firm risk. Further exploration of the latent class that exhibits a positive association between tax avoidance and firm risk suggests that firms in this class use fewer common tax shields, such as NOL carryforwards, interest, R&D and capital expenditures. These firms are also larger, older firms with higher analyst following, lower abnormal returns and costs of capital, that rely on more powerful managerial compensation incentives. Collectively, this evidence is consistent with tax avoidance being positively related to firm risk primarily when mature firms seek new ways to reduce tax payments. Separate evaluations of U.S. domestic-only firms and U.S. multinational firms, reveal that tax avoidance is positively related to firm risk for a meaningful portion of U.S. domestic-only firms. However, U.S. multinational firms are able to avoid income taxes without significantly increasing firm risk.

Our results should be informative to managers, investors, lenders, and analysts who regularly evaluate the costs and benefits of tax avoidance. Our findings reveal that tax avoidance is positively related to firm risk for specific types of firms (i.e., larger, mature, profitable firms), but not for others, especially those that tend to use common (highly certain) tax shields. Thus, recent evidence that tax avoidance is on average *positively* related to the cost of debt and tax uncertainty – but *negatively* related to the cost of equity – potentially masks the fact that different classes of firms exhibit distinct relations between tax avoidance and realized firm risk. Thus, it is important for financial statement users to evaluate whether tax avoidance is associated with higher vs. lower risk within the context of firm type. Lastly, our study re-introduces a novel econometric technique that is powerful and appropriate in settings where researchers expect the relation between variables of interest to vary across homogeneous subsamples of firms.

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Appendix A Variable Definitions	
ABN_RETURN$_t$	= A firm's stock return over year *t,* less the median stock return for all firms in the same size quintile (measured via total assets) during year *t.*
ABN_RETURN$_{t+1}$	= A firm's stock return over year *t+1,* less the median stock return for all firms in the same size quintile (measured via total assets) during year *t+1.*
AGE	= Calculated based on the number of years a firm is included in COMPUSTAT.
ANALYST_DISP	= The standard deviation of analyst forecasts of earnings per share for year *t*.
ANALYST_FOL	= The number of analysis providing an annual earnings per share forecast for year *t*.
ASSETS	= Total assets as of the end of year *t*, unscaled, in millions.
BIDASK_SPREAD	= Calculated from daily high and low prices (following methodology of Corwin and Schultz 2012).
CAPEX	= Total capital expenditures for the fiscal year (CAPX), scaled by total assets at the beginning of the year (AT). Capital expenditures are reset to zero if missing.
CASH_ETR5	= The cash effective tax rate (Dyreng et. al 2008), which is the sum of cash taxes paid (TXPD) for years *t-4* through year *t*, divided by the sum of adjusted pretax income (PI - SPI) for years *t-4* through year *t*. *CASH_ETR5* is winsorized at values of zero and one.
CASHETR_VOL5	= The standard deviation of the cash effective tax rate (TXPD/(PI-SPI) over the five year periods from *t-4* to *t*.
COST_EQUITY	= Implied cost of equity capital based on the price earnings growth ratio, calculated following Easton (2004). Where the implied cost of equity = $\sqrt{(eps_2 - eps_1)/P}$. Where P is price, eps_2 is the earnings per share forecast for year 2, eps_1 is the earnings per share forecast for year 2, and all variables are measured in the 6th month after the fiscal year end (year 0). Consistent with Callahan et al. (2012), we assume that dividends per share are zero.
COST_DEBT	= Log of (Firm-year average loan interest payment in basis points over LIBOR) (all-in spread), from the Thompson Reuters LPC DealScan Database.
DELTA	= The natural log of the dollar change in an executive's wealth for a one percent increase in stock price in year *t* (based on methodology in Core and Guay 2002).
FOR_INC%	= Foreign pre-tax income (PIFO) divided by total pre-tax income (PI). Foreign pre-tax income is reset to zero if missing.
GAAP_ETR5	= The GAAP effective tax rate, which is the sum of tax expense (TXT) for years *t-4* through year *t*, divided by the sum of adjusted pretax income (PI - SPI) for years *t-4* through year *t*. *GAAP_ETR5* is winsorized at values of zero and one.
HAVEN	= An indicator variable equal to one if the firm reports operations in a tax haven, per Scott Dyreng's website. Due to time period constraints and the cessation of haven disclosures in recent years, we set *HAVEN* equal to one for the years 2012-2016 if the firm reported using havens in any of the years 2011-2016.
INSTITUT_OWN%	= The percentage of outstanding shares owned by institutional investors. Calculated using Thompson Reuters 13F filings.

