Tax Avoidance, Tax Risk, and the Volatility of Stock Returns

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Abstract

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Abstract

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1. Introduction and motivation

Analytical arguments contend that corporate tax avoidance increases firm value by transferring wealth from governments to shareholders. However, based on agency theory-based alternative arguments, corporate tax avoidance could be linked with earnings manipulation, resource diversion, and risk-shifting (e.g., Chen et al., 2010; Desai and Dharmapala, 2006, 2009); this can offset the benefits of tax avoidance to shareholders. Motivated by this dichotomy empirical research continues to explore the effects of corporate tax avoidance and its related tax risk — tax risk is defined as the volatility of the effective tax rates that corporations pay.

The effects of corporate tax avoidance on equity value and risk has drawn the attention of current research. Prior work primarily focuses on the relation between tax avoidance and shareholder value, cost of equity, firm risk, and stock return crash risk. Seminal research papers in this area include Desai and Dharmapala (2009), who show that tax avoidance is only value-adding in a corporate environment with effective monitoring that reduces tax avoidance-related

managerial opportunism.[1] In support of the agency theory related view, Hanlon and Slemrod (2009) report negative stock market reactions to news about corporate involvement in tax shelters.[2] We add to this body of literature by exploring the relation between tax avoidance, its related tax risk, and the volatility of stock returns. To illuminate the parts that cash flow- and discount rate-based arguments play, we use variance decomposition (Campbell, 1991; Campbell and Shiller, 1988) to separate discount rate news from cash flow news. In additional examinations we distinguish between domestic corporations (DCs) and multinational corporations (MNCs) to survey the effects of corporate international diversification (CID) on the relation between tax avoidance and stock return volatility.

The papers closest to our study are Guenther et al. (2017) and Kim et al. (2011). In the former paper, Guenther et al. (2017) report a positive relation between tax rate volatility and firm risk, a negative relation between tax avoidance and firm risk, and a positive relation between tax rates and future stock return volatility.[3] In the latter paper, Kim et al. (2011) show a positive relation between tax avoidance and firm-specific stock price crash risk. Kim et al. (2011) argue that their findings are consistent with managerial bad news hoarding for extended time periods — resulting stock price crashes are due to the release of accumulated bad news, once the firm has reached a tipping point.

[1] Desai and Dharmapala (2009) find a positive relation between tax avoidance and firm value, but only for firms with high institutional ownership.

[2] Hanlon and Slemrod (2009) observe negative market reaction to news about firms' involvement in tax shelter activities. The authors argue that investors are concerned about tax shelter disclosures and the possibility of associated managerial asset diversion and performance manipulation.

[3] Guenther et al. (2017) conclude that corporate tax avoidance strategies are persistent, thus do not increase firm risk. This is harmonious with their additional finding — a positive relation between tax rates and future stock return volatility.

We put forth that tax avoidance / risk could affect stock return volatility through its cash flow and discount rate channels for several reasons. It is possible that: 1) Tax avoidance increases volatility through unpredictable outcomes with tax authorities and unanticipated changes in tax laws. Uncertain tax outcomes could lead to larger cash flow surprises for investors, and thus result in increased volatility of expected cash flows. 2) If firms, as part of their tax avoidance strategies, invest in overly risky projects, tax avoidance could correlate with the firm's future riskiness. It follows that tax avoidance could result in increased volatility of future expected returns (discount rates). 3) Tax avoidance strategies increase the opacity of financial reports, thereby increasing the uncertainty of the firm's future cash flows. (Blouin, 2014; Guenther et al., 2017). If investors would perceive this as additional risk, this cash flow effect could also be tied to increased uncertainty of future expected returns. It follows that, based on few intuitive arguments, there could be increased volatility in both, expected cash flows and discount rates.

In addition to the potential negative effects, there is of course the possibility that tax avoidance / risk does not affect stock return volatility; if lower tax rates mainly reflect "benign tax-favored investments" (Dyreng et al., 2014), then tax avoidance activities would unlikely result in cash flow or discount rate surprises for investors. Another possibility is that tax avoidance-related actions may not contain additional information for investors and thus not affect the uncertainty of expected cash flows and expected stock returns (Guenther et al., 2017).[4]

[4] Indirect evidence on the effects of tax avoidance on stock return volatility is provided by several studies that analyze the effects of tax avoidance on components of firm risk; Shevlin et al. (2013) and Hasan et al. (2014) analyze cost of debt. Goh et al. (2016) and Cook et al. (2017) analyze the cost of equity. Overall this research concludes that tax avoidance is perceived as a risk by debt holders. However, results are ambiguous with respect to costs of equity. Whereas Goh et al. (2016) find that costs of equity are lower for tax-avoiding firms, Cook et al. (2017) report the opposite for ex-ante costs of equity. Although these studies provide some indirect evidence that stock return volatility is higher for tax-avoiding firms, further analysis is needed to provide a definite answer.

For a large sample of U.S.-traded firms (the CRSP / Compustat intersection), we observe a U-shaped relation between tax avoidance and stock return volatility; firms with relatively low or high levels of tax avoidance appear to have more volatile stock returns.[5] More formal tests based on firm-level fixed effects models further strengthen our core finding. Further, we find that that firms with higher levels of tax risk have higher stock return volatilities. Additional test reveal that the observed relations appear to be primarily determined by investor's cash flow expectations, and that our results do not differ for DCs compared to MNCs.

Our findings have several important implications for researchers, investors, and managers. First, our study highlights the need for researchers to further explore the non-linear effects of corporate tax avoidance and to further examine the role of tax risk. For financial managers and investors alike, our results emphasize that corporate tax avoidance is a double-edged sword where high levels of tax avoidance are linked to increased risk, but that investors also perceive low levels of tax avoidance to be linked to increased risk. The positive relation between tax risk and stock return volatility emphasizes that financial managers need to recognize tax risk as a source of risk for its investors, and more importantly, be aware that investors perceive tax risk as a contributing source of equity risk.

This study proceeds as follows. Section 2 develops the research hypotheses. Section 3 discusses the methodology used. Section 4 discusses the construction of the sample. Section 5 presents and discusses the study's results and findings. Section 6 concludes.

[5] Based on univariate tests, for more extreme forms of tax avoidance, as measured by the probability of a firm partaking in tax shelter activities, the relation is monotonic — firms with high probabilities of taking part in tax shelters appear to have lower stock return volatilities. However, in the multivariate test setting this relation becomes mostly statistically insignificant.

2. Hypothesis development and relevant literature

Why could there be a link between tax avoidance and stock return volatility? Why could tax risk correlate with stock return volatility?

Based on prior research, there are several reasons why there might be a relation between tax avoidance / risk and stock return volatility. The first possibility is that tax avoidance could increases uncertainty for equity holders through unpredictable outcomes with tax authorities, changes of tax laws that provide equity investors with tax benefits, increasingly risky tax avoidance-related corporate investments, and more opaque tax avoidance-related financial reporting — such sources of uncertainty could increase stock return volatility through either or both, a cash flow and discount rate channel. Conversely, tax avoidance behavior often correlates with corporate earnings smoothing, which in turn could reduce cash flow volatility and consequently also reduce stock return volatility through a cash flow channel. Naturally, a third possibility is that tax avoidance does not affect stock return volatility. This could be the case for firms where lower tax rates mainly reflect "benign tax-favored investments" (Dyreng et al., 2014) or for firms where information about tax avoidance strategies does not provide value-relevant information to investors (Guenther et al., 2017).

Several studies provide arguments for, and indirect evidence of, a positive relation between tax avoidance and stock return volatility. Among these papers, a study by Rego and Wilson (2012) finds that CEOs of firms with lower effective tax rates (ETRs), receive more risk-taking incentives through their executive compensation schemes encouraging managers to take on risky tax avoidance strategies. Balakrishnan et al. (2012) argue that tax aggressiveness is positively associated with lower transparency and larger information asymmetry. The combination of increased complexity with reduced disclosure, for example the failing of reporting operations in

geographic segments (Hope et al., 2013), increases uncertainty of the firms' future cash flows. Further, Kim et al. (2011) using a sample of U.S. firms between 1995 and 2008, find a positive relation between tax avoidance and firm-specific stock price crash risk.[6] Finally, Choy et al. (2017), study stock market effects of a 2011 publication of a British (ActionAid) report that condemned FTSE-100 companies for owning unusual amounts of subsidiaries in tax haven countries. Choy et al. (2017) find that after the publication of the report stock prices of involved firms dropped by 0.9%.[7] Their results are consistent with investors perceiving corporate involvement in tax shelters to be risk-increasing.[8]

However, the relation between tax avoidance and stock return volatility does not need to be positive. Tax avoidance encompasses a wide range of activities, including some that are of relatively low risk (Dyreng et al., 2014). Such benign tax-reducing activities can include corporate investment in tax-advantaged instruments and would unlikely affect stock return volatility. Empirical evidence that finds no relation between tax avoidance and firm risk includes studies by Lisowsky et al. (2013) and Dyreng et al. (2008). The latter paper finds that some firms are able to sustain low ETRs over long time periods, which actually reduces tax risk (low volatility in ETRs). Further, evidence of a negative relation between tax avoidance and stock return volatility is provided by Badertscher et al. (2012) who find that managerial ownership positively correlates

[6] Kim et al. (2011) argue that their findings are consistent with managerial bad news hoarding for extended time periods — stock price crashes result from the release of accumulated bad news, once the firm has reached a tipping point. Moreover, Kim et al. (2011) show that strong external monitoring weakens the relation between tax avoidance and stock price crash risk.

[7] Evidence or risk-increasing effects of tax avoidance on debt is reported by Hasan et al. (2014) who find that firms with higher levels of tax avoidance get charged higher bank loan spreads. Firm with tax avoidance also incur more stringent nonprice loan terms. Consistent with the arguments brought forth by Hasan et al. (2014), Shevlin et al. (2013), find a negative association between tax rates and costs of public debt.

[8] This of course assumes that expected cash flows remain unchanged, but that future expected stock returns (discount rates) increase due to higher risk.

with ETRs; this suggests that managers with concentrated equity positions avoid the risk associated with tax avoidance strategies. Moreover, Guenther et al. (2017) find a positive relation between tax rates and future stock return volatility, but an overall positive relation between tax rate volatility and firm risk.[9] Finally, Goh et al. (2016) observe that costs of equity are lower for firms that participate in tax avoidance.[10,11]

Whether there is a relation between tax avoidance / risk and stock return volatility remains an empirical question. For the sake of exposition, we formulate the first set of hypotheses as follows:

H1a: Firms with higher levels of tax avoidance have more volatile stock returns.

