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The Impact of Hedging and Non-Hedging Derivatives on Tax Avoidance

DISSERTATION

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by

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DEDICATION

To my parents, who gave me everything in life. Thank you for all of your love, support and care.

To Aruhn, who has unfailingly been by my side since we met. Thank you for all of your help, encouragement and patience.

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FIELD OF STUDY

Tax Research in Accounting

ABSTRACT OF THE DISSERTATION

The Impact of Hedging and Non-Hedging Derivatives on Tax Avoidance

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Professor Terry Shevlin, Chair

This paper introduces new evidence on the extent to which non-financial firms use financial derivatives to avoid taxes. In particular, I use the fair value of derivatives segregated by hedging and non-hedging designation to identify derivative activities that are used to benignly and/or aggressively avoid taxes. I use new derivative disclosures required by SFAS 161 to collect detailed information about firms' use of derivatives. I find a negative association between cash effective tax rates and the fair value of hedging derivative assets. This finding implies that firms defer recognition of gains on hedging derivatives to lower cash taxes. Furthermore, I find an association between cash effective tax rates and both non-hedging derivative assets and liabilities. This finding is consistent with firms aggressively avoiding cash taxes using non-hedging derivatives by selectively choosing when to recognize gains and losses. In addition, I find no association between GAAP effective tax rates and derivatives, implying that firms in my sample do not use derivatives to manage earnings through the tax expense.

INTRODUCTION

The purpose of this study is to examine the extent to which firms use financial derivatives to avoid taxes. Prior literature suggests that firms commonly use financial derivatives to reduce their firm's exposure to risk (Bondar et al. 1998). More recently, policymakers, regulators, and academic researchers have voiced concerns about the use of derivatives to avoid or evade taxes. In particular, government reports identify the potential abuse of financial derivatives as a substantial threat to tax revenue (GAO 2011; JCT 2011). In light of anecdotal evidence, several academics have called for research on derivative-based corporate tax avoidance (Shevlin 2007, Hanlon and Heitzman 2010, Raskolnikov 2011). A recent study provides evidence that firms, collectively, saved nearly 4 billion dollars in cash taxes over a three-year period using derivatives (Donohoe 2015). However, little other research has been done on this topic. I contribute to this literature by providing new empirical evidence on the impact of various derivatives and their uses on corporate tax avoidance.

Derivatives can be used to avoid taxes in several ways.[1] First, risk management theory suggests that firms facing convex tax functions can reduce expected tax liabilities by hedging to reduce taxable income volatility (Smith and Stulz 1985).[2] Derivatives can be used for hedging purposes and can thereby reduce taxable income volatility and expected tax liabilities. Second, firms can use hedging derivatives to increase debt capacity by smoothing book earnings (Graham and Smith 2002). Higher levels of debt capacity

[1] I define tax avoidance as a reduction of explicit taxes paid to tax authorities. Also, tax avoidance may result from not only engaging in perfectly legal tax planning strategies but also implementing strategies that are of a more ambiguous and aggressive nature.

[2] Tax function convexity is induced by current US tax provisions, including a zero tax rate on negative taxable income, moderate statutory progressivity for income under a threshold, net operating loss carrybacks and carryforwards, investment tax credits (ITCs), and the alternative minimum tax (AMT).

imply higher tax deductions of interest and, thus, lower taxable income. Third, firms can defer tax on derivative gains and reduce current tax payments because generally, derivative gains are not taxed until firms sell or terminate derivative contracts. Fourth, firms can use ambiguities in the taxation of financial derivatives to coordinate the timing, character, and source of derivative gains and losses with other tax preferences such as NOLs or tax credits (GAO 2011). Specifically, derivative taxation is generally based on the derivative's type rather than on its economic characteristics. As a result, different types of derivatives providing the same economic outcome may be taxed differently because they are of different types. Thus, a firm with a particular economic goal may choose one instrument over another due to tax considerations.

Prior literature demonstrates a positive association between a firm's use of derivatives and corporate tax avoidance at a general level. In particular, Donohoe (2015) finds a positive relationship between derivative use and corporate tax avoidance using an indicator variable (i.e., *Users* vs. *Non-users*). In contrast, I explore how firms use derivatives to avoid taxes at a more granular level. First, I hypothesize that balance sheet fair value adjustments are a more refined proxy for derivative use for derivative-based tax avoidance because they capture cumulative unrealized derivative gains and losses that have been recognized for book but not yet for tax purposes (i.e., they are deferred). That is, these fair value adjustments gauge the extent to which firms have accrued unrealized gains and losses for potential tax avoidance purposes. By using balance sheet fair values, I can directly test the mechanism through which derivatives can achieve tax savings. Second, I disaggregate derivatives into assets and liabilities, which represent accumulated gains and losses respectively, because derivative gains and losses play different roles in avoiding

taxes. Third, I decompose derivatives into hedge and non-hedge designations because hedging derivatives might relate to a benign type of tax avoidance whereas non-hedging derivatives might signal aggressive tax avoidance. [3] Prior research suggests that hedging can lower taxes as a byproduct of risk management. However, derivatives may also be used in aggressive tax planning strategies that push the envelope of tax law. I suspect that non-hedging derivatives are better suited for aggressive tax avoidance because non-hedging derivatives need not hedge against underlying economic events. Thus, they can be more flexibly used. Consequently, I separate the tax effect of derivatives into its hedging and non-hedging components to distinguish between benign and aggressive tax avoidance.

Despite the potential importance of derivatives in a broader tax avoidance strategy, empirical evidence to-date is lacking due to limited data availability. Because prior studies were limited by poor derivative disclosures, they often used an indicator variable or the notional principal amount of derivative contracts as proxies to capture the effect of derivative usage.[4] These noisy proxies do not capture the actual effectiveness of derivative usage because they are not strictly related to the economic performance of derivatives.

I overcome these challenges by taking advantage of a recently mandated derivative disclosure rule, Statement of Financial Accounting Standards (SFAS) No. 161, *Disclosures about Derivative Instruments and Hedging Activities* (FASB, 2008) which became effective in November 2008. SFAS 161 requires firms to report all derivatives as either assets or liabilities at fair values on the balance sheet. Further, SFAS 161 requires firms to

[3] Note that whether a derivative is designated as a hedge or non-hedge is not disclosed for tax purposes. Therefore, I assume that firms designate the same derivatives as hedging and non-hedging for tax purposes as they do for financial reporting purposes.

[4] Aretz and Bartram (2010) also point out that most prior empirical studies use a binary variable or notional amount interpreted as an indication of corporate hedging activities but actually derivatives can also be used for speculative purposes.

distinguish between derivatives that are designated as hedging instruments from those designated as non-hedging instruments. These new disclosures allow me to hand-collect a unique dataset that includes the fair value of derivative assets and liabilities based on hedge accounting designation. The balance sheet fair value of derivatives reflects the amount that a firm would expect to receive, or pay if it terminated the derivative contract at the reporting date. A derivative's fair value changes over time due to the fluctuation in rates or underlying asset prices. I recognize that fair values are not a perfect proxy for derivatives-based tax avoidance. Specifically, managers likely have no control over derivative fair values. Thus, managers might find it challenging to employ derivative-based tax planning. However, I conjecture that the fair value of derivatives is still a more refined measure of derivative usage than prior measures because derivative gains and losses are the amount that directly affects taxable income and hence can be used for tax avoidance purposes.

I first examine whether total derivative assets (i.e., cumulative unrealized gains) and liabilities (i.e., cumulative unrealized losses) are differently associated with tax avoidance. In general, the tax treatment of derivative gains allows firms to delay recognizing gains until the settlement date while financial reporting treatment permits them to recognize unrealized gains in income. Consequently, firms do not pay taxes on gains until they close derivative positions. However, firms achieve the benefit of increased earnings prior to the realization of the tax gains. Thus, larger derivative assets (accumulated fair value gains) can lead to more tax deferrals. In other words, *larger* derivative *assets* may represent more tax avoidance.

On the other hand, *smaller* derivative *liabilities* may represent more tax avoidance. In general, firms can reduce current-period taxes by closing derivative loss positions and

thereby realizing derivative losses. However, realizing derivative losses also removes the associated derivative liabilities from the balance sheet. Thus, a lower level of derivative liabilities on the balance sheet may imply that firms have realized losses to reduce taxes in the current period. Consequently, I predict a positive association between effective tax rates (ETRs) and derivative liabilities. I find a negative association between cash ETR and total derivative assets but no association between cash ETR and total derivative liabilities. These results suggest that, on average, firms engage in derivative-based tax avoidance by deferring fair value gains rather than accelerating (or harvesting) losses. Furthermore, I do not find an association between either the fair value of total derivative assets or the fair value of total derivative liabilities and GAAP ETR. These results imply that firms use derivatives to reduce cash taxes paid in the current period, rather than to manage earnings through the tax expense.

I next separately examine hedging and non-hedging derivative usage. Hedging derivatives can facilitate tax avoidance in two ways. First, GAAP recognition rules for hedging derivatives differ from tax recognition rules. For tax purposes, the recognition of derivative gains and losses is generally delayed until the derivative contract matures or is terminated. Thus, firms can exploit this tax rule to defer taxes and thereby reduce cash taxes in the current period (i.e. firms can enjoy deferrals by using hedging derivatives). For financial accounting purposes, firms are required to adjust derivatives to fair values on balance sheet dates. Thus, firms with high fair values of derivatives recognize gains for financial reporting purposes in the current period, but defer taxes for tax purposes until the derivative is settled or exercised. I exploit this divergence to capture the magnitude of deferrals by using balance sheet fair values of derivative gains and losses.

Second, firms receive tax benefits from increased debt capacity as a result of hedging. From a financial accounting perspective, hedge accounting permits the gains (losses) from derivatives to be offset by the losses (gains) on the underlying hedged items on a timely basis, reducing book earnings volatility. Consequently, reductions in book earnings volatility give rise to increased debt capacity and thus, increased interest tax deductions. After controlling for increased debt capacity, I find that the fair value of hedging derivative assets is negatively associated with cash ETR. Also, I find no association between the fair value of hedging derivative liabilities and cash ETR. This finding implies that firms reduce cash taxes by deferring gains rather than accelerating losses from hedging derivatives.

Next, I investigate an association between non-hedging derivatives and tax avoidance. Derivatives that are not designated as hedges may represent aggressive derivative-based tax planning strategies. In general, firms must meet stringent criteria to designate derivatives as hedges.[5] Thus, firms are likely unable to designate derivatives as hedges if they are used for non-hedging purposes such as tax avoidance. I conjecture that managers reduce taxes through non-hedging derivatives by aggressively exploiting ambiguity in derivative taxation. For example, managers can arrange complex derivative transactions which serve to reduce taxes. Recent legislation has proscribed one particular example of a prominent tax-motivated derivative transaction: cross-border total return equity swaps used to avoid withholding taxes on dividend payments to foreign entities.[6] Similarly, variable prepaid forward contracts used to defer income recognition have been

[5] For example, in order to apply hedge accounting, a derivative needs to be "highly effective" in offsetting changes in the fair value of the hedged item.

[6] Hiring Incentives to Restore Employment (HIRE) Act. Pub. L. No. 111-147 sec.541, 124 Stat. 71, 115-117 (2010)

addressed through litigation.[7] I find that non-hedging derivative assets are negatively associated with cash effective tax rates while non-hedging derivative liabilities are positively associated with cash effective tax rates. These results are consistent with anecdotal evidence: firms likely reduce cash taxes by structuring complex derivative transactions to defer gains and accelerate losses using non-hedging derivatives.

My results are economically significant and robust to risk management controls. Specifically, I find that for a one standard deviation increase in total derivative assets, firms reduce cash tax payments by $61 million on average.[8] Moreover, I find that a one standard deviation increase in hedging (non-hedging) derivative assets reduces cash tax payments by $72 ($38) million on average. Interestingly, the effect of non-hedging derivative liabilities on tax savings is quite large compared to non-hedging derivative assets: the average reduction in cash tax payments is $55 million for non-hedging derivative liabilities compared to $38 million for non-hedging derivative assets. In obtaining each of these results, I control for tax function convexity and reductions in taxable income volatility (i.e. risk management effects).

I perform two cross-sectional tests. First, I examine whether firms associated with extreme forms of tax aggression are more likely to use non-hedging derivatives to avoid taxes. More specifically, I examine whether firms with a high propensity to use tax shelters are more likely to use non-hedging derivatives to avoid taxes relative to firms with a low propensity to use tax shelters. As I argue above, non-hedging derivatives can be used to engage in aggressive tax avoidance due to their opacity and their discretionary nature.

[7] Anschutz co. v. Commissioner. 135 T.C. No. 5 July 22, 2010

[8] I use the mean of pretax earnings before special items (*PTBI*) to calculate the economic magnitude of the effect. When I use the median of *PTBI* to mitigate the concerns about outliers, the economic magnitude decreases to $23 million.

Consequently, firms that are likely to use tax shelters should be more likely to use non-hedging derivatives to avoid taxes because both represent aggressive forms of tax avoidance. In other words, firms that are willing to engage in aggressive, risky forms of tax avoidance might use both tax shelters and non-hedging derivatives to do so. My results are consistent with the notion that firms with a greater propensity to engage in tax shelters are also more likely to use non-hedging derivatives to avoid taxes, relative to firms with a low propensity to use tax shelters.