INSIDE_OWN%	= The number of shares (excluding options) owned by the firm's executives in year *t* as provided by Execucomp (shrown_excl_opts), scaled by the firm's number of outstanding shares in the same year (csho).
INTANG	= Total intangible assets (INTAN) scaled by beginning of year total assets (AT). Total intangible assets are reset to zero if missing.
INT_EXP	= Interest expense (XINT) scaled by beginning of year total assets (AT). Interest expense is reset to zero if missing.
LIFE_CYCLE	= The firm's lifecycle following Dickinson (2011). For ease of interpretation we assign numeric values to each lifecycle stage. We assign "Introduction" a value of 1, "Growth" a value of 2, "Mature" a value of 3, "Shake Out" a value of 4, and "Decline" a value of 5, such that *LIFE_CYCLE* is increasing as the firm progresses throughout the lifecycles. We follow Dickinson and classify each firm-year observation in a specific lifecycle stage based on operating (oancf), investing (ivncf), and financing (fincf) cash flows, as follows: Introduction (if oancf < 0 and ivncf < 0 and fincf >= 0). Growth (if oancf >= 0 and ivncf < 0 and fincf >= 0). Mature (if oancf >= 0 and ivncf < 0 and fincf < 0). Shake-Out (if oancf < 0 and ivncf < 0 and fincf < 0) or (oancf >= 0 and ivncf >= 0 and fincf >= 0) or (oancf >= 0 and ivncf >= 0 and fincf < 0). Decline (if oancf < 0 and ivncf >= 0 and fincf >= 0) or (oancf < 0 and ivncf >= 0 and fincf < 0).
MTB	= Book value of common equity (CEQ) divided by market value of equity as of the fiscal year end (PRCC_F × CSHO).
NOL	= The net operating loss carryforward (TLCF) as of the end of the fiscal year, scaled by total assets at the beginning of the year (AT). Net operating loss carryforward is reset to zero if missing.
ΔNOL	= Current year net operating loss carryforward (TLCF) less prior year net operating loss carryforward, scaled by beginning of year total assets (AT).
PTROA	= Pre-tax return on assets, calculated as pre-tax income (PI) divided by beginning of year total assets (AT).
PTROA_VOL5	= The standard deviation of pre-tax income (PI) scaled by beginning of year total assets (AT), over the five year period from *t-4* to *t*.
R&D	= Total research and development expenditures for the fiscal year (XRD), scaled by beginning of year total assets (AT). Total research and development expenditures are reset to zero if missing.
RET_VOL_{t+1}	= The standard deviation of monthly stock returns from CRSP, calculated for year *t+1*.
S&P_500	= An indicator equal to one if the firm was listed on the S&P 500 during the given year, as reported by the Compustat indices file.
SALES_GROWTH	= Current year sales (SALE) less prior year sales, scaled by prior year sales.
$SETTLEMENT_{t+1,t+3}$	= The sum of settlements with taxing authorities in years *t+1* through *t+3,* scaled by the ending balance of unrecognized tax positions (TXTUBEND) in year *t*.
TAXAVOID	= The cash effective tax rate (Dyreng et. al 2008), which is the sum of cash taxes paid (TXPD) for years *t-4* through year *t*, divided by the sum of adjusted pretax income (PI - SPI) for years *t-4* through year *t*. *CASH_ETR5* is winsorized at values of zero and one. The value is multiplied by negative one, so that tax avoidance is increasing in *CASH_ETR5*.

UTB_END	= Total unrecognized tax benefits at fiscal year-end (TXTUBEND), scaled by beginning of year total assets (AT).
VEGA	= The natural log of the dollar change in an executive's wealth for a one percent increase in stock return volatility in year *t* (based on methodology in Core and Guay 2002).
WW_INDEX	= The Whited-Wu (2006) financial constraint index, multiplied by negative one so that more constrained firms have lower values. The index is calculated as: -0.091×CF – 0.062×DIVPOS + 0.021×TLTD – 0.044×LNTA + 0.102×ISG – 0.035×SG, where CF is operating cash flow (OANCF) scaled by assets (AT), DIVPOS is an indicator variable equal to one if the firm pays dividends during the year (DVC), TLTD Is long-term debt (DLTT) scaled by assets (AT), LNTA is the natural log of total assets (AT), ISG is the 3 digit SIC industry median sales growth, and SG is the firm's sales growth calculated as current year sales (SALE) less prior year sales, scaled by prior year sales.

