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Is Tax Avoidance Related to Firm Risk?

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ABSTRACT: We test whether tax avoidance strategies are associated with greater firm risk. We find that low tax rates tend to be more persistent than high tax rates and that measures of tax avoidance commonly used in the literature are generally not associated with either future tax rate volatility or future overall firm risk. Our evidence suggests that, on average, corporate tax avoidance is accomplished using strategies that are persistent and do not increase firm risk. We also find that the volatility of cash tax rates is associated with future stock volatility, suggesting that tax rate volatility and overall firm risk are related.

Keywords: effective tax rates; tax avoidance; firm risk.

JEL Classifications: M41.

I. INTRODUCTION

Recent studies report empirical findings consistent with the idea that tax avoidance is associated with higher firm-wide risk. Examples include Rego and Wilson (2012), who find that CEOs of firms that have lower effective tax rates (ETRs) receive more risk-taking incentives, which they argue encourages the CEOs to undertake risky tax reduction strategies; Badertscher, Katz, and Rego (2013), who find that managerial ownership is positively associated with ETRs, which is consistent with the idea that poorly diversified owner-managers avoid the risk inherent in tax reduction strategies; and Hasan, Hoi, Wu, and Zhang (2014), who find that firms with lower ETRs incur higher interest rates when obtaining bank loans.

However, as noted by Dyreng, Hanlon, and Maydew (2014, 1), tax avoidance captures "a broad range of tax reduction activities, ranging from benign tax-advantaged investments (e.g., tax-exempt municipal bonds) to more risky strategies that might not be upheld if challenged in a court of law (e.g., 'tax shelters')."[1] Similarly, Lisowsky, Robinson, and Schmidt (2013, 592) locate cash ETRs at the "low" end of their scale of "uncertainty regarding the ability to sustain tax benefits claimed," and Bauer and Klassen (2014) find no relation between low ETRs and unusually large future tax payments, which is inconsistent with low ETRs reflecting risky tax avoidance. Furthermore, Dyreng, Hanlon, and Maydew (2008) find that some firms are able to sustain low ETRs for a long period of time. Thus, it is unclear whether (or to what extent) activities that reduce corporate tax payments impact firm risk in a manner consistent with altering a firm's borrowing costs,[2] managerial risk incentives, or management's risk of ownership.

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[1] Our focus is on whether tax avoidance is associated with well-established empirical measures of risk. We avoid using the term "aggressive" because, consistent with Blouin (2014), we do not view aggressiveness as different from risk in the context of corporate tax avoidance. Tax avoidance that is risky is, by Blouin's (2014) definition, aggressive.

[2] Recent studies find that financially constrained firms with high borrowing costs engage in more tax avoidance to provide more internally generated cash, which suggests that high interest rates could lead to lower cash ETRs, rather than low cash ETRs increasing borrowing costs (Edwards, Schwab, and Shevlin 2016; Law and Mills 2015).

Tax avoidance could increase firm risk for several reasons. First, tax avoidance increases uncertainty with regard to the firm's future tax payments, either through increasing uncertainty regarding challenges by tax authorities, the underlying transactions that generate the tax savings, or the persistence of the tax laws (e.g., the research and development [R&D] tax credit) that provide the tax benefits (Blouin 2014). If tax payments are a sufficiently large component of the firm's cash flows, then uncertainty regarding the amount of the firm's tax payments could lead to uncertainty regarding the firm's overall cash flows. Second, the extent of tax avoidance could serve as a leading indicator regarding the risk of the firm's investments beyond that captured by other signals, such as the volatility of the firm's cash flows. This would occur if a firm's reliance on tax-favored investments were associated with their entering into risky investments. For example, a reduction in a firm's tax rate could reflect increasing investment in countries that use low tax rates to offset high investment risk in their respective country. Finally, tax avoidance activities could add complexity to the firm's financial reports and disclosures, thereby reducing transparency and increasing the uncertainty regarding the firm's future cash flows.[3]

On the other hand, there are several reasons why low tax rates may not be associated with firm risk. For example, to the extent that low tax rates reflect a firm's ability to take advantage of "benign tax-favored investments" (Dyreng et al. 2014, 1) that are unlikely to be challenged by the Internal Revenue Service (IRS) or overturned in the courts, such as investments in municipal bonds, the tax avoidance activities that lower a firm's current tax payments would generally not be followed by high payments in future periods, or increase the uncertainty regarding future tax payments. In addition, the ability to invest in benign tax-favored investments may be relatively stable, such as when it relates to the location of the firm's facilities and production functions. In this case, tax avoidance should not increase uncertainty regarding the firm's future tax rates. Finally, the tax avoidance activities that lower a firm's tax rate may not provide a signal regarding the extent of the firm's risky investments beyond that captured by other observable firm characteristics, or increase uncertainty regarding the firm's future cash flows. For these reasons, the relation between tax avoidance and firm risk is an empirical question that we address in this paper.

To provide evidence on the relation between tax avoidance and firm risk, we conduct three sets of tests. The first is whether low tax rates are less persistent than high tax rates. As noted by Dyreng et al. (2014), one implication of firms relying on "grey area tax avoidance" is that it increases the probability that the firm will have to repay those tax savings in the future. Under this view, the more risky the firm's tax positions, the greater the probability that the firm will be forced to repay the taxes. Thus, if low ETRs reflect the extent to which firms pursue risky "grey area" tax avoidance, then low ETRs should be followed by higher tax rates when the risky tax positions are disallowed and the tax savings are repaid in the future. Similarly, if firms generally reduce their tax rates by relying on temporary tax incentives, such as short-lived tax credits, then we would expect their tax rates to systematically increase as those tax saving opportunities expire.[4] Therefore, if tax avoidance reflects the extent of a firm's risky "grey area tax avoidance," then we would expect low tax rates to exhibit low persistence, i.e., be followed by high tax rates.

Our second test examines whether low ETRs are associated with greater future tax rate volatility. Volatility measures the spread or dispersion of possible outcomes or payoffs from an investment, reflecting the degree of uncertainty about the future (Brealey and Myers 1991, 114). Thus, this test examines whether tax avoidance activities lead to general uncertainty regarding the tax rates the firm will pay in the future. This could be the case either because firms reduce their tax rates by taking tax positions that may not be upheld in court, thereby generating uncertainty regarding whether the positions will be reversed, or the reduction in tax rates is due to short-term tax saving opportunities that occur sporadically, thereby generating uncertainty regarding whether they will arise in the future. Although this test is similar to the persistence test discussed above, it differs conceptually in that the former relates to predictable reversals of tax rates in which current low tax rates are followed by future high tax rates, while the latter focuses on tax strategies that increase the overall level of uncertainty regarding future tax payments.

Our third test examines whether low tax rates are associated with greater uncertainty regarding the firm's overall future cash flows. This test is based on the theory that tax aggressiveness is associated with lower transparency and greater information asymmetry (Balakrishnan, Blouin, and Guay 2012), or that the transactions that generate low tax rates increase future risk, thereby making the tax rate a leading indicator for future volatility. Under these views, firms reduce their tax payments by entering into complex transactions, such as shifting income into low tax rate jurisdictions that could be politically costly if publicly revealed, or by entering into risky transactions, such as investing in unstable countries to take advantage of low tax rates. The combination of additional complexity with reduced disclosure, such as discontinuing the reporting of geographic segments (Hope, Ma, and Thomas 2013), increases uncertainty regarding the firm's future cash flows. This view is

[3] For example, tax expense has been shown to be an indicator of earnings quality (Lev and Nissim 2004; Dhaliwal, Lee, Pincus, and Steele 2015).

[4] Consistent with Dyreng et al. (2014), we do not view risky tax positions as being improper. Instead, a risky tax position could be a favorable interpretation of the tax code. Because the tax code is ambiguous, the firm could believe that their interpretation is appropriate, but that there is also room for disagreement with regard to the interpretation.

consistent with the findings of Hasan et al. (2014) and Shevlin, Urcan, and Vasvari (2013), who find that low ETRs are associated with higher borrowing costs, suggesting that low ETRs are indicative of higher overall firm risk.[5]

For our empirical tests, we use a sample of firms with positive pretax income and data from 1987 through 2010 to construct four effective tax rate measures.[6] From Dyreng et al. (2008) we compute Cash and GAAP ETRs over a five-year period, and from Balakrishnan et al. (2012) we compute Cash and GAAP ETRs over a three-year period and adjust for size and industry.

For our first test, we separate firms into ETR quintiles and examine whether they remain in the same ETR quintile for the next non-overlapping period. Our results indicate that the likelihood of a firm in the lowest ETR quintile remaining in the lowest ETR quintile is higher than the likelihood of firms in other ETR quintiles remaining in the same quintile, i.e., low tax rates tend to be more persistent than higher tax rates. These results are not consistent with the idea that low ETRs are followed by higher tax rates when taxes have to be repaid, or after temporary tax benefits expire.

For our second test, we use the standard deviation of annual *Cash ETR*s, which captures the volatility of tax payments relative to pretax income, to measure the uncertainty underlying a firm's tax rate.[7] In this test, we expand the tax avoidance variables to include a measure of book-tax differences from Frank, Lynch, and Rego (2009), the likelihood that a firm uses tax shelters from Wilson (2009), and the predicted value for unrecognized tax benefits (UTB) from Rego and Wilson (2012). We find evidence that *Cash ETR*s are positively associated with future tax rate volatility. This suggests that a higher tax rate (less tax avoidance) is associated with greater tax rate uncertainty. Overall, we do not find evidence that tax avoidance is associated with greater future tax rate volatility. Thus, our results do not support the contention that tax avoidance activities that lower a firm's tax rate are associated with a greater degree of risk.

Our third test relates each tax avoidance measure to one-year-ahead stock return volatility. We find insignificant relations for the five-year ETR measures and significantly positive relations for the three-year adjusted ETRs. In addition, we do not find a significant relation between any of the other measures of tax avoidance and future stock return volatility. Overall, our results are not consistent with lower tax rates being associated with more firm risk.

In contrast, we find a significant relation between cash ETR volatility and future firm risk. This is consistent with the findings reported by Hanlon, Laplante, and Shevlin (2005) and Thomas and Zhang (2014) that suggest that a firm's tax rate provides incremental information regarding future stock returns. If the level of the firm's tax rate serves as a leading indicator regarding the firm's future returns, then it seems reasonable to expect the volatility of the firm's tax rate to be a leading indicator of the volatility of the firm's future stock return.