Second, I examine whether financially constrained firms are more likely to use derivatives to avoid taxes. Edwards et al. (2016) demonstrate that financially constrained firms are more likely to avoid taxes relative to non-financially constrained firms because financially constrained firms are unable to access external financing. Similarly, Law and Mills (2015) find evidence consistent with financially constrained firms engaging in risky tax avoidance strategies to generate the cash they need to continue operations. Thus, financially constrained firms may use risky, derivative-based tax avoidance strategies to generate cash. My results are consistent with financially-constrained firms engaging in more derivatives-based tax avoidance than non-financially constrained firms.

This paper contributes to the risk management and tax avoidance literature by providing new empirical evidence of derivative-based tax avoidance. This study is the first paper, to the best of my knowledge, to examine the extent to which the fair value of derivatives is associated with tax avoidance. Furthermore, I investigate the potentially important roles of hedging and non-hedging derivatives on corporate tax avoidance.

Regulators and policymakers may consider my results of interest when contemplating new regulation of derivatives. More particularly, my results suggest that

regulators and policymakers should focus on the taxation of non-hedging derivatives if they are interested in stamping out aggressive, derivatives-based tax avoidance. Furthermore, regulators and policymakers have recently debated switching to a "mark-to-market" tax regime from a "wait-and-see" approach (Miller 2011; GAO 2011). My results provide estimates on the tax revenue foregone by taxing derivatives on a "wait-and-see" approach, as opposed to a "mark-to-market" approach and thus should inform this debate.

CHAPTER 1:

Institutional Background

Accounting Treatment of Derivative Instruments

SFAS 133 governs accounting rules for derivative instruments while SFAS 161, an amendment to SFAS 133, governs disclosure rules for firms' derivative activities. SFAS 133, *Accounting for Derivative Instruments and Hedging Activities*, was effective in 2000 and describes the accounting and reporting standards for derivative instruments. It requires firms to record all derivatives as either assets or liabilities at fair value on the balance sheet and to recognize fair value gains or losses on the income statement on a quarterly basis. Further, it allows firms to adopt special hedge accounting for derivatives if the firm lowers earnings volatility by matching the timing of gains or losses from derivatives with the hedged items. If certain criteria for hedge accounting are met, a derivative instrument can be designated as either (i) a fair value hedge or (ii) a cash flow hedge.[9]

Derivative assets (liabilities) recorded on the balance sheet represent cumulative unrealized gains (losses) regardless of their hedge designation. However, the impact of derivatives on the income statement varies depending on their hedge designation. For fair value hedges, changes in the fair value of both an effective hedge and underlying hedged item are included in net income. For cash flow hedges, the effective portion of hedges are first recorded in "Other Comprehensive Income (OCI)" and later reclassified as income in the same period that the forecasted cash flow affects earnings. Any unrealized or realized

[9] The accounting for foreign currency hedges is treated separately in SFAS 133: a hedge of the foreign currency risk exposure to an unrecognized firm commitment, available-for-sale security, a foreign currency-denominated forecasted transaction, and a net investment in a foreign operation. Yet, the accounting treatment of hedges of foreign currency risk exposure still follows either the fair value hedge or cash flow hedge depending on the nature of the underlying hedged item.

gains and losses that result from non-hedging transactions or transactions which are intended as hedges but are ineffective, are immediately reported in net income.

The main benefit of hedge accounting is to reduce earnings volatility by recording gains or losses on the hedging instrument with the offsetting losses or gains on the related hedged item in the income statement in the same period. Otherwise, any gains and losses from changes in the fair value of derivatives that are not qualified for hedge accounting are immediately reflected in contemporaneous earnings. Consequently, earnings volatility may increase because due to the fair value fluctuations of derivatives and no accompanying offset.

FASB issued SFAS 161 to improve transparency of the financial reporting as to how and why firms use derivatives. SFAS 161 requires firms to provide both qualitative and quantitative disclosures about their objectives in using derivatives. Firms are required to disclose the fair value of derivative assets and liabilities as well as fair value derivative gains and losses in a tabular format without netting these positions. In addition, firms must separately disclose derivatives by hedge designation (i.e., hedging and non-hedging instruments) and by risk types (e.g., interest rate risk, foreign exchange rate risk, or commodity price risk).[10] These extended disclosure requirements are intended to help investors assess firms' derivative use and associated risk. I rely on these disclosures to collect balance sheet fair values of assets, liabilities, hedging and non-hedging derivatives.

To sum up, derivatives designated as hedging instruments receive special accounting treatment because firms can match gains or losses from derivatives with those of underlying items. Contrastingly, derivatives that are not designated as hedges or are

[10] See Appendix A for an example of a firm's derivative disclosure under SFAS 161

ineffective hedges immediately hit income, resulting in mismatches between gains and losses from derivatives and losses and gains from the underlying assets. In disclosing derivative activities, firms must separately disclose derivative assets and liabilities as well as gains and losses disaggregated by hedge designation and by types of risk exposure.

Tax Treatment of Derivative Instruments

The U.S. tax rules for derivatives consist of a "cubbyhole approach" and depend on various attributes, including the type of derivative (option, future, forward or swap), motive for use (hedging or speculative), and the type of taxpayer (dealer, trader or investor, business or individual). Ideally, determining the tax treatment of a particular instrument requires consideration of all of these elements. Nevertheless, as a practical matter, it is hard to apply all rules at the same time because the tax rules are inconsistent with each other and often overlap. Specifically, taxpayers need to choose a single tax treatment for a derivative transaction even when it fits into multiple categories. The inconsistencies and complexities of derivative taxation can lead to ambiguity and offer an opportunity for taxpayers to manipulate rules to achieve desired tax consequences.

Key tax considerations for issuers and holders of derivatives include the timing of recognition (marked-to-market vs. wait-and-see) and character (ordinary vs. capital) of gains or losses on derivatives. If a derivative transaction qualifies as a "hedging transaction," the tax hedge rules determine the timing and character of gains and losses from the derivative. The tax hedge rules are intended to match the timing and character of derivative gains and losses with the timing and character of the underlying hedged items. As a result, gains and losses on hedging instruments are offset by gains and losses on

underlying hedged items.[11] Furthermore, the character of the gains and losses from hedging instruments is ordinary in nature because, in order to apply tax hedge rules, hedged items must constitute ordinary property or obligations.[12] More importantly, the application of the tax hedge rules to derivative transactions supersedes other timing rules that might otherwise apply to it.

Contrastingly, if a derivative does not qualify for hedge treatment under the tax law, it is taxed on the basis of other attributes such as its type. In general, options, forwards, and futures are taxed on an open-transaction (wait-and-see) basis. That is, gains and losses on the derivatives are not taxed until the derivatives are settled or terminated. On the other hand, derivatives subject to section 1256 such as regulated futures, exchange-traded non-equity options, and some over-the-counter foreign currency contracts are taxed on a mark-to-market basis. Under the mark-to-market method, a derivative is treated as if it were sold at its fair market value on the last business day of the taxable year and thus results in a tax liability for the taxable year.[13]

Swaps are taxed on the basis of notional principal contracts (NPCs).[14] Firms must classify swap payments as either (i) periodic (payment at intervals of one year or less), (ii) termination (payment in the year the contract is extinguished) (iii) or non-periodic (payment other than periodic or termination). While periodic and termination payments are

[11] The timing rule for hedging derivatives depends on the nature of the underlying items. For example, if firms enter into a forward contract to hedge price risk of an asset that is marked to market, gains or losses from the forward are recognized on a mark-to-market basis along with the hedged asset.
[12] Section 1221(b)(2) states that a hedging transaction must either manage price risk or currency risk with respect to ordinary property held or to be held by the taxpayer or interest rate, price or currency risk with respect to debt issuances and ordinary obligations of the taxpayer. "Ordinary property" refers to a property that does not generate capital gains or losses in the taxpayer's hands.
[13] See section 1256(a)(1) for details.
[14] Treasury regulations define a NPC as a financial instrument that provides for the payment by one party to another at specified intervals computed by the reference item upon a notional amount in exchange for a promise to pay similar amounts. See Treas. Reg. sec. 1.446-3(c)(1)(i) for details.

recognized when realized, non-periodic payments are recognized over the entire term of the contract using one of three allowable allocation methods. Because each non-periodic payment method is taxed differently, firms may choose one tax treatment over another to lower tax bills.

In sum, the objective (i.e., for hedging or non-hedging purpose) and type of a derivative play an important role in determining the tax treatment of a derivative. The timing and character of derivatives that are hedging transactions are matched with those of the underlying hedged items whereas gains and losses from derivatives that are not hedging transactions are determined based on other attributes such as derivative type. Forwards, futures and options are generally taxed on an open transaction basis while section 1256 derivatives are taxed on a mark-to-market basis. Swaps are subject to taxation as NPCs and depend on payment type. Appendix B summarizes in part the key aspects of derivative taxation.

CHAPTER 2:

Prior Literature

In this section, I discuss prior literature examining the relationship between derivative use and taxes. First, I summarize the literature on tax-based incentives and derivative use. Second, I summarize a recent study documenting the tax effects of derivative use. While I focus on tax incentives for derivative use, other streams of research identify non-tax incentives for derivative use, such as financial distress cost (Smith and Stulz 1985), managerial risk aversion (Smith and Stulz 1985), underinvestment due to costly external financing (Froot et al. 1993), information asymmetry between shareholders and mangers (DeMarzo and Duffie 1995) and earnings management (Pincus and Rajgopal 2002).

Tax Incentives to Use Hedging Derivatives

Several studies have explored the actual and potential use of hedging derivatives to avoid taxes. Smith and Stulz (1985) develop a model in which firms with convex tax functions hedge to lower taxable income volatility and thereby reduce expected tax liabilities.[15] Building on Smith and Stulz's work, Graham and Smith (1999) use a simulation to investigate the proportion of firms that face convex tax functions and to estimate the tax savings generated by reducing taxable income volatility. They find that about 50 percent of firms in their sample face convex tax functions.[16] Further, they find

[15] To illustrate, suppose a firm faces two equally probable outcomes: a loss of $100,000 and profit of $100,000. These outcomes give an expected taxable income of $0. Under US tax laws, the loss generates $0 in taxes while the gain generates $35,000 in taxes thus leading to expected taxes of $17,500 (assuming the tax rate is 35% and no loss carrybacks or carryforwards). However, the firm can completely remove this uncertainty through hedging to guarantee $0 in profit, thus leading to zero expected taxes.

[16] They demonstrate that tax function convexity is induced by current U.S. tax provisions, including a zero tax rate on negative taxable income, statutory progressivity, net operating loss carrybacks and carryforwards, investment tax credits (ITCs), and the alternative minimum tax (AMT).

that for firms facing a convex tax function, a 5 percent reduction in the volatility of taxable income can lead to a 5.4 percent decrease in expected tax liabilities. This result implies that firms can generate significant tax savings via hedging with derivatives.

In contrast, Graham and Roger (2002) test these theories empirically and find no evidence that firms use hedging derivatives in response to tax convexity incentives. However, they propose an alternative tax incentive for derivative use: increased debt capacity and interest deductions. They posit that firms use derivatives that reduce book income volatility to increase debt capacity and thereby obtain the tax benefits of increased interest deductions. In support, they find a positive association between hedging with derivatives and firms' debt ratios.

Overall, prior studies suggest that the use of hedging derivatives can result in tax savings. Moreover, hedging derivatives can yield tax savings through at least two different channels. Thus, firms have tax incentives to use hedging derivatives.

The Economic Effects of Derivatives on Tax Avoidance

While prior literature examines whether firms have tax incentives to use hedging derivatives, Donohoe (2015) directly addresses whether firms do, in fact, use derivatives to avoid taxes. He finds that firms that use derivatives avoid more taxes than those that do not. In particular, he shows that derivative users' cash ETR is lower than non-users' cash ETR by 0.9 percent over the subsequent three years.[17] In addition, he documents a 4.4 percent reduction in cash ETR after beginning derivative use by comparing firms' forward-looking three-year cash ETR before and after derivatives program initiation to non-users' cash ETR over the same period. In dollar terms, the 357 new derivative users in the sample

[17] In his empirical tests, Donohoe (2015) uses an indicator variable to indicate whether a firm uses derivatives and whether a firm initiates a derivative program.

achieve an aggregate cash tax savings of about 4 billion dollars. More importantly, he finds that most of these tax savings (about 3.3 billion dollars) are not attributable to tax function convexity, but rather to the strategic use of derivatives. He posits that firms exploit ambiguous rules governing derivatives taxation to reduce taxes by strategically coordinating the timing, character and source of derivative gains and losses. His findings are consistent with prior literature demonstrating that firms receive tax benefits from using options and forward contracts (McDonald 2004; Warren 2004).[18]

To sum up, prior evidence suggests that firms are incentivized to use hedging derivatives to lower taxes because tax functions are convex and because increased debt capacity leads to increased interest deductions. More recently, Donohoe (2015) suggests that firms use derivatives to avoid taxes incremental to risk management incentives by leveraging the ambiguity in derivatives taxation rules. To my knowledge, no prior study has directly examined the tax savings produced by hedging versus non-hedging derivatives. To fill this void, I separately examine the effects of hedging and non-hedging derivatives on tax avoidance using a novel measure of balance sheet fair value adjustments. The balance sheet fair value adjustments capture cumulative, unrealized derivative gains and losses. Firms can potentially avoid taxes by timing the recognition of these unrealized gains and losses for tax purposes because derivatives do not produce any income tax consequences until their disposition. By examining unrealized gains and losses, I am able to provide more granular evidence on derivative-based tax avoidance than prior studies.

