**School of Accounting**

# Three Essays in Investment Efficiency, Accounting Reporting Complexity, and Cybersecurity Breaches: Evidence from Corporate Tax Avoidance

**Mohammed Asiri**
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**This thesis is presented for the Degree of**
**Doctor of Philosophy**
**of**
**Curtin University**

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# Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for award of any other degree or diploma in any university.

**Signature**: Mohammed Asiri

**Date**: 18th January 2021

# Abstract

Corporate tax avoidance has emerged a significant challenge in globalization across many economies (Jenkins, 2005). This issue is increasing rapidly with the expansion of multinational entities (MNEs) in both emerging and less developed economies as MNEs artificially engage in income tax shifting to low tax jurisdictions (Solheim, 2016). The Tax Justice Network (2011) estimates that approximately 5.1% of global gross domestic product is lost through corporate tax avoidance[1].

This thesis comprises three essays that examine the association between corporate tax avoidance and investment efficiency, accounting reporting complexity (ARC) and cybersecurity breaches (CSBs).

Chapter 1 documents the purpose and objectives of this research, and provides an overview of each of the main sections of the thesis. Chapter 2, which represents the first essay, examines the association between investment efficiency and corporate tax avoidance. By using a large sample of U.S. firms over the period 1993-2016, the results of this study indicate that there is a positive association between corporate tax avoidance and investment inefficiency. Moreover, it is also found that the association is mediated by financial statement readability, financial statement comparability and product market competition. The results are robust to alternative measures of both tax avoidance and investment inefficiency. Propensity score matching (PSM), difference-in-difference (DID), and two-stage least squares (2SLS) regression analyses confirm the main results and mitigate any potential endogeneity issues that might result from the effect of omitted variables, reverse causality or model misspecification.

The second essay is presented in Chapter 3. That essay explores the relationship between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). Utilizing a large sample of U.S. firms from 2011 to 2019, it is found that ARC is associated positively with firms' reporting of UTBs. Additionally, the use of industry-specialist auditors magnifies the positive association between ARC and UTBs. The results are robust to different components of UTBs, as well as to alternative measures of UTBs, ARC, and industry-specialist auditors. Propensity score matching (PSM) and difference-in-difference (DID) analyses confirm the positive impact of ARC on UTBs and mitigate any potential endogeneity issues.

Chapter 4 reports the third essay of this thesis that investigates the relationship between the occurrence of cyber-security breaches and corporate tax avoidance. Using a large sample of U.S. firms from 2005 to 2018, it is found that there is a positive and significant association between the occurrence of cybersecurity breaches and corporate tax avoidance in

[1] https://www.taxjustice.net/wp-content/uploads/2014/04/Cost-of-Tax-Abuse-TJN-2011.pdf

both the full sample and the propensity score matched sample. The results are robust to models that use alternative measures of tax avoidance and CSBs. In addition, firms with board-level IT governance are found to be less likely to engage in corporate tax avoidance. Further, this results is robust based on the timing of CSBs, the Heckman test and in models that employ additional control variables.

Finally, Chapter 5 provides the conclusions and describes suggestions for future research.

# Acknowledgements

[And when your Lord proclaimed: “If you give thanks, I will grant you increase”]. Alhamdulillah, I praise and thank Allah for His greatness and for giving me the strength in completing this thesis.

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As to my sweet little girls, Aseel and Thekra, my extreme love and longing for them are beyond words and softest point of my heart. Without your smiles and happiness, life just does not seem alright and I doubt that I would be in this place today.

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# Dedication

To my wonderful parents,

To my brothers and sisters,

And

To my sweet daughters (**Aseel**) and (**Thekra**) “your love is my strength”

# Publications Arising from This Research

## Referred Journal Articles

Asiri, M., Al-Hadi, A., Taylor, G., & Duong, L. (2020). Is corporate tax avoidance associated with investment efficiency?. The North American Journal of Economics and Finance, Vol.52, Article number 101143. https://doi.org/10.1016/j.najef.2020.101143

https://www.sciencedirect.com/science/article/abs/pii/S1062940819300312

Note: Permssion granted from all the co-authors to include the above publication in this thesis and I would like to thank them for their valuable contribution.

## Referred Conference Articles

Asiri, M., Al-Hadi, A., Taylor, G., & Duong, L. (2019). "Is Corporate Tax Avoidance Associated with Investment Efficiency?" In proceedings of Accounting and Finance Association of Australia and New Zealand (AFAANZ) annual conference, Jul 7, 2019, Brisbane.