Figure 1
Graphical Representation of Relation between Tax Avoidance and Firm Risk
As a Percentage of Average Firm Risk for the Latent Class
(Results Reported in Table 2, Panel A)

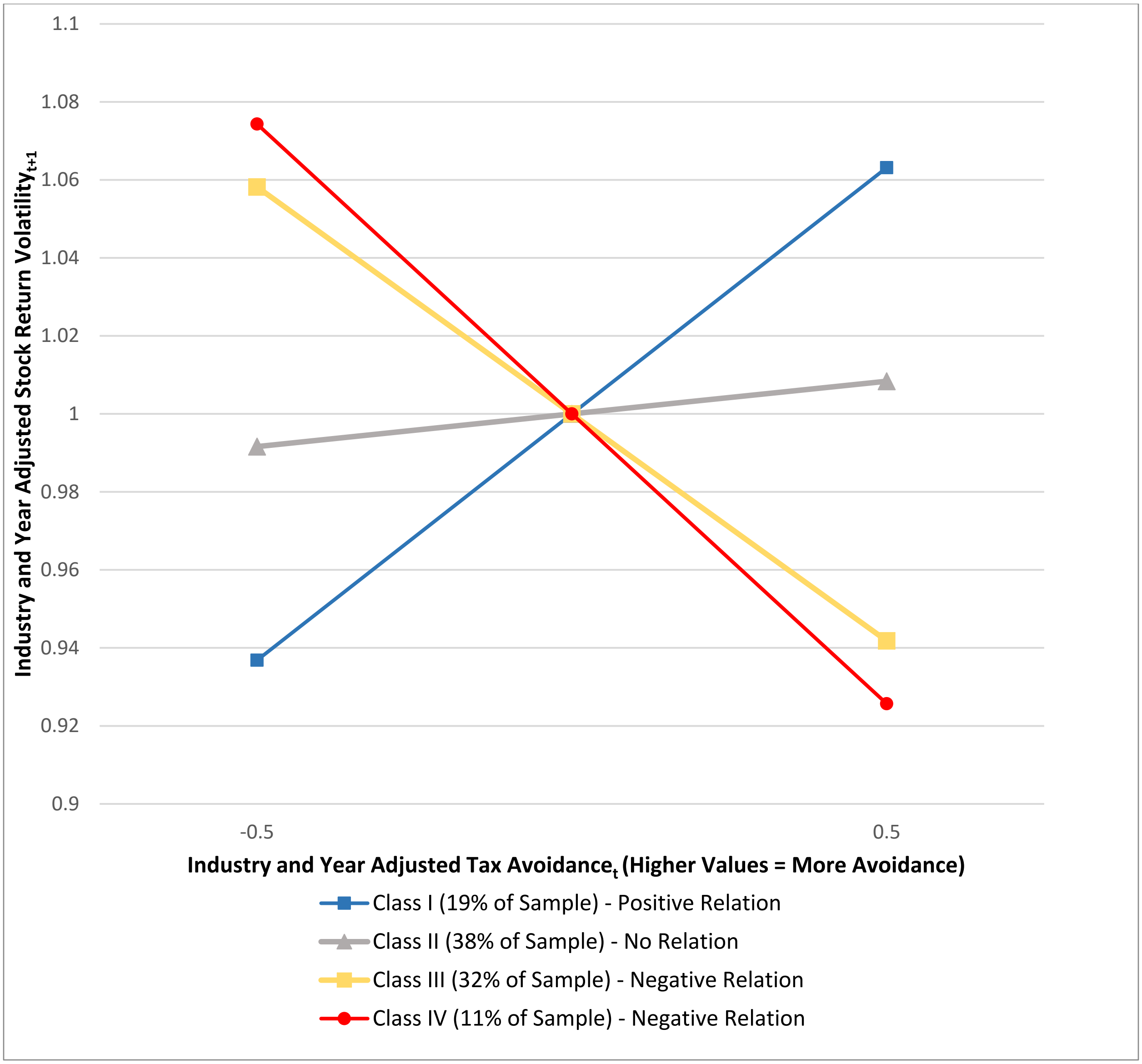
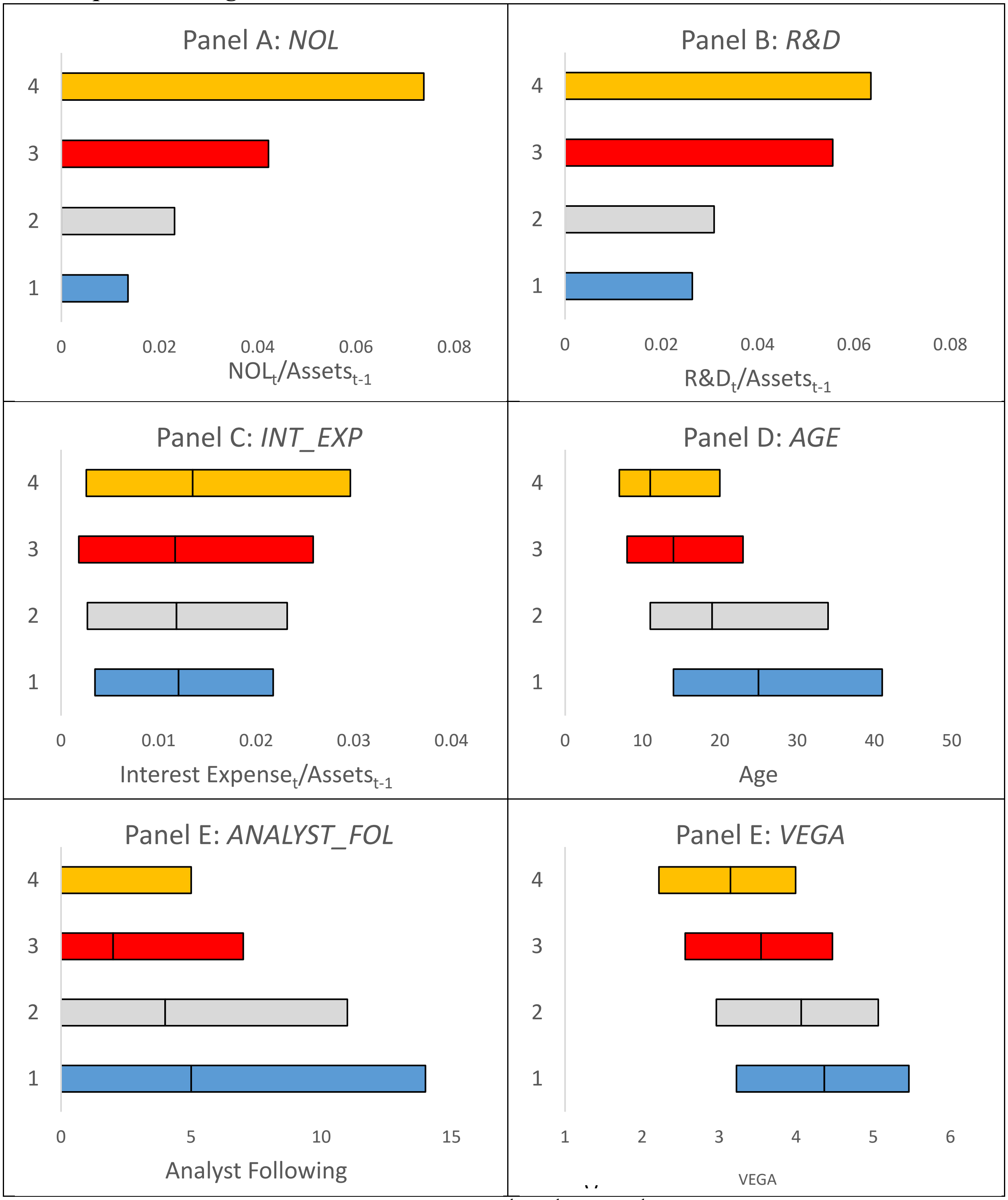