[18] McDonald (2004) illustrates that issuing warrants or convertible bonds with warrants are tax advantaged. Warren (2004) documents that income tax treatments based on certain distinctions (e.g., fixed versus contingent returns, capital gains versus ordinary income, domestic versus foreign sources) can be undermined by new innovative financial instruments (e.g., forward contracts and options).

CHAPTER 3:

Hypothesis Development

In this paper, I use the fair values of derivatives to examine the extent to which firms use derivatives to avoid taxes. Financial reporting standards treat derivative gains and losses differently than tax reporting rules. This disparate treatment creates unrealized gains and losses that have been recognized for book but not for tax purposes. This difference is captured by balance sheet fair value adjustments. Thus, in general, fair value adjustments of derivatives measure the extent to which firms have deferred recognition of gains and losses for tax purposes while recognizing these gains and losses for book purposes. Thus, I am able to directly test the mechanism through which firms can defer gains or accelerate losses on derivatives and thereby achieve tax savings.

I first test whether tax avoidance relates to derivative assets and liabilities differently. In general, the tax treatment of derivative gains allows firms to delay recognizing gains until the settlement date while financial reporting treatment permits them to recognize unrealized gains in income. Consequently, firms do not pay taxes on gains until they close derivative positions. However, firms achieve the benefit of increased earnings prior to the realization of the tax gains. Thus, larger derivative assets (fair value gains) can lead to more tax deferrals. On the other hand, less derivative liabilities may represent more tax avoidance. In general, firms need to realize losses by closing derivative loss positions to reduce taxes in the current period. However, realizing derivative losses also removes the associated derivative liabilities from the balance sheet. Thus, a lower level of derivative liabilities on the balance sheet may imply that firms have realized losses to

reduce taxes in the current period. Therefore, I expect an inverse relation between tax avoidance and derivative liabilities.

Derivatives might also generate *unintentional* tax savings if the firm faces a convex tax function. According to risk management theory, lowering taxable income volatility through hedging reduces expected taxes for firms with convex tax functions (Smith and Stulz 1985). Under current tax rules, firms can reduce their taxable income volatility by using hedging derivatives because gains and losses on derivatives offset gains and losses on the underlying item (the security whose price movement the derivative hedges against).[19] Empirical evidence shows that firms with convex tax functions can lower expected taxes by reducing taxable income volatility (Graham and Smith 1999). However, Donohoe (2015) suggests reductions in taxable income volatility do not explain the full extent of derivative-generated tax savings. That is, firms may engage in derivative-based tax planning which is completely unrelated to taxable income smoothing. In this paper, I explore the direct effects of derivative-usage on tax avoidance after controlling for the tax effects of derivatives that arise from reductions in taxable income volatility and tax function convexity.[20] Thus, my first hypothesis (stated in alternative form) is as follows:

Hypothesis 1: *The fair value of derivative assets (liabilities) is positively (negatively) associated with tax avoidance after controlling for tax function convexity and reduction in taxable income volatility.*

[19] Although firms use hedging derivatives to hedge their business risks, the firms cannot lower taxable income volatility if tax rules do not allow firms to match gains and losses on hedging derivatives to those on the hedged items.

[20] Tax function convexity must accompany reductions in taxable income volatility to have an effect on taxes.

Next, I contend that *hedging derivatives* can be used to reduce taxes in at least two ways. Current tax treatment of hedging derivatives allows firms to match gains and losses from derivatives to the gains and losses of the hedged underlying item. Thus, for tax purposes, the recognition of derivative gains and losses is delayed until the related underlying transaction occurs (the "wait-and-see" approach). Contrastingly, accounting rules require firms to adjust derivatives and their underlying hedged items to fair values on the balance sheet and to make commensurate adjustments to either net income or accumulated other comprehensive income ("mark-to-market" approach). [21] Consequently, unrealized gains and losses on derivatives appear in the financial statements at the end of the fiscal year but not in tax returns until the hedge position is closed. These divergent recognition rules give rise to temporary tax deferrals. Thus, firms can legally avoid taxes by not paying taxes on the unrealized gains from hedging derivatives. In other words, increased derivative use may lead to increased tax avoidance.

Furthermore, hedging derivatives may produce tax benefits by smoothing book earnings and increasing debt capacity. Under GAAP, hedge accounting permits gains (losses) on derivatives to be offset by losses (gains) on hedged items, thus reducing earnings volatility. Lower earnings volatility signals less risky future earnings to lenders. As a result, firms use hedging derivatives to achieve larger debt capacities and thus, benefit from greater interest deductions. Graham and Rogers (2002) find that firms increase their use of derivatives in response to the tax incentive of increased interest deductions.[22]

[21] Unrealized gains and losses from a derivative flow through income if the derivative is designated as a fair value hedge whereas they flow through AOCI if the derivative is designated as a cash flow hedge.
[22] A reduction in earnings volatility is different from a reduction in taxable income volatility because the reduction in earnings volatility increases debt capacity and interest deductions while the reduction in taxable income volatility lowers expected taxes through tax function convexity.

To sum up, hedging derivatives facilitate tax avoidance in at least two ways. First, the difference between income tax and financial reporting of hedging derivatives allows firms to defer taxes and reduce cash tax payments in the current period. Second, firms receive tax benefits from increased debt capacity by hedging. I examine whether firms use hedging derivatives to reduce taxes through the first mechanism controlling for risk management incentives associated with increased debt capacity (i.e., the second mechanism). Therefore, my third hypothesis follows:

Hypothesis 2: *The fair value of hedging derivative assets (liabilities) is positively (negatively) associated with tax avoidance after controlling for risk management incentives (tax function convexity and increased debt capacity).*

Firms may additionally use *non-hedging* derivatives to avoid taxes.[23] Ambiguous and complex tax rules provide firms with opportunities to time the recognition of gains and losses, transform the character of the gains and losses, and alter their sources to obtain a favorable tax outcome. Therefore, firms have incentives to arrange complex derivative transactions to aggressively avoid taxes. However, firms are unlikely to label instruments used in these complex transactions as hedging derivatives because hedging derivatives are stringently linked to the value of underlying items, and are thus relatively inflexible. Therefore, non-hedging derivatives are more likely to be utilized in aggressive and complex transactions that push the envelope of tax laws.

However, non-hedging derivatives can also be used benignly. Under the tax code, derivatives that are non-hedging and are not subject to section 1256 are taxed on an open-

[23] I define non-hedging derivatives as derivatives that are not designated as hedging instruments.

transaction ("wait-and-see") basis.[24] That is, gains and losses on these derivatives are not taxed until they are closed or settled. Therefore, non-hedging derivatives might be used in the same ways that hedging derivatives are: to defer gain recognition and thus reduce taxes in the current period. These arguments lead to my fourth hypothesis.

Hypothesis 3: *The fair value of non-hedging derivative assets (liabilities) is positively (negatively) associated with tax avoidance after controlling for tax function convexity and reduction in taxable income volatility.*

Next, I hypothesize that tax aggressive firms use more non-hedging derivatives to avoid taxes than non-tax-aggressive firms. Theoretically, tax aggressive firms have likely determined that an aggressive and arguably risky tax strategy is appropriate. Thus, these firms likely seize on multiple and diverse tax planning opportunities to aggressively avoid taxes. Thus, firms likely to use tax shelters will probably also use non-hedging derivatives to avoid taxes because both represent aggressive and arguably risky tax planning.

Hypothesis 4a*: The positive (negative) association between the fair value of non-hedging derivative assets (liabilities) and tax avoidance is more pronounced for firms with a high propensity to use tax shelters, relative to firms with a low propensity to use tax shelters.*

Financially constrained firms are also more likely to use derivatives to avoid taxes relative to non-constrained firms. Edwards et al. (2016) suggest that financially constrained firms seek tax planning opportunities because they are unable to generate requisite cash from external financing. Law and Mills (2015) provide evidence that such firms may bear more tax risk to generate cash needed to finance operations and investments. While

[24] Section 1256 refers to regulated futures, exchange-traded non-equity options, and foreign currency contracts.

derivatives-based tax avoidance strategies may be expensive to initially implement, firms that already have derivatives programs in place face a relatively low marginal cost in implementing derivatives-based tax avoidance strategies. Thus, financially constrained firms that already use derivatives are incentivized to use these derivatives to avoid taxes. This leads to my final hypothesis:

Hypothesis 4b*: The positive (negative) association between the fair value of non-hedging derivative assets (liabilities) and tax avoidance is more pronounced for financially constrained firms, relative to unconstrained firms.*

CHAPTER 4:

Sample Construction

The sample includes firms listed on the *Standard and Poor's 500 Index* (S&P 500) as of July 1, 2015. I choose firms in the S&P 500 because they are mid and large-cap companies that are likely to use derivatives. I only include non-financial firms because financial firms use derivatives mostly for trading purposes and are thus subject to different tax reporting rules. I hand-collect information about derivatives from the derivative-related footnote in each firm's 10-K filling, and search for key words to identify firms with a derivative position.[25] The sample period spans from January 1, 2008 to December 31, 2014. The sample period begins in fiscal year 2008 because new derivative disclosures mandated by SFAS 161 are effective on November 2008.[26]

I obtain financial statement data from Compustat. I exclude firm-year observations with (1) missing total assets (AT), (2) negative book value of equity (CEQ) (3) negative pretax income before special items (PI - SPI) and (4) non-U.S. incorporation. I remove financial and utility firms because these firms are more likely to use derivatives for trading purposes or act as derivative dealers, which subjects them to different accounting and tax rules.[27] I use the Global Industry Classification Standard (GICS) as my industry classification because prior research has shown that GICS outperforms Standard Industry

[25] Key words include: derivatives, derivative instruments, financial instruments, hedges, hedging, risk management, fair value measurement, market risk, cash flow, forward, futures, swap and option.
[26] Even though SFAS 161 is effective in November 2008, I am able to collect the derivative-related information from fiscal year 2008 because firms generally report the comparable amounts for the corresponding previous period in annual filings.
[27] Financial firms have two-digit GICS code 40 and utility firms have two-digit GICS code 55.

(SIC), Fama-French (FF), and North American Industry Classification System (NAICS) for explaining stock return movement and key financial ratios (Bhojraj et al. 2003).[28]

My sample consists of 284 firms (1,785 firm-year observations) in total. The number of observations per firm used in estimation varies depending on which independent variables are included (e.g., three-year forward-looking cash ETR loses 2 years). Table 1 reports descriptive statistics for S&P500 firms with derivative positions. Table 2 reports the correlation matrix between tax avoidance measures and derivative measures.

[28] The GICS classification is jointly developed and maintained by Standard & Poor's (S&P) and Morgan Stanley Capital International (MSCI). It is widely accepted and used particularly among financial practitioners whereas academics often use their own metrics such as the FF industry classification.

CHAPTER 5:

Research Design

The Tax Effect of Total Derivative Assets and Liabilities

First, I examine whether the association between the fair value of *total* derivative assets and liabilities are differently associated with tax avoidance (H1).

$$\boldsymbol{ETRs_{it} = b_0 + b_1 FVDA_{it} + b_2 FVDL_{it} + b_3 CV_{it} + \sum b_{4k} Controls_{it} + \sum b_{5k} Ind_{it} + \sum b_{6k} Year_{it} + e_{it}} \quad \textbf{(1)}$$

where *FVDA* is the fair value of total derivative assets. *FVDL* is the absolute fair value of total derivative liabilities. *CV* is an indicator variable equal to 1 if a firm faces a convex function and a reduction in taxable income volatility (0 otherwise). Following Donohoe (2015), a firm faces a convex tax function if the firm-year marginal tax rate (before interest expense) is less than the statutory tax rate (i.e., 35%). A firm experiences a reduction in taxable income volatility if the standard deviation of taxable income over the last five years including the current year (t-4, t) is less than that of taxable income over the last five years excluding the current year (t-5, t-1). The coefficient on *FVDA (FVDL)* represents the overall effect of derivative assets (liabilities) on tax avoidance Thus, I predict that (i) *FVDA* is negatively associated with *ETRs* (i.e., $b_1 < 0$) and (ii) *FVDL* is positively associated with *ETRs* (i.e., $b_2 > 0$).

