Limits of Arbitrage and Tax Expense Momentum

Hyoung-Goo Kang
Department of Finance
Hanyang University Business School
hyoungkang@hanyang.ac.kr

Young Jun Kim*
College of Business
Hankuk University of Foreign Studies
youngjun.kim@hufs.ac.kr

Yongoh Roh
College of Business Administration
Seoul National University
yong0603@snu.ac.kr

* Correspondence to Young Jun Kim (youngjun.kim@hufs.ac.kr)

Limits of Arbitrage and Tax Expense Momentum

ABSTRACT

Thomas and Zhang (2011) document that *seasonally differenced quarterly tax expense* (i.e., ‘tax expense surprise’ or ‘tax expense momentum’) predicts next quarter stock returns. This study examines whether this tax expense momentum can be explained by the limits of arbitrage such as the absence of substitutes and high transaction costs. Using U.S. stocks from 1980 to 2010, we find that the excess returns to the trading strategies based on tax expense momentum are concentrated in firms with high idiosyncratic volatility (a proxy for the absence of substitutes) and low trading volume (a proxy for high transaction costs). Our result suggests that both high arbitrage risk and high transaction costs prevent investors from exploiting the tax expense anomaly, allowing the tax expense momentum to persist for several decades.

JEL classification: M4; M41; G14

Key Words: tax expense; limits of arbitrage; idiosyncratic risk; transaction costs

1. Introduction

Corporate income tax is one of the most controversial but important items in firm valuation. There are two conflicting views on the market valuation of corporate income taxes (Graham et al. 2012; Thomas and Zhang, 2014). On the one hand, corporate income taxes are major expenses to all for-profit firms; therefore tax expenses decrease firm value (Lipe, 1986). On the other hand, tax expenses may signal incremental information about the firm's profitability, thereby increasing firm value (Ohlson and Penman, 1992). Prior studies mainly focus on the relationship between tax expense and *contemporaneous* stock returns and provide mixed empirical evidence on the value implication of tax expenses. In their study, Thomas and Zhang (2011) examine the relation between tax expense and *future* stock returns. They find that tax expense surprise, measured as *seasonally differenced quarterly tax expense*, is positively related to next quarter stock returns after controlling for well-documented risk factors. This positive relation is often referred to as the 'tax expense anomaly' or 'tax expense momentum'.[1]

Thomas and Zhang (2011) attribute their finding to investors' under-reaction to value-relevant information contained in tax expenses. To the extent that corporate taxes are overly complex and its disclosure is quite opaque, investors fail to fully respond to the implication of tax expenses for future profitability in a timely manner and subsequently correct their under-reaction when future earnings are announced. In an efficient market, such a delayed reaction to the public information yields profitable investment opportunities for arbitragers. Nevertheless, the tax expense momentum has persisted over the last four decades (Thomas and Zhang, 2011), suggesting that investors have repeatedly failed to fully impound tax expense information into stock prices. Moreover, several studies suggest that even sophisticated intermediaries such as sell-side analysts, short-sellers, or insiders do not trade based on tax expense signals (Weber,

[1] The tax expense momentum is coined by Thomas and Zhang (2011). The recent subsequent study to Thomas and Zhang (2011), Baik et al. (2015), use the tax expense anomaly instead of the tax expense momentum. Therefore, we use the tax expense momentum and the tax expense anomaly interchangeably in this study.

2009; Chi, Pincus, and Teoh, 2013). These puzzling findings call for further research that investigates why market participants persistently fail to utilize the tax expense-based anomaly. We attempt to fill this void in the literature by considering limits of arbitrage as a potential explanation for why the tax expense anomaly has persisted over times.

In a friction-less market, rational agents exploit arbitrage opportunities by eliminating the mispricing of securities. However, in reality, the mispricing could continue if the costs of arbitrage outweigh the benefits. Pontiff (2006) argues that there are two types of arbitrage costs that restrict the arbitragers from exploiting the mispricing: 1) holding cost and 2) transaction cost.

First, holding costs are borne by traders when they maintain their arbitrage positions. These include interest on margin requirements, short sale cost, and idiosyncratic risk (i.e., the absence of close substitutes). Among different types of holding costs, idiosyncratic risk is the most important and largest arbitrage cost as documented in the studies on limits of arbitrage (Pontiff, 2006). Mispriced assets with high idiosyncratic risk are costly to arbitrage because it is difficult to find close substitutes to form a hedged position (Shleifer and Vishny, 1997). Consistent with this view, many prior studies document a positive relation between idiosyncratic risk and the magnitude of mispricing (Ali et al., 2003; Mendenhall, 2004; Mashruwala et al., 2006; Li et al., 2011). Second, transaction costs are another important impediment and cost to arbitrageurs. Transaction costs include brokerage fees, commissions, and market impact. Numerous studies both theoretically and empirically show that transaction costs are positively related to the magnitude of mispricing (Garman and Ohlson, 1981; Stoll, 2000). Despite the significant role of arbitrage costs in explaining various market anomalies, little is known about their effects on the tax expense anomaly. In this study, we shed light on our understanding on the persistence of tax expense anomaly by investigating the impacts of both idiosyncratic volatility and transaction cost on the tax expense mispricing.

Using U.S. firms from 1980:Q1 to 2010:Q4, we first confirm Thomas and Zhang (2011)'s finding that tax expense surprise predicts next quarter stock returns. We then examine whether this finding can be explained by the limits of arbitrage. Specifically, we investigate whether the excess stock returns from the tax expense strategy are primarily attributable to stocks with high idiosyncratic risk. Consistent with our hypothesis, we find that idiosyncratic volatility is higher in the two extreme portfolios based on tax expense surprise, suggesting that tax expense strategy involves large idiosyncratic risks. Next, we examine whether transaction costs are greater for stocks in the two extreme portfolios. We find that abnormal hedge returns are concentrated among stocks with low price, with low trading volume, and of small-sized firms. Finally, we incorporate the idiosyncratic volatility, price, trading volume, and firm size into a cross-sectional regression model and find that idiosyncratic risk and trading volume play important roles in explaining the variation of abnormal stock returns from the strategy. Taken together, our result suggests that the tax expense momentum persists due to idiosyncratic risks and transaction costs.

This study contributes to the literature on the market mispricing of tax-related information. Most prior research suggests that complexity and opaqueness of corporate tax reporting hinder investors from fully understanding the implications of tax expense (Lev and Nissim, 2004; Thomas and Zhang 2011). However, our finding suggests that the limits of arbitrage largely explain the persistence of the tax expense anomaly. Also, we extend the literature by providing a possible explanation for why investors, even sophisticated ones, have failed to exploit a seemingly lucrative arbitrage opportunity using tax information (Weber, 2009; Chi et al., 2013). As well, our findings add to the literature on the role of arbitrage costs in explaining market anomalies (Mendenhall, 2004; Mashruwala et al., 2006; Lam et al., 2011). Lastly, our finding should also be of interest to investors relying on tax expense signals in making investment decisions.