H1b: Firms with higher levels of tax risk have more volatile stock returns.

As the aforementioned literature indicates, tax avoidance and tax risk can affect stock return volatility through two channels (and the interaction between the two channels) — a cash flow and a discount rate channel. Distinguishing between the two channels is valuable for several reasons: First, shocks to discount rates are permanent, whereas shocks to cash flows are not. Second, investors can diversify cash flow news but not discount rate news (Vuolteenaho, 2002).

[9] Guenther et al. (2017) explore the effects of tax avoidance on firm risk and find that low tax rates are more persistent than high tax rates, concluding that tax avoidance strategies are persistent, thus do not increase firm risk.

[10] Goh et al. (2016) observe that the effect is stronger for firms with better outside monitoring, firms that realize higher marginal benefits from tax savings, and firms with better information quality. Authors argue that equity investors require a lower expected rate of return due to positive cash flow effects associated with tax avoidance.

[11] In contrast to Goh et al. (2016), using ex ante cost of equity estimates, Cook et al. (2017) find increases in ex ante cost of equity when investors experience surprises in tax avoidance. Cook et al. (2017) argue that firms adjust their tax avoidance activities from their prior-year levels, if tax avoidance was above or below investor expectation. The authors argue that their paper provides evidence of trade-off between tax benefits and non-tax costs associated with tax avoidance.

Third, examining the two channels separately, and their interaction, provides us with deeper insight into the mechanisms that connect tax avoidance / risk with stock return volatility.

The body of literature on stock return variance decomposition is vast.[12] At the individual firm level, Vuolteenaho (2002) observes that individual stock returns are mainly driven by cash flow news and that shocks to discount rate and cash flows are positively correlated — good news about cash flows is typically associated with higher expected returns, particularly for small-to-medium size firms.[13] Further, the Vuolteenaho (2002) study finds that discount rate news are highly correlated across firms, whereas cash flow news is largely diversifiable in aggregate portfolios. Vuolteenaho (2002) concludes that cash flow news is largely firm-specific and that expected return news is primarily determined by systematic components. Relying on alternative measures of cash flow and discount rate news, a study by Chen et al. (2013) — using direct cash flow forecasts and implied costs of equity — confirms the importance of cash flow news for stock prices of individual firms.

Whether tax avoidance and tax risk primarily affect cash flow or discount rate news cannot be deduced from the Vuolteenaho (2002) and Chen et al. (2013) studies. Perhaps, due to the dominance of cash flow news at the individual firm-level, and the idiosyncratic nature of tax avoidance / risk, it is plausible that the main link between tax avoidance / risk and stock return volatility is the cash flow channel. However, this need not be the case. Tax avoidance and risk

[12] Most variance decomposition papers focus on portfolio level analysis. Landmark studies include: Campbell (1991), Campbell and Ammer (1993), Campbell and Mei (1993), Campbell et al. (2009b), Campbell and Vuolteenaho (2004), Chen and Zhao (2009), Eisdorfer (2007), and Maio and Philip (2015).

[13] In contrast to Vuolteenaho (2002), variance decomposition at the aggregate market and portfolio levels typically concludes that discount rate news dominate cash flow news (e.g., Campbell, 1991; Campbell and Ammer, 1993; Campbell et al., 2009b; Campbell and Vuolteenaho, 2004). A notable exception is (Chen et al., 2013) who use alternative measures of cash flow and discount rate news. The latter study documents the importance of cash flow news, even at the portfolio level.

could mainly be linked through discount rate news. As investors perceive tax-avoiding firms to be riskier than their peers, investors would expect higher future stock returns — this mechanism would mainly affect discount rate news.

Also, to consider is the agency theory perspective. If tax avoidance / risk are strongly tied to agency problems, a paper by Eisdorfer (2014) provides valuable direction. Eisdorfer (2014) argues that managers move firm value by mainly changing expected cash flows and not firm risk.[14] For our study this would imply that if tax avoidance / risk mainly correlate with managerial value-shifting, then we expect to observe that the volatility impact of tax avoidance / risk would mainly affect cash flow news. Such a view would also be consistent with tax avoidance being mainly linked to the cash flow problem as described by Jensen (1986), or underinvestment linked to excessive cash flow generation in the short-run (e.g., Baker and Wurgler, 2004; Narayanan, 1985; Waegelein, 1988).

However, it is possible that tax avoidance / risk is principally linked to cash flow volatility through non-agency related fundamentals, or that the mechanism used in tax avoidance-related managerial value-shifting is different from other agency incentives to shift firm value. More specifically, if tax avoidance and tax risk are mainly linked with managerial risk-shifting — managerial incentives to change the risk of the firm's assets — then we would expect to mainly find a discount rate news impact.[15]

[14] Eisdorfer (2014) argues that in firms where managers have larger amounts of discretion — firms with high CEO compensation and CEO ownership and firms in unregulated, heterogenous industries.

[15] Managers can increase the risk of the firm's assets in order to favor stockholders to bondholders (Galai and Masulis, 1976; Jensen and Meckling, 1976); Managerial compensation can also distort behavior by providing the incentive to increase the firm's risk (Coles et al., 2006) or reduce firm's risk (Jensen and Meckling, 1976; Parrino et al., 2005; Sundaram and Yermack, 2007).

Whether tax avoidance / risk primarily affects the volatility of cash flow news or discount rate news is unclear and remains an empirical question. For the sake of exposition, we formulate our next set of hypotheses as follows:

H2a: Tax avoidance mainly affects stock return volatility through a cash flow channel.

H2b: Tax risk mainly affects stock return volatility through a cash flow channel.

Corporate tax avoidance appears to be closely linked with the firm's level of multinationality. For U.S. firms, the opacity of tax avoidance transactions is essential to minimize the risk of being detected by the U.S. Internal Revenue Service (IRS). Holding all else unchanged, MNCs are more complex in their structure than DCs. Several studies support this notion. For example, Aabo et al. (2015) analyze a large sample of U.S. firms and find a significant positive relation between corporate multinationality and opaqueness. Aabo et al. (2015) show that firm-level opacity depends on the structure of the firm's foreign operations network.[16] This is further exacerbated since MNCs likely face increased agency issues compared to DCs (e.g., Lee and Kwok, 1988; Reeb et al., 1998).

Consistent with this notion, Giaccotto and Krapl (2014) observe that international exposure of U.S. firms increases the volatility of both, discount rate and cash flow news. Giaccotto and Krapl (2014) interpret the increase in volatility of expected cash flows as good news for firms, while the increase discount rate news volatility likely amounts to bad news for MNCs. Empirically, authors find that cash flow news and discount rate news are affected by corporate foreign exchange

[16] Aabo et al. (2015) argue that the adverse effects of corporate multinationality on investors' information environment can be minimized by an optimal combination of degree of foreign involvement and geographic footprint of the firm's operation structure.

(FX) exposures — both cash flow news and discount rate news volatilities increase with higher FX exposures. The authors also find similar effects of foreign sales and the number of geographic segments reported. Aggregate stock return volatilities, as well as cash flow and discount rate news volatilities, are higher for firms with higher levels of corporate international diversification (CID).

We formulate our final set of hypotheses in the following way:

H3a: Tax avoidance-related effects on stock return volatility are exacerbated for MNCs relative to DCs.

H3b: Tax risk-related effects on stock return volatility are exacerbated for MNCs relative to DCs.

3. Methodology

3.1 Tax avoidance

To capture a broad range of tax avoidance-related activities, we follow Kim et al. (2011) and use three proxies for tax avoidance: 1) the estimated probability of engaging in tax shelters based on Wilson (2009); 2) the long-run cash effective tax rate introduced by Dyreng et al. (2008); and a common factor computed from three book-tax difference measures (Kim et al., 2011). Higher estimated shelter probabilities, lower long-run cash effective tax rates, and larger book-tax differences indicate higher levels of corporate tax avoidance.

First, we estimate for each of our sample firms the estimated probability of engaging in tax shelters ($Shelt$) based on Wilson (2009). This measure focuses on an extreme form of tax avoidance (Kim et al., 2011). The probability of a firm's participation in a tax shelter is measured by the following model:

$$Shelt = -4.86 + 5.20(Btd) + 4.08(|Dap|) - 1.41(Lev) + 0.76(LnAt) + 3.51(ROA) + 1.72(Fs) + 2.43(RD) \quad (1)$$

where Btd is the total book-tax difference; $|Dap|$ is the absolute value of discretionary accruals from the performance-adjusted Jones model (Jones, 1991); Lev is the long-term debt scaled by total assets; $LnAt$ is the log of total assets; ROA is pre-tax earnings scaled by total assets; Fs is a dummy variable taking on the value of 1 for firm years that report foreign income — in our case we use foreign sales due to data availability issues in Compustat's geographical segments database; and RD are research and development expenses scaled by one-period lagged total assets. A higher value of $Shelt$ relates to more tax avoidance (Wilson, 2009).

Our second measure of tax avoidance is the long-run cash effective tax rate ($Letr$) based on the following model by Dyreng et al. (2008):

$$Letr_{i,t} = \frac{\sum_{j=t-4}^{t} Cashtax_{i,j}}{\sum_{j=t-4}^{t} Ptinc - SI_{i,j}} \quad (2)$$

where $Cashtax$ are cash taxes paid by firm i; $Ptinc$ is pre-tax income; and Si are special items of firm i. Using cash taxes instead of GAAP tax expenses has the advantages that it takes tax benefits

of employee stock options into account, and that cash tax rates are unaffected by changes in accounting estimates (Dyreng et al., 2008). Moreover, using cash effective tax rates over the long-run achieves better matching between taxes paid and the taxed incurred (Kim et al., 2011). Further, cash tax rates potentially identify firms that successfully avoid taxes in the long-run (Hanlon and Heitzman, 2010). For the estimation of $Letr$ we use five-year horizons to alleviate potential survivorship bias typically associated with the use of longer horizons (Kim et al., 2011). A lower long run cash effective tax rate indicates tax avoidance.

Our third measure of tax avoidance is based on Kim et al. (2011) who combined three different measures of book-tax differences into one common factor using factor analysis. We label this book-tax factor as Btd_fact. The three individual book-tax difference measures subsumed in the common factor are the following: (1) The total book-tax difference (Btd) as in Eq. (1) which equals the scaled (by lagged total assets) difference between book income and taxable income; (2) The effective tax rate (ETR) differential as defined by Frank et al. (2009); and (3) The residual book-tax difference based on Desai and Dharmapala (2006).