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# List of Abbreviations

| | |
|---|---|
| **2SLS** | Two-Stage Least Square |
| **AFAANZ** | Accounting and Finance Association in Australia and New Zealand |
| **AICPA** | American Institute of Certified Public Accountants |
| **ARC** | Accounting Reporting Complexity |
| **CBSs** | Cybersecurity Breaches |
| **FASB** | Financial Accounting Standards Board |
| **FIN 48** | Financial Interpretation No. 48 |
| **GAAP** | Generally Accepted Accounting Principles |
| **IAS** | International Accounting Standard |
| **MNEs** | Multinational Entities |
| **OECD** | The Organisation for Economic Co-operation and Development |
| **OLS** | Ordinary Least Squares |
| **PCAOB** | Public Company Accounting Oversight |
| **PSM** | Propensity Score Matching |
| **SEC** | Securities and Exchange Commission |
| **SIC** | Standard Industrial Classification |
| **U.S.** | The United States of America |
| **US** | United States of America |
| **UTB** | Unrecognized Tax Benefit |
| **XBRL** | eXtensible Business Reporting Language |

# Chapter 1 Introduction

This thesis examines the association between corporate tax avoidance and investment efficiency, accounting reporting complexity (ARC) and the occurrence of cybersecurity breaches (CSB), respectively. Each area of examination constitutes an essay.

## 1.1 Background and Motivation

Over the past decade, corporate tax avoidance research have seen rapid advances across the field of finance, accounting, law and economics (Gentry, 2007; Hanlon & Heitzman, 2010; Slemrod & Yitzhaki, 2002). However, the definition of corporate tax avoidance captures both legal and illegal attributes. It is important to distinguish between illegal tax evasion and legally permissible tax avoidance. Tax evasion captures illegal transactions that reduce tax liabilities intentionally while tax avoidance refers to the legal usage of a tax regime to decrease the amount of tax payable under the law (Payne & Raiborn, 2018; Sikka & Hampton, 2005). This thesis relies on the definition of corporate tax avoidance that is used by Hanlon and Heitzman (2010) which incorporates all transactions and arrangements that could result in a reduction in the amount of a firm's corporate tax expense (e.g. Dyreng, Hanlon, & Maydew, 2008; Lisowsky, Robinson, & Schmidt, 2013). Consistent with Hanlon and Heitzman (2010), this study views corporate tax avoidance conceptually as falling along a continuum ranging from 'passive' (i.e. complying with tax provisions) to 'aggressive' (i.e. structuring transactions or activities with the principle aim of decreasing the amount of corporate tax payable). Tax avoidance may alternatively be achieved by illegal means or means that are not in compliance with tax legislation or regulations. This type of non-compliance constitutes tax evasion.

According to the Organisation for Economic Co-operation and Development (OECD), it is estimated that about US$240 billion per annum is lost as a result of firms' engagement in tax avoidance practices[2]. The global financial effort in addressing corporate tax avoidance amounts to approximately US$53 billion from 24 countries over the last few years[3]. A report by Christian Aid provides evidence that about US$160 billion is lost to developing economies as a result of tax avoidance activities engaged by MNEs[4]. Thurm and Linebaugh (2013) report that the 60 largest firms in the U.S. deprived the economy of an estimated US$166 billion through offshore transfers and this resulted in shielding approximately 40% from U.S. taxes.

[2] https://www.oecd.org/ctp/oecd-presents-outputs-of-oecd-g20-beps-project-for-discussion-at-g20-finance-ministers-meeting.htm

[3] https://www.theguardian.com/business/2013/jul/14/us-tax-avoidance-google-amazon
https://www.freepressjournal.in/business/g20-set-for-very-aggressive-crackdown-on-tax-avoidance

[4] https://www.smh.com.au/business/global-tax-avoidance--a-trillion-dollar-evil-20140221-337u1.html

For example, by shifting its intellectual property to Puerto Rico, Microsoft took away US$4.5 billion in tax revenue. In 2011, Google shifted almost 80% of its global pre-tax profits to Bermuda, which is well-recognised as one of the tax heaven countries. The US is the largest economy in the world to be deprived of tax revenue compared to any other economy as it has many large MNEs. The tendency of MNEs to shift income to low tax jurisdictions has increased steadily over the last three decades. Therefore, the literature has called for more tax research as a way of thinking broadly and incorporating more theoretical and conceptual evidence from the finance and economic disciplines (Gentry, 2007; Hanlon & Heitzman, 2010; Maydew, 2001; Slemrod, 2004; Slemrod & Yitzhaki, 2002).

Research conducted by various researchers (Chen & Chu, 2005; Crocker & Slemrod, 2005; Desai & Dharmapala, 2006) outlines that it is important to take into account agency theory when considering corporate tax avoidance due to the principal-agent relationship between management and shareholders is significant in terms of corporate governance. A complex and obscure information environment is typical of firms engaging in aggressive tax avoidance. The nature of the information environment may directly impact firm management decisions (Desai & Dharmapala, 2006). Increasing financial information disclosure can solve information asymmetry that is related to tax avoidance. Prior literature illustrates that firms can decrease information asymmetry by enhancing the quality of financial reporting (Bushman & Smith, 2001; Healy & Palepu, 2001; Hope & Thomas, 2008).