Following Dyreng et al. (2014) we investigate whether the relation between each measure of tax risk and future stock return volatility differs when a firm has activity in a tax haven country. Our main finding is that for firms with activity in tax haven countries, the reserve for unrecognized tax benefits (either the predicted reserve for the full sample, or the reported reserve for the limited sample) is negatively related to future stock return volatility. This suggests that the shifting of income to tax haven countries that creates larger UTB reserves (Dyreng et al. 2014) is associated with lower overall firm risk.

Overall, our results are not consistent with the idea that low ETRs are associated with overall firm risk. However, our results are consistent with the volatility of the firm's cash ETR serving as a leading indicator of risk. In addition to providing evidence that our test using the level of cash ETR is sufficiently powerful to detect a positive relation between tax risk and overall firm risk if one were present, this result suggests that the volatility of the firm's tax rate is associated with uncertainty regarding the firm's future cash flows. This effect could occur either because the volatility of the tax rate reflects uncertainty regarding the firm's tax payments, reflects the extent of the firm's risky investments, or reflects general uncertainty regarding the firm's future cash flows.

Our study contributes to the accounting literature by adding to our understanding of the relation between tax avoidance and firm risk. Prior research provides evidence consistent with tax avoidance activity increasing firm risk. This could lead readers to conclude that low ETRs reflect a traditional risk-return trade-off, and that firms obtain low ETRs by incurring additional risk. As we do not find evidence that tax avoidance measures are associated with firm risk, our results suggest that care should be taken in extrapolating from anecdotal evidence of specific tax avoidance cases to broad general assumptions about the relation between tax avoidance and risk. While there are likely to be individual cases in which firms temporarily reduce their tax payments by taking positions that are overturned in the future, in general, measures of tax avoidance do not appear to be indicative of managers undertaking risky investments.

In this regard, our paper is related to two concurrent papers. Dyreng et al. (2014) find evidence that greater degrees of tax avoidance are associated with more uncertainty, as reflected in the firm's UTB balance. While this result may appear contrary

[5] Since tax risk may be either systematic or idiosyncratic, we use a measure of overall firm risk like stock volatility, rather than a measure that only captures systematic risk, such as the cost of capital or beta.

[6] Because the tax treatment of losses and gains is not symmetric, the interpretation of tax rates and book-tax differences differs between profit and loss firms. In tests involving three- or five-year ETRs, we require the sum of pretax income over the three- or five-year period to be positive.

[7] A concurrent study by McGuire, Neuman, and Omer (2013) uses a similar measure to the standard deviation of the *Cash ETR* to measure "tax risk."

our findings, it is not clear whether the UTB balance reflects risk, *per se*. Ciconte, Donohoe, Lisowsky, and Mayberry (2014) report evidence that future tax payments associated with a firm's UTB reserve are predictable, which suggests that, despite its name, the amount in the reserve for uncertain tax benefits may not reflect the degree of uncertainty or risk in the firm's tax payments.

Our results also have implications for studies that use DTAX, Tax Shelter Prediction, or UTBs as measures of "tax aggressiveness" in that we fail to find evidence of strong empirical relations between these measures and future tax rate and stock return volatility. This suggests that the empirical measures are noisy in that they do not reflect *ex post* volatility in tax payments or overall cash flows. One reason is that they could reflect financial reporting choices, as well as tax choices. For example, the UTB allowance is ultimately a financial reporting choice, and risk-averse managers may record larger UTB reserves than aggressive managers to avoid a negative financial impact in the future. The financial reporting choices could thereby mask the aggressiveness of the firm's actual tax positions. Another potential explanation lies with the fact that aggressive tax positions will only result in high future payments if the IRS identifies the issue, chooses to challenge the position, and is successful in their challenge. Thus, even if the measures reflect management's tendency to take positions to reduce their tax payments that are likely to be rejected based on their merits (as stated in FIN 48), in actual practice, the positions are not reversed in the future, either because they are not identified and challenged, or because the firm's legal representation is able to reach a favorable outcome.

Our findings also indicate that the volatility of a firm's cash ETR is associated with future firm risk, after controlling for other determinants, including the volatility of pretax earnings and cash flows. This suggests that the volatility of a firm's cash ETR is a leading indicator of the risk of a firm's investments, either because of uncertainty with regard to a firm's tax payments, or in reflecting the riskiness of the firm's investments in general. In addition, our finding that the predicted UTB balance is associated with the volatility of a firm's future tax rates suggests that the UTB prediction model could be useful as an *ex ante* indicator of the uncertainty regarding a firm's future tax rates.

Our study also suggests several productive avenues for future research that are beyond the scope of our study. First, while our study fails to document a significant association between tax avoidance and risk, on average, there could be conditions under which tax avoidance is a risky activity. Future research to identify the circumstances under which tax avoidance leads to additional risk can provide insights into the factors that influence a firm's tax strategies. Second, we find that the UTB prediction model has a positive relation with tax risk, but a negative association with firm risk, and that the negative association appears to be concentrated in firms with activity in tax haven countries. Thus, future research into how the ability to shift income into tax havens maps into the uncertainty of cash flows could provide further insight into the costs and benefits of an income shifting tax strategy. Finally, although we do not have a sufficient time period to assess the relation between the reported UTB balance and future tax rate volatility, future research can assess whether the predicted UTB balance, which may be less influenced by financial reporting concerns, or the reported UTB balance, which would be less influenced by measurement error, is more closely associated with tax rate uncertainty.

II. HYPOTHESES DEVELOPMENT

Several recent papers present evidence consistent with the idea that investments in tax reduction represent the classic risk-return trade-off whereby firms increase their after-tax return by accepting a higher degree of risk. This leads to the contention that activities that lower tax rates increase the riskiness of the firm. For example, Rego and Wilson (2012) find a negative relation between the CEO's risk-taking incentives (the vega of their equity portfolio) and the level of the firm's cash ETR. This result is consistent with the idea that firms employ risk-taking incentives to encourage managers to undertake risky tax reduction strategies. Similarly, Kubick, Lockhart, and Robinson (2014) find a positive relation between management's inside debt holdings and firms' tax rates, which is consistent with the idea that managers avoid risky tax reduction strategies to protect the value of their contracted future payments from the firm.

Studies have also found evidence consistent with the idea that low tax rates are associated with management's risk preferences. For example, Badertscher et al. (2013) find a positive relation between managerial ownership and a firm's tax rate, and S. Chen, X. Chen, Cheng, and Shevlin (2010) find that family-run firms tend to have higher tax rates. Results from these studies are consistent with the idea that less diversified managers avoid strategies that lower the firm's expected tax rate because the managers would bear a greater proportion of the risk of such strategies. In another example, Huang, Lobo, Wang, and Xie (2014) find that firms with greater customer concentration have lower tax rates, which is consistent with the idea that managers who are willing to bear the high risk of customer concentration are also willing to bear the risk of tax reduction strategies.

Studies also find evidence consistent with the idea that low tax rates lead to riskier cash flows, as reflected in higher borrowing costs. Hasan et al. (2014) find a negative relation between tax rates and borrowing spreads, and Shevlin et al. (2013) find evidence that lower tax rates are associated with higher costs of public debt.

The above results are consistent with the idea that investments in tax reduction increase the riskiness of the firm. There are several potential explanations why firms that have lower tax rates will have a higher degree of risk. The first potential explanation is that a firm's tax rate reflects the extent to which a firm utilizes "grey area tax avoidance" (Dyreng et al. 2014) by taking positions that have a relatively high probability of being overturned by the taxing authority, in which case, the firm will need to pay higher taxes in the future. In this case, tax avoidance reflects the investment trade-off referred to above, in which actions that lower the firm's tax rate create additional risk. A second potential explanation is that firms reduce their tax rates by taking advantage of temporary tax incentives that expire. In this case, low tax rates are "risky" in that they are unlikely to be sustained in the future. A third potential explanation is that low tax rates can be a signal that the firm has engaged in risky investments. This would be the case if the firm reduces its tax rates by increasing its investment risk, such as by obtaining credits for research and development expenditures, or by shifting income to high-risk countries to obtain favorable tax treatment. Finally, tax avoidance could reduce transparency, thereby increasing uncertainty regarding the firm's future cash flows. This could result either from reduced disclosure or from tax avoidance activities increasing the complexity of the firm's financial statements. For example, Hope et al. (2013) present evidence that a greater degree of tax avoidance is accompanied by lower disclosure of geographic segments, and Lev and Nissim (2004) and Dhaliwal et al. (2015) present evidence that tax expense is an indicator of earnings quality.

The proposition that greater tax avoidance increases firm risk has three empirical implications. The first is that low current tax rates should be followed by higher tax rates. This is the traditional hazard view of risk, in which risk reflects the likelihood of a bad outcome (Sunder 2015). In the case of taxes, a bad outcome would be the payment of a high future tax rate either because a firm's grey area tax positions are reversed by the taxing authority, or through the expiration of short-term tax incentives. Empirically, if tax avoidance increases the probability that the firm will pay a high tax rate in the future, then low tax rates should be followed by high tax rates and, therefore, we would expect low tax rates to demonstrate a lower degree of persistence than high tax rates.

Our first hypothesis (stated in alternative form) is:

H1a: Low effective tax rates are less persistent than higher effective tax rates.

A second empirical implication of low tax rates reflecting greater risk is that tax avoidance policies increase the uncertainty regarding the firm's future tax rates. This is the view of risk popularized by Markowitz (1952) that risk reflects the dispersion of possible outcomes (Sunder 2015). In this case, low tax rates have a higher degree of uncertainty because the greater reliance on grey area tax avoidance or short-term tax incentives increases uncertainty regarding the firm's future tax payments. The uncertainty either comes from the likelihood that a firm's grey area tax positions will be reversed by the tax authorities or that additional tax incentives will not be available in the future. Empirically, the greater *ex ante* dispersion of outcomes, or uncertainty, should, on average, be reflected in the spread of the *ex post* outcomes.

Therefore, our second hypothesis is:

H1b: Low effective tax rates are positively associated with future tax rate volatility.