The remainder of the paper is organized as follows. Section 2 reviews the related literature and develops the hypothesis. Section 3 describes the sample and provides variable definitions. Section 4 reports the empirical results. Section 5 concludes.

2. Literature Review and Hypothesis Development

Our paper is related to research on the value implications of tax information and limits of arbitrage in the capital market. We briefly review these two strands of literature.

Tax information and stock returns

Prior research documents the value relevance of tax information in financial reports. Several studies investigate the relation between tax expense and contemporaneous returns. For example, Lipe (1986) demonstrates that stock returns are negatively related to tax expense surprises after controlling for surprises in pre-tax income and other expenses. This confirms the conventional ides that tax expense reduces firm value. However, several studies document the opposite relation that tax expense surprise increases firm value (e.g., Ohlson and Penman, 1992; Lev and Thiagarajan, 1993). Additionally, Hanlon et al. (2005) document that the changes in taxable income are positively associated with stock returns. Recently, Thomas and Zhang (2014) attempt to reconcile the disparity between these two conflicting views by documenting that the both results depend on empirical specifications.

Another line of the literature looks into the link between taxes and future stock returns. To the extent that corporate tax disclosure is deemed overly complex and opaque, market participants may not be able to fully process the information in the tax disclosures. Several studies examine this possibility by focusing on different aspects of corporate taxes. For example, Lev and Nissim (2004) show that book-tax ratios (i.e., the excess of book earnings over taxable income) are positively related to future returns and suggest that investors under-react to information in tax disclosure. Schmidt (2006) provides evidence that investors underestimate the persistence of tax changes measured with the change in effective tax rate. Given the general investors' failure to understand the value implications of tax information, Weber (2009) focuses on more sophisticated market participants, sell-side analysts, and finds that they also fail to update their earnings forecasts based on book-tax ratios. Thomas and Zhang (2011) directly examine the relation between tax expense surprises and future stock returns and find a positive relation between them. They find that such trading strategy results in excess returns after controlling for earnings surprise and other pricing anomalies. They interpret their findings as tax expense surprises reflecting future profitability incremental to reported earnings that investors fail to fully incorporate into the stock prices.

The limits of arbitrage

In an efficient market when securities are mispriced, arbitrageurs generate profit by taking a long position in underpriced securities and a short position in overpriced securities. Such arbitrage activity facilitates price discovery of mispriced securities and should ultimately eliminate mispricing. However, even in the presence of active arbitrageurs, prior research documents that mispricing persists due to limits of arbitrage.

Pontiff (2006) argues that there are two types of arbitrage costs that restrict arbitrageurs from eliminating mispricing: holding cost and transaction cost. Holding costs are borne by traders when they maintain their arbitrage positions. These include interest on margin requirements, short sale cost, and idiosyncratic risk (i.e., the absence of close substitutes)[2]. Among different types of holding costs, idiosyncratic risk is the largest and the most significant

[2] A mispriced asset is traded at a price higher or lower than fundamental value. When the arbitrageur can find the substitute stocks whose returns are exactly correlated with the returns of the mispriced stock, they can perfectly hedge the fundamental value changes of the mispriced asset and the mispricing will eventually go away. However, identifying such perfect substitutes turns out to be a difficult task. When a perfect substitute is not available, the arbitrageur cannot perfectly hedge the fundamental value changes. In other words, the arbitrageur will subject himself every period to idiosyncratic risk and such risk cumulates over time. In this case, the arbitrageur may be forced to liquidate the trading position early because mispricing may worsen in the short run. As such, the arbitrageurs should find available substitute securities and construct a portfolio that is most highly correlated with the returns of the mispriced stock. To quantify the lack of close substitutes, Pontiff (1996) uses a regression of the excess returns of the mispriced security on the excess returns of all other substitute assets available to an arbitrageur. The estimated regression coefficient on each substitute asset′s return can be interpreted as the weight of the respective asset in the hedge portfolio. The variance of the residuals from this regression is the unhedgeable risk that the arbitrageur must bear. Since Pontiff (1996), many prior studies use idiosyncratic risk as a proxy for the absence of close substitute (Wurgler and Zhuravskaya 2002;Ali et al. 2003).

arbitrage cost, as documented in studies on limits of arbitrage (e.g. Pontiff, 2006)[3]. Shleifer and Vishny (1997) highlight the role of idiosyncratic risk. They argue that arbitrageurs are poorly diversified and hold a limited variety of stocks and thus are concerned about the idiosyncratic risks in their portfolios.[4] Therefore, it is likely that stocks with higher idiosyncratic risk are less attractive to arbitrageurs, which in turn leads to greater mispricing.

Several papers confirm this view by showing evidence that the persistence of anomalies is inversely related to idiosyncratic risks. For example, Ali et al. (2003) show that the book-to-market anomaly is greater in stocks with higher idiosyncratic return volatility and attribute the results to higher arbitrage risk deterring price discovery. In a similar vein, Mendenhall (2004) finds that the magnitude of the post-earnings-announcement drift is strongly related to idiosyncratic volatility. Subsequently, Mashruwala et al. (2006) and Li et al. (2011) provide evidence consistent with idiosyncratic risks contributing to the persistence of accrual anomaly and assets growth anomalies. Recently, Li et al. (2014) document that the low-volatility anomaly is concentrated in stocks with high idiosyncratic volatility.

However, most prior research on to the mispricing of tax information attributes the persistence of such anomalies to the complex nature of tax disclosure (Dhaliwal et al., 2004; Lev and Nissim, 2004; Weber, 2009). To the best of our knowledge, there is no research that investigates whether the trading strategy based on tax expense momentum entails arbitrage risks and costs. To the extent that there are idiosyncratic risks in implementing trading strategies based on other anomalies, it is likely that idiosyncratic risks also act as an impediment to implementing a trading strategy based on tax expense momentum. Thus, we state our first hypothesis as follows:

---

[3] We also refer to arbitrage risk as idiosyncratic risk following prior literature (Ali et al. 2003; Mendenhall et al. 2004).

[4] Both idiosyncratic risk and systematic risk is of concern to specialized arbitrageurs. However, idiosyncratic risk poses a greater risk because it cannot be hedged whereas systematic risk can be eliminated by taking hedge positions or be compensated with higher expected returns. Furthermore, arbitrageurs with poorly diversified portfolios may suffer from increased portfolio volatility due to the stocks with high idiosyncratic risk.

Hypothesis 1: The greater the idiosyncratic risk, the greater the extent of tax expense mispricing.