Although there is some empirical evidence within the investment literature suggesting that investment decisions are influenced by accounting quality (Biddle, Hilary, & Verdi, 2009), many of these studies did not take into account for tax considerations. This has been noted by Hanlon and Heitzman (2010) to be an important issue in understanding the influence of tax on investment decisions. Firm value is largely affected by managers' decisions, and decisions relating to investment represent some of the most important decisions for a firm in terms of dollar amount of capital outlay, and in determining the ability of the firm to achieve its strategic and business objectives (Hubbard, 1998). Shareholders therefore require firm managers to invest prudently so that the firm will be able to increase its value and shareholder welfare maximization. Further, tax avoidance by firms may affect their ability to achieve investment targets through an increase in tax savings (Armstrong, Blouin, & Larcker, 2012; Graham, Hanlon, Shevlin, & Shroff, 2014; Leone 2008) and also in influencing the level of governance and control in place (Dyreng et al., 2008; Hanlon & Heitzman, 2010). Therefore, the main objective of **Chapter 2** to examine the association between corporate tax avoidance activities and investment efficiency.

Regulators and standard setters observe that financial reporting has grown more complex (FRC 2009; SEC 2008). The adoption of the eXtensible Business Reporting

Language (XBRL) for financial reporting, which became mandatory for U.S. public firms, has increased the volume of information via an extended tagging procedure. Complexity is manifested through an increase in the number of XBRL tags. Hoitash and Hoitash (2018) introduce a new measure of accounting reporting complexity (ARC) using the natural log of the total number of discrete monetary XBRL tags in Item 8 of the 10-K filings. Management may utilise XBRL tags to make accounting disclosures more complex in order to facilitate or preserve agency related activities designed to increase their welfare (Hoitash & Hoitash, 2018). Firms that generate financial reports characterized by high ARC have a less comparable information content (Lehavy, Li, & Merkley, 2011; Li, 2008; Peterson, 2012; You & Zhang, 2009), increase financial misstatement risk (Filzen & Peterson, 2015; Hoitash & Hoitash, 2018), and obfuscate financial reports (Li, 2008; Lo, Ramos, & Rogo, 2017). Obfuscate financial reports may be generated through incorrect use of extended tags instead of taxonomy tags (Debreceny et al., 2011; Guragai, Hunt, Neri, & Taylor, 2017). Li (2008) shows that firms characterized by comparatively less readable reports have lower and less consistent earnings. You and Zhang (2009) find that companies with longer 10-K filings experience more delays in market reaction to credible information contained in those reports. Tax avoidance transactions are able to make provision for opportunistic managerial behaviour (Desai & Dharmapala, 2006) and lower corporate transparency (Balakrishnan, Blouin, & Guay, 2019). De Simone, Robinson, and Stomberg (2014) gives an illustration of how the complexity of tax accounts for a firm's disclosures relating to unrecognized tax benefits (UTB). Consequently, **Chapter 3** of this thesis investigates the relationship between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs), a measure of corporate tax avoidance.

Cybersecurity breaches (CSBs) represent one of the greatest challenges in today's digital era. Cybersecurity breaches result in a negative market reaction (Campbell, Gordon, Loeb, & Zhou, 2003; Cavusoglu, Mishra, & Raghunathan, 2004; Garg, Curtis, & Halper, 2003; Goel & Shawky, 2009; Telang & Wattal, 2007), increased business risk (Gwebu, Wang, & Xie, 2014), higher audit fees (Li, No, & Boritz, 2020; Smith, Higgs, & Pinsker, 2019), result in higher litigation risk (Romanosky, Hoffman, & Acquisti, 2014) and operational control risk (Lawrence, Minutti-Meza, & Vyas, 2018). The non-disclosure of cybersecurity breaches exacerbates agency costs and information asymmetry which can facilitate an environment in which tax planning can flourish (Desai & Dharmapala, 2006; Kim, Li, & Zhang, 2011). The objective of **Chapter 4** in this thesis is to examine the relationship between the occurrence of cybersecurity breaches and corporate tax avoidance.

## 1.2 Summary of Key Findings

Chapter 2 provides the results of models that examined the association between investment efficiency and corporate tax avoidance. A large sample of U.S. firms from 1993-2016 is used. The results indicate that there is a positive association between corporate tax avoidance activities and investment inefficiency. Moreover, the study finds that this association is mediated by financial statement readability, financial statement comparability and product market competition. This results are robust to alternative measures of both tax avoidance and investment inefficiency. Propensity Score Matching (PSM), Difference-in-Differenc (DID) analyses, and Instrumental variables (2SLS) regression analysis confirm the results and mitigate any potential endogeneity issues that might result from the effect of omitted variables, reverse causality or model misspecification.