3.2 Tax risk

Not all firms pursue tax strategies that prioritize tax minimization — sustainability of tax strategies is an another important aspect of corporate tax planning (Drake et al., 2017; Neuman, 2014). In the spirit of Drake et al. (2017) and Guenther et al. (2017), we measure tax risk as the volatility of cash effective tax rates $(Letr)$. To be consistent with the approach throughout this study, we use 5-Year horizons to compute rolling-period standard deviations of annual $Letr$s.

3.3 Volatility of stock returns and return decomposition

Based on a simple present value formula, stock prices change because of changes in expected cash flows, discount rates, or both. Based on the log-linear dividend-ratio model of Campbell and Shiller (1988), Campbell (1991) derives the following log-linear approximate decomposition of equity returns:

$$h_{t+1} - E_t h_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j h_{t+1+j} \qquad (3)$$

where h_{t+1} is the log stock return, d_{t+1} is the log dividend paid by the stock, ρ is a constant of linearization, Δ denotes a one-period change, and E_t is the rational expectation operator at time t. Typically, ρ is a number slightly smaller than 1 and can be estimated by: $\rho = \frac{1}{(1+exp(f))}$ where f is the sample mean of the log dividend price ratio. Campbell and Shiller (1988) discuss the approximation process and Vuolteenaho (2002) find that Eq. (3) holds well for a wide range of possible ρ values. We follow Campbell (1991) and several other studies and use $\rho = 0.996$.

Based on Eq. (3), unexpected stock returns can be expressed as a function of expected future cash flows and future stock returns (discount rates). For unexpected stock returns to be positive, future cash flows have to increase, expected future stock returns have to decrease, or both. It follows that Eq. (3) can be expressed as:

$$U_{ri,t+1} = N_{cf,t+1} - N_{er,t+1} \qquad (4)$$

where $U_{ri,t+1} \equiv h_{t+1} - E_t h_{t+1}$ are defined as unexpected stock returns. Changes in future expected cash flows (cash flow news) are defined as $N_{cf,t+1} \equiv (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j}$, and

changes in future expected stock returns (discount rate news) are defined as $N_{er,t+1} \equiv (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j h_{t+1+j}$.

Campbell (1991) further shows that the unexpected returns, cash flow news, and discount rate news can be empirically estimated using the following vector autoregressive (VAR) system:

$$N_{cf,t+1} = (e1' + \lambda')w_{t+1} \quad (5)$$

$$N_{er,t+1} = \lambda' w_{t+1} \quad (6)$$

where $\lambda \equiv e1'\rho A(I - \rho A)^{-1}$. A is the companion matrix of a first-order VAR system [17] of the form: $z_{t+1} = Az_t + w_{t+1}$ (where z is the vector of the VAR variables and w is the vector of the error terms with a corresponding variance/covariance matrix that is denoted by Σ). $e1$ is a vector whose first element is one and whose other elements are zero.

Using monthly data, we follow Campbell et al. (2009a) and include the following forecasting variables in the VAR system: (1) The excess log returns of the U.S. market (CRSP value-weighted index); (2) The term yield spread, computed as the difference between the 10-Year and 1-Year constant maturity U.S. Treasury rates; (3) The log-smoothed price/earnings ratio of the S&P 500 index, computed as the ratio of the S&P 500 price index divided by the 10-Year moving average earnings of index companies; (4) The small stock value spread, calculated as the difference between log book-to-market ratios of small-firm high book-to-market and small-firm low book-to-market portfolios).[18]

[17] Most variance decomposition studies show VAR systems of order 1 provide good empirical results and that in most cases, including more lags does not improve results. See for example Campbell (1991) and Vuolteenaho (2002).

[18] Based on Campbell et al. (2009a), we use data for book-to-market and size portfolios from Professor Kenneth French's website.

3.4 Main model

As multivariate tests of our hypotheses, we estimate variations of the following core model:

$$Vol_{i,t} = \alpha_i + \beta_1 Tax_{i,t} + \sum_{k=2}^{K} \beta_k X_{k,t} + \sum_{j=1}^{J} \delta_j TFE_{j,t} + \varepsilon_{i,t} \quad (7)$$

where, for each firm i in the panel, $Vol_{i,t}$ is one of the stock volatility measures. In our initial analysis, we rely on the standard deviation of monthly stock returns (SD_{Ret}). In additional tests, to distinguish discount rate from cash flow effects, we rely on measures of cash flow and discount rate volatility (Var_{Cf} and Var_{Er}). $Tax_{i,t}$ is one of the following tax avoidance or tax risk measures: 1) the long-run effective tax rate ($Letr$); the tax shelter probability ($Shelt$); the book-tax factor (Btd_factor); and the standard deviation of the long-run effective tax rate (SD_{Letr}). We also include a set of control variables that capture firm characteristics such as size, measures of CID (number of geographic segments, foreign sales, and foreign assets), liquidity, capital structure, and potential financial distress. All variables are described in greater detail in Appendix Table A.

4. Data and sample period

Our main analysis relies on an unbalanced panel data set spanning January 1993 to December 2016. We exclude the fiscal year 2017 from our sample period due to the uncertainty created by the Trump tax cuts. To build the main panel, we start by using Compustat accounting variables starting in January 1988; a 5-Year horizon is required to compute the tax avoidance and tax risk variables, $Letr$, $Shelt$, Btd_fact, and $Letr_{SD}$. Similarly, CRSP stock return data starting

in January 1988 to December 2016 is used to compute the stock return volatility measures, including the stock return decomposition required to estimate cash flow and discount rate news.

We start with all firms from the Compustat/CRSP intersection and exclude firms from the non-classified industry group or firms for which industry information is missing. Further, following Kim et al. (2011) we exclude firms with non-positive book and asset values as well as firms with stock price (end of fiscal year) of less than $1.00.

Table 1 summarizes the panel data set that spans January 1993 to December 2016. After the aforementioned data screening procedure our final sample includes 9,348 unique firms with a total of 84,634 firm/year observations for the stock return volatility measures. Although stock return volatility measures are estimated using monthly frequency CRSP-based data, only end of (fiscal) year volatility measures are retained in order to match the data with annual-frequency tax avoidance and tax risk variables; the tax avoidance / risk and control variables are based on annual Compustat data.

Table 1 presents summary statistics for the panel data. Panel A shows whole sample distributions of the stock return volatility measures: Stock return volatility (SD_{Ret}) which is the standard deviation of the past 5-years of monthly stock returns, systematic risk (SD_{Ret}^{Sys}) which is the standard deviation of predicted stock returns based on the CAPM model; idiosyncratic risk (SD_{Ret}^{Idi}) which is the standard deviation of the residual stock returns based on the CAPM.

For further analysis, we decompose stock return variance into cash flow and discount rate news (Campbell, 1991; Campbell and Ammer, 1993; Campbell et al., 2009b; Campbell and Vuolteenaho, 2004; Eisdorfer, 2007; Vuolteenaho, 2002). The variances of cash flow news and discount rate news are labeled as Var_{Cf} and Var_{Er} correspondingly. The variance of unexpected

stock returns is labeled as Var_{UR}. The latter is the sum of the variances of cash flow and discount rate news and the covariance of the two news terms. The relative importance of the news components and the covariance term is labeled as PV_{Cf}, PV_{Er}, and PV_{Cov} where PV stands for percentage weight of the variance term. A negative value of PV_{Cov} indicates a positive covariance between cash flow and discount rate news. The negative sign is due to the fact an increase in expected cash flows increases unexpected returns but an increase in expected future returns (discount rates) decreases unexpected returns, and vice versa.

Table 1 also shows summary statistics for firm-level control variables — described in greater detail in Appendix Table A. Panel B reports average foreign sales $(Fsale)$ and average foreign asset $(Fasset)$ ratios, as well as average firm size $(Lsize)$, for each industry group represented in the sample. The size of firms is measured as the natural log of market capitalization. Panel C presents averages for stock return volatility measures, tax avoidance, and tax risk measures for each industry group.

For the whole sample, average monthly stock return standard deviation is 13% for our sample. Using CAPM to distinguish systematic from idiosyncratic stock return risk, we find an average systematic volatility of 15.2% and an idiosyncratic volatility of 7.4%. Panel C shows that stock returns are most volatile for firms in the Manufacturing industry group, followed by the Mining industry group. Average monthly return standard deviations are 14.2% and 14% respectively. There are 3,427 unique firms (33,901 firm/year observations) in the Manufacturing industry group, which comprises 36.66% of the entire sample. Respectively, there are 452 unique firms (3,743 firm/year observations) in the Mining industry group; this makes up 4.84% of the total sample. Conversely, there are 2,290 unique firms in the Finance, Insurance, and Real Estate

industry group (24.54% of all sample firms). Average stock return volatility is the lowest for firms in this industry group, averaging a stock return standard deviation of 9.8%.

The largest firms are in the Transportation and Public Utilities industry group. The smallest firms are in the Wholesale Trade and Agriculture, Forestry & Fishing industry groups. Both industry groups make up a relatively small part of the whole sample, 3.08% and 0.31% of all sample firms respectively. Firms with highest foreign sales ratios are in the Manufacturing and Mining industry groups. Here we observe average foreign sales ratios of 28.9% and 28.3%. The mining industry group also contains firms with the highest foreign asset ratios (14.4%). Both, foreign sales and foreign asset ratios are very low for the Finance, Insurance & Real Estate industries, 8.3% and 3.7%.

Based on long-run effective tax rates, firms that are most aggressive with their tax avoidance are in the Finance, Insurance & Real Estate and Transportation & Public Utilities industry groups. Conversely, firms with the highest long-run effective tax rates are in the Construction and Wholesale Trade industry groups. On average, firms with the highest tax risk (SD_{Letr}), measured as the standard deviation of long-run effective tax rates, are in the Construction and Agriculture, Forestry, & Fishing industry groups. Firms with the lowest tax risk are in the Finance, Insurance, & Real Estate industry group.

On average, firms that are the most likely to pursue tax shelter activities are in the Mining industry group, followed by firms in the Finance, Insurance & Real Estate industries and Transportation & Public Utilities firms. Average book-tax differences based on the book-tax difference factor (Btd_factor) are the highest for firms in the Agriculture, Forestry, & Fishing industries and the Mining industry group. Firms that do the least tax avoidance, according to the Btd_factor, are in the Construction industry group.