While H1a and H1b relate specifically to a firm's tax payments, low tax rates could also be related to firm risk by reflecting the degree of the firm's risky investments, or by increasing the information asymmetry between management and investors through a reduction of financial transparency. This leads to the proposition that low tax rates increase uncertainty regarding future cash flows.

Low tax rates could reflect the firm's risky investments if the tax attributes of specific transactions were associated with the underlying risk of the transaction. For example, various countries provide R&D tax credits to encourage risky investment. Therefore, firms are able to reduce their tax payments, not by incurring "tax risk" *per se,* but by increasing the overall risk of the firm. Similarly, countries provide tax incentives, such as low tax rates and tax holidays, to encourage foreign investment. If the risk of investment is one of the barriers to capital flowing to such countries, then the tax benefits would be tied to the risk of investing in those countries.

Low tax rates could reflect information asymmetry for two reasons. First, tax avoidance activities could lead to a greater degree of information asymmetry from a lower degree of disclosure. Second, the complexity induced by the intricate tax avoidance strategies employed can increase information asymmetry. For example, Balakrishnan et al. (2012) find evidence that low tax rates are associated with lower financial transparency. In addition, Kim, Li, and Zhang (2011) find evidence that low tax rates are associated with more negative skewness in stock returns and increased stock price crash risk, which is consistent with managers of firms with low tax rates withholding the disclosure of unfavorable information. Hope et al. (2013) examine a specific disclosure and find that firms with low tax rates are more likely to discontinue geographic segment disclosure to hide the source of their tax avoidance activities. Donohoe and Knechel (2014) find that firms with low ETRs pay higher audit fees, and Chyz, Leung, Li, and Rui (2013) find that firms with a greater union presence have higher tax rates. The former suggests

TABLE 1

Sample Selection

	5-Year Cash ETR	*5-Year GAAP ETR*	*3-Year Adjusted Cash ETR*	*3-Year Adjusted GAAP ETR*	*Cash ETR Volatility*	*DTAX*	*Shelter*	*Predicted UTB*	*Reported UTB*
Compustat (1987–2010)	231,088	231,088	231,088	231,088	231,088	231,088	231,088	231,088	231,088
Non U.S. Incorporation	(43,348)	(43,348)	(43,348)	(43,348)	(43,348)	(43,348)	(43,348)	(43,348)	(43,348)
Insufficient Data to Calculate									
Pretax Income or Cash Taxes Paid	(48,898)	(48,898)	(48,898)	(48,898)	(48,898)	(48,898)	(48,898)	(48,898)	(48,898)
Stock Return Volatility	(20,338)	(20,338)	(20,338)	(20,338)	(20,338)	(20,338)	(20,338)	(20,338)	(20,338)
Control Variables	(79,777)	(79,777)	(79,777)	(79,777)	(79,777)	(79,777)	(79,777)	(79,777)	(79,777)
Tax Variable	(6,704)	(7,856)	(9,614)	(9,956)	(18,585)	(22,288)	(9,221)	(12,743)	(34,271)
Return Volatility Final Sample	32,023	30,871	29,113	28,771	20,142	16,439	29,506	25,984	4,456
Future Tax Volatility (t+1 to t+5)	(22,830)	(21,828)	(20,271)	(19,934)		(11,032)	(20,442)	(18,323)	
Future Tax Volatility Final Sample	9,193	9,043	8,842	8,837		5,407	9,064	7,661	

All variables are defined in Appendix A.

that audit firms both perceive and price higher reporting risk for firms that have low tax rates, and the latter is consistent with monitoring by unions disciplining managers from taking tax positions that allow managers to extract rents.

The above results are consistent with the idea that low tax rates reflect complex tax structures and managers reduce transparency in order to avoid potential political costs from the revelation of their tax reduction strategies. This increases the risk of the firm because the complex tax positions could fail to survive a detailed audit by the tax authorities in the relevant jurisdictions, leading to uncertainty regarding future tax cash flows. Also, the lower degree of transparency reduces the ability of outside stakeholders to properly assess management's actions and investment decisions, leading to greater uncertainty regarding the firm's future cash flows.

Our third hypothesis is:

H2: Lower effective tax rates are positively associated with future stock price volatility.

While the hypotheses above suggest that low tax rates are associated with a higher degree of firm risk, the relation between tax avoidance and firm risk is an empirical question for several reasons. The first is that firms are often able to reduce their tax rates by taking advantage of benign tax-favored investments. In such instances, there is little, if any, risk that the firm will be assessed future taxes and penalties for lowering their current tax payments. If the firm's ability to make such investments is relatively stable over time, then the firm should be able to maintain their low tax rate, in which case, there should be no relation between the firm's tax rate and either tax rate persistence or future tax rate volatility. Similarly, while the tax benefits may be tied to the risk of underlying transactions, it is not clear that the tax rate provides incremental information regarding the risk of those transactions beyond that captured by other observable indicators. Also, while tax avoidance could lead to a lower degree of transparency and a higher degree of volatility, it is not clear whether this would have a substantial effect on stock return volatility for a broad sample of firms.

III. RESEARCH DESIGN AND RESULTS

Sample Selection and Variable Definitions

Table 1 summarizes our sample selection procedure. Our sample begins with all observations on the CRSP/Compustat merged database from 1987 to 2011 with available data. We start with 1987 because this is the first year that cash taxes paid are available on Compustat. Because several of our variables require five years of data, our stock return volatility measure requires one year of future data, and our tax rate volatility measure requires five years of future data, our sample period effectively runs from 1992–2010 for tests using the stock return volatility measure and 1992–2006 for tests using the tax rate volatility measure. To reduce the impact of different legal systems, including tax laws and enforcement, we drop firms that are not incorporated in the U.S. In addition, each firm must have sufficient data for five consecutive years to calculate the *Cash ETR,* and data for a

sixth consecutive year to calculate subsequent stock return volatility. Finally, we require sufficient data to calculate the control variables and each tax avoidance variable. We lose a substantial number of observations for control variables because several of the variables, such as the volatility of special items, volatility of pretax book income, and volatility of cash flows, all require five consecutive years of data. The sample is relatively evenly distributed across the sample period. Because the data requirements differ across the tax avoidance measures, and because reserves for uncertain tax benefits (UTB reserves) are only reported beginning in 2007, the maximum sample size varies from a maximum of 32,023 firm-years for tests using the *5-Year Cash ETR* to 4,456 firm-years for tests using the *Reported UTB* reserve.[8]

Following Dyreng et al. (2008), we calculate the *Cash* (*GAAP*) *ETR* as the ratio of the sum of the cash tax payments (tax expense) over a five-year period to the sum of income before taxes and special items over the same five-year period. To ensure that tax rates have a reasonable economic interpretation, we winsorize tax rates to values between 0 and 1. Following Balakrishnan et al. (2012), we define the three-year adjusted *Cash* (*GAAP*) *ETR* as the sum of taxes paid (tax expense) over a three-year period scaled by the sum of pretax income over the same period adjusted by the ETR for the firm's size/industry portfolio.[9] To measure the volatility of the *Cash ETR* (*Cash ETR Volatility*), we use the standard deviation of five annual *Cash ETR*s (cash taxes paid for the year scaled by income before taxes and special items for the year).[10] We use a rolling five-year window to calculate each measure and include a firm if it has sufficient data for the five-year period to construct the tax avoidance measures and sufficient data to calculate the subsequent year's stock return volatility.

For our measure of firm risk, we use the one-year-ahead volatility of stock returns (*SD_Ret*), computed as the standard deviation of the 12 monthly returns in the fiscal year immediately following the last of the five years used in our tax measures. We use the one-year-ahead stock return volatility to capture the resolution of the uncertainty about future tax payments that exists as of the end of our sample year.[11]

Descriptive Statistics

Panel A of Table 2 presents descriptive statistics for the dependent and independent variables used in the regressions with future stock return volatility as the dependent variable. The mean (median) *5-Year Cash ETR* of 30.7 percent (29.2 percent) is similar to the levels reported in prior research. The mean (median) *5-Year GAAP ETR* of 34.0 percent (34.3 percent) is higher, reflecting firms' tendency to defer tax payments. The distribution of the *Cash ETR Volatility* appears to be positively skewed, with a mean of 14.3 percent and median of 8.4 percent.

Panel B of Table 2 presents descriptive statistics for the dependent and independent variables used in the regressions with future tax rate volatility as the dependent variable. As noted above, because this measure requires five years of future data to estimate, rather than the one year for the stock return volatility measure, for these tests, the sample period ends in 2006 rather than 2010. The statistics for the key variables approximate those from the longer sample period. For example, the mean *5-Year Cash ETR* drops from 30.7 percent to 30.4 percent and the mean *5-Year GAAP ETR* increases from 34.0 percent to 34.5 percent.

Panel C of Table 2 presents the pairwise correlations between the risky tax avoidance measures. As expected, there are strong positive correlations between each of the effective tax rate measures, with correlations ranging from 0.740 for the *5-Year Cash ETR* measure and the three-year size- and industry-adjusted *Cash ETR* measure to 0.271 for the *5-Year GAAP ETR* measure and the three-year size- and industry-adjusted *Cash ETR* measure. Interestingly, we find relatively weak relations between the ETRs and the other measures of risky tax avoidance. None of the pairwise correlations exceeds 0.229 in absolute value and several are below 0.100. Finally, we find the Tax Shelter Prediction (*Shelter*) and the *Predicted UTB* to be positively related with a correlation of 0.311.[12]

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[8] Our sample includes banks and insurance companies. Our results are qualitatively similar if we exclude financial institutions.

[9] To form a variable that is consistent with the Dyreng et al. (2008) tax rate, in calculating three-year ETRs, we subtract the industry-size ETR from the firm's ETR.

[10] We require a positive numerator and denominator for each year to calculate the volatility of the *Cash ETR*. We impose this restriction to maintain a reasonable interpretation of the annual *Cash ETR*. It is not clear how to interpret negative tax rates and because firms do not necessarily receive a refund for annual tax losses, the tax refund associated with a negative numerator is not necessarily determined by the loss reflected in a negative denominator.

[11] Recall that the *Cash ETR* is calculated over a five-year period. Therefore, the one-year-ahead stock return volatility could reflect the resolution of uncertain tax positions taken over the five-year period.