Chapter 3 investigates the relationship between accounting reporting complexity (thereafter ARC) and unrecognized tax benefits (UTBs). Using a large sample of U.S. firms from 2011 to 2019, the study findings that accounting reporting complexity is positively associated with firms' reporting of unrecognized tax benefits. Additionally, the use of industry-specialist auditors magnifies the positive association between accounting reporting complexity and unrecognized tax benefits. The results are robust to different components of UTBs, alternative measures of UTBs, of accounting reporting complexity, and of industry-specialist auditors. Propensity score matching (PSM) and difference-in-difference (DID) analyses confirm the positive impact of accounting reporting complexity on unrecognized tax benefits, and mitigate any potential endogeneity issues.

Chapter 4 presents the relationship between the occurrence of cybersecurity breaches (CSBs) and corporate tax avoidance. Using a large sample of U.S. firms from 2005 to 2018, the study finds a positive and significant association between the occurrence of cybersecurity breaches and corporate tax avoidance in both the full sample and the propensity score matched sample. The results are robust by using alternative measures of tax avoidance and CSBs. Further, the study find that firms with board-level IT governance are less likely to engage in corporate tax avoidance. Finally, the results are robust based on the timing of cybersecurity breaches, the Heckman test and in models that employ additional control variables. Table 1-1 summarizes the key findings in this thesis.

**Table 1-1 Summary of Key Findings**

| Chapter | Essay | Hypothesis | Findings |
|---|---|---|---|
| 2 | ONE | i. There is a positive relationship between corporate tax avoidance and investment inefficiency.<br><br>ii.Financial statement obscurity mediates the association of corporate tax avoidance and investment inefficiency.<br><br>iii.Financial statement comparability mediates the association of corporate tax avoidance and investment inefficiency.<br><br>iv.Product market competition mediates the association of corporate tax avoidance and investment inefficiency. | -There is a positive association between corporate tax avoidance activities and investment inefficiency.<br><br>-This association is mediated by financial statement readability, financial statement comparability and product market competition. |
| 3 | TWO | v.There is a positive association between ARC and UTBs.<br><br>vi.Industry-specialist auditor moderates the positive association of ARC and UTBs. | - This study finds that ARC is positively associated with firms' reporting of UTBs.<br><br>- The use of industry-specialist auditors magnifies the positive association between ARC and UTBs. |
| 4 | THREE | vii.There is a positive relationship between CSBs and corporate tax avoidance. | -This study finds a positive and significant association between the occurrence of cybersecurity breaches and corporate tax avoidance in both the full sample and the propensity score matched sample.<br><br>- Cross-sectional tests further show that the positive relationship between CSBs and tax avoidance is only prevalent in firms with poor board-level IT governance. |

## 1.3 Contributions of this thesis

This thesis provides a valuable contributions to the literature in several ways. Chapter 2 findings are important for several reasons. Firstly, this study adds to the literature of examining the consequences of corporate tax avoidance. Recent research indicates that, as external funding becomes difficult to access, cash tax savings through tax planning could be employed as an internal source of funding (Edwards, Schwab, & Shevlin, 2016). Therefore, this study provides evidence that firms that inefficiently use cash tax savings also engage in

tax avoidance activities. Second, this study contributes to the existing literature on investment efficiency. The findings of this study provides evidence on how efficiently firms use cash tax savings from tax avoidance activities to fund their investments. Previous studies examine the relationship between investment efficiency and financial reporting quality (Balakrishnan, Core, & Verdi, 2014; Biddle & Hilary, 2006; Biddle et al., 2009; Chen, Hope, Li, & Wang, 2011; Cheng, Dhaliwal, & Zhang, 2013), accounting conservatism (Lara, Osma, & Penalva, 2016), auditor characteristics (Bae, Choi, Dhaliwal, & Lamoreaux, 2017), or corporate social responsibility (Benlemlih & Bitar, 2018). Nevertheless, there is a lack of research that examines the association of corporate tax avoidance and investment efficiency. Green and Kerr (2016) find that firms use cash tax savings from tax avoidance activities on new investments. However, they do not provide evidence whether this internally-generated cash is used efficiently. Blaylock (2016) and Khurana, Moser, and Raman (2018) are among the first papers to examine tax avoidance and investment efficiency. This study differs from prior studies in this area in a number of ways. While this study shows there is a positive association between tax avoidance and investment inefficiency for both overinvestment and underinvestment, Blaylock (2016) does not find a significant relation and Khurana et al. (2018) only find a significant association for overinvestment. Moreover, the measure of investment efficiency that this study use is different from that used by Blaylock (2016) and Khurana et al. (2018) in that it relies on the regression residuals of Richardson (2006)'s method to define overinvestment and underinvestment. Khurana et al. (2018) also examine the influence of managerial ability and corporate governance on the relation between corporate tax avoidance and investment efficiency. On the other hand, this study investigates the mediation effect of product market competition, financial statement obscurity and financial statement comparability on this relationship. This study also contributes to the literature by providing evidence of the direct and indirect (mediating) effect of corporate tax avoidance on investment efficiency. Specifically, this study adds to the literature as to whether firms benefits from tax avoidance in the presence of product market competition, financial statement obscurity and financial statement comparability. The role of product market competition, of financial statement obscurity, and of financial statement comparability have in constraining agency related effects such as rent extraction, information asymmetry and opportunistic managerial activities may exacerbate the corporate tax avoidance-investment inefficiency relation.