Figure 2
Interquartile Ranges for Select Variables across the Latent Classes in Table 2, Panel A



The charts in Panels A-E provide the values for the 25th, 50th, and 75th percentiles of the respective variables for each latent class presented in Table 2, Panel A.

Table 1 - Results for Pooled OLS Regressions of Monthly Stock Return Volatility in Year *t+1* (*RET_VOL*) on 5-Year Cash ETRs (*TAXAVOID)* in Year *t*

	(1) Coefficient (T-Stat)	(2) Coefficient (T-Stat)
TAXAVOID	-0.022***	-0.002
	(-8.55)	(-0.80)
PTROA		-0.107***
		(-27.19)
Log(ASSETS)		-0.010***
		(-35.24)
Fixed Effects	Industry and Year	Industry and Year
Observations	47,137	47,137
R-squared	0.182	0.284

Notes: *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively, based on two-sided t-tests. Variables are defined in Appendix A.

Table 2 - Results for Latent Class Mixture Model of the Relation between Monthly Stock Return Volatility in Year *t+1* (*RET_VOL*) and 5-Year Cash ETRs (*TAXAVOID)* – Full Sample

Panel A: Results for Estimation of Latent Class Mixture Model (Total # Observations = 47,137)				
Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.006***	0.002	-0.019***	-0.042***
T-statistic	(3.20)	(0.96)	(-8.70)	(-8.62)
% of Total Obs.	19%	38%	32%	11%
Panel B: Mean Values for Latent Class Mixture Model Variables and Other Tax Rate Variables				
RET_VOL_{t+1}	0.069	0.092	0.161*	0.282*
CASH_ETR5	0.292	0.289	0.305*	0.329*
GAAP_ETR5	0.312	0.310	0.310	0.323*
CASHETR_VOL5	0.097	0.109	0.132*	0.150*
Panel C: Mean Values for Tax Planning and Tax Shield Variables				
UTB_END	0.011	0.010	0.009*	0.009*
SETTLEMENT	0.264	0.256	0.224*	0.199*
FOR_INC%	0.200	0.207	0.173*	0.139*
HAVEN	0.336	0.305	0.245*	0.217*
INTANG	0.182	0.166	0.143*	0.128*
R&D	0.022	0.026	0.038*	0.042*
NOL	0.031	0.046	0.070*	0.089*
ΔNOL	0.001	0.002	0.005*	0.013*
CAPEX	0.060	0.066	0.071*	0.064*
INT_EXP	0.015	0.015	0.017*	0.019*
Panel D: Mean Values for Firm Characteristic Variables				
AGE (in years)	27.5	23.3	17.5*	15.3*
ASSETS (Millions)	5520.8	3093.6	1189.8*	775.7*
S&P_500	0.308	0.183	0.065*	0.029*
PTROA	0.111	0.104	0.080*	0.028*
ABN_RETURN_t	0.046	0.082	0.131*	0.077*
ABN_RETURN_{t+1}	0.039	0.047	0.087*	0.296*
SALES_GROWTH	0.083	0.102	0.134*	0.105*
MTB	2.934	2.747	2.502*	2.221*
LIFE_CYCLE	2.796	2.726	2.601*	2.584*
WW_INDEX	0.345	0.316	0.263*	0.230*
Panel E: Mean Values for Volatility, Cost of Capital, and Information Environment Variables				
PTROA_VOL5	0.047	0.057	0.088*	0.111*
COST_EQUITY	0.094	0.106	0.130*	0.157*
COST_DEBT	4.514	4.771	5.144*	5.375*
ANALYST_FOL	8.250	7.001	4.808*	3.081*
ANALYST_DISP	0.060	0.066	0.070*	0.081*
BIDASK_SPREAD	0.009	0.010	0.015*	0.019*
Panel F: Mean Values for Executive Compensation and Ownership Variables				
DELTA	6.004	5.799	5.498*	5.028*
VEGA	4.198	3.899	3.443*	3.058*
INSTITUT_OWN%	0.497	0.493	0.399*	0.292*
INSIDE_OWN%	0.035	0.040	0.050*	0.052*

Notes: Analysis includes industry and year fixed effects. In Panels B-F all variables are statistically different across the four classes at < 0.001 significance level, based on ANOVA F-tests for differences. * denotes statistically significant difference in means for columns (3) and (4) as compared to column (1), based on t-tests.