In addition to idiosyncratic risks, transaction cost is another important challenge to arbitrageurs (Pontiff, 2006). Transaction costs include brokerage fees, commissions and market impact (Pontiff, 2006). Garman and Ohlson (1981) theoretically show that transaction costs are positively related to the magnitude of mispricing. Specifically, the existence of transaction costs reduces the profitability of arbitrage trades, thereby limiting the extent to which investors can take advantage of the mispricing. Therefore, stocks with higher transaction costs are likely to exhibit greater mispricing. Prior studies tend to confirm this prediction. For example, Mendenhall (2004) finds that abnormal returns generated by the post earnings announcement drift is concentrated in stocks with high transaction costs, proxied with low trading volume. Mashruwala et al. (2006) documents that the accrual anomaly is also concentrated in stocks with high transaction costs, proxied with low trading volume. Li et al. (2014) examine the effect of transaction costs on the low-volatility anomaly and find that abnormal returns are significantly reduced when excluding small-sized firms, a proxy for high transaction costs. Based on the above discussion, we hypothesize the following:

Hypothesis 2: The greater the transaction costs, the greater the extent of tax expense mispricing.

3. Sample

We obtain accounting data from the quarterly Compustat from 1980:1Q to 2010:4Q. Stock market data are from CRSP. Fama-French risk factors, including a momentum factor, are taken from Ken French's website. We exclude firms without complete three month returns and winsorize all independent variables at 1% and 99% of each quarter's distribution.

Our variable definition is based largely on Thomas and Zhang (2011). ΔTax is our key independent variable, indicating seasonally differenced changes in tax expenses (tax expense surprise). Following Thomas and Zhang (2011), we define ΔTax as tax expense per share in quarter q minus tax expense per share in quarter q-4, scaled by assets per share in quarter q-4. For the dependent variables, we use both raw and size-adjusted future returns. For return accumulation period, we also follow Thomas and Zhang (2011). The holding period of returns begins from the fourth month after the end of quarter q, assuming that tax expense is released to the public before a portfolio based on tax expense is constructed. *Ret3* is the future three-month buy-and-hold stock returns beginning from four months after a firm's fiscal quarter's end. *SAR3* controls for the size effect in *Ret3*. It also begins from four months after a firm's fiscal quarter's end. *SAR3* is the three-month buy-and-hold return of a stock minus the equivalent return of its size benchmark. The size benchmark of a stock is the CRSP equally weighted size decile of which the stock is a member at the beginning of the calendar year.

To measure arbitrage risk, we use *Arbrisk*, measured as the idiosyncratic volatility of a stock, the standard deviation of the residuals of each stock from the CAPM model:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it}(R_{mt} - R_{ft}) + \varepsilon_{it} \qquad (1)$$

where$R_{it} - R_{ft}$ is the monthly return on stock i in excess of the Treasury bill rate in month t,$R_{mt} - R_{ft}$ is monthly excess return on the equal-weighted market index.

We estimate equation (1) using 48 months ending two months after a firm's fiscal quarter's end. The variance of the residuals from this regression captures the unhedgeable risk that the arbitrageur must bear (Pontiff, 1996; Shleifer and Vishny, 1997; Wurgler and Zhuravskaya, 2002; Mashruwala et al., 2006; Li et al., 2011).

We also use three proxies for transaction costs. Specifically, we use *PRC*, *VOL*, and *size* to capture the transaction cost. *PRC* is the closing price of a share of common stock at a fiscal quarter's end. Prior research suggests that transaction costs are inversely related to stock price (Bhardwaj and Brooks, 1992; Bhushan, 1994; Ball et al., 1995). *VOL* is another proxy for transaction costs. *VOL* indicates average dollar trading value, measured as the product of closing daily stock price and number of traded shares averaged over the 250 trading days ending two months after a firm's fiscal quarter's end in US$ billions. *VOL* is negatively associated with trading costs and the time required to fill an order (Bhushan, 1994; Stoll, 2000). *Size* is the market value of the equity at a fiscal quarter's end in US$ thousands. Prior studies find that the smaller the firm, the higher transaction cost it is (Korajczyk and Sadka, 2004; Zhang, 2006). Although a firm size is an indirect measure of transaction costs than the aforementioned two proxies for transaction costs, we use firm size to facilitate the comparability with prior studies (Lakonishok et al., 1994; Ali et al., 2003; Thomas and Zhang, 2011).

In their untabulated result, Thomas and Zhang (2011), which is closely related to our study, show that the abnormal return to hedge portfolio based on tax expense decreases with a firm's size. However, they do not examine the effect of more direct transaction costs, such as stock price and trading volume, on the abnormal returns to the tax expense momentum strategy. More importantly, they do not consider the joint effect of both transactions costs and idiosyncratic risk on the tax expense anomaly. Other variables are defined as in line with prior studies. Detailed definitions of all variables used in this study are provided in Appendix.

4. Empirical Results

4.1 Basic statistics and correlation

Panel A of Table 1 reports the summary statistics for the variable used in our analyses. Consistent with Thomas and Zhang (2011), ΔTax is positive with a mean (median) of 0.001 (0.000). Our main variable of interest, arbitrage risk (*Arbrisk*), has a mean (median) of 0.021 (0.011). Our proxies for transaction costs, price (*PRC*) and trading volume (*VOL*), have standard deviations of 766 and 118, respectively. This indicates that there are substantial variations in the costs of transaction across firms and quarters.

[Place Table 1 about here]

Panel B of Table 1 presents the mean values of selected variables of decile portfolio sorted on tax expense surprise. Both three-month future raw returns (*Ret3*) and size-adjusted returns (*SAR3*) monotonically increase from 2.3% (-1.5%) for the lowest tax expense decile to 5.7% (2.2%) for the highest tax expense decile. This predicted pattern of stock returns yields arbitrage opportunities, as suggested in Thomas and Zhang (2011). Specifically, the return to a hedge portfolio consisting of a long position in the highest decile and a short position in the highest portfolio is 3.4%, which is equivalent to an annualized return of 13.6%(14.8%) . This result demonstrates the economic significance of the annual hedge portfolio returns in our sample.

Moreover, idiosyncratic risks are greatest among the stocks in the lowest and the highest portfolio. This provides preliminary evidence that the stocks comprising the extreme portfolios based on tax expense strategy are associated with greater arbitrage risk, thereby limiting investors' ability to trade on the tax expense strategy.

[Place Table 2 about here]

Table 2 presents the Pearson and Spearman correlation coefficients among the variables used in our analyses. Consistent with Thomas and Zhang (2011), the correlations between the tax expense surprise (ΔTax) and three-month future raw returns (*Ret3*) as well as size adjusted returns (SAR3) are significantly positive. The correlation between *Arbrisk* and proxies of transaction cost is generally low except for price (PRC). Most of the correlations among transaction-cost proxies are greater than 0.5, raising concerns on multi-collinearity in the regression. To access the impact of multi-collinearity, we separately include each variable in the regression and report the regression results for each variable.

4.2 Fama-French three-factor regression

We estimate the following four-factor regression model using monthly returns on each tax expense surprise decile.