I measure *ETR* in two different ways: cash effective tax rate at year *t* (*Cash*) and GAAP effective tax rate at year *t* (*GAAP*). I calculate cash ETR as cash taxes paid for year t divided by pretax book income less special items in year t. I calculate GAAP ETR as the total tax expense (i.e., current and deferred tax expense) at year t divided by pretax book

income less special items. [29] I use two different tax avoidance measures because each ETR captures different tax strategies. Cash ETR captures tax strategies that reduce actual cash tax payments in the current period, which likely represent explicit reduction in taxes. In contrast, GAAP ETR captures tax strategies that permanently reduce taxes and includes earnings management through tax-related accruals. I also use forward-looking long-run ETRs (i.e., *Cash3 and Gaap3*) estimated over three years (*t* to *t+2*). I employ these long-run ETRs to mitigate concerns about year-to-year volatility in annual effective tax rates.

I control for variables likely to impact both derivative fair values and tax avoidance. I include total assets (*logAT*) to control for size. Bodnar et al. (1998) show that larger firms are more likely to use derivatives. I include market-to-book (*MB*) to control for growth opportunities, return on assets (*ROA*) for profitability and long-term debt (*LEV*) for leverage. I control for income from foreign operations (*Foreign*). More foreign sales imply greater foreign currency risk exposure and potentially increased hedging activities. Further, firms may reduce taxes by shifting income to or otherwise earning income in foreign countries where tax rates are lower than the U.S. top statutory tax rate (35%). I control for net operating losses (*NOL*). Firms with NOLs have a wider range of tax convexity because NOLs can smooth losses. Thus, these firms are more likely to receive tax benefits from derivatives related to tax function convexity and reductions in taxable income volatility. Furthermore, these firms can directly reduce their tax bills by using their NOLs to get a refund (carrybacks) or to offset taxable income (carryforwards). I control for R&D (*RD*) because prior studies find that hedging increases with R&D spending (Geczy et al. 1997). I include volatility in cash flows (*CFO_vol*), sales (*Sale_vol*) and earnings (*ROA_vol*) to

[29] I treat ETRs as a missing value if ETRs are greater (less) than 1 (0). That is, I omit these observations when running my tests.

control for other general incentives to use derivatives which may be associated with tax avoidance. See Appendix D for detailed calculations of variables.

In the regression model, I include industry fixed effects using GICS classification to control for variation in tax avoidance across industries. I also include year fixed effects to mitigate potential omitted correlated variables bias related to year-specific events such as the financial crisis in 2008 and 2009. In addition, I cluster standard errors by firm to allow for potential correlation in errors and derivative measures within each firm (Petersen 2009).

Next, to control for the tax effect of derivatives through tax function convexity and reductions in taxable income volatility, I include an interaction between derivative assets (liabilities) with a dummy variable which represents firms with tax function convexity and reductions in taxable income volatility. I estimate the following regression model:

$$\boldsymbol{ETRs_{it} = b_0 + b_1 FVDA_{it} + b_2 FVDL_{it} + b_3 FVDA * CV_{it} + b_4 FVDL * CV_{it} +}$$

$$\boldsymbol{+ b_5 CV_{it} + \sum b_{6k} Controls_{it} + \sum b_{7k} Ind_{it} + \sum b_{8k} Year_{it} + e_{it}} \quad \textbf{(2)}$$

where *FVDA*CV (FVDL*CV)* is an interaction term between *FVDA (FVDL)* and *CV*. The coefficient on *FVDA*CV (FVDL*CV)* represents the incremental tax effect of derivative assets (liabilities) associated with tax function convexity to other tax-motived derivatives. The coefficient on *FVDA (FVDL)* represents the effect of derivative assets (liabilities) on tax avoidance unrelated to tax function convexity and reductions in taxable income volatility. Thus, I predict that (i) *FVDA* is negatively associated with *ETRs* (i.e., $b_1 < 0$) and (ii) *FVDL* is positively associated with *ETRs* (i.e., $b_2 > 0$).

The Tax Effect of Hedging and Non-Hedging Derivatives

Hypothesis 2 investigates whether the fair value of *hedging* derivative assets (liabilities) is positively (negatively) associated with tax avoidance. Hypothesis 3 investigates whether the fair value of *non-hedging* derivatives (liabilities) is positively (negatively) associated with tax avoidance. I test H2 and H3 together by including both hedging and non-hedging derivative measures in the same regression. I first test the average effect of hedging and non-hedging derivatives on tax avoidance. Thus, I estimate the following regression model:

$$\boldsymbol{ETRs_{it} = b_0 + b_1 FVHDA_{it} + b_2 FVHDL_{it} + b_3 FVNHDA_{it} +}$$

$$\boldsymbol{b_4 FVNHDL_{it} + b_5 CV_{it} + \sum b_{6k} Controls_{it} + \sum b_{7k} Ind_{it} + \sum b_{8k} Year_{it} + e_{it}} \qquad \textbf{(3)}$$

where *FVHDA* is the fair value of derivative assets designated as hedging instruments. *FVHDL* is the absolute fair value of derivative liabilities designated as hedging instruments. *FVNHDA* is the fair value of derivative assets that are not designated as hedging instruments. *FVNHDL* is the absolute fair value of derivative liabilities that are not designated as hedging instruments. I use the same set of control variables and industry and year fixed effects as in Eq. (1). Also, I include industry and year fixed effects to control for variation in the fair values of derivatives and ETRs across industries and years, respectively. I cluster standard errors by firm to mitigate concerns about potential time-series correlation in errors and derivative measures within each firm.

I include the fair values of hedging and non-hedging derivatives because I intend to test the incremental effect of hedging on ETRs after controlling for non-hedging derivatives and vice versa. The fair values of hedging derivatives should capture benign tax avoidance whereas non-hedging derivatives should capture aggressive forms of

derivative-based tax avoidance. Thus, I expect (i) *FVHDA* is negatively associated with *ETRs* (i.e., $b_1 < 0$), (ii) *FVHDL* is positively associated with *ETRs* (i.e., $b_2 > 0$), (iii) *FVNHDA* is negatively associated with *ETRs* (i.e., $b_3 < 0$) and (iv) *FVNHDL* is positively associated with *ETRs* (i.e., $b_4 > 0$).

Next, I include the interaction term between *CV* and derivative measures to control for tax function convexity and reductions in taxable income volatility. Specifically, I estimate the following regression model:

$$\boldsymbol{ETRs_{it} = b_0 + b_1 FVHDA_{it} + b_2 FVHDL_{it} + b_3 FVNHDA_{it} + b_4 FVNHDL_{it} + b_5 FVHDA * CV_{it} + b_6 FVHDL * CV_{it} + + b_7 FVNHDA * CV_{it} + b_8 FVNHDL * CV_{it} + b_9 CV_{it} + \sum b_{10k} Controls_{it} + \sum b_{11k} Ind_{it} + \sum b_{12k} Year_{it} + e_{it}} \quad \textbf{(4)}$$

where *FVHDA*CV (FVHDL*CV)* is an interaction term between *FVHDA* (*FVHDL*) and *CV*. *FVNHDA*CV (FVNHDL*CV)* is an interaction term between *FVNHDA* (*FVNHDL*) and *CV*. The coefficient on *FVHDA (FVHDL)* and *FVNHDA (FVNHDL)* represent the effect of hedging and non-hedging derivative assets (liabilities) on tax avoidance unrelated to tax function convexity and reductions in taxable income volatility. Thus, I predict that (i) *FVHDA* is negatively associated with *ETRs* (i.e., $b_1 < 0$), (ii) *FVHDL* is positively associated with *ETRs* (i.e., $b_2 > 0$), (iii) *FVNHDA* is negatively associated with *ETRs* (i.e., $b_3 < 0$) and (iv) *FVNHDL* is positively associated with *ETRs* (i.e., $b_4 > 0$).

Propensity to Use Tax Shelters as a Moderator

To test H4a, I split my sample between firms with a high propensity to use tax shelters and firms with a low propensity to use tax shelters. I use Wilson's (2009) tax shelter score to calculate the propensity of firms to use tax shelters. If a firm's tax shelter

score is above its industry's median, the firm is considered to have a high propensity to shelter income. I estimate Eq. (1) and Eq. (3) separately for each sub-sample. I compare coefficients across sub-samples to evaluate whether firms with a high propensity to use tax shelters use more derivatives to avoid taxes compared to firms with a low propensity to use tax shelters.

Financial Constraints as a Moderator

To test H4b, I split my sample between firms that are financially constrained and firms that are unconstrained. I measure financial constraints using Altman's Z-score. Firms with a Z-score below 3 are considered financially constrained. I estimate Eq. (1) and Eq. (3) separately for each sub-sample. I compare coefficients across sub-samples to determine whether financial constraints affect the use of derivatives to avoid taxes.

CHAPTER 6:

Empirical Findings

Descriptive Statistics

Table 1 reports descriptive statistics for my two tax avoidance measures, derivatives measures, and control variables. The mean (median) of *Cash* and *GAAP* are 23.3% (22.6%) and 27.4% (28%), respectively. These average rates are lower than rates reported in Dyreng et al. (2008). These differences may arise for several reasons. First, firms in my sample are relatively large firms compared to the firms in Dyreng et al. (2008). Thus, my firms are likely able to engage in more sophisticated and effective tax planning strategies than the firms in Dyreng et al. (2008). Second, effective tax rates of U.S. corporations have been trending downwards over the past 25 years (Dyreng et al. 2016). More specifically, average cash effective tax rates have declined from 30% in 2008 to 24% in 2011. My sample period (2008 to 2014) includes years in which effective tax rates have declined for the most part.

The mean (median) fair value of total derivative assets is 0.51% (0.12%) of total assets. The mean (median) fair value of total derivative liabilities is 0.46% (0.10%) of total assets. In dollar terms, the mean (median) fair value of derivative assets is $151 million ($12 million) while the mean (median) fair value of derivative liabilities is $129 million ($9 million). In untabulated descriptive statistics, the mean fair value of total derivative assets scaled by pre-tax book income is 7.4% and the mean fair value of total derivative liabilities scaled by pre-tax book income is 7.0%. That is, firms on average, have cumulative unrealized gains and losses from derivatives equal to 7.4% and 7% of pre-tax

book income, respectively. Thus, the fair value of derivatives is fairly large compared to pre-tax book income.

The fair values of derivative assets (liabilities) are fairly evenly spread between hedging and non-hedging derivative assets (liabilities). For example, the mean (median) fair value of hedging derivative assets is $71 ($3) million and the mean fair value of non-hedging derivative assets is $78 ($0.3) million. Thus, these fair value amounts are similar. The distributions of the fair value measures are right skewed. However, skewness in independent variables still results in unbiased coefficients in an OLS regression because OLS makes no assumptions about the distributions of independent variables (Wooldrige 2009).

The mean of the natural log of total assets is 9.5 which translates into approximately $30 billion. This suggests that firms in my sample are bigger than firms in some prior studies.[30] Descriptive statistics for other variables such as market-to-book (MB), leverage (LEV) and R&D expense (RD) are similar to prior studies.

Table 2 reports the Pearson (above the diagonal) and Spearman (below the diagonal) correlation matrices between my tax avoidance measures and derivative measures. In general, ETRs are significantly correlated with derivative measures but correlation coefficients (ρ) are small in magnitude.

The Tax Effect of Total Derivative Assets and Liabilities

Table 3 presents results from testing my first hypothesis. In Panel A, I present results from regressing contemporaneous effective tax rates on total derivative assets and

[30] Donohoe 2015 reports log assets of 7.1 and Dyreng et al. 2016 reports log assets of 5.4. In addition, Pierce (2015) examines non-financial firms in the S&P 500 from 2008 to 2012 and reports mean total assets of $23 billion.

liabilities. In Column (1) and (3), I find that the fair value of derivative assets is negatively associated with cash ETR but not with GAAP ETR. Specifically, the coefficient on *FVD_A* in my regression with *Cash* as the dependent variable is -1.685 and is significant at the 1% level. Further, the decrease in cash effective tax rates is economically large. My results suggest that a one-standard-deviation increase in the *fair value of derivative assets* reduces cash ETR by 1.85 percent which translates into $54 ($20) million of tax savings annually.[31] This result is consistent with the notion that firms use unrealized gains from derivatives to lower actual cash taxes paid rather than to manage total tax expense in the income statement. Further, this result is consistent with the possibility that firms take advantage of derivatives' tax-favored treatment by deferring the recognition of gains from derivatives until the settlement date.

In Column (2) and (4), I control for tax function convexity and reductions in taxable income volatility to isolate the byproduct effect of risk management. To do so, I include interactions between derivative measures and tax function convexity. In both columns, the coefficient on the interaction, *FVDA*CV,* is not significant. This result implies that the effect of derivative assets on cash ETR for firms with a convex tax function and a reduction in taxable income volatility does not significantly differ from the tax effect of derivative assets for firms without a convex tax function and reduction in taxable income volatility. Thus, the decrease in cash effective tax rates associated with derivative assets is not likely driven by tax function convexity and reduction in taxable income volatility. Rather, the

[31] To estimate the economic magnitude of tax savings, I calculate the average reduction in cash ETRs by multiplying the coefficient on each derivative variable by its standard deviation. To estimate economic magnitudes in dollar terms, I multiply the reduction in cash ETR by the mean (median) of pre-tax book income before special items.

effect is likely driven by the tax-favored treatment of derivatives or complex, derivative-based tax planning by firms.