[12] The correlations reported are based on 9,143 observations for which all the data are available. The correlations for the limited sample for which reported UTB data are available are similar. In addition, the correlation between the *Predicted UTB* and the *Reported UTB* is 0.347, which suggests that the prediction model is reasonably effective.

TABLE 2

Descriptive Statistics

Panel A: Return Volatility Sample

Variable	n	Mean	Std. Dev.	25th Percentile	50th Percentile	75th Percentile
SD_Ret	38,727	0.134	0.082	0.078	0.114	0.167
5-Year Cash ETR	32,023	0.307	0.187	0.196	0.292	0.372
5-Year GAAP ETR	30,871	0.340	0.146	0.278	0.343	0.383
3-Year Adjusted Cash ETR	29,113	0.026	0.207	−0.093	−0.001	0.085
3-Year Adjusted GAAP ETR	28,771	0.005	0.142	−0.040	−0.002	0.029
Cash ETR Volatility (historical)	20,142	0.143	0.219	0.051	0.084	0.142
DTAX	16,439	0.015	0.624	−0.024	0.027	0.115
Shelter	29,506	0.200	0.400	0.000	0.000	0.000
Predicted UTB	25,984	0.010	0.008	0.005	0.009	0.014
Reported UTB	4,456	0.014	0.018	0.003	0.007	0.017
PTBI	38,727	0.061	0.150	0.007	0.068	0.138
Vol_PTBI	38,727	0.083	0.090	0.028	0.054	0.101
BTM	38,727	0.663	0.533	0.318	0.524	0.822
Leverage	38,727	0.187	0.196	0.005	0.141	0.300
Size	38,727	5.802	1.987	4.344	5.757	7.179
Abn_Accruals	38,727	0.181	0.806	0.001	0.005	0.032
Return	38,727	0.122	0.637	−0.248	0.018	0.312
Inst_Own	38,727	0.529	0.293	0.283	0.523	0.791
Shares_Out	38,727	3.163	1.421	2.149	3.089	4.045
Vol_SpecialItems	38,727	0.029	0.046	0.003	0.012	0.034
Vol_CashFlow	38,727	0.073	0.068	0.031	0.053	0.090
Vol_ETBSO	38,727	0.001	0.003	0.000	0.000	0.000
ETBSO	38,727	0.001	0.003	0.000	0.000	0.000
NOLCF	38,727	0.102	0.349	0.000	0.000	0.023
CHG_NOLCF	38,727	0.001	0.069	0.000	0.000	0.000

Panel B: Future Tax Rate Volatility Sample

Variable	n	Mean	Std. Dev.	25th Percentile	50th Percentile	75th Percentile
5-Year Cash ETR	9,193	0.304	0.141	0.225	0.308	0.371
5-Year GAAP ETR	9,043	0.345	0.105	0.306	0.355	0.385
3-Year Adjusted Cash ETR	8,842	0.018	0.165	−0.066	0.006	0.072
3-Year Adjusted GAAP ETR	8,837	0.002	0.101	−0.027	0.001	0.025
Cash ETR Volatility (future)	9,694	0.134	0.203	0.050	0.081	0.135
DTAX	5,407	−0.012	0.676	−0.030	0.018	0.082
Shelter	9,064	0.198	0.398	0.000	0.000	0.000
Predicted UTB	7,661	0.010	0.007	0.006	0.009	0.014
PTBI	9,694	0.123	0.109	0.056	0.107	0.178
Vol_PTBI	9,694	0.057	0.063	0.021	0.038	0.070
BTM	9,694	0.543	0.404	0.280	0.456	0.675
Leverage	9,694	0.189	0.181	0.019	0.158	0.298
Size	9,694	6.178	1.895	4.838	6.186	7.471
Abn_Accruals	9,694	0.091	0.494	0.001	0.003	0.017
Vol_SpecialItems	9,694	0.019	0.035	0.001	0.008	0.022
Vol_CashFlow	9,694	0.058	0.051	0.026	0.044	0.073
Vol_ETBSO	9,694	0.000	0.002	0.000	0.000	0.000
ETBSO	9,694	0.000	0.003	0.000	0.000	0.000
NOLCF	9,694	0.032	0.170	0.000	0.000	0.000
CHG_NOLCF	9,694	0.001	0.033	0.000	0.000	0.000

(continued on next page)

TABLE 2 (continued)

Panel C: Pairwise Correlations of Tax Variables using Sample from Panel A

	5-Year Cash ETR	*5-Year GAAP ETR*	*3-Year Adjusted Cash ETR*	*3-Year Adjusted GAAP ETR*	*Cash ETR Volatility*	*DTAX*	*Shelter*
5-Year GAAP ETR	0.542						
3-Year Adjusted Cash ETR	0.740	0.271					
3-Year Adjusted GAAP ETR	0.362	0.666	0.401				
Cash ETR Volatility (historical)	0.260	0.146	0.207	0.046			
DTAX	−0.018	−0.009	−0.016	−0.001	−0.004		
Shelter	−0.221	−0.229	−0.092	−0.110	−0.110	−0.016	
Predicted UTB	−0.097	−0.184	−0.034	−0.088	−0.062	−0.026	0.311

All continuous variables are winsorized at the 1 percent level. All variables are as of time *t*, with the exception of *Cash ETR* (future), which is measured from *t*+1 to *t*+5, and *SD_Ret*, which is measured for year *t*+1.
All variables are defined in Appendix A.

Test of H1a: Persistence of Low ETRs

Our first hypothesis is that low ETRs are less persistent than other ETRs because tax positions that lower current tax rates generate high tax rates when they reverse in future periods. To provide evidence on the persistence of ETRs, we calculate the probability that a firm that is in a tax rate quintile in one five-year period will remain in the same tax rate quintile in the next non-overlapping five-year period. Panel A of Table 3 presents the likelihood that a firm that is in a current-year *Cash ETR* quintile appears in a subsequent *Cash ETR* quintile. The diagonal can be considered as a measure of persistence in that it reflects the probability that the firm will remain in the same *Cash ETR* quintile in the subsequent non-overlapping five-year period. The first row in the table describes firms in the lowest *Cash ETR* quintile, i.e., firms that have relatively low tax rates. We find that a firm in the lowest *Cash ETR* quintile remains in the lowest *Cash ETR* quintile 40 percent of the time. This is the highest probability of any of the *Cash ETR* quintiles and does not support the prediction of H1a that low *Cash ETR*s are less persistent than high *Cash ETR*s.

To provide statistical tests of this hypothesis, we estimate a logistic regression with the dependent variable equal to 1 if the firm remains in the same ETR quintile in the subsequent period. Panel B of Table 3 presents the results for two versions of this regression for the five-year ETR measures (Dyreng et al. 2008), and Panel C presents the results for the three-year adjusted ETR measures (Balakrishnan et al. 2012). The first regression includes indicator variables for ETR quintiles 2–5 (the lowest ETR quintile is used as a baseline). The coefficient for each quintile indicator reflects the tax rate persistence of firms in that quintile relative to the lowest ETR quintile. H1a predicts that low ETRs will have a low degree of persistence, thereby leading to positive coefficients on each of the ETR indicator variables. However, the coefficient of each indicator variable is significantly negative, indicating that the likelihood of remaining in the same ETR quintile is significantly lower for each of the ETR quintiles 2 through 5, relative to ETR quintile 1.

The second column in Panel B in Table 3 includes an indicator variable set equal to 1 if the firm is in the lowest ETR quintile. The coefficient on the indicator variable reflects the persistence of firms in the lowest ETR quintile relative to all other firms. H1a predicts the coefficient is negative, indicating that low ETRs have a lower degree of persistence. We find a significantly positive coefficient, suggesting that low ETRs are more persistent than other *Cash ETR*s. This is contrary to the prediction of H1a that low ETRs have low persistence because taking risky tax positions that lower the firm's current tax rate lead to higher payments in the future that substantially increase the firm's tax rate. As shown in Panels B and C, the results are consistent across each of the ETR measures.

Test of H1b: The Relation between Tax Avoidance and Future Tax Rate Volatility

H1b predicts that tax avoidance policies that reduce ETRs are associated with a greater degree of tax rate volatility. To test this prediction, we estimate the following regression model:

$$\begin{aligned} Cash\_ETR\_Volatility_{t+1,5} = {} & \alpha_0 + \alpha_1 TAX_{it} + \alpha_2 Size_i + \alpha_3 PTBI_t + \alpha_4 Leverage_{it} + \alpha_5 Vol\_PTBI_{it} + \alpha_6 BTM_{it} \\ & + \alpha_7 Abn\_Accruals_{it} + \alpha_8 Vol\_SpecialItems_{it} + \alpha_9 Vol\_CashFlow_{it} + \alpha_{10} Vol\_ETBSO_{it} \\ & + \alpha_{11} ETBSO_{it} + \alpha_{12} CHG\_NOLCF_{it} + \alpha_{13} NOLCF_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

where:

TABLE 3

Persistence of High Tax Rates

Panel A: Unconditional Rates of Remaining in the Same ETR Quintile

	Future ETR Quintiles				
Current Year Quintile	**1st Quintile (Lowest ETRs)**	**2nd Quintile**	**3rd Quintile**	**4th Quintile**	**5th Quintile (Highest ETRs)**
1st ETR Quintile (Lowest ETRs)	40%	20%	10%	6%	10%
2nd ETR Quintile	26%	28%	19%	11%	14%
3rd ETR Quintile	14%	23%	27%	21%	17%
4th ETR Quintile	8%	16%	28%	38%	26%
5th ETR Quintile (Highest ETRs)	12%	13%	16%	24%	33%

Panel B: Persistence Regression based on the Five-Year ETR

	1 Cash ETR	**2 Cash ETR**	**3 GAAP ETR**	**4 GAAP ETR**
1st ETR Quintile (Lowest ETRs)		0.529***		0.408***
		(6.50)		(4.78)
2nd ETR Quintile	−0.464***		−0.353***	
	(−4.61)		(−3.27)	
3rd ETR Quintile	−0.572***		−0.487***	
	(−6.07)		(−4.74)	
4th ETR Quintile	−0.443***		−0.293***	
	(−4.63)		(−2.92)	
5th ETR Quintile (Highest ETRs)	−0.674***		−0.539***	
	(−6.52)		(−5.00)	
Constant	−0.385	−1.681**	−0.635	−1.058
	(−0.47)	(−2.54)	(−0.89)	(−1.50)
Industry and Year Effects?	Yes	Yes	Yes	Yes
R^2	0.019	0.018	0.019	0.018
n	12,930	12,930	12,700	12,700