Panel A confirms prior findings, that stock returns at the individual firm-level are primarily determined by cash flow volatility (e.g., Eisdorfer, 2014; Vuolteenaho, 2002). The average variance of cash flow news is 0.031 compared to the average variance of discount rate news that is 0.015. The covariance between cash flow and discount rate news appears to be mostly positive as indicated by the negative sign on the relative importance measure of the covariance term (PV_{Cov}). Cash flow news appear to be about twice as important as discount rate news; for the whole sample, PV_{Cf} is 1.632, whereas PV_{Er} is 0.807. However, there is substantial variation in the relative importance of discount rate news, which indicates that discount rate news can be quite important for subsets of individual firms.

[Insert Table 1 approximately here]

Table 2 presents Pearson correlation coefficients for three sets of variables. For the sake of exposition Table 2 is sub-divided to add clarity. First, we examine the correlations of our stock return volatility measures. Second, we report correlations for the tax avoidance and tax risk variables. Third, correlations for the control variables, such as foreign sales and foreign asset ratios, as well as firm size are shown.

Cursory inspection of the correlation coefficients indicates a negative relation between tax avoidance and stock return volatility based on two variables of tax avoidance — the long-run effective tax rate ($Letr$) and the tax shelter probability ($Shelt$). The correlation coefficient between $Letr$ and SD_{Ret} is 0.095, indicating that firms with lower effective tax rates (more tax avoidance) have lower stock return volatility. Consistent with this view, firms that are more likely to pursue tax shelter activities have lower stock return volatilities (correlation coefficient of -

0.350). The correlation between the book-tax difference factor and stock return volatilities are also negative, further confirming that firms that pursue less tax avoidance have lower stock return volatilities.

The correlation coefficient between tax risk (SD_{Letr}) and stock return volatility is 0.253, indicating that firms that face higher tax risk also have higher stock return volatility. Tax risk also is positively correlated with systematic and idiosyncratic risk, as well as both, cash flow and discount rate news volatility.

Analysis of the tax avoidance measures shows that, perhaps not surprisingly, low long-run effective tax rates (high tax avoidance) correlates with both, high probability of tax shelter activity, and high values of the book-tax difference factor. This shows that, although the three tax avoidance measures likely reflect different aspects of tax avoidance (Kim et al., 2011), they still overall agree on corporate tax avoidance activity. Finally, considering the correlations between SD_{Letr} and the three tax avoidance measures, firms that pursue less tax avoidance appear to have more tax risk.

Cursory analysis also provides surprising correlations between $Letr$ and the internationalization measures. Table 2 shows a positive relation between $Letr$ and foreign sales, and foreign asset ratios. However, less surprising are positive correlations between $Shelt$ and the internationalization measures, indicating that MNCs are more likely to partake in tax shelter activities.[19] Book-tax differences appear to be lower for MNCs but tax risk is higher — we observe positive correlations between SD_{Letr} and all three internationalization variables ($Geo, Fsale$ and $Fasset$).

[19] It is important to note that this is partly due to the estimation procedure of the Wilson (2009) tax shelter probability ($Shelt$). Foreign sales are part of the model's input and by definition firms with foreign sales will have higher estimated tax shelter probabilities, holding all else constant.

[Insert Table 2 approximately here]

5. Results and Discussions

5.1 Portfolio analysis

In the first part of our analysis we perform portfolio-based tests on the relation between tax avoidance (tax risk) and stock return volatility, as measured by the standard deviations of monthly stock returns, SD_{Ret}. Further, we survey the systematic and idiosyncratic components of stock return volatility using the CAPM. In this study, we define systematic risk as the volatility of CAPM-predicted returns and idiosyncratic risk as the standard deviation of CAPM-based residuals.

Table 3 consists of three parts. In the first part, quintile portfolios are constructed based on long-run effective tax rates. Here firms in Quintile 1 have the lowest $Letr$, thus, have the highest levels of tax avoidance. In the second part of Table 3, we assign firm/year observations into quintiles based on the firm's tax shelter probabilities — firms with high probability of partaking in tax shelter-related activity (high tax avoidance) are in Quintile 5. Similarly, in the third part of Table 3, firm/year observations are sorted based on the book-tax value factor; firms with high book-tax differences (high tax avoidance) are assigned to Quintile 5. Lastly, in the fourth part of Table 3, firms are sorted into quintiles by their $Letr$ volatilities; firms with high volatilities in their $Letr$'s have more tax risk, thus are part of Quintile 5.

With the exception of the Btd_factor, all variable values in Table 3 are reported in percentage terms. ANOVA F-test statistics and their respective p-values (in parentheses) testing

the statistical significance of differences in the variables within each of the quintile sets are also reported in Table 3.

Portfolio tests reveal a U-shaped relation between $Letr$ and SD_{Ret}. For firms in Quintiles 1 through 3, we observe a positive relation between tax avoidance and stock return volatility and for firms in Quintiles 4 and 5, the relation between tax avoidance and stock return volatility is negative. Analogously, we see the same U-shaped pattern for systematic and idiosyncratic risk. The U-shape is even more pronounced for systematic risk. Firms with very low or very high values of $Letr$ have the highest levels of systematic, idiosyncratic, and total equity risk. Firms in Quintile 4 (average $Letr$ of 36.422%) have the lowest level of systematic risk, 11.49%. Similarly, firms in Quintile 4 also have the lowest level of idiosyncratic risk, 5.098%. It follows that firms with either extremely low or high $Letr$ have the highest stock return volatilities across all three measures of equity risk.

The univariate relation between $Shelt$ and stock return volatility appears monotonic for all three measures of stock return volatility. Firms with high levels of tax avoidance have lower stock return volatilities, according to the $Shelt$ measure, keeping in mind that $Shelt$ is designed to detect more extreme forms of corporate tax avoidance. The differences are quite stark. Firms in Quintile 1 have an average stock return standard deviation of 16.917% compared to Quintile 5, where the SD decreases to 11.532%. Systematic risk decreases from 19.599% to 15.613% going from Quintile 1 to 5. Such a pattern would be consistent with firms that are more likely to pursue tax shelter activities to also smooth earnings and thus achieve less stock return volatility. Further examination will be needed to confirm the observed relation in a multivariate setting.

The relation between book-tax differences, as measured by the book-tax factor (Btd_fact), and stock return volatility mirrors the relation between $Letr$ and stock return volatility. We observe a similar U-shape. Firms with high or low book-tax differences have the highest amount of equity risk. The standard deviation of stock returns is 16.097% for Quintile 1 — these are firms with very low book-to-market differences (low level of tax avoidance). The average stock return volatility is also high for Quintile 5 (14.470%), and the lowest equity risk is for observations in Quintile 3, where the average SD_{Ret} is 11.793%. Systematic and idiosyncratic risk mirror the same U-shaped pattern.

Further, we observe a monotonic positive relation between tax risk and stock return volatility. Firms with higher levels of tax risk, as measured by the standard deviation of $Letr$, have higher stock return volatilities. This pattern is particularly pronounced for systematic risk. The standard deviation of systematic risk is 10.175% for Quintile 1 (firms with very low tax risk) and 15.914% for firms in Quintile 5 (firms with high tax risk).

To summarize our initial findings, the univariate relation between two measures of tax avoidance and stock return volatility is U-shaped. Firms with low and high values of $Letr$ (Btd_fact) have the highest levels of stock return volatility. We observe monotonic relations between $Shelt$ and stock return volatility, as well as SD_{Letr} and stock return volatility. Firms with high probabilities of pursuing tax shelter activities have lower stock return volatilities. Firms with higher levels of tax risk have higher stock return volatilities.

[Insert Table 3 approximately here]

In the next step of our analysis we examine the univariate relation between tax avoidance / tax risk and the components of stock return volatility. More specifically, we survey cash flow and discount rate news, as well as their relative importance. These results are reported in Table 4. The table is organized similarly to Table 3; firm/year observations are sorted into quintiles based on $Letr$, $Shelt$, Btd_fact, and SD_{Letr}. For the sake of brevity, the number of observations and the average values of the tax avoidance / tax risk variables is untabulated — they are identical to the values in Table 3. In the first three columns, Table 4 presents the average volatilities (variances) of unexpected stock returns (Ur), discount rate news (Er), and cash flow news (Cf). The rightmost three columns of Table 4 present the relative importance of the news terms and the covariance term. Higher values of the PV measures indicate increased relative importance; the average negative values of PV_{Cov} signifies that discount rate and cash flow news are positively correlated and thus offsetting. This finding is consistent with several prior studies that decompose equity returns at the individual firm-level (Eisdorfer, 2014; Giaccotto and Krapl, 2014; Vuolteenaho, 2002).

Consistent with the results reported in Table 3, we observe U-shaped patters between the volatility of unexpected stock returns and $Letr$ and Btd_fact. Also consistent with the stock return volatility relations, are the monotonically decreasing relation between Var_{Ur} and $Shelt$, as well as the monotonically increasing relation between SD_{Letr} and Var_{Ur}. Essentially, we observe no substantial differences in patterns between realized stock return volatilities (reported in Table 3) and the volatilities of unexpected stock returns (reported in Table 4).

The U-shaped pattern between tax avoidance and stock return volatility components is observable for both, discount rate and cash flow news, suggesting that the factors that determine these relations affect both, expected returns as well as cash flow expectations. Cash flow news are

consistently more volatile at the individual firm level. This is also a finding reported by prior literature (Eisdorfer, 2014; Vuolteenaho, 2002). Cash flow and discount rate news volatilities also mirror the monotonically decreasing and increasing relations with $Shelt$ and SD_{Letr}.

Does the level of tax avoidance or tax risk affect the relative importance of expected cash flows / expected future stock returns? With respect to tax avoidance, cash flow and discount rate news are increasingly offsetting for firms with very low and very high value of $Letr$ and Btd_fact. This means that positive cash flow news for firms with very low or high levels of tax avoidance are increasingly coupled with offsetting expectations of increased risk for discount rate news (increasing discount rates). This leads to a simultaneous increase in the relative importance of both, discount rate news and cash flow news. In contrast, the relative importance of both news terms monotonically decreases for firms that are more likely to partake in tax shelter activities, as measured by $Shelt$. This also means that for firms that are more likely to partake in tax shelter activities, cash flow and discount rate news are less offsetting.

Despite the monotonically increasing relation between both, cash flow and discount rate news volatilities and tax risk, as measured by SD_{Letr}, we do not observe a corresponding increase in the relative importance of both the news terms, i.e. cash flow and discount rate news do not become more offsetting for firms with high levels of tax risk. Indeed, news appear most offsetting for firms with very low and very high levels of tax risk. This means that for such firms both of the news terms are relatively more important.