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_pSMB_t + h_pHML_t + d_pUMD_t + \varepsilon_{pt} \qquad (2)$$

where $R_{pt} - R_{ft}$ is the monthly return on tax expense surprise portfolio p in excess of the risk free rate measured as the Treasury bill rate in month *t*; $R_{mt} - R_{ft}$ is the excess return of the CRSP equally weighted market index; and SMB_t and HML_t are the returns on factor mimicking portfolios for size and book-to-market, respectively, as defined in Fama and French (1996); and UMD_t are the returns on factor mimicking portfolios for momentum, as defined in Carhart (1997). The intercept (α_p) represents the monthly excess return for each tax expense surprise decile, after controlling for the effect of all four factors. The four-factor data are from Kenneth French′s website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

[Place Table 3 about here]

Table 3 presents estimated monthly abnormal returns from Fama-French regression model. Consistent with Thomas and Zhang (2011), while abnormal monthly returns for stocks in the smallest decile of tax expense surprises is -0.3%, those for the highest decile is 0.8%. The estimated abnormal returns monotonically increase as the move from the lowest to the highest deciles. More importantly, the hedge portfolio that goes long in the highest decile (D10) and short in the lowest decile (D1) yields significant monthly return of 1.1%. These monthly returns amount to annualized returns of 13.2%, which is also economically significant. In sum, our result indicates that the tax expense anomaly is robust to Fama-French factors in our sample period.

4.3 Arbitrage risk and tax expense momentum

We turn next to examine whether stocks listed in the extreme tax surprise portfolios are likely to have greater arbitrage risk. To assess this, we further classify stocks in both highest and lowest tax expense decile (*ΔTax D1* and *D10*) every year into partitions based on high and low arbitrage risk (*Arbrisk Q1* and *Q5*). Arbrisk Q1 and Q5 are defined as stocks that fall in the lowest or highest quintile of Arbrisk for that year. We then count the number of observations in each portfolios based on the two independent sorts.

[Place Table 4 about here]

Table 4 reports the results. We find compelling evidence supporting our hypothesis. For both sorts of extreme tax expenses, there are on average more than four times the number of observations in the highest arbitrage sort (*Arbrisk Q5*) than in the lowest sort (*Arbrisk Q1*). Moreover, this trend is robust across the period from 1981 to 2006. This result indicates that the stocks in the extreme tax expense deciles are likely to have greater arbitrage risk, making it difficult for investors to implement the strategy based on tax expense anomaly.

Next, we further examine whether the abnormal returns to the tax expense strategy are concentrated among the stocks with higher arbitrage risk. This is done by separately estimating the equation (2) for tax expense portfolios based on two extreme arbitrage risk quintiles (*Arbrisk*).

[Place Table 5 about here]

Table 5 reports the estimated coefficients from Fama-French regression for portfolios based on the two independent sorts upon ΔTax and *Arbrisk*. As expected, most of the abnormal returns to the tax expense strategy are concentrated in the highest arbitrage-risk quintile. Specifically, the abnormal hedge returns to the tax expense momentum is significant 0.7% for stocks in highest arbitrage risk quintile, while the corresponding hedge returns for lowest arbitrage risk quintile become insignificant and even negative. This result implies that although the hedge returns to the tax expense strategy are significant, investors would find it difficult to trade based on this strategy due to the high arbitrage risk.

4.4 Transaction costs and tax expense momentum

In this subsection, we examine whether the alternative measures of limit-to-arbitrage can explain the anomaly. Specifically, we investigate the effect of transaction costs on the tax expense anomaly. To capture the costs involved in arbitrage transaction, we use the following proxies: closing price (*PRC*), trading volume (*VOL*), and market capitalization of a firm (*Size*).

[Place Table 6 about here]

Panel A of Table 6 reports the equally weighted buy-and-hold returns, average market capitalization, and the average stock price for price-based quintiles. The result shows that the future returns from the lowest tax surprise sort (Δ*Tax D1*) are highest in the lowest price quintiles, although the relation between price and future returns is not monotonic. For the highest tax surprise deciles (Δ*Tax D10*), the future stock returns monotonically decrease with the magnitude of PRC. The mean stock prices for the Δ*Tax D1* and *PRC Q1* (Δ*Tax D10* and *PRC Q1*) sort is $2.81 ($2.65), indicating that it could be hard for investors to profit from the stocks assigned in these sorts due to their high transaction costs. More importantly, we find that the hedge portfolio[5] consisting of long position in the lowest tax expense decile and the highest tax expense decile in each price quintile returns are concentrated among the firms for lowest price quintile. Specifically, we find that a three-month hedge return is 5.0%, or 20.0% per annum, for stocks in the lowest price quintile. In contrast, the corresponding hedge return is only 1.2%, or 4.8% per annum, for stocks in the highest price group. Thus, the tax expense anomaly is most pronounced in firms with low stock prices.

In Panel B of Table 6, we evaluate the effect of trading volume on the profitability of the tax expense strategy. As is the case with the price quintile, we find that for both extreme tax expense deciles, future returns are highest among stocks in the highest average daily trading volume quintiles. We also report the hedge returns of stocks in different volume partitions. We find that hedge portfolio returns are 6.0%, or 24.0% per annum, in the lowest volume quintile. However, the abnormal returns are only 0.8%, or 3.2% per annum, in the highest volume quintile. This result suggests that the tax expense anomaly disproportionately exists among stocks with low trading volume.

Panel C of Table 6 reports the hedge portfolio returns based on the extreme firm size deciles. Consistent with other proxies for transaction costs, we find the evidence that abnormal hedge returns are concentrated among smaller firms than their larger counterparts. Specifically, three-month hedge returns are 6.2% in the lowest size quintile, while the hedge returns are 0.3%

[5] As for trading volume and size, the hedge portfolio is similarly defined in Panel B and C of Table 6.

in the largest size quintile.

In conclusion, our hedge portfolio results suggest that the tax expense anomaly, manifested as the difference in stock returns between the extreme tax expense surprise deciles, arises only for stocks that suffer from high transaction costs, measured as low stock prices, low trading volume, and small size.