Second, I find no association between the fair value of derivative liabilities and either cash ETR or GAAP ETR. Specifically, the coefficient on *FVD_L* is insignificant for both ETR measures, suggesting that firms do not seem to accelerate or harvest derivative losses to reduce taxes. This finding may imply that some firms strategically accelerate losses from derivatives while others do not, thus leading to a non-significant result. Alternatively, aggregating hedging and non-hedging liabilities may obscure the individual effects that each has on tax avoidance. More specifically, firms may be reluctant to realize or harvest hedging derivative losses because hedging derivatives smooth firm volatility. Consequently, firms may be unwilling to trade low volatility for tax savings. On the other hand, firms need not use non-hedging derivatives to smooth earnings volatility. Rather, non-hedging derivatives can be flexibly used for other purposes (such as speculation). Consequently, firms may be more willing to accelerate or harvest losses from non-hedging derivatives to increase tax savings. Thus, to the extent firms avoid taxes by accelerating losses from non-hedging derivatives but not from hedging derivatives, aggregated non-hedging liabilities may be unassociated with tax avoidance.

In Panel B, I present the results from regressing forward-looking, long-run effective tax rates on derivative assets and liabilities. I find no association between long-run effective tax rates and my derivative measures. These non-significant results are consistent with firms realizing large, unrealized gains and losses within a few years. Long-run effective tax rates will thus reflect (average out) both low individual ETRs when fair value amounts

are large and high individual ETRs when fair value amounts are small in the subsequent years.

The Tax Effect of Hedging and Non-Hedging Derivatives

Table 4 reports results from testing my second and third hypotheses. In Panel A, I present results from regressing contemporaneous effective tax rates on hedging and non-hedging derivative assets and liabilities. In Column (1), I examine whether hedging and non-hedging derivatives are associated with Cash ETR. I find a negative and significant association between hedging derivative assets and cash ETR. I also find a negative and significant association between non-hedging derivative assets and cash ETR. These results indicate that firms lower cash taxes paid by deferring recognition of gains from both hedging and non-hedging derivatives.

In Column (2), I find a negative and significant association between hedging derivative assets and cash ETR after controlling for increased debt capacity as well as tax function convexity. In particular, the coefficient on *FVHDA* is -2.054 and is significant at the 5% level. In terms of economic magnitude, a one-standard-deviation increase in the *fair value of hedging derivative assets* reduces cash ETR by 2.46 percent which translates into $72 ($27) million of tax savings annually. This result is consistent with firms using hedging derivatives to exploit the tax-favored treatment of hedging transactions (i.e. delaying the recognition of hedging derivative gains for tax purposes). This tax effect is incremental to the effect that hedging derivatives have through increased debt capacity, suggesting that firms receive tax benefits not only from increased tax interest deductions but also favorable tax treatments of hedging derivatives.

In addition, I find a negative and significant association between non-hedging derivative assets and cash ETR. The coefficient on *FVNHDA* is -3.218 and is significant at the 1% level. The economic magnitude is large: a one-standard-deviation increase in the *fair value of non-hedging derivative assets* reduces cash ETR by 1.28 percent which translates into $38 ($14) million of tax savings annually. This result is consistent with firms using non-hedging derivatives to exploit the favorable "wait-and-see" tax treatment of derivatives (which allows firms to delay recognition derivatives gains until termination) and to leverage ambiguity in derivative taxation to avoid taxes. Again, tax savings are primarily driven by tax deferral strategies.

Similar to my finding in H1, I find no association between hedging derivative liabilities and cash ETR. This result suggests that firms do not accelerate losses from hedging derivatives to reduce taxes and is consistent with firms being unwilling to sacrifice low earnings volatility for tax savings. Interestingly, I find that non-hedging derivative liabilities are positively and significantly associated with cash ETR. Specifically, the coefficient on *FVNHDL* in my regression with *Cash* as the dependent variable is 2.343 and is significant at the 1% level. This result suggests that a one-standard-deviation decrease in the *fair value of non-hedging derivative liabilities* reduces cash ETR by 1.87% which translates to $55 ($21) million of tax savings annually. Furthermore, this result is consistent with the possibility that firms accelerate losses from non-hedging derivatives by engaging in complex transactions intended to aggressively reduce cash taxes. In Column (3) and (4), I find no association between GAAP ETR and both derivative assets and liabilities. This result suggests that tax savings from either hedging or non-hedging derivatives are mainly due to tax deferrals on unrealized gains.

In panel B, I find non-significant results when regressing three-year forward-looking cash ETR (*Cash3*) on both the fair value of hedging derivatives and the fair value of non-hedging derivatives. One possible explanation for the relationship between derivatives in year t and three-year forward-looking cash ETRs is that short-term tax-deferrals may not show up in forward-looking ETRs. For example, a firm with a high level of derivative assets in year *t* may realize derivative gains in the following two years. Consequently, the firm's ETR in years *t+1* and *t+2* should be higher than in year *t*. As a result, forward-looking ETRs may contain years with low ETRs and other years with high ETRs. Thus, the long-run forward looking ETRs may aggregate over both sets of years, thus leading to non-significant results.

Propensity to Use Tax Shelters as a Moderator

The results of my cross-sectional tests are reported in Table 5 and Table 6. In Table 5, I report the results of splitting my sample between firms with a high propensity to use tax shelters and firms with a low propensity to use tax shelters. In Panel A, I examine whether firms with a high propensity to use tax shelters are more likely to use derivative *assets* or *liabilities* to avoid taxes, relative to firms with a low propensity to use tax shelters. I find results consistent with both groups using derivative assets to avoid taxes. However, the difference in the coefficients is non-significant. This result is consistent with neither type of firm using more or less derivatives than the other to avoid taxes.

In Panel B, I disaggregate my derivative measures into hedging and non-hedging derivative assets and liabilities. I find results consistent with firms with a high propensity to shelter income use non-hedging derivatives to avoid taxes, whereas firms with a low propensity to use tax shelters do not. The coefficients are significantly different across sub-

samples. These results are consistent with tax-aggressive firms (i.e. firms that are likely to use tax shelters) using non-hedging derivatives to engage in risk tax avoidance.

Financial Constraints as a Moderator

In Table 6, I report the results splitting my sample between financially constrained and unconstrained firms. In Panel A, I find that only financially constrained firms use derivative assets to avoid taxes. However, the difference in coefficients between constrained and unconstrained firms is non-significant. Based on my results, neither constrained nor unconstrained firms seem to use liabilities to avoid taxes.

Interestingly, in Panel B, my results are consistent with financially constrained firms using more of both hedging and non-hedging derivatives to avoid taxes, compared to unconstrained firms. The coefficient comparison yields significant differences across sub-samples for both hedging and non-hedging derivatives. This result is consistent with financially constrained firms engaging in more benign tax avoidance, using hedging derivatives, as well as riskier tax avoidance, using non-hedging derivatives to generate cash because they likely cannot access external financing.

Table 1. Descriptive Statistics

Variable	N	Mean	Median	Std Dev	25th Pctl	75th Pctl
Cash	1,710	0.233	0.226	0.131	0.145	0.303
Gaap	1,680	0.274	0.280	0.107	0.212	0.339
Cash3	1,480	0.229	0.230	0.107	0.159	0.291
Gaap3	1,476	0.265	0.270	0.103	0.206	0.329
FVDA	1,783	0.005	0.001	0.011	0.000	0.005
FVDL	1,783	0.005	0.001	0.011	0.000	0.005
FVHDA	1,783	0.005	0.001	0.012	0.000	0.004
FVHDL	1,783	0.003	0.000	0.006	0.000	0.003
FVNHDA	1,783	0.002	0.000	0.004	0.000	0.002
FVNHDL	1,783	0.002	0.000	0.008	0.000	0.001
FVD_Assets (in mil)	1,785	150.76	11.90	423.55	0.202	84.00
FVD_Liab	1,785	129.49	9.00	437.38	0.294	58.00
FVHD_Assets	1,785	70.66	3.20	196.41	0.000	36.00
FVHD_Liab	1,785	45.73	2.00	142.79	0.000	23.40
FVNHD_Assets	1,785	77.98	0.32	326.56	0.000	13.00
FVNHD_Liab	1,785	77.01	0.60	334.51	0.000	13.00
CV	1,785	0.170	0.000	0.376	0.000	0.000
logAT	1,785	9.484	9.312	1.144	8.613	10.282
BM	1,778	0.390	0.334	0.243	0.215	0.504
ROA	1,783	0.113	0.102	0.085	0.063	0.154
LEV	1,778	0.222	0.210	0.138	0.126	0.303
Foreign	1,783	0.046	0.033	0.047	0.006	0.076
NOL	1,783	0.046	0.009	0.095	0.000	0.048
RD	1,783	0.027	0.007	0.041	0.000	0.040
SG&A	1,783	0.195	0.155	0.161	0.075	0.272
Sale_vol4	1770	0.145	0.095	0.163	0.057	0.172
CFO_vol4	1770	0.039	0.029	0.039	0.017	0.047
ROA_vol4	1770	0.043	0.025	0.060	0.014	0.047
PTBI	1,785	2947.01	1125.00	4950.73	568.76	2900.00

Note: The table presents descriptive statistics for derivative users among S&P500 firms excluding financial and utilities over the sample period from 2008 to 2014. *Cash* (*GAAP*) is defined as contemporaneous cash (total) effective tax rates in year t*; Cash3* (*GAAP3*) is defined as three-year forward-looking cash (total) effective tax rates over the three years (*t* to *t+2*). Any effective tax rates greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (derivative liabilities) defined as cumulative unrealized gains (losses) from derivatives scaled by lagged total assets. *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments scaled by lagged total assets. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments scaled by lagged total assets. *FVD_Assets*, *FVD_Liab*, *FVHD_Assets*, *FVHD_Liab*, *FVNHD_Assets*, and *FVNHD_Liab* are unscaled variable. All continuous variables are winsorized at the 1 and 99 percentiles. See Appendix D for detailed definitions of control variables.

Table 2. Pearson (above) and Spearman (below) Correlation Matrices

Variable	*Cash*	*GAAP*	*Cash3*	*GAAP3*	*FVDA*	*FVDL*	*FVHDA*	*FVHDL*	*FVNHDA*	*FVNHDL*
Cash	1.000	**0.388**	**0.741**	**0.391**	**-0.068**	-0.001	**-0.100**	**-0.042**	-0.009	0.021
GAAP	**0.414**	1.000	**0.403**	**0.713**	**0.090**	**0.056**	0.003	**-0.063**	**0.108**	**0.098**
Cash3	**0.774**	**0.441**	1.000	**0.527**	**-0.037**	-0.024	**-0.095**	**-0.061**	0.037	0.007
GAAP3	**0.426**	**0.805**	**0.528**	1.000	**0.077**	0.015	0.005	**-0.073**	**0.102**	**0.065**
FVDA	**-0.076**	**-0.045**	**-0.045**	**-0.050**	1.000	**0.620**	**0.662**	**0.256**	**0.820**	**0.629**
FVDL	**-0.054**	-0.026	**-0.054**	**-0.049**	**0.590**	1.000	**0.258**	**0.543**	**0.653**	**0.899**
FVHDA	**-0.091**	**-0.146**	**-0.076**	**-0.136**	**0.783**	**0.426**	1.000	**0.329**	**0.148**	**0.162**
FVHDL	**-0.061**	**-0.134**	**-0.066**	**-0.114**	**0.433**	**0.751**	**0.572**	1.000	**0.137**	**0.173**
FVNHDA	-0.028	-0.037	0.002	**-0.049**	**0.646**	**0.532**	**0.231**	**0.197**	1.000	**0.732**
FVNHDL	-0.035	-0.014	-0.038	**-0.049**	**0.510**	**0.675**	**0.205**	**0.214**	**0.768**	1.000

Note: The table 2 presents the correlation coefficients between tax avoidance measure and derivative measures. I calculate correlation coefficients for derivative users among S&P500 firms excluding financial and utilities over the sample period from 2008 to 2014. *Cash* (*GAAP*) is defined as contemporaneous cash (total) effective tax rates in year t*; Cash3* (*GAAP3*) is defined as three-year forward-looking cash (total) effective tax rates over the three years (*t* to *t+2*). Any effective tax rates greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (liabilities). *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments. All continuous variables are winsorized at the 1 and 99 percentiles. Bold coefficients are significant from zero at the 10 percent level.