Table 3 - Results for Latent Class Mixture Model of the Relation between Monthly Stock Return Volatility in Year *t+1* (*RET_VOL*) and 5-Year Cash ETRs (*TAXAVOID*) - U.S. Domestic-Only Firms

Panel A: Results for Estimation of Latent Class Mixture Model (Total # Observations = 25,077)				
Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.014***	-0.001	-0.015***	-0.041***
T-statistic	(3.69)	(-0.36)	(-3.34)	(-6.20)
% of Total Obs.	23%	44%	21%	13%
Panel B: Mean Values for Latent Class Mixture Model and Other Tax Rate Variables				
RET_VOL_{t+1}	0.070	0.108	0.182*	0.286*
CASH_ETR5	0.305	0.294	0.315	0.333*
GAAP_ETR5	0.329	0.318	0.317*	0.322
CASHETR_VOL5	0.103	0.113	0.135*	0.152*
Panel C: Mean Values for Tax Planning and Tax Shield Variables				
UTB_END	0.007	0.005	0.006*	0.006*
SETTLEMENT	0.231	0.223	0.193*	0.260
INTANG	0.142	0.133	0.119*	0.115*
R&D	0.012	0.018	0.030*	0.032*
NOL	0.028	0.040	0.055*	0.071*
ΔNOL	0.000	0.002	0.004*	0.010*
CAPEX	0.069	0.078	0.080*	0.068
INT_EXP	0.015	0.017	0.019*	0.019*
Panel D: Mean Values for Firm Characteristic Variables				
AGE (in years)	23.125	18.851	14.517*	13.640*
ASSETS (Millions)	2551.246	1416.573	574.955*	506.705*
S&P_500	0.153	0.074	0.020*	0.014*
PTROA	0.113	0.105	0.079*	0.035*
ABN_RETURN_t	0.063	0.095	0.146*	0.085*
ABN_RETURN_{t+1}	0.033	0.054	0.111*	0.319*
SALES_GROWTH	0.087	0.128	0.152*	0.114*
MTB	2.496	2.501	2.324*	2.218*
LIFE_CYCLE	2.800	2.667	2.558*	2.582*
WW_INDEX	0.303	0.274	0.232*	0.210*
Panel E: Mean Values for Volatility, Cost of Capital, and Information Environment Variables				
PTROA_VOL5	0.051	0.067	0.098*	0.112*
COST_EQUITY	0.095	0.109	0.130*	0.162*
COST_DEBT	4.617	4.927	5.229*	5.425*
ANALYST_FOL	5.343	4.783	3.406*	2.475*
ANALYST_DISP	0.057	0.063	0.066*	0.076*
BIDASK_SPREAD	0.010	0.013	0.017*	0.021*
Panel D: Mean Values for Executive Compensation and Ownership Variables				
DELTA	5.738	5.643	5.436*	4.973*
VEGA	3.695	3.478	3.296*	2.931*
INSTITUT_OWN%	0.395	0.387	0.302*	0.237*
INSIDE_OWN%	0.053	0.058	0.066*	0.060*

Notes: Analysis includes industry and year fixed effects. In Panels B-F all variables are statistically different across the four classes at < 0.001 significance level, except *SETTLEMENT* (p=0.354), based on ANOVA F-tests for differences. * denotes statistically significant difference in means for columns (3) and (4) as compared to column (1), based on t-tests.

Table 4 - Results for Latent Class Mixture Model of the Relation between Monthly Stock Return Volatility in Year *t+1* (*RET_VOL*) and 5-Year Cash ETRs (*TAXAVOID)* - U.S. Multinational Firms

Panel A: Results for Estimation of Latent Class Mixture Model (Total # Observations = 22,060)

Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.004	-0.003	-0.024***	-0.045***
T-statistic	(1.26)	(-1.04)	(-5.74)	(-6.16)
% of Total Obs.	18%	37%	33%	12%
Panel B: Mean Values for Latent Class Mixture Model and Other Tax Rate Variables				
RET_VOL_{t+1}	0.072	0.081	0.146*	0.258*
CASH_ETR5	0.283	0.282	0.296*	0.319*
GAAP_ETR5	0.299	0.296	0.304	0.320*
CASHETR_VOL5	0.097	0.103	0.130*	0.148*
Panel C: Mean Values for Tax Planning and Tax Shield Variables				
UTB_END	0.012	0.013	0.012	0.011
SETTLEMENT	0.263	0.267	0.245	0.206*
FOR_INC%	0.393	0.406	0.419*	0.411*
HAVEN	0.537	0.505	0.457*	0.419*
INTANG	0.216	0.209	0.168*	0.148*
R&D	0.031	0.035	0.050*	0.059*
NOL	0.043	0.051	0.085*	0.116*
ΔNOL	0.002	0.003	0.007*	0.016*
CAPEX	0.051	0.052	0.059*	0.061*
INT_EXP	0.014	0.014	0.015*	0.018*
Panel D: Mean Values for Firm Characteristic Variables				
AGE (in years)	30.492	28.340	20.908*	18.515*
ASSETS (Millions)	6895.466	5662.884	2161.821*	1307.207*
S&P_500	0.393	0.327	0.137*	0.064*
PTROA	0.106	0.101	0.078*	0.024*
ABN_RETURN_t	0.065	0.052	0.101*	0.074
ABN_RETURN_{t+1}	0.046	0.042	0.057	0.222*
SALES_GROWTH	0.076	0.079	0.115*	0.100*
MTB	3.193	3.105	2.708*	2.324*
LIFE_CYCLE	2.809	2.788	2.671*	2.586*
WW_INDEX	0.374	0.359	0.302*	0.270*
Panel E: Mean Values for Volatility, Cost of Capital, and Information Environment Variables				
PTROA_VOL5	0.046	0.050	0.081*	0.104*
COST_EQUITY	0.094	0.100	0.125*	0.154*
COST_DEBT	4.445	4.618	4.999*	5.253*
ANALYST_FOL	10.037	9.605	6.940*	4.479*
ANALYST_DISP	0.066	0.067	0.073*	0.083*
BIDASK_SPREAD	0.008	0.008	0.012*	0.016*
Panel F: Mean Values for Executive Compensation and Ownership Variables				
DELTA	6.020	5.995	5.602*	5.091*
VEGA	4.308	4.282	3.686*	3.138*
INSTITUT_OWN%	0.594	0.596	0.520*	0.399*
INSIDE_OWN%	0.025	0.028	0.037*	0.045*

Notes: Analysis includes industry and year fixed effects. In Panels B-F all variables are statistically different across the four classes at < 0.001 significance level, except *SETTLEMENT* (p=0.029) and *UTB_END* (p=0.056), based on ANOVA F-tests for differences. * denotes statistically significant difference in means for columns (3) and (4) as compared to column (1), based on t-tests.

Table 5 - Results for Latent Class Mixture Model of the Relation between Adjusted Monthly Stock Return Volatility in Year *t+1* (*ADJ_RET_VOL*) and 5-Year Cash ETRs (*TAXAVOID)* – Full Sample

Panel A: Results for Estimation of Latent Class Mixture Model (Total # Observations = 47,137)				
Dep. Var. = *ADJ_RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.028***	0.003	-0.004	-0.024***
T-statistic	(7.71)	(0.51)	(-0.78)	(-5.09)
% of Total Obs.	42%	7%	33%	18%
Panel B: Mean Values for Latent Class Mixture Model and Other Tax Rate Variables				
RET_VOL$_{t+1}$	0.092	0.178	0.115	0.235*
CASH_ETR5	0.278	0.311	0.330	0.311*
GAAP_ETR5	0.301	0.318	0.328	0.321*
CASHETR_VOL5	0.108	0.126	0.114	0.131*
Panel C: Mean Values for Tax Planning and Tax Shield Variables				
UTB_END	0.010	0.009	0.011	0.009*
SETTLEMENT	0.244	0.207	0.262	0.230
FOR_INC%	0.201	0.176	0.192	0.174*
HAVEN	0.303	0.248	0.298	0.257*
INTANG	0.171	0.133	0.151	0.136*
R&D	0.028	0.042	0.025	0.036*
NOL	0.055	0.053	0.041	0.076*
ΔNOL	0.003	0.005	0.003	0.008*
CAPEX	0.062	0.073	0.067	0.070*
INT_EXP	0.015	0.017	0.017	0.019*
Panel D: Mean Values for Firm Characteristic Variables				
AGE (in years)	24.130	18.280	22.715	17.968*
ASSETS (Millions)	3356.576	1981.584	3037.986	1506.621*
S&P_500	0.194	0.121	0.174	0.074*
PTROA	0.093	0.102	0.097	0.073*
ABN_RETURN$_t$	0.073	0.126	0.100	0.118*
ABN_RETURN$_{t+1}$	0.056	0.082	0.060	0.185*
SALES_GROWTH	0.092	0.151	0.103	0.130*
MTB	2.739	2.757	2.556	2.440*
LIFE_CYCLE	2.735	2.566	2.721	2.597*
WW_INDEX	0.313	0.275	0.304	0.264*
Panel E: Mean Values for Volatility, Cost of Capital, and Information Environment Variables				
PTROA_VOL5	0.064	0.078	0.067	0.084*
COST_EQUITY	0.106	0.135	0.111	0.135*
COST_DEBT	4.772	5.212	4.763	5.212*
ANALYST_FOL	7.004	5.870	6.094	4.544*
ANALYST_DISP	0.064	0.068	0.071	0.077*
BIDASK_SPREAD	0.011	0.015	0.012	0.016*
Panel D: Mean Values for Executive Compensation and Ownership Variables				
DELTA	5.804	5.838	5.734	5.461*
VEGA	3.933	3.799	3.866	3.323*
INSTITUT_OWN%	0.490	0.395	0.440	0.366*
INSIDE_OWN%	0.039	0.047	0.041	0.052*