4.5 Regression results

Lastly, we conduct a cross-sectional regression analysis to test our hypothesis in an integrated framework. We estimate the following regression model (3) for each fiscal quarter:

$$SAR3_{i,q+1} = \beta_0 + \beta_1 \Delta Tax_{i,q} + \beta_2 \Delta Tax_{i,q} * Arbrisk_{i,q} + \beta_3 \Delta Tax_{i,q} * PRC_{i,q}$$
$$+\beta_4 \Delta Tax_{i,q} * VOL_{i,q} + \beta_5 \Delta Tax_{i,q} * Size_{i,q} + BM_{i,q} + \varepsilon_{i,q} \qquad (3)$$

where *SAR3* is the three-month size-adjusted abnormal return measured from four months after fiscal quarter end; *Arbrisk* is arbitrage risk, measured as the standard deviation of residuals from a market model regression; *PRC* is closing price of a share of common stock at fiscal quarter end; *VOL* is average daily trading volume, measured as the average of closing price times daily trading volume over 250 trading days; *Size* is market value of equity at fiscal quarter end; and *BM* is book-to-market ratio at fiscal quarter end. All independent variables are the scaled decile ranks for each quarter, where the values range between -0.5 and 0.5. Thus, the coefficients can be interpreted as returns to a zero-investment tax expense portfolio (Bernard and Thomas, 1990; Mashruwala et al, 2006). For example, the coefficient on ΔTAX is the return on a long and short position of the tax expense portfolio. We expect the coefficient on ΔTAX, β_1, to be positive because tax expense is positively related to future stock returns. To test hypothesis 1, we examine, β_2, the coefficient on *ΔTAX*Arbrisk*. It (β_2) captures the incremental returns to a long and short position of the tax expense portfolio for high arbitrage risk firms. We also hypothesize β_2 to be positive because high transaction costs increases future stock returns related to the tax expense anomaly. To test hypothesis 2, we examine the coefficients on *ΔTAX*PRC*, *ΔTAX*VOL*, and *ΔTAX*SIZE*. These capture the incremental returns to a long and short position of the tax expense portfolio for high transaction cost firms. We expect the coefficients β_3, β_4, and β_5, to be negative because higher transaction costs increase future stock returns related to the tax expense anomaly.

[Place Table 7 about here]

Table 7 reports the estimated coefficients of equation (3). We find compelling evidence to support our hypothesis. Consistent with Thomas and Zhang (2011), we find that in column (1), the coefficient on the tax expense surprise is positive and highly significant, suggesting that tax expense surprise predicts future stock returns. Interpreting the coefficient as a three-month size-adjusted buy-and-hold return, we find that the hedge strategy of going long (short) positions in highest (lowest) tax expense surprise firms yields a three-month size-adjusted return of 3.6%, or 14.4% per annum. In columns (2) to (6), we interact the tax expense surprise with our proxies for limits of arbitrage. Column (2) shows that the coefficient on interaction of Δ*Tax* and *Arbrisk* is positive and significant. This coefficient can be interpreted as the additional spread in abnormal returns between the high and low tax expense surprises stocks for observations in the highest versus lowest *Arbrisk* deciles (Mashruwala et al. 2006). For example, for stocks in the highest (lowest) tax expense portfolio and the lowest *Arbrisk* portfolio, the size-adjusted three-month returns are 0.55% (-0.55%) [0.033*-0.5+0.044*(-0.5*-0.5) = − 0.0055] However, for stocks in the highest (lowest) tax expense portfolio and highest *Arbrisk* portfolio, the size-adjusted three-month returns are 2.75% (-2.75%) [0.033*0.5+0.044*(0.5*0.5)= 0.0275] This result is consistent with our hypothesis that abnormal hedge returns from tax expense strategy increase with the arbitrage risk.

In columns (3) to (4), we include the several proxies for transaction costs. As expected, we find that the interaction term between ΔTax and *PRC* is negative and significant. In addition, the interaction term between the ΔTax and *VOL* is negative and significant. These results indicate that the hedge returns to the tax expense strategy decrease with higher stock prices and higher trading volume, consistent with transaction costs deterring investors from enjoying profitable returns from this strategy.

Column (5) reports the estimates of coefficients when *Size* is used as a proxy for transaction costs. We expect that the interaction term between ΔTax and *Size* is negative because observed mispricing is greater if information uncertainty and limits to arbitrage are greater. As expected, the coefficient on the interaction term is significantly negative, indicating that the hedge portfolio returns for tax expense surprise are concentrated among small firms. This result is also consistent with the finding of Thomas and Zhang (2011).

In column (6), we include all proxies of arbitrage risks and cost into one regression equation. We find that idiosyncratic risk (*Arbrisk*) and average trading volume (*VOL*) are highly significant. Overall, our regression results suggest that tax expense changes can generate excess abnormal returns only in the class of stocks for which arbitrageurs found risky and costly to implement the strategy.

5. Conclusion

Thomas and Zhang (2011) document that changes in tax expense are related to future abnormal returns. They suggest that tax expense changes contain incremental fundamental information about future profitability, but investors seem to under react to the information because tax disclosures are difficult to understand. In this study, we examine an alternative explanation to the persistence of a tax expense based anomaly.

Using several arbitrage risk proxies including idiosyncratic risk, price, and trading volume, we find that limits of arbitrage explain a significant portion of the excess returns of the trading strategy based on tax expense surprise. Specifically, the hedge returns are concentrated in stocks with higher idiosyncratic volatility, lower stock prices, and lower dollar trading volume.

In conclusion, while Thomas and Zhang (2011) argue that the tax expense anomaly arises due to investors' lack of sophistication or complexity of corporate tax disclosures, our findings indicate that even if the corporate tax disclosure are improved to enhance investors' understanding of tax expenses, tax expense momentum would likely persist due to limits of arbitrage.

6. Reference

Ali, A., Hwang, L. S., &Trombley, M. A. (2003). Arbitrage risk and the book-to-market anomaly. Journal of Financial Economics, 69(2), 355-373.

Baik, B., Kim, K., Morton, R., and Roh, Y.(2015) Analysts' pre-tax income forecasts and the tax expense anomaly. Review of Accounting Studies, Forthcoming.

Ball, R., Kothari, S., &Shanken, J. (1995). Problems in measuring portfolio performance: An application to contrarian investment strategies. Journal of Financial Economics, 38(1), 79-107.

Bernard, V., &Thomas, J. (1990). Evidence that stock prices do not fully reflect the implicationsof current earnings for future earnings. Journal of Accounting and Economics 13:305–41.

Bhardwaj, R. K., & Brooks, L. D. (1992). The January anomaly: Effects of low share price, transaction costs, and bid-ask bias. The Journal of Finance, 47(2), 553-575.

Bhushan, R. (1994). An informational efficiency perspective on the post-earnings announcement drift. Journal of Accounting and Economics, 18(1), 45-65.

Carhart, M. (1997). On persistence in mutual fund performance. Journal of Finance, 52, 57–82.

Chi, S. S., Pincus, M., & Teoh, S. H. (2013). Mispricing of book-tax differences and the trading behavior of short sellers and insiders. The Accounting Review, 89(2), 511-543.

Dhaliwal, D. S., Gleason, C. A., & Mills, L. F. (2004). Last-chance earnings management: Using the tax expense to meet analysts' forecasts. Contemporary Accounting Research, 21, 431-459.

Fama, E., & K. French (1996). Multifactor explanations of asset pricing anomalies. Journal of Finance 51: 55–84.

Garman, M.B., &Ohlson, J.A., (1981). Valuation of risky assets in arbitrage free economies with transaction costs.Journal of Financial Economics, 9, 271–280.

Graham, J., Raedy, J., & Shackelford, D. (2012). Research in accounting for income taxes. Journal of Accounting and Economics, 53, 412–434

Hanlon, M., Laplante, S. K., &Shevlin, T. (2005). Evidence for the possible information loss of conforming book income and taxable income. Journal of Law and Economics, 48, 407-442.