Table 3. H1: The Tax Effect of Derivative Assets and Liabilities

Panel A: Contemporaneous ETRs and Derivative Assets and Liabilities

VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *GAAP*	(4) *GAAP*
FVDA	-	**-1.685*** **	**-1.903*** **	-0.297	-0.089
		(-3.02)	(-3.23)	(-0.91)	(-0.29)
FVDL	+	0.529	0.797	0.101	-0.313
		(0.88)	(1.38)	(0.33)	(-1.09)
*FVDA*CV*	-		0.823		-0.583
			(0.49)		(-0.97)
*FVDL*CV*	+		-0.747		1.221*
			(-0.55)		(1.87)
CV	-	-0.029***	-0.029**	0.007	0.003
		(-2.89)	(-2.55)	(0.89)	(0.38)
Sale_vol	-/+	0.059*	0.061*	0.035	0.033
		(1.68)	(1.74)	(1.13)	(1.07)
CFO_vol	-	-0.156	-0.158	0.046	0.054
		(-0.95)	(-0.96)	(0.37)	(0.44)
ROA_vol	-	-0.099	-0.100	-0.111	-0.114
		(-1.13)	(-1.14)	(-1.38)	(-1.40)
logAT	-/+	0.008*	0.008*	0.003	0.003
		(1.90)	(1.87)	(0.96)	(0.99)
BM	-/+	0.063**	0.063**	0.027	0.028
		(2.56)	(2.54)	(1.31)	(1.36)
ROA	+	0.147**	0.147**	0.547***	0.544***
		(2.05)	(2.06)	(7.39)	(7.37)
LEV	-	-0.052	-0.053	-0.005	-0.003
		(-1.36)	(-1.38)	(-0.18)	(-0.11)
Foreign	-	-0.224*	-0.228*	-0.820***	-0.816***
		(-1.83)	(-1.87)	(-8.23)	(-8.20)
NOL	-	-0.167***	-0.168***	-0.076***	-0.073***
		(-3.59)	(-3.64)	(-2.73)	(-2.64)
RD	-	-0.638***	-0.633***	-0.413***	-0.417***
		(-4.07)	(-4.05)	(-3.49)	(-3.51)
SG&A	+	0.144***	0.144***	0.052*	0.051*
		(4.24)	(4.25)	(1.96)	(1.94)
Constant	-/+	0.180***	0.182***	0.296***	0.295***
		(3.79)	(3.81)	(7.30)	(7.25)
Observations		1,694	1,694	1,662	1,662
Adjusted R-squared		0.155	0.155	0.305	0.307
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES

Panel B: Forward-looking Long-run ETRs and Derivative Assets and Liabilities					
	Predicted	(1)	(2)	(3)	(4)
VARIABLES	Sign	*Cash3*	*Cash3*	*GAAP3*	*GAAP3*
FVDA	-	-0.776	-1.154	-0.141	-0.174
		(-1.12)	(-1.56)	(-0.27)	(-0.31)
FVDL	+	-0.174	0.004	-0.318	-0.132
		(-0.28)	(0.01)	(-0.77)	(-0.26)
*FVDA*CV*	-		2.116		-0.113
			(1.43)		(-0.10)
*FVDL*CV*	+		-0.703		-0.522
			(-0.76)		(-0.76)
CV	-	-0.017*	-0.023**	-0.001	0.002
		(-1.83)	(-2.56)	(-0.18)	(0.24)
Constant	-/+	0.153***	0.154***	0.289***	0.289***
		(3.33)	(3.40)	(6.71)	(6.74)
Observations		1,464	1,464	1,457	1,457
Adjusted R-squared		0.237	0.240	0.307	0.307
Controls		YES	YES	YES	YES
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES

Note: This table presents results for the association between ***ETRs*** and **the fair value of derivative assets and liabilities.** Panel A reports the results for estimating H1 using contemporaneous ETRs as a dependent variable. Panel B reports results using forward-looking long-run ETRs as a dependent variable. Column (1) and (3) present the average effect of derivative assets and liabilities on firms' ETRs. Column (2) and (4) present the results for estimating the effect of derivative assets and liabilities on ETRs controlling for tax convexity. *Cash* (*GAAP*) is defined as contemporaneous cash (total) effective tax rates in year t*; Cash3* (*GAAP3*) is defined as three-year forward-looking cash (total) effective tax rates over the three years (*t* to *t+2*). Any effective tax rates greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (liabilities). *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. *FVDA*CV* (*FVDL*CV*) is an interaction of *FVDA* (*FVDL*) and *CV*. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

Table 4. H2 and H3: The Tax Effect of Hedging and Non-Hedging Derivatives

Panel A: Contemporaneous ETRs and Hedging Vs. Non-hedging Derivative Assets and Liabilities

VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *GAAP*	(4) *GAAP*
FVHDA	-	**-2.025****	**-2.054****	-0.264	0.015
		(-2.41)	(-2.23)	(-0.54)	(0.03)
FVHDL	+	-0.203	-1.035	-1.051	-1.362*
		(-0.16)	(-0.72)	(-1.52)	(-1.88)
FVNHDA	-	**-1.806***	**-3.218*****	-0.625	-0.509
		(-1.89)	(-3.86)	(-1.18)	(-1.00)
FVNHDL	+	0.947	**2.343*****	0.599	0.214
		(1.11)	(2.87)	(1.27)	(0.51)
*FVHDA*CV*	-		0.044		-1.359
			(0.02)		(-1.24)
*FVHDL*CV*	+		3.474		1.372
			(1.35)		(0.89)
*FVNHDA*CV*	-		2.455		0.034
			(1.29)		(0.04)
*FVNHDL*CV*	+		-2.576		0.789
			(-1.56)		(0.91)
CV	-	-0.029***	-0.035**	0.007	0.004
		(-2.93)	(-2.49)	(0.88)	(0.49)
Sale_vol	-/+	0.056	0.060*	0.032	0.031
		(1.57)	(1.71)	(1.05)	(1.00)
CFO_vol	-	-0.161	-0.163	0.043	0.055
		(-0.96)	(-0.98)	(0.35)	(0.44)
ROA_vol	-	-0.095	-0.094	-0.109	-0.113
		(-1.07)	(-1.05)	(-1.33)	(-1.37)
logAT	-/+	0.008*	0.007*	0.003	0.003
		(1.94)	(1.75)	(0.93)	(0.97)
BM	-/+	0.060**	0.063**	0.025	0.026
		(2.39)	(2.50)	(1.20)	(1.27)
ROA	+	0.143**	0.144**	0.543***	0.541***
		(1.99)	(2.02)	(7.33)	(7.29)
LEV	-	-0.052	-0.052	-0.006	-0.005
		(-1.39)	(-1.37)	(-0.20)	(-0.16)
Foreign	-	-0.208*	-0.207*	-0.807***	-0.805***
		(-1.69)	(-1.68)	(-8.10)	(-8.05)
NOL	-	-0.166***	-0.161***	-0.074***	-0.071***
		(-3.62)	(-3.54)	(-2.71)	(-2.60)
RD	-	-0.638***	-0.628***	-0.413***	-0.417***
		(-4.10)	(-4.03)	(-3.52)	(-3.53)
SG&A	+	0.145***	0.142***	0.051*	0.050*
		(4.30)	(4.25)	(1.95)	(1.91)
Constant	-/+	0.181***	0.188***	0.300***	0.297***
		(3.82)	(3.90)	(7.52)	(7.39)
Observations		1,694	1,694	1,662	1,662
Adjusted R-squared		0.154	0.157	0.307	0.307

Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES

Panel B: Forward-looking Long-run ETRs and Hedging Vs. Non-hedging Derivative Assets and Liabilities

		(1)	(2)	(3)	(4)
VARIABLES		*Cash3*	*Cash3*	*GAAP3*	*GAAP3*
FVHDA	-	-1.666*	-1.588	-0.648	-0.640
		(-1.71)	(-1.49)	(-0.81)	(-0.80)
FVHDL	+	-0.688	-0.989	-1.250	-1.548*
		(-0.63)	(-0.79)	(-1.48)	(-1.66)
FVNHDA	-	0.396	-1.125	0.361	-0.085
		(0.30)	(-0.74)	(0.43)	(-0.09)
FVNHDL	+	-0.452	0.437	-0.162	0.483
		(-0.51)	(0.39)	(-0.26)	(0.69)
*FVHDA*CV*	-		-0.410		-0.559
			(-0.18)		(-0.25)
*FVHDL*CV*	+		0.892		1.525
			(0.44)		(0.82)
*FVNHDA*CV*	-		3.458*		0.344
			(1.72)		(0.26)
*FVNHDL*CV*	+		-1.437		-1.320*
			(-1.08)		(-1.70)
CV	-	-0.017*	-0.022**	-0.002	0.000
		(-1.86)	(-2.18)	(-0.19)	(0.02)
Constant		0.158***	0.155***	0.296***	0.299***
		(3.51)	(3.43)	(7.08)	(7.04)
Observations		1,464	1,464	1,457	1,457
Adjusted R-squared		0.239	0.242	0.309	0.309
Controls		YES	YES	YES	YES
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES

Note: This table presents results for the association between ***ETRs*** and the fair value of **hedging** and **non-hedging derivative assets a**nd **liabilities.** Panel A reports results for testing H2 and H3 using contemporaneous ETRs as a dependent variable. Panel B reports for testing H2 and H3 results using forward-looking long-run ETRs as a dependent variable. Column (1) and (3) present the average effect of hedging and non-hedging derivative assets and liabilities on firms' ETRs. Column (2) and (4) present the results for estimating the effect of derivative assets and liabilities on ETRs controlling for tax convexity. *Cash* (*GAAP*) is defined as contemporaneous cash (total) effective tax rates in year t*; Cash3* (*GAAP3*) is defined as three-year forward-looking cash (total) effective tax rates over the three years (*t* to *t+2*). Any effective tax rates greater (less) than 1 (0) are treated as a missing value. *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments. *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. *FVHDA*CV* (*FVHDL*CV*) is an interaction of *FVHDA* (*FVHDL*) and *CV*. *FVNHDA*CV* (*FVNHDL*CV*) is an interaction of *FVNHDA* (*FVNHDL*) and *CV*. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

Table 5. H4a: Propensity to Use Tax Shelters as a Moderator

Panel A: Cash ETRs and Derivative Assets and Liabilities				
		Low tax shelter score	High tax shelter score	
		WShelter = 0	WShelter =1	
VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *Difference in Coeff*
FVDA	-	**-1.177***	**-2.081*****	-0.904
		(-1.88)	(-2.77)	p-value = 0.31
FVDL	+	0.014	1.220	1.207
		(0.02)	(1.58)	p-value = 0.15
CV	-	-0.027**	-0.035***	
		(-2.14)	(-2.63)	
Constant	-/+	0.090	0.185***	
		(1.02)	(2.80)	
Observations		830	864	
Adjusted R-squared		0.119	0.241	
Controls		YES	YES	
Year FE		YES	YES	
Industry FE		YES	YES	
Panel B: Cash ETRs and Hedging and Non-Hedging Derivative Assets and Liabilities				
		Non-aggressive tax avoiders	Aggressive tax avoiders	
		WShelter = 0	WShelter =1	
VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *Difference in Coeff*
FVHDA	-	-1.074	-2.013*	-0.938
		(-1.41)	(-1.65)	p-value = 0.53
FVHDL	+	1.227	-1.319	-2.546
		(0.96)	(-0.74)	p-value = 0.22
FVNHDA	-	-1.144	**-3.561*****	**-2.416***
		(-0.92)	(-4.12)	p-value = 0.09
FVNHDL	+	-0.230	**2.921*****	**3.150*****
		(-0.34)	(3.41)	p-value = 0.00
CV	-	-0.026**	-0.031**	
		(-2.04)	(-2.36)	
Constant	-/+	0.075	0.192***	
		(0.83)	(2.89)	
Observations		830	864	
Adjusted R-squared		0.116	0.227	
Controls		YES	YES	
Year FE		YES	YES	
Industry FE		YES	YES	

Note: This table presents results for the association between tax avoidance and fair value of derivatives for **subsamples** based on a **firm's tax aggressiveness** (Wilson's tax shelter score). Panel A reports results for testing H1 and Panel B reports for testing H2 and H3. Column (1) and (2) report coefficients for a fixed effect regression model. Column (3) reports the p-value for the difference in coefficients on derivative measures between the two subsamples. *Cash* is defined as contemporaneous cash effective tax rates in year t. *Cash*

greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (liabilities). *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments. *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

Table 6. H4b: Financial Constraints as a Moderator

Panel A: Cash ETRs and Derivative Assets and Liabilities

		Financially not constrained firms	Financially constrained firms	
		Altz >= 3	Altz < 3	
VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *Difference in Coeff*
FVDA	-	-0.600	**-1.922*** **	-1.322
		(-0.95)	(-3.20)	p-value = 0.12
FVDL	+	-0.320	0.947	1.267
		(-0.49)	(1.34)	p-value = 0.18
CV	-	-0.059***	-0.018*	
		(-3.61)	(-1.62)	
Constant	-/+	0.419***	0.166***	
		(5.17)	(3.02)	
Observations		395	1299	
Adjusted R-squared		0.294	0.131	
Controls		YES	YES	
Year FE		YES	YES	
Industry FE		YES	YES	

Panel B: Cash ETRs and Hedging and Non-Hedging Derivative Assets and Liabilities

		Financially not constrained firms	Financially constrained firms	
		Altz >= 3	Altz < 3	
VARIABLES	Predicted Sign	(1) *Cash*	(2) *Cash*	(3) *Difference in Coeff*
FVHDA	-	0.419	**-2.286** **	**-2.705***
		(0.31)	(-2.51)	p-value = 0.09
FVHDL	+	0.689	-0.752	-1.441
		(0.38)	(-0.51)	p-value = 0.53
FVNHDA	-	-0.641	**-2.448*** **	**-1.807***
		(-1.04)	(-2.68)	p-value = 0.09
FVNHDL	+	-0.689	**2.035** **	**2.725*** **
		(-1.26)	(2.16)	p-value = 0.01
CV	-	-0.060***	-0.019*	
		(-3.63)	(-1.69)	
Constant	-/+	0.424***	0.175***	
		(5.27)	(3.23)	
Observations		395	1299	
Adjusted R-squared		0.344	0.134	
Controls		YES	YES	
Year FE		YES	YES	
Industry FE		YES	YES	

Note: This table presents results for the association between tax avoidance and fair value of derivatives for **subsamples** based on a **firm's financial constraints** (Altman-Z score). Panel A reports results for testing H1 and Panel B reports for testing H2 and H3. Column (1) and (2) report coefficients for a fixed effect regression model. Column (3) reports the p-value for the difference in coefficients on derivative mesures between the two subsamples. *Cash* is defined as contemporaneous cash effective tax rates in year t. *Cash*

greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (liabilities). *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments. *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

CHAPTER 7

Robustness Tests

Using Alternative Measures of Tax Avoidance

To assess the sensitivity of my results to the tax avoidance measure, I estimate Equations (1) – (4) using current effective tax rate and cash taxes paid scaled by lagged total assets as my dependent variable. The results of these tests are reported in Table 7. I find that my results are qualitatively and quantitatively similar when using alternate measures of tax avoidance.