In summary, based on $Letr$ and Btd_fact, cash flow news as well as discount rate news become more offsetting and thus both news terms become relatively more important for firms with very low and very high levels of tax avoidance. Similarly, both news terms become more offsetting for firms with very low and very high levels of tax risk. The latter finding is surprising in light of

the monotonically increasing relation between tax risk, and both, cash flow and discount rate news volatility.

[Insert Table 4 approximately here]

5.2 Regression analysis: The relation between stock return volatility and tax avoidance / tax risk

We continue our examination and test *H1a* and *H1b* in the panel data setting. The results of these tests are presented in Table 5. We employ variations of the main model shown in Eq. (7), estimating it as a fixed effects model. [20]All models include time fixed effects variables. Additional industry control variables are not applicable in the fixed effects models due to perfect collinearity. T statistics reported in parentheses are based on two-way clustered standard errors on firm and year (Petersen, 2009). [21] We rely on STATA code provided by Schaffer (2015) to estimate the two-way clustered standard errors for the fixed effects models used throughout this study.

To further capture the potentially non-linear relation between tax avoidance and stock return volatility in a more intuitive way, as well as possible differences in the tax avoidance measures across the major industry groups, we compute industry-adjusted relative tax avoidance measures for models [ix] through [xi]. We modify the $Letr$, $Shelt$, and Btd_fact measures by subtracting the industry group average for each variable. We then take the absolute value of the differences.

[20] Breusch and Pagan (1980) Lagrange multiplier tests reject the use of pooled regression models; Hausman (1978) tests support the use of fixed effects models. For the sake of brevity, results based on pooled regressions and random effects models, including Hausman (1978) and Breusch and Pagan (1980) test results, are not reported but available upon request from the authors.

[21] We rely on STATA code provided by Schaffer (2015) to estimate the two-way clustered standard errors for the fixed effects models used throughout this study.

Consistent with the portfolio-based analysis reported in Table 3, the relation between stock return volatility and the long-run effective tax rate appears non-linear. This becomes clear when a square term of $Letr$ is included in model [ii]. Initially, tax avoidance appears to reduce stock return volatility, but the effect changes with higher levels of $Letr$. Similarly, non-linearities also appear when using Btd_fact as the tax avoidance measure. Here higher levels of book-tax differences appear to relate to higher stock return volatilities, although when the squared Btd_fact is included, the relation loses its statistical significance — further analysis is need to explore this particular relation.

In contrast to the tax avoidance measures, tax risk appears to be more clearly linked to stock return volatility. Even in the panel setting, firms with higher levels of tax risk appear to have more volatile stock returns. The effects are diminishing the higher tax risk becomes, as indicated by the negative slope of the squared term. To provide a more intuitive interpretation of this result, we further explore this relation in the subsequent analysis.

In contrast to the univariate results reported in Table 3, the relation between tax avoidance, as measured by $Shelt$, and stock return volatility is not statistically significant when controlling for other key firm characteristics that might be linked with stock return volatility. With respect to the control variables, we observe that smaller firms have more volatile stock returns, as do growth firms, and perhaps surprisingly, firms with higher Altman Z-score measures. Firms that report operations in more geographic segments (Geo) and foreign sales have more volatile stock returns, but foreign assets appear risk-decreasing. The last finding is consistent with Krapl (2015) who observed the same relation for stock return and cash flow volatilities.

Based on models [ix] through [xi], we find that firms with more extreme values of tax avoidance, as measured by long-run effective tax rates and market-to-book differences, have more volatile stock returns. For more extreme forms of tax avoidance, as measured by the tax shelter probability, this does not appear to be the case. Here we observe statistically insignificant results.

[Insert Table 5 approximately here]

5.3 Regression analysis: The relation between stock return volatility components and tax avoidance / tax risk

To test hypotheses *H2a* and *H2b*, we explore the links between tax avoidance / tax risk and the components of stock return volatility. More specifically, we separate the volatility of discount rate news from the volatility of cash flow news. We repeat the core analysis presented in Table 5 using the variances of discount rate news (Var_{Er}), cash flow news (Var_{Cf}), and unexpected stock returns (Var_{Ur}). As in our prior analysis in sub-section 5.2, we rely on fixed effects models that include time control variables. As in Table 5, t-statistics are based on standard errors that are clustered by firm and year (Petersen, 2009). To make the size of Table 6 more manageable, we do not report the estimated coefficients and t-statistics for the firm-characteristic control variables. The full results are available from the authors upon request.

In the top part of Table 6, we observe similar patters between the volatility of unexpected stock returns and our tax avoidance / tax risk variables. The reader should keep in mind that the magnitudes of the coefficients are not directly comparable with the ones reported in Table 5, since the results reported in Table 6 are based on stock return component variances rather than standard deviations. Perhaps not surprisingly, we observe that the estimated coefficients of the squared

terms (of the tax avoidance and tax risk variables) confirm the non-linearities that were apparent in the portfolio analysis presented in Table 4. This motivates the use of industry-adjusted relative measures of tax avoidance and tax risk. These results are reported in the bottom half of Table 6. Here we see that, based on $Letr$ and Btd_fact, firms with very low and very high levels of tax avoidance have the most volatile unexpected stock returns. Similarly, firms with very low and very high levels of tax risk have the most volatile unexpected stock returns.

The relation between $Shelt$ and the volatility of discount rate news appears positive based on estimates of model [vi], however the relation does not appear to be linear. Using industry-adjusted relative tax avoidance, so a modified version of $Shelt$, shows that firms with extreme tax shelter probabilities have less volatile discount rate news. This appears surprising in light of the other results. Moreover, there appears to be a positive relation between tax risk and discount rate news based on estimates of model [viii]; despite a statistically significant squared term of SD_{Letr}, the relation between industry-adjusted relative tax risk and discount rate news volatility is not statistically significant. Indeed, the patterns observed for tax avoidance / tax risk and the volatility of unexpected stock returns appear to be primarily determined by cash flow news volatilities. With the exception of $Shelt$, where we find that firms with more extreme tax shelter probabilities have lower cash flow news volatilities, the relation between relative tax avoidance / tax risk and cash flow news volatility is positive.

[Insert Table 6 approximately here]

5.4 The effects of CID on the relation between tax avoidance / tax risk on stock return volatility

We continue our examination by exploring the question whether CID affects the relation between tax avoidance / tax risk and stock return volatility — we test our third set of hypotheses, *H3a* and *H3b*. To shed light on this issue, we modify some of our core tests reported in Tables 5 and 6. We define firms as MNCs or DCs. Although there is no well-established definition of what constitutes a MNC, typically high levels of foreign sales and foreign assets, as well as reported operations in multiple geographic segments are commonly-recognized aspects of a MNC (Shapiro, 2009) . For sake of exposition, we follow Krapl (2017) and define a MNC as a firm that: 1) Reports an average foreign sales ratio in excess of 10%, 2) reports an average foreign asset ratio in excess of 10%, 3) reports more than three geographical segments in Compustat. Based on this definition we create a dummy variable, labeled MNC_dum, that takes on the value of 1 if the firm is an MNC, otherwise zero. We include the MNC dummy variable and MNC interaction terms with our tax avoidance / risk variables, as well as their industry-adjusted relative measures.

In Table 7, we report the results of fixed effects regressions that include the tax avoidance / risk interaction terms and the MNC dummy variable. Similar to Table 6, we omit the estimated coefficients and t-statistics for firm-characteristic control variables. The complete regression results are available from the authors upon request. To further manage the volume of reported results, due to the similarity of results between stock return volatilities and the volatilities of unexpected stock returns, Table 6 focuses on three dependent variables: 1) the volatility of stock returns (as in Table 5); 2) the volatility of discount rate news (as in Table 6); and the volatility of cash flow news (as in Table 6).

Analogue to Table 6, we focus on tax avoidance / risk measures and their squared terms, including new MNC interaction terms and intercepts, in the top part of Table 7. In the bottom half

of Table 7 we present results that rely on industry-adjusted relative measures of tax avoidance / risk.

The relation between tax avoidance and stock return volatility appears to be similar as previously reported. In the top half of Table 7 the MNC interaction terms are mostly statistically insignificant. An exception is Btd_fact, the only statistically significant interaction term, which would indicate that for MNCs the relation between tax avoidance, as measured by Btd_fact, and stock return volatility is weaker for MNCs. Similarly, we observe a slightly weaker relation between tax avoidance, as measured by $Shelt$ and discount rate news volatility for MNCs (based on estimates of model [vi]). Otherwise, tax avoidance and tax risk interaction terms are statistically insignificant at conventional levels.

When we examine industry-adjusted relative tax avoidance/risk, we find again very little evidence that CID in itself significantly affects the observed prior results. Based on $Letr$ there is some evidence that for MNCs the relation between relative tax avoidance and stock return volatility is slightly weaker. This appears to be mainly a cash flow issue, based on estimates of models [xiii] and [xxi]. The only other statistically significant interaction term in the bottom half of Table 7 is in the estimates of model [xx]. We conclude that the level of CID does not seem to affect the relation between tax avoidance / risk and stock return volatility (including its discount rate and cash flow components).

[Insert Table 7 approximately here]

6. Conclusions

We examine the effects of corporate tax avoidance and tax risk on stock return volatility. Tax risk is defined as the volatility in the long run effective tax rate. Using two alternative measures of tax avoidance, the long run effective tax rate and a book-tax difference measure, we find that firms with very low or very high levels of tax avoidance have more volatile stock returns. However, we find weak evidence in multivariate tests that there is a relation between more extreme forms of tax avoidance, as measured by the Wilson (2009) tax shelter probability, and overall stock return volatility.

Using variance decomposition, we observe that the observed patterns between tax avoidance and stock return volatility mainly appear to be cash flow driven. When we decompose unexpected stock returns into discount rate and cash flow news, we observe the same U-shaped patterns between $Letr$ / Btd_fact and cash flow news volatilities.

In contrast to tax avoidance, we find evidence that a positive relation exists between tax risk, as measured by the volatility of the long-run effective tax rate, and stock return volatility. Firms, with increased tax risk appear to have more volatile stock returns. This relation is primarily determined by investors' cash flow expectations. Firms with increased tax risk have more volatile cash flow news. Finally, based on portfolio tests, firms with increased tax risk have also more volatile discount rate news; however the latter finding is not statistically significant in regression-based tests.