Panel C: Three-Year Adjusted ETR

	1 Cash ETR	**2 Cash ETR**	**3 GAAP ETR**	**4 GAAP ETR**
1st ETR Quintile (Lowest ETRs)		0.310***		0.447***
		(4.90)		(6.66)
2nd ETR Quintile	−0.425***		−0.402***	
	(−5.46)		(−4.78)	
3rd ETR Quintile	−0.313***		−0.500***	
	(−4.14)		(−6.32)	
4th ETR Quintile	−0.259***		−0.551***	
	(−3.49)		(−6.93)	
5th ETR Quintile (Highest ETRs)	−0.206**		−0.324***	
	(−2.47)		(−3.88)	
Constant	−0.903**	−1.226***	−1.143	−1.581
	(−2.06)	(−2.79)	(−1.56)	(−2.13)
Industry and Year Effects?	Yes	Yes	Yes	Yes
R^2	0.009	0.008	0.015	0.014
n	15,641	15,641	15,713	15,713

(continued on next page)

TABLE 3 (continued)

, * Indicate statistical significance at the 0.05 and 0.01 levels, respectively.
Panel A of this table presents the unconditional probability that a firm will be in a specific ETR quintile in the future period given its current ETR quintile. For example, 40 percent of the firms in the lowest current ETR quintile remain in the lowest quintile in the subsequent period. Panels B and C present the results of logit regressions with the dependent variable set equal to 1 if the firm appears in the same ETR quintile computed over the next period. In Panels A and B, the ETRs are computed following Dyreng et al. (2008), and in Panel C, the ETRs are computed following Balakrishnan et al. (2012). In Columns 1 and 3, the coefficient for each quintile represents the persistence of each quintile relative to the first quintile. In Columns 2 and 4, the coefficient on the first quintile represents the persistence of the first quintile relative to all other quintiles. Robust Z-statistics calculated based on standard errors clustered by firm are in parentheses. All continuous variables are winsorized at the 1 percent level.
All variables are defined in Appendix A.

Cash ETR Volatility = the standard deviation of annual *Cash ETR*s measured over a five-year period;
TAX = a measure of tax avoidance;
Size = natural log of total assets (AT);
PTBI = pretax book income (PI) scaled by lagged total assets;
Leverage = year-end long-term debt (DLTT) scaled by lagged total assets;
Vol_PTBI = standard deviation of annual pretax income (PI) scaled by lagged total assets (AT) measured over a five-year period;
BTM = year-end book value of equity (CEQ) over the price per share (PRCC_F) times the total number of shares outstanding (CSHO);
Abn_Accruals = square of year-end discretionary accruals, estimated using the modified Jones model from Dechow, Sloan, and Sweeney (1996);
Vol_SpecialItems = standard deviation of special items (SPI) scaled by lagged total assets (AT) measured over a five-year period;
Vol_CashFlow = standard deviation of operating cash flow (OANCF) scaled by lagged total assets (AT) measured over a five-year period;
Vol_ETBSO = standard deviation of the excess tax benefit of stock options (TXBCOF + TXBCO) scaled by lagged total assets (AT) measured over a five-year period;
ETBSO = the excess tax benefit of stock options (TXBCOF + TXBCO) scaled by lagged total assets (AT);
CHG_NOLCF = change in net operating loss carryforward (*NOLCF*) scaled by lagged total assets (AT); and
NOLCF = net operating loss carryforward (*NOLCF*) scaled by lagged total assets (AT).

H1b predicts a positive association between a firm's reliance on tax avoidance activities and future rate volatility. Our test variable, *TAX*, represents one of several measures of tax avoidance that are drawn from the literature. Our first four measures are the Cash and GAAP ETRs from Dyreng et al. (2008) and Balakrishnan et al. (2012). Because tax avoidance activities lower current ETRs, we predict that $\alpha_1 < 0$ for the ETR measures. In addition, we use a measure of discretionary permanent book-tax differences (*DTAX*) developed by Frank et al. (2009),[13] the tax shelter prediction model (*Shelter*) developed by Wilson (2009), and a model of predicted UTBs (*Predicted UTB*) developed by Rego and Wilson (2012).[14,15]

The control variables include several measures, such as firm size, leverage, and book-to-market, to capture the volatility of the underlying economic environment. In addition, we include the level of pretax income and abnormal accruals to capture the potential accounting adjustments firms can use to either smooth reported income or adjust reported income to meet other reporting objectives. We control for the tax benefit of stock options, as well as the net operating loss carryforward, as these items can affect both future rate volatility and the current rate. Finally, we control for the volatilities of pretax income, special items, operating cash flows, and the excess tax benefits from the exercise of employee stock options.

Table 4 presents the results of the test of H1b. Columns 1–4 present the relations between the level of the firm's ETR and future tax rate volatility. The coefficients for the *5-Year GAAP ETR* and the *3-Year Adjusted GAAP ETR* are not significant at

[13] Badertscher et al. (2013), Goh, Lee, Lim, and Shevlin (2013), Goh, Lim, Shevlin, and Zang (2013), Hasan et al. (2014), Hutchens and Rego (2015), Kubick et al. (2014), and Rego and Wilson (2012) also use this as a measure of risky tax avoidance.
[14] Badertscher et al. (2013), Goh et al. (2013), Hutchens and Rego (2015), Kim et al. (2011), Rego and Wilson (2012), and Robinson, Xue, and Zhang (2012) also use this as a measure of risky tax avoidance.
[15] Because the measurement period for the dependent variable covers the subsequent five years and unrecognized tax benefits (UTBs) were not reported until 2007, there is insufficient data to use the reported UTB balance for the test using the volatility of *Cash ETR* as the dependent variable. Because the test using stock return volatility as the dependent variable requires one year of future data, as opposed to the five years required for the volatility of *Cash ETR*, we are able to use the reported UTB values for the sample period beginning in 2007.

TABLE 4

The Relation between Tax Avoidance Measures and Future Rate Volatility

Variables	1 *5-Year Cash ETR*	2 *5-Year GAAP ETR*	3 *3-Year Adjusted Cash ETR*	4 *3-Year Adjusted GAAP ETR*	5 *DTAX*	6 Tax Shelter Prediction	7 Predicted UTBs
TAX	0.066**	0.014	0.075***	0.053	−0.008	0.004	0.451
	(2.48)	(0.41)	(3.81)	(1.40)	(−1.25)	(0.52)	(0.91)
Size	−0.010***	−0.011***	−0.011***	−0.011***	−0.012***	−0.012***	−0.013***
	(−4.67)	(−4.77)	(−4.84)	(−4.75)	(−3.87)	(−4.14)	(−5.01)
PTBI	−0.227***	−0.241***	−0.209***	−0.225***	−0.225***	−0.187***	−0.201***
	(−5.90)	(−5.94)	(−5.12)	(−5.32)	(−4.13)	(−4.49)	(−4.80)
Leverage	0.033*	0.027	0.021	0.016	0.044*	0.033*	0.036*
	(1.79)	(1.46)	(1.17)	(0.90)	(1.89)	(1.69)	(1.86)
Vol_PTBI	0.253**	0.237**	0.209*	0.226*	0.278*	0.131	0.137
	(2.07)	(2.19)	(1.79)	(1.87)	(1.69)	(1.12)	(1.11)
BTM	0.044***	0.047***	0.044***	0.047***	0.036**	0.046***	0.037***
	(3.75)	(3.86)	(3.43)	(3.57)	(2.28)	(3.74)	(2.97)
Abn_Accruals	−0.010**	−0.009**	−0.005	−0.005	−0.001	−0.001	0.002
	(−2.37)	(−2.21)	(−1.25)	(−1.11)	(−0.14)	(−0.02)	(0.29)
Vol_SpecialItems	−0.172	−0.195	−0.220*	−0.220*	−0.074	−0.050	−0.092
	(−1.25)	(−1.37)	(−1.83)	(−1.79)	(−0.42)	(−0.39)	(−0.71)
Vol_CashFlow	0.121	0.139	0.123	0.115	0.185	0.123	0.123
	(1.15)	(1.43)	(1.16)	(1.07)	(1.29)	(1.17)	(1.07)
Vol_ETBSO	0.667	1.319	0.886	1.649	−0.569	1.189	0.833
	(0.23)	(0.41)	(0.30)	(0.51)	(−0.14)	(0.40)	(0.27)
ETBSO	0.555	0.793	0.383	0.370	1.873	0.270	0.759
	(0.28)	(0.38)	(0.19)	(0.18)	(0.65)	(0.14)	(0.38)
CHG_NOLCF	0.120	0.159	−0.011	0.040	0.051	−0.006	−0.003
	(0.74)	(0.95)	(−0.08)	(0.28)	(0.31)	(−0.04)	(−0.02)
NOLCF	−0.045**	−0.052*	−0.042**	−0.042*	−0.037	−0.028	−0.027
	(−2.10)	(−1.77)	(−2.13)	(−1.95)	(−1.59)	(−1.64)	(−1.41)
Constant	0.253***	0.267***	0.275***	0.276***	0.291***	0.269***	0.460
	(3.36)	(3.53)	(3.72)	(3.71)	(4.53)	(3.48)	(1.54)
Industry FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,193	9,043	8,842	8,837	5,407	9,064	7,661
R^2	0.092	0.090	0.096	0.092	0.111	0.084	0.096

*, **, *** Indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.
The dependent variable in the analysis is the volatility of *Cash ETR*s calculated over the period *t*+1 through *t*+5. t-statistics calculated using standard errors clustered by firm are in parentheses. Each column represents a regression with the tax avoidance measure listed in the column heading. All continuous variables are winsorized at the 1 percent level.
All variables are defined in Appendix A.

conventional levels. However, we find significantly positive coefficients for the *5-Year Cash ETR* and the *3-Year Adjusted Cash ETR*. The significantly positive coefficients indicate a positive relation between current tax rates and future tax rate volatility, contrary to our hypothesized negative relation. In Columns 5–7, we present the results for the alternative measures of risky tax avoidance. None of the coefficients are significant. Therefore, our evidence is not consistent with tax avoidance being associated with greater risk.