Focusing on the Tax Effect of Derivative Liabilities

This test focuses on the role of derivative liabilities in tax avoidance. To avoid taxes using derivative liabilities, firms must realize their unrealized derivative losses. Firms with large, unrealized losses on their current balance sheets are able to realize larger losses in the subsequent period and are thus able to shield more income from taxes in the subsequent period. Consequently, I hypothesize that firms with large derivative liabilities in the current year, realize losses in the following year to reduce their effective tax rates. Empirically, I predict that current period hedging and non-hedging derivative liabilities in year t are negatively associated with ETR measures in year t+1. I use cash ETR and current ETR as my ETR measures because GAAP ETR is non-significant in all prior tests.

I report the results of this set of tests in Table 8. My results are consistent with my conjectures. In Column (2) and Column (4), I find that non-hedging derivative liabilities are negatively and significantly associated with cash and current ETR. My results are consistent with firms with derivative losses in year t waiting till the following year to realize such losses.

Table 7. Alternative Tax Avoidance Measures

Panel A: Testing H1 with a current portion of ETRs and Cash Tax Paid scaled by total assets					
VARIABLES	Predicted Sign	(1) *Curr*	(2) *Curr*	(3) *CashTax/lagAT*	(4) *CashTax/lagAT*
FVDA	-	**-1.342****	**-1.595*****	**-0.260*****	**-0.292*****
		(-2.13)	(-2.81)	(-3.51)	(-3.99)
FVDL	+	0.552	0.871	0.050	0.095
		(0.75)	(1.63)	(0.63)	(1.44)
*FVDA*CV*	-		0.901		0.111
			(0.56)		(0.68)
*FVDL*CV*	+		-0.843		-0.126
			(-0.65)		(-0.88)
CV	-	-0.023**	-0.023**	-0.003**	-0.003*
		(-2.35)	(-2.02)	(-2.01)	(-1.75)
Constant	-/+	0.174***	0.175***	0.008	0.008
		(3.81)	(3.86)	(1.01)	(1.04)
Observations		1,672	1,672	1,704	1,704
Adjusted R-squared		0.117	0.117	0.603	0.603
Controls		YES	YES	YES	YES
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES
Panel B: Testing H2 with a current portion of ETRs and Cash Tax Paid scaled by total assets					
VARIABLES	Predicted Sign	(1) *Curr*	(2) *Curr*	(3) *CashTax/lagAT*	(4) *CashTax/lagAT*
FVHDA	-	**-1.847***	**-1.710***	**-0.312*****	**-0.294*****
		(-1.97)	(-1.72)	(-2.94)	(-2.60)
FVHDL	+	1.510	1.033	0.009	-0.056
		(1.11)	(0.69)	(0.07)	(-0.40)
FVNHDA	-	-0.969	**-1.954****	-0.253*	**-0.433*****
		(-0.87)	(-2.24)	(-1.83)	(-3.56)
FVNHDL	+	0.244	1.085	0.064	**0.239****
		(0.23)	(1.26)	(0.51)	(2.52)
*FVHDA*CV*	-		-0.722		-0.195
			(-0.35)		(-0.83)
*FVHDL*CV*	+		1.694		0.269
			(0.67)		(0.87)
*FVNHDA*CV*	-		1.986		0.335*
			(1.07)		(1.76)
*FVNHDL*CV*	+		-1.496		-0.321**
			(-1.14)		(-2.24)
CV	-	-0.022**	-0.025*	-0.003**	-0.003
		(-2.36)	(-1.94)	(-1.99)	(-1.64)
Constant	-/+	0.171***	0.173***	0.007	0.008
		(3.77)	(3.76)	(0.99)	(1.05)
Observations		1,672	1,672	1,704	1,704
Adjusted R-squared		0.116	0.116	0.602	0.603

Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES

Note: This table presents results for robustness tests using **alternative tax avoidance measures**. Panel A reports results for testing H1 and Panel B reports for testing H2 and H3. Column (1) and (3) present the average effect without tax convexity interactions whereas Column (2) and (4) present the results with the tax convexity interactions. *Curr* is defined as current effective tax rates in year t*; CashTax/laggedAT* is defined as cash tax paid in year t divided by total assets in year t-1. Both *Curr* and *CashTax/laggedAT* greater (less) than 1 (0) are treated as a missing value. *FVDA (FVDL)* is the fair value of total derivative assets (liabilities). *FVHDA (FVHDL)* is the fair value of derivative assets (liabilities) designated as hedging instruments. *FVNHDA (FVNHDL)* is the fair value of derivative assets (liabilities) that are not designated as hedging instruments. *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. *FVDA*CV* (*FVDL*CV*) is an interaction of *FVDA* (*FVDL*) and *CV*. *FVHDA*CV* (*FVHDL*CV*) is an interaction of *FVHDA* (*FVHDL*) and *CV*. *FVNHDA*CV* (*FVNHDL*CV*) is an interaction of *FVNHDA* (*FVNHDL*) and *CV*. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

Table 8. The Tax Effect of Derivative Liabilities

VARIABLES	Predicted Sign	(1) *Cash1*	(2) *Cash1*	(3) *Curr1*	(4) *Curr1*
FVHDL	-	-1.182	-1.325	0.517	-0.029
		(-1.15)	(-1.08)	(0.46)	(-0.02)
FVNHDL	-	-0.809*	**-1.107*** **	-0.756	**-0.795** **
		(-1.72)	(-2.93)	(-1.63)	(-2.15)
*FVHDL*CV*	-		0.721		2.542
			(0.33)		(1.12)
*FVNHDL*CV*	-		0.770		-0.029
			(0.97)		(-0.04)
CV	-	-0.017*	-0.021**	-0.007	-0.012
		(-1.75)	(-1.98)	(-0.69)	(-1.24)
Sale_vol	-/+	0.074**	0.071**	0.065**	0.065**
		(2.18)	(2.10)	(2.09)	(2.10)
CFO_vol	-	-0.178	-0.165	-0.124	-0.119
		(-1.28)	(-1.20)	(-1.04)	(-1.00)
ROA_vol	-	-0.113*	-0.114*	-0.126*	-0.126*
		(-1.67)	(-1.67)	(-1.88)	(-1.87)
logAT	-/+	0.010**	0.010**	0.007*	0.007*
		(2.48)	(2.50)	(1.81)	(1.72)
BM	-/+	0.062**	0.063**	0.038	0.039
		(2.46)	(2.50)	(1.35)	(1.39)
ROA	+	0.273***	0.272***	0.220***	0.218***
		(5.00)	(4.96)	(3.70)	(3.65)
LEV	-	-0.039	-0.037	-0.051	-0.050
		(-1.06)	(-1.02)	(-1.44)	(-1.41)
Foreign	-	-0.146	-0.148	-0.090	-0.088
		(-1.25)	(-1.28)	(-0.72)	(-0.70)
NOL	-	-0.144***	-0.143***	-0.136***	-0.133***
		(-3.14)	(-3.10)	(-3.32)	(-3.22)
RD	-	-0.706***	-0.706***	-0.387**	-0.385**
		(-4.86)	(-4.85)	(-2.48)	(-2.46)
SG&A	+	0.127***	0.126***	0.117***	0.115***
		(4.34)	(4.34)	(3.68)	(3.64)
Constant	-/+	0.137***	0.137***	0.147***	0.151***
		(3.11)	(3.08)	(3.26)	(3.26)
Observations		1,666	1,666	1,647	1,647
Adjusted R-squared		0.166	0.165	0.106	0.106
Year FE		YES	YES	YES	YES
Industry FE		YES	YES	YES	YES

Note: This table presents results for **the effect of hedging** and **non-hedging derivative liabilities** on **next year's cash ETR**. Column (1) and (3) present the average effect without tax convexity interactions whereas Column (2) and (4) present the results with the tax convexity interactions. *Cash1* (*Curr1*) is defined as cash (current) effective tax rates in year t+1. *FVHDL (FVNHDL)* is the fair value of derivative liabilities that are (not) designated as hedging instruments. *CV* is a dummy variable equals 1 for firms with convex tax functions and reductions in taxable income volatility. *FVHDL*CV* (*FVNHDL*CV*) is an interaction of *FVHDL* (*FVNHDL*) and *CV*. Robust standard errors are clustered by firm (Peterson, 2009). t-statistics are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10 % levels, respectively.

CHAPTER 8

Conclusion

In this study, I provide evidence that firms use both hedging and non-hedging derivatives to avoid taxes. My results suggest that derivative-based tax avoidance stems largely from fair value gains on derivatives and, to a lesser extent, fair value losses. These results are consistent with the notion that firms utilize the tax-favored treatment (i.e. taxation on the basis of a "wait-and-see" approach) of derivatives to avoid taxes. Furthermore, these results are consistent with the possibility that firms engage in complex and aggressive tax planning using non-hedging derivatives. While I find that *hedging* derivative *losses* are non-significantly associated with tax avoidance, I find that *non-hedging* derivative *losses* are, contrastingly, significantly associated with tax avoidance. This suggests that firms exploit the ambiguity of non-hedging derivative tax treatment to aggressively avoid taxes, rather than benignly deferring taxation. In addition, I find no association between derivative use and GAAP ETR. This result suggests that firms do not likely use derivatives to manage earnings through the tax expense. These results are robust to the addition of numerous known determinants of tax avoidance.

At a broad level, this study is the first to empirically explore the specific mechanisms through which corporations use derivatives to avoid taxes. To my knowledge, this study is the first to associate particular uses of derivatives (hedging and non-hedging) and effective tax rates. Furthermore, to my knowledge, this study is the first to document opposing signs on the relationships between derivative gains and tax avoidance (negative) and derivative losses and tax avoidance (positive). I am able to do so due to a novel, hand-collected data set which distinguishes between derivative fair

value gains and losses as well as the different derivative uses (hedging v. non-hedging). Fair values better represent the underlying economics of derivative-based tax avoidance than other measures. Consequently, I am able to provide more detailed estimates of the economic magnitudes of the effects of various derivative measures on tax savings.

This paper and its results should be of interest to policymakers, academics and the public-at-large. Recently, policymakers and regulators have publicly criticized firms that use derivatives and firms that engage in aggressive tax avoidance. My results suggest that derivatives are used to avoid taxes in two ways. First, my results are consistent with the notion that firms use the tax-favored status of derivatives to *benignly* avoid taxes. Second, my results are consistent with firms using non-hedging derivatives to *aggressively* avoid taxes. Thus, if policymakers or regulators are interested in scrutinizing derivative-based tax avoidance, they would be well-served to focus on non-hedging derivatives. Consequently, my results might provide useful evidence for policymakers interested in stemming aggressive corporate tax planning. Furthermore, several policymakers have suggested that derivatives should be taxed on a mark-to-market basis. Currently, derivatives are taxed when the derivative positions are closed. This paper provides a rough estimate of the revenue that tax authorities can expect to collect from the average firm, should they opt to tax derivatives on a fair value basis.

In a similar vein, academics may find my results relevant. Several academics have called for research on derivative-based tax avoidance. I answer this call by providing detailed evidence on how firms avoid taxes through derivative use. While prior research has suggested that firms, broadly, use derivatives to avoid taxes, I provide detailed evidence that firms use hedging and non-hedging derivative assets and liabilities to avoid taxes in

different ways. Finally, the public has increasingly scrutinized the tax avoidance strategies of corporations. My results explain one particular conduit through which corporations reduce taxes. Consequently, concerned citizens may find this research pertinent.