Chapter 3 findings' contribute to literature in several ways. First, the study uses a new measure of accounting reporting complexity based on XBRL tags (Hoitash & Hoitash, 2018). I provide a methodological contribution based on this new measure of ARC. Accounting reporting complexity (ARC) captures increments in complexity based on the layout and narrative of accounting and financial reporting information. ARC measure differs from

previous studies that rely on linguistic complexity as a measure of complexity (Bozanic & Thevenot, 2015; Hoitash & Hoitash, 2018; Li, 2008; Loughran & McDonald, 2014). Importantly though linguistic complexity relies on the disclosed narrative of financial reports and is unable to distinguish between accounting and non-accounting information. Second, to the best of my knowledge, no prior study has examined the association between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). The findings observe that there is a positive relationship between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). This relationship is important for a several of reasons. Plumlee (2003) reports that the errors in the forecasts of analysts increase with more complex tax law changes. Peterson (2012) shows that there is an increased likelihood of revenue-related restatements as a consequence of revenue-recognition complexity increments. Managers can deliberately increase ARC through an increase in the number of inappropriately allocated XBRL tags to obfuscate their rent and to increase complexity of accounting reporting. Hanlon and Heitzman (2010) argue that unrecognized tax benefits (UTBs) measure tax risk and uncertainty as higher unrecognized tax benefits (UTBs) generate higher uncertainty in the tax positions of firms. If firms manipulate the way in which accounting information is reported via XBRL tags, this may exacerbate the uncertainty pertaining to UTB estimates. The reason for this is that following the introduction of Uncertain Tax Position (UTP) reporting requirements in 2010, there is greater nexus between tax reporting and financial reporting requirements in that firms' tax filings and tax footnotes require the use of both tax and financial information. Third, this study investigates whether industry-specialist auditor moderates the positive association between accounting reporting complexity and unrecognized tax benefits (UTBs). Prior researches find that audit specialization is associated to higher audit quality (Audousset-Coulier, Jeny, & Jiang, 2016; Dunn & Mayhew, 2004; Ho & Kang, 2013; Reichelt & Wang, 2010). An increased in accounting complexity can result in delay in the audit or could result in a poorer quality audit (see e.g. Bronson, Hogan, Johnson, & Ramesh, 2011; Ettredge, Li, & Sun, 2006). Increased audit risk could stem from higher financial complexity and hence auditors will need to put in more effort and/or charge a fee premium to compensate for the added risk (Bedard & Johnstone, 2004). Thus, it is likely given that industry-specialist auditors moderate the positive association between accounting reporting complexity and Uncertain Tax Position.

The results provided in Chapter 4 contribute to literature in several important ways. Prior research has identified that the occurrence of cybersecurity breaches (CSBs) have a negative market reaction (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009; Johnson, Kang, & Lawson, 2017; Telang & Wattal, 2007), result in increased risk (Gwebu et al., 2014; Romanosky et al., 2014), in higher audit fees (Li et al.,

2020; Smith et al., 2019), and an increase cash holdings (Boasiako & Keefe, 2020). This study shows for the first time that firms with CSBs are associated with increased levels of corporate tax avoidance. Second, a study by Gallemore and Labro (2015) indicates that firms with higher internal information quality are more likely to engage in tax avoidance. Managers have ability to access and possess internal information such as cybersecurity breaches. I extend the findings of Gallemore and Labro (2015) by providing evidence that increased CSBs result in higher levels of corporate tax avoidance. Finally, this study also provides new evidence of the importance of IT governance. Prior research shows the presence of board-level IT governance mitigates CSB risk (e.g., Haislip, Masli, Richardson, & Sanchez, 2016; Haislip, Peters, & Richardson, 2016; Higgs, Pinsker, Smith, & Young, 2016; Smith et al., 2019) and reduces agency costs through monitoring and oversight of IT systems designed to enhance the effectiveness and efficiency of IT systems, policies, and procedures (Fama & Jensen, 1983). In additional analyses, it is found that the existence of a risk committee, compliance committee, technology committee or IT executives in top managements plays an important role in moderating the association between CSB and tax avoidance.

## 1.4 Structure of the Thesis

This thesis is categorized based into three-essays and contains five chapters. Chapter 2 presents **the first essay** entitled, "Is Corporate Tax Avoidance associated with Investment Efficiency?" which examines the association between corporate tax avoidance and investment efficiency. Chapter 3 provides **the second essay** entitled, "Accounting Reporting Complexity, Unrecognized Tax Benefits" that investigates the relationship between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). Chapter 4 reports the third essay entitled, "The Effect of Cybersecurity Breaches on Corporate Tax Avoidance" which explores the relation between cybersecurity breaches (CSBs) and corporate tax avoidance. Chapter 5 presents the conclusion and directions for future research.