Test of H2: The Relation between Tax Avoidance and Future Return Volatility

H2 predicts that firms with low ETRs have a greater degree of return volatility, a measure of overall firm risk. To test this prediction, we estimate the following regression models:

$$SD\_Ret_{t+1} = \beta_0 + \beta_1 TAX_{it} + \beta_2 PTBI_t + \beta_3 Vol\_PTBI_{it} + \beta_4 BTM_{it} + \beta_5 Leverage_{it} + \beta_6 Size_{it} + \beta_7 Abn\_Accruals_{it} + \beta_8 Return_{it} + \beta_9 Inst\_Own_{it} + \beta_{10} Shares\_Out_{it} + \beta_{11} Vol\_SpecialItems_{it} + \beta_{12} Vol\_CashFlow_{it} + \beta_{13} Vol\_ETBSO_{it} + \beta_{14} ETBSO_{it} + \beta_{15} CHG\_NOLCF_{it} + \beta_{16} NOLCF_{it} + \beta_{17} Loss_{it} + \varepsilon_{it} \quad (2)$$

where:

SD_Ret = the standard deviation of monthly stock returns computed over the following year;
Return = firm's annual buy and hold stock return measured over the fiscal year;
Shares_Out = log of the firm's common shares outstanding (CSHO);
Inst_Own = firm's average institutional ownership measured over the fiscal year; and
Loss = an indicator variable equal to 1 if a firm has negative pretax income.
All other variables are as previously defined.

We use pretax income from operations to control for the firm's operating performance, which has been shown to be negatively associated with stock return volatility (Hanlon, Rajgopal, and Shevlin 2004). The volatilities of pretax income, special items, operating cash flows, and the excess tax benefit from the exercise of employee stock options measured over the same period as the tax rate variables controls for the riskiness of the firm's operations.[16] The book-to-market variable controls for the extent of the firm's growth opportunities, which we expect to be positively associated with stock return volatility. We include financial leverage to control for the additional risk imposed by financial distress and capital constraints (Rajgopal and Venkatachalam 2011). We control for size since smaller firms experience greater return volatility (Pastor and Veronesi 2003). The extent of discretionary accruals controls for the risk associated with lower earnings quality (Rajgopal and Venkatachalam 2011). We also control for the firm's stock return over the current year, as stock return is negatively related to return volatility (Duffie 1995). To control for stock trading differences due to investor composition, we include the firm's average institutional ownership over the year (Bushee and Noe 2000). We include the number of shares outstanding in the current year, as the supply of a firm's shares has been shown to be a significant determinant of stock return volatility (Cohen, Ness, Okuda, Schwartz, and Whitcomb 1975). We control for the excess benefit of stock options (and the volatility) as the tax benefit could be related to the firm's stock return. We control for net operating loss (NOL) carryforwards and the change in net operating loss carryforwards because firms can use NOLs to decrease their tax liabilities below that expected by other economic fundamentals.

Our regression specification also includes firm and year fixed effects. A Hausman test between fixed and random effects indicates that ordinary least squares (OLS) is not consistent and that fixed effects are appropriate. As noted above, we have a substantial number of firms included in the sample multiple times. By including firm fixed effects, the regression explains deviations from the average return volatility for each firm and, therefore, reduces potential problems associated with firm-specific omitted variables that are correlated with the firm's average stock return volatility. The year fixed effect controls for differences in tax laws and other macroeconomic effects across time.

Table 5 presents the results for the test of H2. In Panel A, we report the results for our four ETR measures, along with the results for *Cash ETR Volatility*. We include this measure of tax risk to assess the power of the test, and to investigate whether ETR volatility has incremental explanatory power with regard to total firm risk.

In general, in Table 5, Panel A, we find the coefficients for the *Cash ETR* measures to be insignificant and the coefficients for the three-year adjusted ETR measures to be significantly positive. The positive relations are not consistent with the hypothesis that lower tax rates are associated with higher levels of firm risk. A potential explanation for the insignificant coefficient for each five-year ETR measure is that the empirical model does not have sufficient power to detect the relation. While this explanation cannot be completely discounted, we note the relatively strong explanatory power of the regressions (R^2s are approximately 0.23) and the significance of the control variables in the expected directions. We also note that the signs of the coefficients on the five-year ETR measures are positive, opposite of the predicted direction. Finally, the significantly positive coefficient for *Cash ETR Volatility* (t-statistic = 2.14) indicates that the regression is able to detect the expected positive association between future stock return volatility and the firm's tax rate volatility. The significant relations for the tax rate volatility and insignificant, or positive, relations for the level of cash ETR suggest that the relation between future stock return volatility and tax avoidance (as reflected by low tax rates) is not as strong as the relation between future stock return volatility and ETR volatility.

We assess the economic significance of *Cash ETR Volatility* by using a model that standardizes each variable by subtracting the mean and scaling by the standard deviation (Demere, Donohoe, and Lisowsky, 2014). Each coefficient

[16] In unreported sensitivity tests, we use the standard deviation of cash flows from operations instead of the standard deviation of pretax income to control for the riskiness of the firm's operations. Inferences are unchanged.

TABLE 5

The Relation between Tax Avoidance and Firm Risk

Panel A: ETR-Based Measures

Variables	1 *5-Year Cash ETR*	2 *5-Year GAAP ETR*	3 *3-Year Adjusted Cash ETR*	4 *3-Year Adjusted GAAP ETR*	5 *Cash ETR Volatility*
TAX	0.005	0.003	0.006**	0.017***	0.006**
	(1.52)	(0.87)	(2.40)	(4.56)	(2.14)
PTBI	0.009*	0.009	0.021***	0.021***	0.025***
	(1.67)	(1.50)	(3.46)	(3.42)	(3.40)
Vol_PTBI	0.073***	0.070***	0.054***	0.056***	0.096***
	(4.67)	(4.40)	(3.59)	(3.65)	(4.48)
BTM	0.019***	0.019***	0.015***	0.016***	0.016***
	(10.60)	(9.96)	(8.14)	(8.17)	(6.55)
Leverage	0.025***	0.022***	0.026***	0.024***	0.024***
	(7.46)	(6.64)	(7.87)	(7.32)	(6.79)
Size	−0.008***	−0.007***	−0.006***	−0.005***	−0.006***
	(−4.77)	(−4.40)	(−3.56)	(−3.31)	(−3.38)
Abn_Accruals	−0.001**	−0.001**	−0.001	−0.001	0.000
	(−1.95)	(−1.98)	(−1.52)	(−1.53)	(0.21)
Return	0.008***	0.008***	0.006***	0.006***	0.002*
	(8.01)	(7.80)	(5.53)	(5.20)	(1.65)
Inst_Own	0.006*	0.005*	0.006*	0.007*	0.005
	(1.77)	(1.48)	(1.73)	(1.95)	(1.19)
Shares_Out	0.002	0.002	0.003**	0.003**	0.004**
	(1.19)	(1.40)	(2.09)	(1.91)	(2.65)
Vol_SpecialItems	0.007	0.001	−0.013	−0.019	−0.025
	(0.31)	(0.06)	(−0.62)	(−0.91)	(−0.74)
Vol_CashFlow	0.012	0.020	0.031**	0.026	0.013
	(0.76)	(1.19)	(2.15)	(1.63)	(0.68)
Vol_ETBSO	−1.834***	−1.901***	−1.743***	−1.865***	−1.812***
	(−6.99)	(−7.15)	(−6.79)	(−7.12)	(−6.76)
ETBSO	0.330**	0.318**	0.082	0.094	0.035
	(2.24)	(2.10)	(0.56)	(0.64)	(0.23)
CHG_NOLCF	0.035***	0.030**	0.018	0.011	0.014
	(3.36)	(2.57)	(1.56)	(0.92)	(0.77)
NOLCF	−0.006	−0.001	−0.003	0.001	0.008
	(−0.98)	(−0.16)	(−0.46)	(0.12)	(0.74)
Loss	0.019***	0.018***	0.017***	0.017***	
	(12.35)	(11.71)	(9.77)	(9.55)	
Constant	0.118***	0.117***	0.105***	0.105***	0.096***
	(13.94)	(13.65)	(12.65)	(12.56)	(9.90)
Firm Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes
n	32,032	30,871	29,113	28,771	20,142
R^2	0.232	0.230	0.215	0.216	0.212

Panel B: Other Tax Avoidance Measures

Variables	1 *DTAX*	2 *Shelter*	3 *Predicted UTB*	4 *Reported UTB*
TAX	0.001	0.002	−0.066	0.073
	(0.66)	(−1.38)	(−0.53)	(0.65)

(continued on next page)

TABLE 5 (continued)

Variables	1 *DTAX*	2 *Shelter*	3 *Predicted UTB*	4 *Reported UTB*
PTBI	0.020**	0.018***	0.021***	−0.026
	(2.50)	(3.00)	(3.29)	(−1.57)
Vol_PTBI	0.050**	0.053***	0.054***	−1.07**
	(2.14)	(3.68)	(3.60)	(−2.09)
BTM	0.012***	0.009	0.009***	0.030***
	(4.55)	(4.72)	(4.51)	(5.59)
Leverage	0.028***	0.025***	0.025***	0.036***
	(6.33)	(7.43)	(7.39)	(2.57)
Size	−0.006***	−0.005***	−0.007***	−0.006
	(−2.58)	(−3.36)	(−4.02)	(−0.73)
Abn_Accruals	−0.001	−0.001*	−0.001	0.002***
	(−1.26)	(−1.74)	(−1.54)	(2.19)
Return	0.009***	0.009***	0.010***	0.012***
	(6.04)	(9.00)	(8.67)	(4.23)
Inst_Own	0.007	0.007**	0.005	−0.043***
	(1.44)	(2.09)	(1.35)	(−2.82)
Shares_Out	0.002	0.002	0.002	−0.013
	(1.09)	(1.37)	(1.17)	(−1.11)
Vol_SpecialItems	0.003	−0.007	−0.010	0.153*
	(0.10)	(−0.33)	(−0.49)	(2.28)
Vol_CashFlow	0.039*	0.024	0.029*	0.086*
	(1.89)	(1.63)	(1.82)	(1.90)
Vol_ETBSO	−1.667***	−1.827***	−1.724***	−0.783*
	(−6.04)	(−7.37)	(−6.74)	(−1.75)
ETBSO	0.038	0.235*	0.263*	1.013***
	(0.21)	(1.67)	(1.84)	(2.72)
Chg_NOLCF	0.011	0.015	0.012	0.027*
	(0.99)	(1.48)	(1.21)	(1.70)
NOLCF	0.003	0.006	0.004	−0.020*
	(0.59)	(1.41)	(1.02)	(−2.14)
Loss			0.133***	0.004
			(13.81)	(1.09)
Constant	0.118***	0.115***	0.114***	0.244***
	(10.17)	(13.75)	(10.39)	(4.04)
Firm Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
n	16,439	29,506	25,984	4,456
R^2	0.202	0.200	0.201	0.325

*, **, *** Indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.
The dependent variable is the volatility of stock returns at year *t*+1. t-statistics are in parentheses and reflect standard errors that are clustered by firm. Each column represents a regression with the tax avoidance measure listed in the column heading. All continuous variables are winsorized at the 1 percent level. All variables are defined in Appendix A.

thereby represents the impact of a one-standard-deviation change in the independent variable on the dependent variable, thereby facilitating comparison. In the model (not reported), the coefficient on *Cash ETR Volatility* of 0.016 is between the coefficients for the volatility of operating cash flow (0.010) and the volatility of pretax income (0.105).