Notes: Analysis includes industry and year fixed effects. In Panels B-F all variables are statistically different across the four classes at < 0.001 significance level, based on ANOVA F-tests for differences. * denotes statistically significant difference in means for column (4) as compared to column (1), based on t-tests.

Table 6 - Results for OLS Regressions of Monthly Stock Return Volatility in Year *t+1* (*RET_VOL*) on 5-Year Cash ETRs (*TAXAVOID*), Using the Most Likely Class – Full Sample

Panel A: Results for Estimation of Latent Class Mixture Model (Total # Observations = 47,137)
As reported in Table 2, Panel A, for Ease of Comparison.

$RET\_VOL_{t+1} = \alpha + \beta_1 Tax\ Avoidance_t + Industry\ FE + Year\ FE + \varepsilon$

Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.006***	0.002	-0.019***	-0.042***
T-statistic	(3.20)	(0.96)	(-8.70)	(-8.62)
% of Total Obs.	19%	38%	32%	11%

Panel B: Results for Separate OLS Estimations for Each Latent Class, Using Most Likely Class Membership, No Control Variables Included (N= 47,137)

$RET\_VOL_{t+1} = \alpha + \beta_1 Tax\ Avoidance_t + Industry\ FE + Year\ FE + \varepsilon$

Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.004***	0.001	-0.012***	-0.027***
T-statistic	(4.83)	(1.29)	(-11.43)	(-7.63)
% of Total Obs.	21%	43%	28%	8%

Panel C: Results for Separate OLS Estimations for Each Latent Class, Using Most Likely Class Membership, Including Controls that Allow for Large Sample (N= 43,720)

$$\begin{aligned} RET\_VOL_{t+1} = {} & \alpha + \beta_1 Tax\ Avoidance_t + Haven + INTANG + R\&D + NOL + \Delta NOL + CAPEX \\ & + Log(AGE) + Log(ASSETS) + S\&P500 + PTROA + ABN\_RETURN \\ & + SALES\_GROWTH + MTB + LIFECYCLE + WW\_INDEX + PTROA\_VOL5 \\ & + Log(ANALYST_{FOL}) + BIDASK\_SPREAD + INSTITUT\_OWN\% + Industry\ FE \\ & + Year\ FE + \varepsilon \end{aligned}$$

Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.003***	0.001	-0.009***	-0.014***
T-statistic	(3.61)	(1.35)	(-7.75)	(-3.68)
% of Total Obs.	22%	44%	28%	6%

Panel D: Results for Separate OLS Estimations for Each Latent Class, Using Most Likely Class Membership, Including Controls for *DELTA* and *VEGA* (N= 14,954)

$$\begin{aligned} RET\_VOL_{t+1} = {} & \alpha + \beta_1 Tax\ Avoidance_t + Haven + INTANG + R\&D + NOL + \Delta NOL + CAPEX \\ & + Log(AGE) + Log(ASSETS) + S\&P500 + PTROA + ABN\_RETURN \\ & + SALES\_GROWTH + MTB + LIFECYCLE + WW\_INDEX + PTROA\_VOL5 \\ & + Log(ANALYST_{FOL}) + BIDASK\_SPREAD + INSTITUT\_OWN\% + DELTA \\ & + VEGA + Industry\ FE + Year\ FE + \varepsilon \end{aligned}$$

Dep. Var. = *RET_VOL*	Class I	Class II	Class III	Class IV
Coeff. on *TAXAVOID*	0.003**	0.001	-0.007***	-0.018**
T-statistic	(1.99)	(1.18)	(-2.84)	(-1.97)
% of Total Obs.	26%	48%	22%	4%

Notes: *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively, based on two-sided t-tests. Variables are defined in Appendix A.