# Chapter 2 Is corporate tax avoidance associated with investment efficiency?

## 2.1 Introduction

This study examines the association between corporate tax avoidance activities and investment efficiency[5]. I predict that firms' participation in tax avoidance activities will lead them to invest inefficiently. I am motivated to undertake such a study because firm value is largely affected by managers' decisions, and decisions relating to investment represent some of the most important decisions for a firm in terms of dollar amount of capital outlay, and in determining the ability of the firm to achieve its strategic and business objectives (Hubbard, 1998). Shareholders therefore require firm managers to invest prudently so that the firm will be able to increase its value and shareholder welfare maximization. Further, tax avoidance by firms may affect their ability to achieve investment targets through an increase in tax savings[6] (Armstrong et al., 2012; Graham et al., 2014; Leone 2008) and also in influencing the level of governance and control in place (Dyreng et al., 2008; Hanlon & Heitzman, 2010).

Following Eisdorfer, Giaccotto, and White (2013) I measure investment efficiency as the difference between real and predictable investment in order to reflect the degree to which a firm departs from its optimum investment strategy. The real investment of a firm is calculated by dividing gross capital outlays by book value of total assets at the commencement of the year. The firm's predictable level of investment is proxied by the median investment in the industry during the year. Following prior literature (e.g. Dyreng, Hanlon, & Maydew, 2010; Hoi, Wu, & Zhang, 2013; Rego, 2003), I employ the accounting effective tax rate as the key proxy of tax avoidance. A lower accounting effective tax rate denotes a higher level of tax avoidance ( Dyreng et al., 2010).

Using a large sample of U.S. firms from 1993 to 2016, I show that the there is a positive association between corporate tax avoidance activities and investment inefficiency. In terms of economic significance, decreasing the accounting effective tax rate (GAAP_ETR) by 1% (i.e. higher tax avoidance) increases investment by 2.51% amongst firms that are over-investing. Moreover, I find that the effect of corporate tax avoidance activities on investment

[5] Investment efficiency denotes an event whereby firms partake in a venture that produces positive net present value (NPV) and there are no market frictions, such as agency costs or information asymmetry (Biddle et al., 2009; Jensen, 1986; Jensen & Meckling, 1976; Myers, 1977).

[6] For instance, Mills, Erickson, and Maydew (1998) find that the tax planning strategy of the firm is estimated an average return of approximately $4 for each $1 invested in tax planning. Wilson (2009) estimates an average return of approximately $12 for each $1 in fees paid related to tax shelters (ignoring any associated in house costs).

inefficiency is mediated by financial statement obscurity, financial statement comparability and product market competition. These results are robust to the use of alternative tax avoidance and investment inefficiency proxies. PSM, DID and 2SLS analyses confirm the results and mitigate any potential endogeneity issues that might result from the effect of omitted variables, reverse causality or model misspecification.

The findings of this study are important for several reasons. Firstly, I contribute to the literature examining the consequences of corporate tax avoidance. Edwards et al. (2016) find that cash generated from tax planning represents an important source of funds within corporations, and firms with financial constraints are more likely to engage in tax avoidance activities. The study provides evidence that firms' cash tax savings from avoidance activities are not used efficiently. Secondly, I contribute to the investment efficiency literature by providing evidence on how efficiently firms use cash tax savings from tax avoidance activities to fund their investments. Prior studies investigate the association between investment efficiency and financial reporting quality (Balakrishnan et al., 2014; Biddle & Hilary, 2006; Biddle et al., 2009; Chen et al., 2011; Cheng et al., 2013), accounting conservatism (Lara et al., 2016), auditor characteristics (Bae et al., 2017), or corporate social responsibility (Benlemlih & Bitar, 2018). However, there is a paucity of work that examines the association of corporate tax avoidance and investment efficiency. Green and Kerr (2016) find that firms use cash tax savings from tax avoidance activities on new investments but they do not provide evidence as to whether this internally-generated cash is used efficiently. Blaylock (2016) and Khurana et al. (2018) are among the first papers to investigate the issue of tax avoidance and investment efficiency. This study differs from prior studies in this area in a number of ways. While I find a positive association between tax avoidance and investment inefficiency for both overinvestment and underinvestment, Blaylock (2016) does not find a significant relation and Khurana et al. (2018) only find a significant association for overinvestment. In addition, my measure of investment efficiency differs from that used by Blaylock (2016) and Khurana et al. (2018) in that it relies on the regression residuals of Richardson (2006)'s method to define overinvestment and underinvestment. While Khurana et al. (2018) examine the impact of managerial ability and corporate governance on the relation between corporate tax avoidance and investment efficiency, I investigate the mediation effect of product market competition, financial statement obscurity and financial statement comparability on this relationship. My study, therefore adds to the literature by providing evidence of the direct and indirect (mediating) effect of corporate tax avoidance on investment efficiency. In doing so, this study contributes to the debate as to whether the firm benefits economically from increased levels of tax avoidance, and the role of product market competition, financial statement obscurity and financial statement comparability have in constraining agency related effects such as rent extraction, information asymmetry and opportunistic managerial activities that may

exacerbate the corporate tax avoidance-investment inefficiency relation.