We find no evidence that the relation between tax avoidance / risk and stock return volatility — including its discount rate and cash flow news components — is affected by corporate international diversification. This conclusion is based on fixed effects regressions, where we

control for numerous differences between DCs and MNCs, such as firm size, profitability, capital structure, foreign sales, foreign assets, and the number of geographic segments.

Our findings have several important implications for researchers, investors, and managers. For researchers, our study highlights the need to further explore the non-linear effects of corporate tax avoidance and to further examine the role of tax risk. For the latter, there appears to be a significant link to investors' discount rate and cash flow expectations. For financial managers and investors alike, our results emphasize that corporate tax avoidance is a double-edged sword where too much tax avoidance is linked to increased risk, but perhaps surprisingly, too little tax avoidance is also linked to increased risk. This leads to the possibility that there exists an optimal level of tax avoidance. How can financial managers find this optimal level of tax avoidance? Does this relation possibly change? Future research could explore these research questions.

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Table 1
Summary statistics

Panel A: Summary statistics

Variable	N	Mean	SD	P25	P50	P75
Stock return volatility measures						
SD_{Ret}	84,634	0.130	0.054	0.084	0.120	0.169
SD_{Ret}^{Sys}	84,634	0.152	0.129	0.054	0.109	0.211
SD_{Ret}^{Idi}	84,634	0.074	0.070	0.029	0.047	0.088
Var_{Ur}	84,634	0.019	0.015	0.007	0.014	0.028
Var_{Cf}	84,634	0.031	0.032	0.009	0.020	0.041
Var_{Er}	84,634	0.015	0.023	0.002	0.005	0.016
PV_{Cf}	84,634	1.632	1.216	0.941	1.208	1.717
PV_{Er}	84,634	0.807	1.115	0.179	0.390	0.856
PV_{Cov}	84,634	-1.436	2.287	-1.523	-0.581	-0.173
Tax avoidance and tax risk measures						
$Letr$	53,975	0.351	0.412	0.183	0.292	0.383
$Shelt$	33,065	0.604	0.320	0.314	0.668	0.914
Btd_fact	38,810	0.013	1.378	-0.338	-0.063	0.257
SD_{Letr}	32,840	0.157	0.241	0.037	0.070	0.141
Control variables						
$Lsize$	84,634	6.090	2.166	4.447	6.024	7.612
MB	84,634	2.786	3.127	1.194	1.852	3.054
Liq	65,293	2.678	2.342	1.302	1.977	3.117
Lev	84,491	2.029	3.560	0.246	0.647	1.831
Pro	71,480	0.333	0.464	0.225	0.350	0.520
ROA	84,634	0.014	0.128	0.004	0.028	0.068
Z_sco	64,094	4.543	5.269	1.933	3.288	5.345
Geo	73,295	2.845	2.395	1.000	2.000	4.000
$Fsale$	73,295	0.211	0.294	0.000	0.021	0.366
$Fasset$	73,295	0.074	0.202	0.000	0.000	0.000

Panel B: Industry groups represented in sample

Industry	SIC codes	Firms	% of total	N	*Lsize*	*Fsale*	*Fasset*
Agriculture, Forestry, & Fishing	01-09	29	0.31	233	5.612	0.191	0.112
Mining	10-14	452	4.84	3,743	6.755	0.283	0.145
Construction	15-17	92	0.98	951	6.058	0.111	0.057
Manufacturing	20-39	3,427	36.66	33,901	6.011	0.289	0.092
Transportation & Public Utilities	40-49	804	8.60	7,549	7.067	0.105	0.043
Wholesale Trade	50-51	288	3.08	2,588	5.539	0.151	0.080
Retail Trade	52-59	486	5.20	4,535	6.192	0.051	0.033
Finance, Insurance, and Real Estate	60-67	2,290	24.50	19,975	5.967	0.083	0.037
Services	70-89	1,480	15.83	11,159	5.763	0.222	0.064
Aggregate		9,348	100.00	84,634	6.090	0.211	0.074

Table 1
Summary statistics (continued)

Panel C: Tax avoidance, tax risk, and stock return volatility by industry group

	SD_{Ret}	SD_{Ret}^{Sys}	SD_{Ret}^{Idi}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Agriculture, Forestry, & Fishing	0.115	0.087	0.051	0.297	0.533	0.201	0.218
Mining	0.140	0.136	0.078	0.295	0.658	0.139	0.160
Construction	0.139	0.177	0.075	0.424	0.610	-0.157	0.222
Manufacturing	0.142	0.181	0.082	0.377	0.609	-0.008	0.164
Transportation & Public Utilities	0.106	0.113	0.057	0.284	0.621	0.105	0.132
Wholesale Trade	0.132	0.138	0.062	0.419	0.591	-0.145	0.168
Retail Trade	0.137	0.160	0.067	0.399	0.610	-0.038	0.141
Finance, Insurance, and Real Estate	0.098	0.085	0.054	0.282	0.623	0.101	0.124
Services	0.160	0.218	0.101	0.385	0.569	0.004	0.189

This table presents summary statistics of our sample firms (Panel A), the industry groups represented in the sample (Panel B), and descriptive statistics of tax avoidance, tax risk, and stock return volatility reported by industry group. Reported statistics are for a panel data set containing firms from the Compustat/CRSP intersection between January 1993 to December 2016. Firms from the non-classified industry group are omitted from the sample. We also exclude observations with non-positive book values of equity and assets. We also exclude observations with stock prices (fiscal year end) of less than $1.00. Variable descriptions are presented in Appendix Table A. In Panel B and Panel C report the average values of $LSize$, $Fsale$, $Fasset$, $Letr$, $Shelt$, Btd_fact, and SD_{Letr} for firms in each industry group.

Table 2
Correlations

Variable		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Stock return volatility measures												
SD_{Ret}	[1]	1.000										
SD_{Ret}^{Sys}	[2]	0.828	1.000									
SD_{Ret}^{Idi}	[3]	0.707	0.798	1.000								
Var_{Ur}	[4]	0.983	0.831	0.734	1.000							
Var_{Cf}	[5]	0.659	0.506	0.464	0.664	1.000						
Var_{Er}	[6]	0.397	0.320	0.307	0.394	0.874	1.000					
PV_{Cf}	[7]	-0.013	-0.077	-0.029	-0.020	0.643	0.742	1.000				
PV_{Er}	[8]	-0.005	-0.028	0.003	-0.012	0.611	0.811	0.934	1.000			
PV_{Cov}	[9]	0.010	0.054	0.014	0.016	-0.637	-0.787	-0.985	-0.981	1.000		
Tax avoidance and tax risk measures												
$Letr$	[10]	0.095	0.066	0.030	0.082	0.089	0.066	0.049	0.038	-0.045	1.000	
$Shelt$	[11]	-0.350	-0.099	-0.150	-0.336	-0.359	-0.256	-0.204	-0.155	0.184	-0.142	1.000
Btd_fact	[12]	-0.001	0.005	0.017	0.009	-0.004	-0.014	-0.023	-0.022	0.023	-0.175	0.329
SD_{Letr}	[13]	0.253	0.182	0.138	0.238	0.181	0.090	0.041	-0.001	-0.022	0.442	-0.079
Control variables												
$Lsize$	[14]	-0.350	-0.088	-0.178	-0.339	-0.356	-0.249	-0.211	-0.158	0.190	-0.145	0.799
MB	[15]	0.122	0.144	0.108	0.137	0.060	0.036	-0.057	-0.027	0.044	-0.063	0.102
Liq	[16]	0.248	0.219	0.178	0.238	0.131	0.053	-0.029	-0.030	0.030	-0.006	-0.191
Lev	[17]	-0.188	-0.196	-0.106	-0.183	-0.030	0.014	0.168	0.115	-0.145	0.082	-0.059
Pro	[18]	-0.116	-0.089	-0.068	-0.128	-0.111	-0.074	-0.031	-0.026	0.029	-0.083	0.166
ROA	[19]	-0.310	-0.274	-0.252	-0.333	-0.267	-0.186	-0.064	-0.063	0.065	-0.232	0.386
Z_sco	[20]	0.049	0.036	0.009	0.036	-0.015	-0.040	-0.044	-0.043	0.045	-0.077	0.036
Geo	[21]	0.064	0.179	0.122	0.055	-0.042	-0.045	-0.114	-0.079	0.100	0.034	0.311
$Fsale$	[22]	0.112	0.222	0.166	0.104	-0.015	-0.026	-0.122	-0.079	0.104	0.028	0.338
$Fasset$	[23]	-0.048	-0.023	-0.043	-0.048	-0.027	0.000	0.003	0.019	-0.011	0.044	0.139

Table 2
Correlations (continued)

Variable		[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
Btd_fact	[12]	1.000										
SD_{Letr}	[13]	-0.056	1.000									
Control variables												
$Lsize$	[14]	0.062	-0.155	1.000								
MB	[15]	0.115	-0.070	0.206	1.000							
Liq	[16]	0.022	0.001	-0.186	-0.004	1.000						
Lev	[17]	-0.056	0.030	-0.183	-0.227	-0.232	1.000					
Pro	[18]	0.029	-0.060	0.104	-0.020	-0.171	-0.001	1.000				
ROA	[19]	0.134	-0.134	0.257	-0.038	-0.062	-0.062	0.409	1.000			
Z_sco	[20]	0.072	-0.080	0.064	0.281	0.529	-0.268	0.021	0.243	1.000		
Geo	[21]	-0.006	0.066	0.241	0.001	-0.002	-0.069	0.109	0.022	-0.045	1.000	
$Fsale$	[22]	-0.011	0.062	0.237	0.028	0.012	-0.078	0.132	0.003	-0.037	0.656	1.000
$Fasset$	[23]	-0.024	0.020	0.084	0.007	-0.061	-0.010	0.033	0.033	-0.033	0.141	0.394

This table presents Pearson correlations for stock return volatility, tax avoidance, tax risk, and control variables of a panel data set spanning January 1993 to December 2016.