Panel B of Table 5 presents the results for the regressions using the alternative measures for tax avoidance. Because we only need one year of data to calculate the volatility of future stock returns, we include the *Reported UTB* balance as an additional measure of risky tax avoidance. However, due to the limited time period the UTB balance is available, our sample size for the UTB balance is greatly reduced.

We find insignificant coefficients for each measure of tax avoidance. Overall, the results do not support the H2 prediction that tax avoidance is associated with higher firm risk, and suggest that ETR volatility is a potentially important determinant of overall firm risk.[17]

A potential explanation for the positive relation between ETR volatility and firm risk is that past volatility leads to greater uncertainty regarding the firm's future tax rate and overall uncertainty regarding the firm's future cash flows. This finding is also consistent with Hanlon et al. (2005) and Thomas and Zhang (2014), who report evidence that a firm's tax rate is informative with regard to future returns. Hanlon et al. (2005) suggest that the difference between tax and book income provides information with regard to the quality of earnings, thereby allowing investors to better map reported book income into future cash flows, whereas Thomas and Zhang (2014) suggest that tax expense reflects beliefs regarding future profitability, thereby providing a useful signal to investors. To the extent that a firm's tax rate is useful in predicting future income, cash flows, or returns, volatility in the tax rate would increase the uncertainty inherent in those forecasts.

IV. ACTIVITY IN TAX HAVEN COUNTRIES

In a concurrent working paper, Dyreng et al (2014) examine the relationship between tax avoidance and tax uncertainty, as reflected in the firm's UTB reserve, and find that increased uncertainty from R&D-related tax avoidance is concentrated in firms with high tax haven activity. This raises the question as to whether the relation between tax avoidance and firm risk depends on whether the firm has activities in tax haven countries. To investigate this issue, we use data from the website maintained by Scott Dyreng (https://sites.google.com/site/scottdyreng/Home/data-and-code) to identify firms that have activities in tax haven countries, and define a variable (*Tax Haven*) set equal to 1 if the firm has activities in tax haven countries, and 0 otherwise. We interact the *Tax Haven* variable with each of the tax avoidance measures and report the results in Table 6.

Panel A of Table 6 reports the results for the ETR tax avoidance measures. The results are consistent with the findings reported in Panel A of Table 5. The coefficients for the three-year adjusted Cash and GAAP ETR measures and the volatility of the *Cash ETR* are significantly positive. Of primary interest, the coefficient for the interaction of the *Tax Haven* variable with each tax avoidance ETR measure is not significant. Thus, we do not find evidence that the impact of tax avoidance on firm risk is related to the firm's presence in tax havens.

Panel B of Table 6 reports the results for the other tax avoidance measures. We find significantly negative coefficients for the interactions of *Tax Haven* with each of the two UTB measures. The negative coefficient for the interaction with the *Predicted UTB* value (t-statistic = −3.03) and *Reported UTB* value (t-statistic = −1.97) suggest that when a firm has activities in tax haven countries, larger UTB reserves are associated with lower firm risk. This is consistent with tax havens providing firms with the opportunity to engage in tax-planning strategies (such as income shifting) that increase the UTB reserve, but decrease overall firm risk. Finally, we note that the interactions between *Tax Haven* and the *DTAX* and *Shelter* measures of risky tax avoidance are not significant. Therefore, we do not find evidence that activities in tax havens affect the relation between discretionary permanent book-tax differences or the predicted likelihood of a tax shelter and overall firm risk.

V. CONCLUSION

Results from prior studies are consistent with the idea that low tax rates reflect the extent to which managers take risky tax positions. Such positions serve to lower current tax payments, but have a relatively high likelihood of requiring the repayment of the tax savings, plus interest and penalties, in the future. In addition, tax avoidance can lead to greater firm risk if it reflects the ability to take advantage of targeted short-term tax incentives, is associated with risky investments, or leads to less transparency and greater information asymmetry. To provide direct evidence on the relation between low ETRs and firm risk, we identify a set of empirical implications and conduct a set of empirical tests. Specifically, we examine whether low tax rates are associated with lower persistence and whether a broad range of tax avoidance measures are associated with higher future tax rate or stock return volatility.

To capture the extent of a firm's risky tax avoidance activity, we use measures that have been used in the literature, including four measures of effective tax rates, the discretionary permanent book-tax difference measure from Frank et al.

[17] In a concurrent paper, Hutchens and Rego (2015) similarly find that the volatility of the cash ETR is positively associated with firm risk. However, they also find that *DTAX* is associated with firm risk, where we fail to find such an association. After further investigation, we find that the difference between our results can be attributed to annual loss firms. Although Hutchens and Rego (2015) exclude firms with cumulative negative pretax income, they do not exclude firms with negative annual pretax income. Because *DTAX* is based on a measure called PermDiff (pretax income minus grossed-up tax expense), for a firm with negative pretax income and negative tax expense, the resulting *DTAX* value is negative, which changes the interpretation of the measure. For example, a firm operating in a very low tax rate country that has negative pretax income would have a large negative measure for *DTAX*, while in the next year, the same firm with positive pretax income would have a large positive value for *DTAX*. We eliminate any firm-year in which the pretax income is negative when computing *DTAX* to avoid this problem. We note that if we include firm-years with an annual loss, then *DTAX* is positively and significantly associated with firm risk, consistent with the results in Hutchens and Rego (2015).

TABLE 6

The Impact of Tax Havens on the Relation between Tax Avoidance and Firm Risk

Panel A: ETR-Based Measures

Variables	1 *5-Year Cash ETR*	2 *5-Year GAAP ETR*	3 *3-Year Adjusted Cash ETR*	4 *3-Year Adjusted GAAP ETR*	5 *Cash ETR Volatility*
Tax	0.005	0.007	0.006**	0.019***	0.008**
	(1.50)	(1.50)	(2.22)	(4.04)	(2.44)
Tax ∗ Tax Haven	−0.002	−0.011	−0.001	−0.004	−0.008
	(−0.32)	(−1.52)	(−0.21)	(−0.66)	(−1.57)
Tax Haven	0.000	0.004	0.001	0.001	0.000
	(0.10)	(1.30)	(0.57)	(0.52)	(0.18)
PTBI	0.009*	0.009	0.021***	0.0209***	0.025***
	(1.67)	(1.52)	(3.48)	(3.43)	(3.40)
Vol_PTBI	0.073***	0.070***	0.054***	0.056***	0.097***
	(4.67)	(4.40)	(3.59)	(3.64)	(4.51)
BTM	0.019***	0.019***	0.015***	0.016***	0.016***
	(10.59)	(9.96)	(8.12)	(8.15)	(6.55)
Leverage	0.025***	0.022***	0.026***	0.024***	0.025***
	(7.46)	(6.64)	(7.87)	(7.32)	(6.82)
Size	−0.008***	−0.007***	−0.006***	−0.005***	−0.006***
	(−4.76)	(−4.42)	(−3.58)	(−3.33)	(−3.36)
Abn_Accruals	−0.001*	−0.001*	−0.001	−0.001	0.000
	(−1.94)	(−1.95)	(−1.51)	(−1.52)	(0.20)
Return	0.008***	0.008***	0.006***	0.006***	0.002
	(8.01)	(7.79)	(5.53)	(5.20)	(1.64)
Inst_Own	0.006*	0.005	0.006*	0.007*	0.005
	(1.77)	(1.49)	(1.74)	(1.96)	(1.14)
Shares_Out	0.002	0.002	0.003**	0.003*	0.004***
	(1.19)	(1.41)	(2.07)	(1.90)	(2.68)
Vol_SpecialItems	0.007	0.002	−0.013	−0.019	−0.025
	(0.31)	(0.07)	(−0.63)	(−0.90)	(−0.75)
Vol_CashFlow	0.012	0.020	0.031**	0.026*	0.012
	(0.76)	(1.29)	(2.05)	(1.65)	(0.64)
Vol_ETBSO	−1.834***	−1.909***	−1.746***	−1.870***	−1.808***
	(−6.99)	(−7.17)	(−6.80)	(−7.14)	(−6.75)
ETBSO	0.329**	0.319**	0.081	0.094	0.033
	(2.23)	(2.10)	(0.55)	(0.64)	(0.21)
CHG_NOLCF	0.035***	0.030**	0.018	0.012	0.013
	(3.35)	(2.55)	(1.57)	(0.92)	(0.74)
NOLCF	−0.006	−0.001	−0.003	0.001	0.008
	(−0.97)	(−0.13)	(−0.46)	(0.11)	(0.81)
Loss	0.019***	0.018***	0.017***	0.017***	
	(12.35)	(11.72)	(9.77)	(9.57)	
Constant	0.118***	0.116***	0.105***	0.105***	0.096***
	(13.88)	(13.40)	(12.68)	(12.58)	(9.84)
Firm Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Observations	32,032	30,871	29,113	28,771	20,142
R^2	0.232	0.230	0.215	0.216	0.212