The rest of this chapter is as follows. Section 2 examines the theory and develops the hypotheses. Section 3 outlines the research design. Section 4 presents the empirical results, and Section 5 describes additional analyses. Finally, conclusions are discussed in Section 6.

## 2.2 Literature review and hypotheses development

### 2.2.1 Investment efficiency and tax avoidance

Prior research has examined corporate tax avoidance from a cost-benefit perspective, where the paybacks from reduced taxes are weighed against costs pertaining to obscure financial reporting, penalties and fines, reputation and regulation (Hanlon & Heitzman, 2010; Scholes, Wolfson, Erickson, Maydew, & Shevlin, 2008; Shackelford & Shevlin, 2001). Mills et al. (1998) corroborate the fact that for each dollar spent on tax planning, the firm retains approximately four dollars in tax commitments. This finding indicates that tax avoidance is a value-enhancing activity owing to its ability to increase cash flows via decreased explicit taxes. Because tax expenditure is normally one of the major expenditures on firms' income statements, it appears logical that tax planning benefits would be substantial. Robinson, Sikes, and Weaver (2010) posit that numerous firms regard their tax unit as a profit centre.

According to the pecking order theory, there is no optimum level of cash, and cash functions only as a link between retained earnings and investment requirements. Hence, firms may avoid tax even if they have enough internal resources to fund their investments. In the presence of information asymmetry, the cost of external funding is higher than the cost of internal funding. Therefore, firms are inclined to use internally generated funds before they pursue external funding. Edwards et al. (2016) provide evidence that tax planning could be employed as an internal source of funding to enable financially distressed firms with tax savings to access worthy investment ventures. Thus, tax avoidance could be a value increasing firm action. Firms use tax avoidance to grow their internal resources and to reduce capital rationing. As external funding gets expensive, or less available, in the presence of information asymmetry, the incremental returns from cash tax savings, as internally generated funds, become more important (Edwards et al., 2016; Leone 2008).

Prior research indicates that tax avoidance can be considered along with other investment opportunities available to management (Armstrong et al., 2012; Green & Kerr, 2016; Mayberry, 2012; McGuire, Omer, & Wang, 2012). Thus, to the extent that the benefits of generating cash tax saving through tax avoidance activities exceed the associated costs, firms maximizing profits would consider the opportunity to reduce tax burdens (Goh, Lee, Lim, &

Shevlin, 2016; Hanlon & Heitzman, 2010; Hanlon, Maydew, & Saavedra, 2017; Mills et al., 1998).

One of the most important determinants of the value of a firm is managers' decisions in relation to investment as such decisions can significantly affect the returns of the shareholders (Hubbard, 1998). Therefore, shareholders usually expect a firm's management to invest shrewdly, to increase its value and result in higher returns. In capital markets without any frictions, firms invest if the marginal returns are higher than the marginal cost, i.e. they invest in investment projects that produce positive net present value (NPV). The imperfections that exist in the capital market, such as 'agency problems' and 'information asymmetry' hinder investment efficiency and, hence, result in either overinvestment or underinvestment (Jensen, 1986; Jensen & Meckling, 1976; Myers, 1977; Myers & Majluf, 1984).

Firms with cash flows generated from tax avoidance may face the agency problem by investing in projects that are not value-enhancing (Jensen, 1986). Self-serving managers would utilise their freedom of choice in taking decisions that advantage them, if there is an absence of appropriate surveillance (Shleifer & Vishny, 1997). Hence, managers with extra cash savings from tax avoidance could potentially invest in negative NPV projects, leading to sub-optimal overinvestment. Harvey, Lins, and Roper (2004) show that overinvestments are likely to occur in firms with a large available cash flow. Moral hazard arises when firm managers embark on overinvestment choices for personal profit or "empire building", i.e. to expand their firms beyond optimal size to gain more power and benefits for themselves (Aggarwal & Samwick, 2006; Avery, Chevalier, & Schaefer, 1998; Blanchard, Lopez-de-Silanes, & Shleifer, 1994; Hope & Thomas, 2008; Stulz, 1990).