Korajczyk, R.,&SADKA, R. (2004). Are momentum profits robust to trading costs? Journal ofFinance 59, 1039–82

Lakonishok, J., Shleifer, A., &Vishny, R. W. (1994). Contrarian investment, extrapolation, and risk. The Journal of Finance, 49(5), 1541-1578.

Lev, B., &Thiagarajan, S. R. (1993). Fundamental information analysis. Journal of Accounting Research, 31, 190-215.

Lev, B., &Nissim, D. (2004). Taxable income, future earnings, and equity values. The Accounting Review, 79, 1039-1074

Li, X., & Sullivan, R. N. (2011). The limits toarbitrage revisited: The accrual anomaly and asset growth anomalies, Financial Analysts Journal, 67(4), 50-66.

Li, X., Sullivan, R. N., &L.Garcia-Feijoo. (2014). The limitstoarbitrage and the low-volatility anomaly, Financial Analysts Journal, 70(1), 52-63.

Lipe, R. C. (1986). The information contained in the components of earnings. Journal of Accounting Research, 37-64.

Mashruwala, C., Rajgopal, S., &Shevlin, T. (2006). Why is the accrual anomaly not arbitraged away? The role of idiosyncratic risk and transaction costs. Journal of Accounting and Economics, 42(1), 3-33.

Mendenhall, R. R. (2004). Arbitrage risk and post-earnings-announcement drift. The Journal of Business, 77(4), 875-894.

Ohlson, J. A., & Penman, S. H. (1992). Disaggregated accounting data as explanatory variables for returns. Journal of Accounting, Auditing & Finance, 7, 553-573.

Pontiff, J. (1996). Costly arbitrage: Evidence from closed-end funds. The Quarterly Journal of Economics, 1135-1151.

Pontiff, J. (2006). Costly arbitrage and the myth of idiosyncratic risk. Journal of Accounting and Economics, 42(1), 3-33.

Schmidt, A. P. (2006). The persistence, forecasting, and valuation implications of the tax change component of earnings. The Accounting Review, 81, 589-616.

Shleifer, A., &Vishny, R. (1997). The limits of arbitrage. The Journal of Finance 52 (1), 35–55.

Stoll, H. R. (2000). Presidential address: friction. The Journal of Finance, 55(4), 1479-1514.

Thomas, J., & Zhang, F. (2011). Tax expense momentum. Journal of Accounting Research, 49(3), 791-821.

Thomas, J., & Zhang, F. (2014). Valuation of tax expense. Review of Accounting Studies, 19(4), 1436-1467.

Weber, D. P. (2009). Do analysts and investors fully appreciate the implications of book-tax differences for future earnings?. Contemporary Accounting Research, 26(4), 1175-1206.

Wurgler, J., &Zhuravskaya, E. (2002). Does arbitrage flatten demand curves for stocks? The Journal of Business, 75(4), 583-608.

Zhang, X. F. (2006). Information uncertainty and stock returns. Journal of Finance 61, 105–37.

7. Appendix

Variable definitions

Variables	Definition
ΔTax	Seasonally differenced changes in tax expense in Thomas and Zhang (2011), measured as difference between tax expense per share in quarter t and tax expense per share in quarter t-4, scaled by assets per share in quarter t-4
Ret3	Three-month buy-and-hold stock returns beginning from four months after a firm's fiscal quarter's end
SAR3	Three-month size-adjusted abnormal returns from four months after a firm's fiscal quarter's end. They are computed as the three-month buy-and-hold returns minus the buy-and-hold return on its size benchmark. The size benchmark is CRSP equally weighted size-decile of which the stock is a member at the beginning of the calendar year
PRC	Closing price of a share of common stock at fiscal quarter's end from Compustat database
VOL	Closing daily stock price x number of shares traded. This is the averaged over the 250 trading days ending two months after firm's fiscal quarter's end (in billion)
Arbrisk	A standard deviation of residuals from a following market model regression. Market portfolio is the equally weighted CRSP index over 48 months ending two months after firm's fiscal quarter's end $$R_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{mt} - R_{ft}\right) + \varepsilon_{it}$$ R_{it} is the monthly return for firm i. R_{mt} is the return on the CRSP equally weighted market index. Rft is the Treasury bill rate at month t.
Size (*MV*)	Market value of equity at fiscal quarter's end (in thousand)
BM	Book-to-market ratio, measured as book value of equity divided by its market value at fiscal quarter's end

Table 1: Descriptive Statistics

This table provides basic statistics for the variables used in our analyses. Panel A shows univariate statistics, and Panel B states mean values of selected variables of decile portfolio sorted by tax expense change. t-tests use the means of differences between *D1* and *D10* and the time-series variation in this difference to estimate the standard error. *t*-statistics are in parentheses. See Appendix for variable definitions.

Panel A: Univariate statistics

	N	Mean	Q1	Median	Q3	Std.
ΔTax	391,642	0.001	-0.002	0.000	0.004	0.012
Ret3	391,642	0.042	-0.097	0.020	0.146	0.287
SAR3	381,919	0.006	-0.124	-0.012	0.104	0.269
PRC	391,178	29.15	6.29	15.12	27.75	766
VOL	181,096	13.50	0.047	0.226	14.63	117.70
Arbrisk	391,302	0.021	0.006	0.011	0.024	0.041
MV	383,392	1712.93	35.64	156.12	788.04	6393
BM	383,228	0.749	0.371	0.612	0.950	0.610

Panel B: Mean values of selected variables of decile portfolio sorted by tax expense change

Deciles Sorted by *ΔTax*	*ΔTax*	*Ret3*	*SAR3*	*PRC*	*VOL*	*Arbrisk*	*Size (MV)*	*BM*
D1	-0.021	0.023	-0.015	15.14	15.12	0.030	1033.97	0.789
D2	-0.006	0.029	-0.008	28.73	11.90	0.022	1413.55	0.831
D3	-0.002	0.034	-0.002	34.53	9.13	0.020	1657.11	0.821
D4	-0.001	0.038	0.001	24.29	6.42	0.018	1701.50	0.807
D5	0.000	0.041	0.005	29.32	5.93	0.016	1865.69	0.793
D6	0.001	0.046	0.009	33.41	8.34	0.016	2051.35	0.746
D7	0.002	0.048	0.012	38.48	13.34	0.018	2188.44	0.708
D8	0.004	0.050	0.015	37.13	17.11	0.019	2100.48	0.678
D9	0.008	0.054	0.019	29.43	19.29	0.022	1740.91	0.672
D10	0.023	0.057	0.022	21.03	25.86	0.032	1375.39	0.650
D10 – D1	0.044	0.034	0.037	5.88	10.73	0.002	341.4	-0.139
	(417.50)	(13.97)	(16.23)	(2.42)	(6.80)	(6.05)	(8.45)	(-30.08)

Table 2: Correlations

This table provides correlations among the variables used in our analyses. Pearson and Spearman correlation coefficients are presented above and below the diagonal, respectively. See Appendix for variable definitions. Correlations that are significant at the 1% level are boldfaced.