Table 3
Univariate analysis: Stock return volatility

$Letr$ quintile	N	$Letr$	SD_{Ret}	SD_{Ret}^{Sys}	SD_{Ret}^{Idi}
1	10,795	5.685	12.736	14.834	7.563
2	10,795	20.931	11.763	13.550	6.102
3	10,795	29.231	11.110	11.858	5.226
4	10,795	36.422	11.138	11.490	5.098
5	10,795	83.443	12.813	14.576	6.532
F-test statistic		9,211.59	353.11	214.52	331.45
P-value F-test		(<.0001)	(<.0001)	(<.0001)	(<.0001)
$Shelt$ quintile	N	$Shelt$	SD_{Ret}	SD_{Ret}^{Sys}	SD_{Ret}^{Idi}
1	6,613	12.202	16.917	19.599	9.944
2	6,613	38.525	14.479	17.279	7.871
3	6,613	66.464	13.764	17.573	7.617
4	6,613	87.444	12.809	16.807	7.177
5	6,613	97.292	11.532	15.613	6.640
F-test statistic		209,748.00	1,111.68	82.12	193.68
P-value F-test		(<.0001)	(<.0001)	(<.0001)	(<.0001)
Btd_fact quintile	N	Btd_fact	SD_{Ret}	SD_{Ret}^{Sys}	SD_{Ret}^{Idi}
1	7,762	-1.360	16.097	21.780	10.078
2	7,762	-0.276	12.746	14.790	6.695
3	7,762	-0.061	11.793	12.955	5.866
4	7,762	0.183	11.880	13.425	6.088
5	7,762	1.577	14.470	18.868	8.894
F-test statistic		8,562.09	1,067.57	731.59	550.15
P-value F-test		(<.0001)	(<.0001)	(<.0001)	(<.0001)
SD_{Letr} quintile	N	SD_{Letr}	SD_{Ret}	SD_{Ret}^{Sys}	SD_{Ret}^{Idi}
1	6,568	1.962	9.997	10.175	4.626
2	6,568	4.312	10.476	10.702	4.907
3	6,568	7.048	11.103	11.945	5.298
4	6,568	12.276	11.949	13.375	6.005
5	6,568	52.833	13.498	15.914	6.857
F-test statistic		13,190.8	788.83	373.68	204.10
P-value F-test		(<.0001)	(<.0001)	(<.0001)	(<.0001)

This table presents univariate results. Quintile portfolios are formed based on three measures of tax avoidance and one measure of tax risk. Firms are sorted based on $Letr, Shelt, Btd\_fact,$ and SD_{Letr} which are the long-run effective tax rate, the tax shelter probability, the book-tax- difference factor, and the standard deviation of the long-run effective tax rates. ANOVA F-test and corresponding p-values (in parentheses) are reported to assess the statistical differences in average values of tax avoidance (and tax risk) and stock return variables.

Table 4
Univariate analysis: Components of stock return volatility and their relative importance

$Letr$ quintile	Var_{Ur}	Var_{Er}	Var_{Cf}	PV_{Er}	PV_{Cf}	PV_{Cov}
1	0.0186	0.0126	0.0280	0.6972	1.5165	-1.2109
2	0.0156	0.0105	0.0228	0.6686	1.4389	-1.1043
3	0.0138	0.0097	0.0209	0.6609	1.4216	-1.0795
4	0.0138	0.0101	0.0219	0.6960	1.5041	-1.1962
5	0.0181	0.0150	0.0308	0.8466	1.6971	-1.5403
F-test statistic	375.27	141.34	284.73	62.56	110.25	88.76
P-value F-test	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
$Shelt$ quintile	Var_{Ur}	Var_{Er}	Var_{Cf}	PV_{Er}	PV_{Cf}	PV_{Cov}
1	0.0302	0.0255	0.0515	1.0189	1.8668	-1.8817
2	0.0229	0.0191	0.0387	0.9019	1.7422	-1.6411
3	0.0209	0.0152	0.0319	0.7506	1.5417	-1.2907
4	0.0184	0.0117	0.0258	0.6300	1.3801	-1.0068
5	0.0152	0.0088	0.0192	0.5743	1.2156	-0.7834
F-test statistic	1,010.00	549.13	1,155.10	200.14	358.98	287.20
P-value F-test	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
Btd_fact quintile	Var_{Ur}	Var_{Er}	Var_{Cf}	PV_{Er}	PV_{Cf}	PV_{Cov}
1	0.0278	0.0215	0.0439	0.8692	1.6679	-1.5333
2	0.0180	0.0147	0.0298	0.8325	1.6411	-1.4701
3	0.0156	0.0122	0.0251	0.7565	1.5489	-1.3026
4	0.0160	0.0113	0.0242	0.6988	1.4693	-1.1643
5	0.0236	0.0166	0.0357	0.7372	1.5084	-1.2413
F-test statistic	1,054.81	249.10	555.50	32.78	41.52	38.64
P-value F-test	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
SD_{Letr} quintile	Var_{Ur}	Var_{Er}	Var_{Cf}	PV_{Er}	PV_{Cf}	PV_{Cov}
1	0.0112	0.0076	0.0162	0.6442	1.3772	-1.0159
2	0.0121	0.0071	0.0167	0.5517	1.3165	-0.8654
3	0.0137	0.0077	0.0185	0.5349	1.3017	-0.8346
4	0.0157	0.0092	0.0221	0.5353	1.3417	-0.8753
5	0.0194	0.0111	0.0274	0.5610	1.4113	-0.9708
F-test statistic	667.12	85.87	342.04	23.96	19.44	16.73
P-value F-test	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)

This table presents univariate results. Quintile portfolios are formed based on three measures of tax avoidance and one measure of tax risk. Firms are sorted based on $Letr, Shelt, Btd\_fact,$ and SD_{Letr} which are the long-run effective tax rate, the tax shelter probability, the book-tax- difference factor, and the standard deviation of the long-run effective tax rates. The first three columns report the volatility (variances) of unexpected stock return (Ur), discount rate news (Er), and cash flow news (Cf). The second three columns indicate the relative importance of the two news terms and its covariance term. ANOVA F-test and corresponding p-values (in parentheses) are reported to assess the statistical differences in average values of tax avoidance (and tax risk) and stock return variables.

Table 5
Tax avoidance, tax risk, and stock return volatility: Panel data analysis

Model:	[i]	[ii]	[iii]	[iv]	[v]	[vi]	[vii]	[viii]	[ix]	[x]	[xi]
	Tax avoidance and tax risk including squared terms								Industry-adjusted relative tax avoidance		
$Letr$	0.0007*	-0.0024**							0.0019***		
	(2.04)	(-2.14)							(5.87)		
$Letr^2$		0.0011***									
		(3.45)									
$Shelt$			0.0002	0.0030						-0.0013	
			(0.24)	(1.16)						(-1.15)	
$Shelt^2$				-0.0027							
				(-1.08)							
Btd_fact					0.0002***	-0.0001					0.0008***
					(2.78)	(-1.05)					(7.22)
Btd_fact^2						0.0001***					
						(6.01)					
SD_{Letr}							0.0118***	0.0249***			
							(7.56)	(6.87)			
$SD_{Letr}{}^2$								-0.0125***			
								(-4.11)			
$Lsize$	-0.0032***	-0.0032***	-0.0031***	-0.0031***	-0.0032***	-0.0031***	-0.0023***	-0.0022***	-0.0031***	-0.0031***	-0.0031***
	(-7.28)	(-7.32)	(-7.49)	(-7.48)	(-7.79)	(-7.65)	(-5.90)	(-5.69)	(-7.11)	(-7.73)	(-7.53)
Z_sco	0.0003***	0.0003***	0.0002***	0.0002**	0.0002***	0.0002***	0.0003***	0.0003***	0.0003***	0.0002***	0.0002***
	(4.89)	(4.79)	(2.81)	(2.77)	(2.80)	(2.89)	(4.07)	(3.99)	(4.88)	(2.78)	(2.90)
MB	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0002**	0.0002**	0.0003***	0.0003***	0.0003***
	(3.61)	(3.61)	(4.55)	(4.61)	(4.94)	(4.60)	(2.31)	(2.26)	(3.45)	(4.67)	(4.41)
Liq	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002*	0.0003**	0.0003**	0.0002*	0.0002	0.0002*
	(1.84)	(1.85)	(1.48)	(1.48)	(1.63)	(1.72)	(2.09)	(2.19)	(1.88)	(1.47)	(1.81)
Lev	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0004	0.0004	0.0001	0.0002	0.0002
	(0.73)	(0.81)	(0.85)	(0.85)	(1.12)	(1.12)	(1.38)	(1.42)	(0.63)	(0.85)	(1.11)

Table 5
Tax avoidance, tax risk, and stock return volatility: Panel data analysis (continued)

Model:	[i]	[ii]	[iii]	[iv]	[v]	[vi]	[vii]	[viii]	[ix]	[x]	[xi]
			Tax avoidance and tax risk including squared terms						Industry-adjusted relative tax avoidance		
Pro	0.0015	0.0013	0.0003	0.0003	0.0000	0.0001	0.0012	0.0013	0.0016	0.0003	0.0001
	(1.29)	(1.15)	(0.60)	(0.53)	(-0.05)	(0.16)	(1.04)	(1.12)	(1.39)	(0.55)	(0.22)
Geo	0.0004***	0.0004***	0.0003***	0.0003***	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***	0.0003***	0.0004***
	(4.44)	(4.45)	(3.07)	(3.08)	(3.23)	(3.23)	(4.13)	(4.14)	(4.46)	(3.08)	(3.22)
$Fsale$	0.0029*	0.0029*	0.0021	0.0022	0.0017	0.0018	0.0007	0.0006	0.0028	0.0021	0.0018
	(1.74)	(1.76)	(1.24)	(1.28)	(1.01)	(1.04)	(0.47)	(0.41)	(1.66)	(1.27)	(1.05)
$Fasset$	-0.0040***	-0.0040***	-0.0043***	-0.0043***	-0.0045***	-0.0045***	-0.0025**	-0.0025*	-0.0040***	-0.0043***	-0.0045***
	(-4.04)	(-4.04)	(-3.93)	(-3.95)	(-4.07)	(-4.08)	(-2.09)	(-2.01)	(-4.03)	(-3.94)	(-4.09)
Time Eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-Test	94.27	96.51	74.21	74.15	73.69	74.34	59.63	56.78	101.02	76.71	79.54
$Prob > F$	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
$Centered\ R^2$	0.1609	0.1621	0.1587	0.1589	0.1596	0.1618	0.2019	0.2058	0.1636	0.1588	0.1636
Obs.	42,449	42,449	31,206	31,206	31,894	31,894	27,017	27,017	42,449	31,206	31,894