(continued on next page)

TABLE 6 (continued)

Panel B: Other Tax Avoidance Measures

Variables	1 *DTAX*	2 *Shelter*	3 *Predicted UTB*	4 *Reported UTB*
Tax	0.001	−0.000	0.076	0.192
	(1.11)	(−0.24)	(0.56)	(1.53)
Tax ∗ Tax Haven	−0.001	−0.003	−0.445***	−0.225**
	(−1.07)	(−1.49)	(−3.03)	(−1.97)
Tax Haven	0.001	0.002	0.006***	−0.002
	(0.41)	(1.20)	(2.91)	(−0.62)
PTBI	0.020**	0.018***	0.020***	−0.026
	(2.51)	(3.01)	(3.20)	(−1.59)
Vol_PTBI	0.050**	0.053***	0.054***	−0.107**
	(2.14)	(3.66)	(3.58)	(−2.10)
BTM	0.012***	0.009***	0.009***	0.030***
	(4.54)	(4.71)	(4.48)	(5.57)
Leverage	0.028***	0.025***	0.025***	0.036***
	(6.33)	(7.42)	(7.40)	(2.61)
Size	−0.006***	−0.005***	−0.007***	−0.006
	(−2.59)	(−3.41)	(−4.13)	(−0.72)
Abn_Accruals	−0.001	−0.001*	−0.001	0.001**
	(−1.29)	(−1.75)	(−1.56)	(2.15)
Return	0.009***	0.009***	0.010***	0.012***
	(6.04)	(9.01)	(8.66)	(4.28)
Inst_Own	0.007	0.007**	0.005	−0.044***
	(1.45)	(2.13)	(1.33)	(−2.89)
Shares_Out	0.002	0.002	0.002	−0.012
	(1.08)	(1.36)	(1.22)	(−1.11)
Vol_SpecialItems	0.002	−0.007	−0.0106	0.155**
	(0.09)	(−0.33)	(−0.52)	(2.34)
Vol_CashFlow	0.039*	0.025*	0.029*	0.086*
	(1.89)	(1.66)	(1.86)	(1.90)
Vol_ETBSO	−1.669***	−1.825***	−1.714***	−0.715
	(−6.05)	(−7.35)	(−6.71)	(−1.62)
ETBSO	0.035	0.235*	0.264*	1.000***
	(0.20)	(1.66)	(1.85)	(2.71)
CHG_NOLCF	0.011	0.015	0.012	0.029*
	(0.98)	(1.43)	(1.23)	(1.80)
NOLCF	0.003	0.005	0.004	−0.021**
	(0.60)	(1.39)	(1.01)	(−2.12)
Loss				0.004
				(1.10)
Constant	0.118***	0.115***	0.132***	0.245***
	(10.20)	(13.78)	(13.74)	(4.07)
Firm Fixed Effects?	Yes	Yes	Yes	Yes
Year Fixed Effects?	Yes	Yes	Yes	Yes
Observations	16,439	29,506	25,984	4,456
R^2	0.202	0.200	0.202	0.327

*, **, *** Indicate statistical significance at the 0.10, 0.05, and 0.01 levels, respectively.
The dependent variable is the volatility of stock returns for year *t*+1. t-statistics are in parentheses, with standard errors clustered by firm. Each column represents a regression with the tax avoidance measure listed in the column heading. All continuous variables are winsorized at the 1 percent level. All variables are defined in Appendix A.

(2009), and the tax shelter (Wilson 2009) and UTB prediction (Rego and Wilson 2012) models. In the tests of overall firm risk, we also use the reported UTB balance as an additional measure of risky tax avoidance.

Contrary to the predictions, we find low ETRs tend to be more persistent. We also fail to find evidence, using any of our measures of tax avoidance, that a greater degree of tax avoidance is associated with higher and future tax rate or stock return volatility. In fact, we find evidence of significantly positive relations between some tax rate measures and future volatility, indicating that higher tax rates may be associated with a greater degree of uncertainty than lower tax rates. Our results have implications for studies that use DTAX, Tax Shelter Prediction, or UTBs as measures of "tax aggressiveness" in that we fail to find evidence of strong empirical relations between these measures and future tax rate and stock return volatility. This suggests that the empirical measures are noisy in that they do not reflect *ex post* volatility in tax payments or overall cash flows.

However, we find evidence of a positive association between a firm's tax rate volatility and overall firm risk, which suggests that tax rate volatility is a potentially important indicator of higher overall firm risk. This evidence suggests that for researchers that wish to measure the riskiness, or uncertainty, of a firm's tax policies, cash ETR volatility may be the most appropriate measure. Overall, our findings are most consistent with the idea that low ETRs reflect the extent to which a firm's operations allow the firm to take advantage of benign tax-favored transactions, as opposed to differences in managers' willingness to reduce the firm's tax payments through risky tax positions.

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APPENDIX A

Variable Definitions

Panel A: Tax Avoidance Measures

Variable Name	Description
TAX	One of the measures of tax avoidance activity, defined based on column.
5-Year Cash ETR	The five-year sum (from year $t-4$ to year t) of cash taxes paid (TXPD) divided by the five-year sum of pretax income (PI) less special items (SPI). Firms are required to have a positive denominator and *Cash ETR* is winsorized at 0 and 1. Based on the measure developed by Dyreng et al (2008).
5-Year GAAP ETR	The five-year sum (from year $t-4$ to year t) of tax expense (TXT) divided by the five-year sum of pretax income (PI) less special items (SPI). Firms are required to have a positive denominator and *Cash ETR* is winsorized at 0 and 1. Based on the measure developed by Dyreng et al (2008).
3-Year Adjusted Cash ETR	The three-year sum (from year $t-2$ to year t) of cash taxes paid (TXPD) divided by the three-year sum of pretax income (PI), adjusted by the same period three-year ETR for the portfolio of firms in the same quintile of total assets and the same industry. Based on the measure developed by Balakrishnan et al (2012).
3-Year Adjusted GAAP ETR	The three-year sum (from year $t-2$ to year t) of tax expense (TXT) divided by the three-year sum of pretax income (PI), adjusted by the same period three-year ETR for the portfolio of firms in the same quintile of total assets and the same industry. Based on the measure developed by Balakrishnan et al (2012).
Cash ETR Volatility	The standard deviation of annual cash taxes paid (TXPD) divided by pretax income (PI) less special items (SPI) over a five year period.
DTAX	Model of discretionary book-tax differences developed by Frank et al. (2009). *DTAX* = the residual from the following regression estimated by year and two-digit SIC code: $PermDiff_{it} = \alpha_0 + \alpha_1(1/AT_{it-1}) + \alpha_2 INTANG_{it} + \alpha_3 UNCON_{it} + \alpha_4 MI_{it} + \alpha_5 CSTE_{it} + \alpha_6 \Delta NOL_{it} + \alpha_7 LAGPERM_{it} + \varepsilon_{it}$. When computing *DTAX*, we use all Compustat firm-year observations with the available data.
Shelter	An indicator variable set equal to 1 for firms in the top quintile of the predicted probability that the firm is engaged in tax sheltering based on the model from Wilson (2009). *Shelter* = −4.30 + 6.63 * BTD − 1.72 * LEV + 0.66 * SIZE + 2.26 * ROA + 1.62 * FOR_INCOME + 1.56 * R&D.
Predicted UTB	Predicted unrecognized benefits at the end of year *t*, based on the model from Rego and Wilson (2012). *Predicted UTB* = −0.004 + 0.011 * PTROA + 0.001 * SIZE + 0.010 * FOR_SALE + 0.092 * R&D − 0.002 * DISC_ACC + 0.003 * LEV + 0.014 * SG&A − 0.018 * SALES_GR.
Reported UTB	Reported Unrecognized Tax Benefits (TXTUBEND) scaled by lagged assets (AT).

Panel B: Other Variables

Variable Name	Description
SD_Ret	The standard deviation of monthly stock returns over the subsequent year.
Size	Natural log of total assets (AT).
PTBI	Pretax book income (PI) scaled by lagged total assets (AT).
BTM	Book value of equity (CEQ) over price per share (PRCC_F) times total common shares outstanding (CSHO).
Leverage	Long-term debt (DLTT) scaled by lagged total assets.
Abn_Accruals	The square of discretionary accruals, where discretionary accruals are estimated using the modified Jones method from Dechow et al (1996). When computing discretionary accruals, we do so using a sample of all Compustat firm-year observations with the available data.
Vol_PTBI	Standard deviation of the ratio of annual pretax book income (PI) to lagged total assets (AT) measured over a five-year period.
Return	The firm's annual buy and hold stock return measured over the fiscal year.
Inst_Own	The firm's average institutional ownership measured over the fiscal year.
Shares_Out	The log of the firm's common shares outstanding (CSHO).
Vol_SpecialItems	Standard deviation of special items (SPI) scaled by lagged total assets (AT) measured over a five-year period.
Vol_CashFlow	Standard deviation of operating cash flow (OANCF) scaled by lagged total assets (AT) measured over a five-year period.
Vol_ETBSO	Standard deviation of the excess tax benefit of stock options (TXBCOF + TXBCO) scaled by lagged total assets (AT) measured over a five-year period; *Vol_ETBSO* is set to 0 if missing.

(continued on next page)

APPENDIX A (continued)

Variable Name	Description
ETBSO	Excess tax benefit of stock options (TXBCOF + TXBCO) scaled by lagged total assets (AT); *ETBSO* is set to 0 if missing.
NOLCF	Net operating loss carryforward (TLCF) scaled by lagged total assets (AT). *NOLCF* is set equal to 0 if missing (TLCF).
CHG_NOLCF	Change in net operating loss carryforward (TLCF) scaled by lagged total assets (AT). *NOLCF* is set equal to 0 if missing (TLCF).
Tax Haven	Equals 1 if the firm reports activity in a tax haven country in the current year, and 0 otherwise (Dyreng and Lindsey 2009). Tax haven data from website maintained and updated by Scott Dyreng.

The variable descriptions above provide the general structure of the models underlying the calculations of some of the complex variables. Additional information regarding the calculations, including the definitions of the variables in the models, can be found in the referenced papers. In our empirical analyses, we winsorize all of our continuous variables at the 1 percent levels of their respective distributions.