	Δ*Tax*	*Ret3*	*SAR3*	*PRC*	*VOL*	*Arbrisk*	*Size (MV)*	*BM*
Δ*Tax*	1.000	**0.026**	**0.032**	0.002	**0.022**	**0.014**	**0.013**	**-0.063**
Ret3	**0.037**	1.000	**0.925**	-0.001	**-0.013**	0.000	**-0.010**	**0.051**
SAR3	**0.049**	**0.845**	1.000	0.000	**-0.006**	-0.004	-0.003	**0.026**
PRC	**0.086**	**0.056**	**0.067**	1.000	**0.092**	**-0.011**	**0.113**	**-0.010**
VOL	**0.071**	-0.006	0.006	**0.585**	1.000	0.001	**0.726**	**-0.089**
Arbrisk	**0.027**	**-0.078**	**-0.070**	**-0.631**	**0.010**	1.000	**-0.082**	0.002
Size (MV)	**0.049**	**0.045**	**0.048**	**0.783**	**0.861**	**-0.448**	1.000	**-0.147**
BM	**-0.150**	**0.043**	**0.021**	**-0.339**	**-0.481**	**-0.053**	**-0.394**	1.000

Table 3: Fama-French regression for monthly returns on portfolio sorted by tax expense change

This table reports the coefficients estimated from the Fama-French regression for monthly returns on portfolio sorted on tax expense change (ΔTax). *D1*(*D10*) refers to the lowest (highest) decile of the tax expense changes. $R_{pt} - R_{ft}$ is the monthly return on the tax-expense-change portfolio *p* in excess of the Treasury bill rate in month *t*, $R_{mt} - R_{ft}$ is the excess return of the CRSP equally weighted market index, and *SMB*, *HML*, and *UMD* are the returns on factors mimicking portfolios for size, book-to-market, and momentum, respectively. Each regression is estimated using monthly returns beginning from four months after a firm's fiscal quarter's end. *t*-statistics are in parentheses. See Appendix for variable definitions.

Deciles Sorted by ΔTax	*Intercept*	$R_{mt} - R_{ft}$	*SMB*	*HML*	*UMD*	R^2
D1	-0.003	0.985	0.965	0.182	-0.328	87.90%
	(-2.25)	(30.85)	(24.12)	(3.80)	(-11.44)	
D2	-0.001	0.951	0.832	0.332	-0.281	90.07%
	(-1.22)	(37.67)	(26.31)	(8.74)	(-12.40)	
D3	0.000	0.956	0.750	0.408	-0.219	90.74%
	(-0.03)	(41.83)	(26.20)	(11.87)	(-10.67)	
D4	0.001	0.903	0.672	0.415	-0.202	90.14%
	(1.70)	(41.39)	(24.58)	(12.66)	(-10.33)	
D5	0.002	0.930	0.560	0.537	-0.143	85.10%
	(1.49)	(35.79)	(17.19)	(13.74)	(-6.14)	
D6	0.003	0.914	0.545	0.412	-0.088	88.50%
	(3.57)	(40.86)	(19.44)	(12.23)	(-4.37)	
D7	0.004	0.951	0.580	0.342	-0.104	90.56%
	(4.60)	(44.21)	(21.55)	(10.58)	(-5.37)	
D8	0.005	0.954	0.655	0.298	-0.087	91.08%
	(5.43)	(43.87)	(24.02)	(9.11)	(-4.44)	
D9	0.005	1.046	0.759	0.282	-0.092	91.65%
	(5.77)	(44.26)	(25.65)	(7.94)	(-4.32)	
D10	0.008	1.075	0.939	0.101	-0.168	88.75%
	(6.43)	(33.37)	(23.27)	(2.09)	(-5.80)	
D10 – D1	0.011	0.090	-0.026	-0.081	0.160	
	(4.35)	(1.40)	(-0.33)	(-0.84)	(2.78)	

Table 4: Number of observations in portfolios based on two independent sorts on extreme Δ*Tax* deciles and extreme *Arbrisk* quintiles

This table reports the number of observations in portfolios based on two independent sorts. Δ*Tax D1*(*D10*) refer to the lowest (highest) decile of tax expense changes. *Arbrisk Q1* (*Q5*) refer to the lowest (highest) quintile of the magnitude of arbitrage risk. From these two independent sorts, we identify firms that belong to combinations of extreme Δ*Tax* deciles and *Arbrisk* quintiles. See Appendix for variable definitions.

Post-ranking	Δ*Tax D1*		Δ*Tax D10*	
year	*Arbrisk Q1*	*Arbrisk Q5*	*Arbrisk Q1*	*Arbrisk Q5*
1981	48	288	50	311
1982	85	283	73	340
1983	97	376	56	412
1984	72	454	111	434
1985	74	384	76	457
1986	96	393	61	494
1987	88	446	76	472
1988	86	386	76	475
1989	99	410	57	520
1990	90	421	92	509
1991	133	370	78	529
1992	133	434	79	486
1993	115	457	83	477
1994	119	497	117	494
1995	107	496	104	544
1996	101	594	87	643
1997	112	637	83	677
1998	119	642	98	689
1999	108	613	103	688
2000	106	549	105	694
2001	110	582	84	635
2002	86	574	82	635
2003	116	478	89	583
2004	107	518	110	487
2005	120	520	98	467
2006	96	437	92	501
average	100.88	470.73	85.38	525.12

Table 5: Fama-French regression for portfolios based on two independent sorts on extreme Δ*Tax* deciles and extreme *Arbrisk* quintiles

Arbrisk Q1(Q5) refers to the lowest (highest) quintile of the magnitude of arbitrage risk. We identify firms that belong to combinations of extreme Δ*Tax* deciles and *Arbrisk* quintiles. See Appendix 1 for further descriptions. See Appendix for variable definitions.