This table presents regression results of the following fixed effects model:

$$SD_{Ret,i,t} = \alpha + \beta_1 Tax_{i,t} + \sum_{k=2}^{K} \beta_k X_{k,t} + \sum_{j=1}^{J} \delta_j TFE_{j,t} + \varepsilon_{i,t}$$

where $SD_{Ret,i,t}$ is the volatility of stock returns of firm i; this is measured as the standard deviation of monthly stock returns in the past 5-years prior to end-of-fiscal year t. $Tax_{i,t}$ is one of the following tax avoidance or tax risk measures: Long-run effective tax rate ($Letr$), tax shelter probability ($Shelt$), book-tax factor (Btd_fact), standard deviation of the long-run effective tax rate (SD_{Letr}). Models [ii], [iv], [vi], and [viii] include squared terms of the tax avoidance/risk variables. Models [ix] through [xi] use industry-adjusted relative tax avoidance measures that is constructed in the following way: $|Tax - \overline{Tax_Y}|$, where Tax is one of three tax avoidance measures and $\overline{Tax_Y}$ is the average value of the tax avoidance measure for the respective industry group. $X_{k,t}$ is a vector of firm-specific control variables and $TFE_{j,t}$ represents a set of dummy variables capturing time fixed effects. T statistics reported in parentheses are based on two-way clustered standard errors on firm and year (Petersen, 2009). Corresponding statistical significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 6
Tax avoidance, tax risk, and the volatility of discount rate and cash flow news

Dep. Var:	Var_{Ur}				Var_{Er}				Var_{Cf}			
Tax Var:	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Model:	[i]	[ii]	[iii]	[iv]	[v]	[vi]	[vii]	[viii]	[ix]	[x]	[xi]	[xii]
Tax	-0.0008**	0.0010	0.0000	0.0054***	0.0002	0.0018***	0.0000**	0.0025***	-0.0007*	0.0017	0.0000	0.0063***
	(-2.38)	(1.19)	(-0.87)	(5.10)	(1.18)	(3.69)	(2.20)	(3.07)	(-2.01)	(1.66)	(0.85)	(3.41)
Tax^2	0.0003***	-0.0010	0.0000***	-0.0024**	0.0000	-0.0015***	0.0000	-0.0021**	0.0003***	-0.0015*	0.0000***	-0.0036*
	(3.71)	(-1.21)	(6.41)	(-2.57)	(-1.00)	(-3.91)	(-0.71)	(-2.80)	(3.08)	(-1.72)	(5.18)	(-1.96)
F-Test	57.61	68.19	65.27	41.67	52.69	43.31	45.80	42.59	42.53	46.51	49.58	36.07
$Prob > F$	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
$Centered\ R^2$	0.1355	0.1332	0.1369	0.1666	0.2144	0.2246	0.2248	0.2312	0.1711	0.1721	0.1747	0.1979
Obs.	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017
Dep. Var:	Var_{Ur}				Var_{Er}				Var_{Cf}			
Tax Var:	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Model:	[xiii]	[xiv]	[xv]	[xvi]	[xvii]	[xviii]	[xix]	[xx]	[xxi]	[xxii]	[xxiii]	[xxiv]
Rel_Tax	0.0006***	-0.0004	0.0003***	0.0022***	0.0000	-0.0008***	0.0000	0.0002	0.0005***	-0.0008*	0.0003***	0.0019**
	(5.48)	(-1.23)	(7.44)	(4.53)	(0.05)	(-3.72)	(0.45)	(0.62)	(4.02)	(-1.88)	(7.34)	(2.77)
F-Test	61.01	70.09	69.84	45.95	55.05	42.68	46.7	46.51	45.85	48.2	53.44	40.04
$Prob > F$	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
$Centered\ R^2$	0.1368	0.1332	0.1388	0.1564	0.2143	0.2245	0.2244	0.2276	0.1717	0.1721	0.1761	0.1911
Obs.	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017

This table presents regression results of the following fixed effects model:

$$Var_{Ret,i,t} = \alpha + \beta_1 Tax_{i,t} + \sum_{k=2}^{K} \beta_k X_{k,t} + \sum_{j=1}^{J} \delta_j TFE_{j,t} + \varepsilon_{i,t}$$

where $Var_{Ret,i,t}$ is the volatility of unexpected stock returns, discount rate news, or cash flow news of firm i. $Tax_{i,t}$ is one of the following tax avoidance / tax risk measures: Long-run effective tax rate ($Letr$), tax shelter probability ($Shelt$), book-tax factor (Btd_fact), standard deviation of the long-run effective tax rate (SD_{Letr}). Models [xiii] through [xxiv] use industry-adjusted relative tax avoidance / risk measures that are constructed in the following way: $|Tax - \overline{Tax_Y}|$, where Tax is one of four tax measures and $\overline{Tax_Y}$ is the average value of the tax avoidance/risk measure for the respective industry group. $X_{k,t}$ is a vector of firm-specific control variables and $TFE_{j,t}$ represents a set of dummy variables capturing time fixed effects. T statistics reported in parentheses are based on two-way clustered standard errors on firm and year (Petersen, 2009). Corresponding statistical significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 7
Corporate international diversification and the effects of tax avoidance and tax risk on the volatility of stock returns

Dep. Var:	SD_{Ret}				Var_{Er}				Var_{Cf}			
Tax Var:	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Model:	[i]	[ii]	[iii]	[iv]	[v]	[vi]	[vii]	[viii]	[ix]	[x]	[xi]	[xii]
Tax	-0.0028**	0.0028	0.0000***	0.0252***	0.0002	0.0018***	0.0001***	0.0021**	-0.0007*	0.0017	0.0001	0.0063***
	(-2.49)	(1.07)	(0.33)	(6.78)	(1.00)	(3.85)	(2.88)	(2.62)	(-1.99)	(1.70)	(1.55)	(3.78)
Tax^2	0.0010***	-0.0034	0.0001***	-0.0125***	0.0000	-0.0013***	0.0000	-0.0020**	0.0003***	-0.0012	0.0000***	-0.0036**
	(3.40)	(-1.45)	(5.94)	(-4.17)	(-1.00)	(-3.15)	(-0.76)	(-2.80)	(3.06)	(-1.50)	(5.17)	(-2.03)
Int_Tax	0.0007	0.0018	-0.0002*	-0.0004	0.0000	-0.0005*	0.0000	0.0006**	0.0001	-0.0006	-0.0001	0.0001
	(1.25)	(1.43)	(-1.79)	(-0.21)	(0.33)	(-1.93)	(-1.39)	(2.11)	(0.23)	(-1.21)	(-0.87)	(0.14)
MNC_Dum	-0.0012*	-0.0020	-0.0011	-0.0008	0.0000	0.0004*	0.0001	-0.0001	-0.0001	0.0004	0.0000	0.0000
	(-1.85)	(-2.03)	(-1.71)	(-1.26)	(0.38)	(1.78)	(0.78)	(-0.94)	(-0.28)	(1.04)	(0.00)	(-0.20)
F-Test	109.22	70.93	76	52.68	48.67	39.86	42.87	39.5	39.5	43.59	47.41	33.15
$Prob > F$	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
$Centered\ R^2$	0.1625	0.1593	0.1623	0.2062	0.2144	0.2250	0.2249	0.2318	0.1711	0.1722	0.1748	0.1979
Obs.	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017
Dep. Var:	SD_{Ret}				Var_{Er}				Var_{Cf}			
Tax Var:	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Model:	[xiii]	[xiv]	[xv]	[xvi]	[xvii]	[xviii]	[xix]	[xx]	[xxi]	[xxii]	[xxiii]	[xxiv]
Rel_Tax	0.0025***	-0.0006	0.0009***	0.0085***	-0.0001	-0.0010***	0.0000	-0.0003	0.0007***	-0.0007	0.0003***	0.0016
	(5.19)	(-0.33)	(5.09)	(3.62)	(-0.58)	(-3.85)	(0.44)	(-0.80)	(3.39)	(-1.05)	(5.39)	(1.46)
Int_Rel_Tax	-0.0010*	-0.0015	-0.0001	-0.0003	0.0001	0.0004	0.0000	0.0008**	-0.0004*	-0.0003	0.0000	0.0005
	(-1.78)	(-0.79)	(-0.58)	(-0.13)	(1.04)	(1.16)	(-0.17)	(2.22)	(-1.74)	(-0.44)	(-0.31)	(0.47)
MNC_Dum	-0.0005	-0.0005	-0.0010	-0.0009	0.0000	0.0000	0.0001	-0.0001	0.0001	0.0001	0.0000	-0.0001
	(-0.77)	(-0.60)	(-1.51)	(-1.24)	(0.12)	(-0.28)	(0.79)	(-1.27)	(0.51)	(0.40)	(0.09)	(-0.49)

Table 7
Corporate international diversification and the effects of tax avoidance and tax risk on the volatility of stock returns (continued)

Dep. Var:	SD_{Ret}				Var_{Er}				Var_{Cf}			
Tax Var:	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}	$Letr$	$Shelt$	Btd_fact	SD_{Letr}
Model:	[xiii]	[xiv]	[xv]	[xvi]	[xvii]	[xviii]	[xix]	[xx]	[xxi]	[xxii]	[xxiii]	[xxiv]
F-Test	104.03	77.96	73.99	54.65	50.72	39.46	43.02	42.85	42.12	47.19	50.08	36.67
$Prob > F$	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
$Centered\ R^2$	0.1641	0.1591	0.1639	0.1914	0.2144	0.2246	0.2245	0.2283	0.172	0.1721	0.1761	0.1912
Obs.	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017	42,449	31,206	31,894	27,017

This table presents regression results of the following fixed effects model:

$$Var_{Ret,i,t} = \alpha + \beta_1 Tax_{i,t} + \beta_2 Int\_Tax_{i,t} + \beta_3 MNC\_dum + \sum_{k=4}^{K} \beta_k X_{k,t} + \sum_{j=1}^{J} \delta_j TFE_{j,t} + \varepsilon_{i,t}$$

where $Var_{Ret,i,t}$ is the volatility of unexpected stock returns, discount rate news, or cash flow news of firm i. $Tax_{i,t}$ is one of the following tax avoidance / tax risk measures: Long-run effective tax rate ($Letr$), tax shelter probability ($Shelt$), book-tax factor (Btd_fact), standard deviation of the long-run effective tax rate (SD_{Letr}). Models [xiii] through [xxiv] use industry-adjusted relative tax avoidance / risk measures that are constructed in the following way: $|Tax - \overline{Tax_Y}|$, where Tax is one of four tax measures and $\overline{Tax_Y}$ is the average value of the tax avoidance/risk measure for the respective industry group. $X_{k,t}$ is a vector of firm-specific control variables and $TFE_{j,t}$ represents a set of dummy variables capturing time fixed effects. T statistics reported in parentheses are based on two-way clustered standard errors on firm and year (Petersen, 2009). Corresponding statistical significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.