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Appendix A: Representative Examples of SFAS 161 Derivative Disclosures

ROYAL CARIBBEAN CRUISES LTD

Total Derivatives: As of 2013, derivative assets are $188,576 (*FVDA*) and derivative liabilities are $100,260 (*FVDL*)

Hedging Derivatives: As of 2013, hedging derivative assets are $173.229 (*FVHDA*)and hedging derivative liabilities are $77.629, (*FVHDL*)

Non-Hedging Derivatives: As of 2013, non-hedging derivative assets are $15.347 (*FVNHDA*) and non-hedging derivative liabilities are $22,631(*FVNHDL*)

	Balance Sheet Location	As of December 31, 2014	As of December 31, 2013	Balance Sheet Location	As of December 31, 2014	As of December 31, 2013
		Fair Value	Fair Value		Fair Value	Fair Value
(In thousands)						
Derivatives designated as hedging instruments						
Interest rate swaps	Other assets	$ —	$ 56,571	Other long-term liabilities	$ 65,768	$ 66,920
Foreign currency forward contracts	Derivative financial instruments	—	61,596	Derivative financial instruments	17,619	—
Foreign currency forward contracts	Other assets	63,981	13,783	Other long-term liabilities	164,627	—
Foreign currency collar options	Other assets	—	22,172	Other long-term liabilities	—	—
Foreign currency collar options	Derivative financial instruments	—	—	Derivative financial instruments	21,855	—
Fuel swaps	Derivative financial instruments	—	10,902	Derivative financial instruments	227,512	1,657
Fuel swaps	Other assets	—	8,205	Other long-term liabilities	270,254	9,052
Total derivatives designated as hedging instruments		63,981	173,229		767,635	77,629
Derivatives not designated as hedging instruments						
Foreign currency forward contracts	Derivative Financial Instruments	—	15,347	Derivative financial instruments	—	22,631
ɔtal derivatives not designated as hedging instruments under ASC 815-20		—	15,347		—	22,631
Total derivatives		$ 63,981	$ 188,576		$ 767,635	$ 100,260

The effect of derivative instruments qualifying and designated as hedging instruments and the related hedged items in fair value hedges on the consolidated statements of comprehensive income (loss) was as follows:

Derivatives and related Hedged Items under ASC 815-20 Fair Value Hedging Relationships	Location of Gain (Loss) Recognized in Income on Derivative and Hedged Item	Amount of Gain (Loss) Recognized in Income on Derivative		Amount of (Loss) Gain Recognized in Income on Hedged Item	
		Year Ended December 31, 2014	Year Ended December 31, 2013	Year Ended December 31, 2014	Year Ended December 31, 2013
(In thousands)					

	Interest rate swaps	Interest expense, net of interest capitalized	$ 12,217	$ 9,354	$ 17,403	$ 37,745
	Interest rate swaps	Other income (expense)	42,530	(71,630)	(34,304)	68,743
			$ 54,747	$ (62,276)	$ (16,901)	$ 106,488

The effect of derivative instruments qualifying and designated as cash flow hedging instruments on the consolidated financial statements was as follows:

Derivatives under ASC 815-20 Cash Flow Hedging Relationships	Amount of (Loss) Gain Recognized in OCI on Derivative (Effective Portion)		Location of (Loss) Gain Reclassified from Accumulated OCI into Income (Effective Portion)	Amount of (Loss) Gain Reclassified from Accumulated OCI into Income (Effective Portion)		Location of (Loss) Gain Recognized in Income on Derivative (Ineffective Portion and Amount Excluded from Effectiveness Testing)	Amount of (Loss) Gain Recognized in Income on Derivative (Ineffective Portion and Amount Excluded from Effectiveness testing)	
	Year Ended December 31, 2014	Year Ended December 31, 2013		Year Ended December 31, 2014	Year Ended December 31, 2013		Year Ended December 31, 2014	Year Ended December 31, 2013
(In thousands)								
Cross currency swaps	$ —	$ —	Interest Expense	$ (261)	$ (3,531)	Other income (expense)	$ —	$ —
Interest rate swaps	(97,851)	111,223	Other income (expense)	—	—	Other income (expense)	(99)	431
Foreign currency forward contracts	(246,627)	68,364	Depreciation and amortization expenses	(1,887)	(1,797)	Other income (expense)	(34)	9
Foreign currency forward contracts	—	—	Other income (expense)	(4,291)	27,423	Other income (expense)	—	—
Foreign currency forward contracts	—	—	Interest expense	(57)	(440)	Other income (expense)	—	—
Foreign currency collar options	(44,028)	13,199	Depreciation and amortization expenses	—	—	Other income (expense)	—	—
Fuel swaps	(515,324)	4,642	Fuel	(27,984)	47,944	Other income (expense)	(14,936)	(3,413)
	$ (903,830)	$ 197,428		$ (34,480)	$ 69,599		$ (15,069)	$ (2,973)

The effect of derivatives not designated as hedging instruments on the consolidated financial statements was as follows:

Derivatives Not Designated as Hedging Instruments under ASC 815-20	Location of Gain (Loss) Recognized in Income on Derivative	Amount of Gain (Loss) Recognized in Income on Derivative	
		Year Ended December 31, 2014	Year Ended December 31, 2013
(In thousands)			
Foreign currency forward contracts	Other income (expense)	$ (48,791)	$ (21,244)
Fuel swaps	Other income (expense)	(1,795)	243
Fuel call options	Other income (expense)	—	(23)
		$ (50,586)	$ (21,024)

Appendix B. The Accounting Treatment of Hedging and Non-Hedging Derivatives

Nature of hedge designation	**Changes in fair value of derivative instruments**	**Example**
Fair value hedge	An unrealized/realized gain or loss is recorded in current period income along with the change in fair value of the hedged assets and liabilities.	Options, forwards, futures, and swap contracts that hedge recognized assets and liabilities or firms commitment (e.g., receivables/payables, debt obligations/securities, or commodities)
Cash flow hedge	An unrealized gain or loss is first recorded in other comprehensive income (OCI) and reclassified into income when the hedged transaction affects income	Options, forwards, futures, and swap contracts that hedge forecasted transactions (e.g., purchase of inventory, sales of goods)
Net investment hedge	An unrealized gain or loss is reported in other comprehensive income (OCI) as part of the cumulative translation adjustment until sale or complete liquidation of the net investment in the foreign entity takes place.	A hedge of a net investment in a foreign operation
Non-hedging derivatives	An unrealized/realized gain or loss is immediately recorded in current period income	Any derivatives that take the same position as the underlying items or are betting along with the price movement of the underlying items.

Appendix C. The Summary of the Tax Treatment of Hedging and Non-Hedging Derivatives

Category		Description	Tax code	Timing	Character
Hedging Derivatives		Transactions that are intended to reduce the entity's business risk exposure	Section 1221	Matched with the timing of recognition of gains or losses on underlying hedged items	Generally ordinary in nature
Non-Hedging Derivatives	Option	Exchange-traded and over-the-counter options on debt, equity, commodities and other indices	Section 1234	Wait-and-see (deferred) until exercise, sale, expiration, or lapse	Same as underlying
	Forward	Privately negotiated contracts to buy or sell underlying for a predetermined price on a specified date being either cash settled or physically delivered	Section 1234	Wait-and-see (deferred) until settlement	Same as underlying
	Futures	Exchange-traded futures that provide for the sale of underlying (most likely securities)	Section 1234	Wait-and-see (deferred) until settlement or termination	Same as underlying
	Section 1256	Regulated futures, exchange-traded non-equity options, and some over-the-counter foreign currency contracts	Section 1256	Marked-to-market at the end of year	Capital
	Notional Principal Contracts (swaps)	Contracts that require one party to make two or more payments to the counterparty at specified intervals calculated based on a specified index with notional principal amount in exchange for specified consideration to pay similar amounts	Section 446	Recognized a gain or losses as being received for periodic and termination payment; special rules for non-periodic payments (amortized and recognized over the term of the contract)	Generally ordinary, but same as underlying for termination payment

Appendix D: Definition of Variables

Variables	Definition
Derivative measures	
FVDA	Fair value of derivative assets as the fair value of all derivative assets scaled by lagged total assets (at)
FVDL	Fair value of derivative liabilities as the absolute fair value of all derivative liabilities scaled by lagged total assets (at)
FVHDA	Fair value of hedging derivative assets as the fair value of derivative assets that are designated as hedging instruments scaled by lagged total assets (at)
FVHDL	Fair value of hedging derivative liabilities as the absolute fair value of derivative liabilities that are designated as hedging instruments scaled by lagged total assets (at)
FVNHDA	Fair value of non-hedging derivative assets as the fair value of derivative assets that are not designated as hedging instruments scaled by lagged total assets (at)
FVNHDL	Fair value of non-hedging derivative liabilities as the absolute fair value of derivative liabilities that are not designated as hedging instruments scaled by lagged total assets (at)
CV	An indicator variable equal to 1 if a firm faces a convex function and a reduction in taxable income volatility; otherwise zero. Following Donohoe (2015), a firm faces a convex tax function if the firm-year marginal tax rate (before interest expense) is less than the statutory tax rate (i.e., 35%). A firm experiences a reduction in taxable income volatility if the standard deviation of taxable income over the last five years including the current year (t-4, t) is less than that of taxable income over the last five years excluding the current year (t-5, t-1).
Interaction terms	I interact all seven derivative measures with *CV* to capture the incremental tax effect of fair value of derivatives for each hypothesis test
Tax avoidance measures[*]	
Cash	Cash effective tax rate, defined as worldwide cash taxes paid (txpd) in year t divided by worldwide pre-tax income (pi) less special items (spi) in year *t*
Cash1	Cash effective tax rate in year t+1 as worldwide cash taxes paid (txpd) in year t+1 divided by worldwide pre-tax income (pi) less special items (spi) in year *t+1*
Cash3	Three-year forward-looking long-run cash effective tax rate as the sum of worldwide cash taxes paid (txpd) over three years (*t* to *t+2*) divided by the sum of pre-tax income (pi) less special items (spi) over three years (*t* to *t+2*)

[*] Observations with negative pretax book income before special items (i.e., denominator of ETRs) are dropped in the analyses. Also, I treat ETRs as a missing value if ETRs are greater (less) than 1 (0)

CashTax/laggedAT	Cash Tax paid (txpd) in year t scaled by lagged total assets (at)
Curr	Current effective tax rate as worldwide current tax expense (txt-txdi) in year t divided by worldwide pre-tax income (pi) less special items (spi) in year t
Curr1	Current effective tax rate in year t+1 as worldwide current tax expense (txt-txdi) in year t+1 divided by worldwide pre-tax income (pi) less special items (spi) in year t+1
GAAP	GAAP effective tax rate as worldwide total tax expenses (txt) in year t divided by worldwide pre-tax income less special items (spi) in year *t*
GAAP3	Three-year forward-looking long-run GAAP effective tax rate as the sum of worldwide total tax expense (txt) over three years (*t* to *t+2*) divided by the sum of worldwide pre-tax income (pi) less special items (spi) over three years (*t* to *t+2*)
Control variables	
Altman Z	Altman's (1968) Z-Score computed as {3.3*PI + SALE +1.4*RE + (ACT – LCT)}/lagAT, where PI is pre-tax income, SALE is sales, RE is retained earnings, ACT is current assets, LCT is current liabilities, and lagAT is lagged total assets (at).
BM	Growth as book value of equity (ceq) divided by the market value of equity (prcc_f*csho)
CFO_vol	The standard deviation of cash flow from operation (oancf) deflated by lagged total assets over the last five years including the current year (t-4, t)
Foreign	Foreign income as pre-tax foreign income (pifo) divided by lagged total assets (at)
LEV	Leverage as long-term debt (dltt) divided by lagged total assets (at)
logAT	Firm size as the natural logarithm of total assets (at)
NOL	Net operating loss as tax-loss carryforward (tlcf) divided by lagged total assets (at)
RD	Research and development expense (xrd) in year t scaled by lagged total assets (at). I set missing values to zero
ROA	Return on assets as pre-tax income (pi) divided by lagged total assets (at)
ROA_vol	The standard deviation of income before extraordinary items (ib) deflated by lagged total assets over the last five years including the current year (t-4, t)
Sale_vol	The standard deviation of sales (sale) deflated by lagged total assets over the last five years including the current year (t-4, t)
SG&A	Selling, general, and administrative expense in year t (xsga) scaled by lagged total assets. I set missing values to zero
Wshelter	Tax shelter prediction score (Wilson, 2009) is calculated as follows: Wshelter = -4.86 + 5.20*BTD + 4.08*DAP – 1.41*Lev +0.76*Size +3.51*ROA +1.72*Foreign +2.43*R&D, where BTD is book-tax difference as pretax book

	income (pi) less taxable income ((txt-txdi)+Δnol) scaled by lagged total assets (at), DAP is discretionary accruals from performance-adjusted modified Jones Model (Kothari et al., 2005), Lev is long-term debt (dltt) scaled by average total assets (at), Size is the natural logarithm of total assets (at), ROA is pre-tax income (pi) scaled by average total assets (at), Foreign is pre-tax foreign income (pifo) scaled by lagged total asset (at), and R&D is research and development expense (xrd) scaled by lagged total assets (at).