	Intercept	$R_{mt} - R_{ft}$	*SMB*	*HML*	*UMD*	R^2
Arbrisk Q1						
Δ*Tax D1*	-0.001	0.742	0.198	0.390	-0.116	69.52%
	(-0.77)	(24.36)	(5.14)	(8.47)	(-4.21)	
Δ*Tax D10*	-0.002	1.030	1.318	-0.108	-0.471	77.60%
	(-0.84)	(17.40)	(17.77)	(-1.21)	(-8.87)	
D10 – D1	-0.001	0.288	1.121	-0.498	-0.355	
	(-0.29)	(3.21)	(9.95)	(-3.69)	(-4.41)	
Arbrisk Q5						
Δ*Tax D1*	0.004	0.776	0.183	0.359	0.005	60.57%
	(2.85)	(20.48)	(3.83)	(6.25)	(0.14)	
Δ*Tax D10*	0.012	1.162	1.266	-0.125	-0.269	80.70%
	(5.27)	(20.95)	(18.22)	(-1.50)	(-5.41)	
D10 – D1	0.007	0.385	1.083	-0.484	-0.274	
	(1.97)	(4.13)	(9.24)	(-3.44)	(-3.26)	

Table 6: Fama-French regression for portfolios based on two independent sorts on extreme Δ*Tax* deciles and extreme *Transaction cost* quintiles

Panel A reports the equally weighted buy-and-hold returns, average market capitalization and the average stock price for Δ*Tax* and price-based quintiles. Panel B reports the equally weighted buy-and-hold returns, average market capitalization and average dollar trading volume for portfolios sorted on Δ*Tax* and *VOL*. Panel C is for Δ*Tax* and market capitalization. See Appendix for variable definitions.

Panel A: Analysis of Price-quintile portfolios formed every quarter

	Ret3			*Market Capitalization*			*Price*		
	Mean	Std.	Median	Mean	Std.	Median	Mean	Std.	Median
Δ*Tax D1*									
PRC Q1	0.032	0.436	-0.031	61.24	469.94	14.25	2.81	1.712	2.62
PRC Q2	0.014	0.302	-0.014	261.61	1778.62	55.12	7.92	2.712	7.59
PRC Q3	0.016	0.260	0.002	851.28	4291.87	171.95	14.77	3.677	14.5
PRC Q4	0.023	0.231	0.016	1805.59	5574.06	484.46	24.49	4.894	24.25
PRC Q5	0.027	0.216	0.020	6170.63	12311.13	1831.16	67.67	694.97	42.85
Δ*Tax D10*									
PRC Q1	0.082	0.465	0	58.02	432.59	12.47	2.65	1.67	2.43
PRC Q2	0.058	0.317	0.017	212.72	1355.26	45.95	7.87	2.78	7.5
PRC Q3	0.043	0.273	0.017	621.75	3485.29	132.11	15.01	3.64	14.81
PRC Q4	0.040	0.264	0.023	1463.57	5124.29	390.60	25.14	4.96	24.89
PRC Q5	0.039	0.262	0.031	5814.05	12642.57	1541.77	71.73	1053.2	45.24
Hedge portfolio (D10 – D1)									
PRC Q1	0.050								
PRC Q2	0.044								
PRC Q3	0.027								
PRC Q4	0.016								
PRC Q5	0.012								

Panel B: Analysis of Volume-quintile portfolios formed every quarter

	Ret3			*Market Capitalization*			*Average Daily Volume*		
	Mean	Std	Median	Mean	Std	Median	Mean	Std	Median
ΔTax D1									
VOL Q1	0.043	0.458	-0.024	22.35	100.98	10.36	0.025	0.042	0.011
VOL Q2	0.011	0.323	-0.020	70.06	431.28	26.73	0.156	0.290	0.053
VOL Q3	0.010	0.344	-0.023	117.00	421.58	55.20	0.734	1.513	0.175
VOL Q4	0.021	0.355	-0.011	264.85	1178.53	128.80	3.397	6.240	0.791
VOL Q5	0.019	0.369	0.000	1879.62	6330.72	444.77	72.527	264.637	6.932
ΔTax D10									
VOL Q1	0.103	0.466	0.017	24.91	231.02	10.33	0.023	0.039	0.010
VOL Q2	0.079	0.372	0.023	62.92	356.29	27.08	0.157	0.296	0.053
VOL Q3	0.080	0.384	0.026	112.95	314.60	61.07	0.751	1.517	0.176
VOL Q4	0.040	0.345	0.005	306.85	1302.80	151.42	3.407	6.372	0.744
VOL Q5	0.027	0.355	0.006	2717.74	7891.91	704.87	89.497	335.147	9.152
Hedge portfolio (D10 – D1)									
VOL Q1	0.060								
VOL Q2	0.068								
VOL Q3	0.070								
VOL Q4	0.019								
VOL Q5	0.008								

Panel C: Analysis of size-quintile portfolios formed every quarter

	Ret3			*Market Capitalization*		
	Mean	Std	Median	Mean	Std	Median
ΔTax D1						
Size Q1	0.025	0.416	-0.028	15.11	15.28	10.43
Size Q2	0.016	0.337	-0.019	62.30	56.07	42.46
Size Q3	0.024	0.335	0.000	203.53	173.71	141.22
Size Q4	0.024	0.262	0.016	693.02	558.08	499.62
Size Q5	0.032	0.220	0.030	7925.86	13139.36	3274.17
ΔTax D10						
Size Q1	0.087	0.438	0.000	14.35	14.82	9.90
Size Q2	0.061	0.348	0.014	61.38	54.98	42.75
Size Q3	0.048	0.303	0.019	206.40	173.03	143.29
Size Q4	0.033	0.272	0.019	731.70	566.58	559.29
Size Q5	0.035	0.248	0.032	8502.50	14466.16	3307.10
Hedge portfolio (D10 – D1)						
Size Q1	0.062					
Size Q2	0.045					
Size Q3	0.024					
Size Q4	0.007					
Size Q5	0.003					

Table 7: Cross-sectional regression of size-adjusted returns on tax expense changes and proxies for limit to arbitrage

This table reports the cross-sectional regression estimated every fiscal quarter. The dependent variable is SAR3. The reported coefficients are averages over the 105 fiscal-quarters. *t*-statistics in parentheses are Fama-Macbeth t-statistics. All independent variables are the scaled decile rank where ranking is conducted every quarter. Note that all the decile rankings are scaled to take a value ranging between -0.5 and 0.5. Thus the coefficient can be interpreted as returns to a zero-investment tax expense portfolio. See Appendix for variable definitions.

Model	Predicted Sign	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	?	0.006***	0.006***	0.006***	0.021	0.006***	0.026*
		(3.49)	(3.39)	(3.67)	(1.39)	(3.54)	(1.68)
Δ*Tax*	+	0.036***	0.033***	0.034***	0.011	0.033***	0.009
		(14.07)	(13.99)	(13.26)	(0.30)	(12.49)	(0.24)
Δ*Tax *Arbrisk*	+		0.044***				0.051***
			(8.06)				(3.87)
Arbrisk	?		0.003				0.010
			(0.36)				(1.11)
Δ*Tax *PRC*	–			-0.055***			0.011
				(-7.42)			(0.66)
PRC	?			-0.010**			0.015
				(-2.22)			(1.58)
Δ*Tax *VOL*	–				-0.058***		-0.053***
					(-4.74)		(-3.57)
VOL	?				-0.021***		-0.035***
					(-3.09)		(-3.42)
Δ*Tax *size*	–					-1.887***	-0.560
						(-7.98)	(-1.45)
Size	?					-0.012***	0.020*
						(-4.10)	(1.67)
BM	+						0.024***
							(3.50)