Firms with cash savings from tax avoidance could be susceptible to underinvestment when their managers forgo investments that produce positive NPVs (Biddle et al., 2009). Previous literature on underinvestment show that risk-averse managers who are concerned about their career may avoid risky but optimal investment projects, if they perceive that such projects will place their own personal welfare at risk (Lambert, 1986; Shavell, 1979). Similarly, Brito and John (2002), from the perspective of risk avoidance, find that managers will avoid making highly risky investment projects because they are afraid of losing control of the firm. Managers with cash-based compensation may refrain from investing in positive but risky investment projects to enhance their current compensation (Rajagopalan, 1997; Rajagopalan & Finkelstein, 1992). Alternatively, underinvesting firms may forego positive NPV projects because their management may prefer to pursue a 'quiet life' (Bertrand & Mullainathan, 2003).

Slemrod (2004), Crocker and Slemrod (2005) are among the first to view corporate tax avoidance within the agency framework. Managers, under the agency perspective, could potentially relinquish investments with positive NPVs, when the projects involved are

bankrolled by cash tax saving from tax avoidance activities. There is mixed evidence on the relationship between tax avoidance and investment efficiency. While Blaylock (2016) does not find an association of tax avoidance and investment efficiency, Khurana et al. (2018) document a significant positive relationship between tax avoidance and overinvestment. Khurana et al. (2018) also investigate the role of managerial ability and corporate governance on this relation. They find that firms with high (low) managerial ability, or firms with strong (weak) corporate governance, increase (decrease) investment efficiency when there is high level of tax avoidance.

On the basis of the aforementioned discussions, increased tax savings through tax avoidance activities may lead managers to invest inefficiently. I therefore state my hypothesis as follows:

*H1: There is a positive relationship between corporate tax avoidance and investment inefficiency.*

### 2.2.2 Financial statement obscurity

In an environment with less-transparent information, managers have the opportunity to engage in rent extraction or other self-serving activities (Bushman, Chen, Engel, & Smith, 2004). Obscurity of financial information can have a number of financial reporting effects. An obscure financial reporting environment is manifested in less-readable annual financial reports. For instance, Li (2008) argues that firms with annual reports that are harder to read tend to have lower reported earnings. Guay, Samuels, and Taylor (2016) show that firms issue more managerial forecasts of sales, cash flows and earnings per share in order to mitigate the negative effect of less-readable annual reports. Previous studies (Lawrence, 2013; Miller, 2010; Rennekamp, 2012; You & Zhang, 2009) argue that the reactions of investors to less-readable disclosure reports are weaker, indicating that the readability may affect capital market efficiency.7 Based on this evidence, less-readable annual reports lead to reduced transparency or increased obscurity (Balakrishnan et al., 2019).

Prior literature (Desai & Dharmapala, 2006, 2008, 2009; Desai, Dyck, & Zingales, 2007) suggest that firms with free cash flow by undertaking tax avoidance may produce less transparent financial statements in an effort to hide their tax avoidance activities from taxing authorities. In firms with less transparent financial statements and high levels of free cash flow,

[7] Readability refers to the ease with which a reader can process and comprehend written texts. In terms of financial disclosure readability, the Securities and Exchange Commission (SEC) provides some very specific guidance in recommending that managers employ plain English attributes by avoiding writing constructs like passive voice, weak or hidden verbs, superfluous words, legal and financial jargon, numerous defined terms, abstract words, unnecessary details, lengthy sentences, and unreadable design and layout in their financial disclosures (SEC ,1998).

managers may redirect tax savings to overinvestment activities to grow the firm beyond its optimal size for empire building purposes (Aggarwal & Samwick, 2006; Desai & Dharmapala, 2009) or underinvestment for their own personal benefits such as enhancing compensation or pursuing "quite life" (Bertrand & Mullainathan, 2003; Rajagopalan, 1997). Biddle et al. (2009) find that less readable financial reports are associated with more overinvestment and underinvestment. In an obscure financial reporting environment, managers could potentially have a higher chance to engage in corporate tax avoidance and to use tax savings to fund investments that will benefit themselves which leads to overinvestment, or forego positive NPV projects which leads to underinvestment. I therefore hypothesize that financial statement obscurity has an indirect impact on the relationship between tax avoidance and investment inefficiency. I state my second hypothesis in the following form:

*H2: Financial statement obscurity mediates the association between corporate tax avoidance and investment inefficiency.*

### 2.2.3 Financial statement comparability

Previous research proposed that accounting information is critical to a well-functioning capital market (Bushman & Smith, 2001; Healy & Palepu, 2001; Lambert, Leuz, & Verrecchia, 2007). Accounting information gives information to all relevant stakeholders and enables them to assess and benchmark their levels of investment efficiency with that of their peers within a particular industry (Armstrong, Guay, & Weber, 2010; Beyer, Cohen, Lys, & Walther, 2010; Bushman & Smith, 2001). The Financial Accounting Standards Board (FASB, 2010) emphasizes the importance of accounting comparability in investment decision-making, by stating that rational decision-making requires accounting information that is comparable, to evaluate similarities and differences in investment opportunities properly. Accounting comparability is enhanced when economic events are reflected properly in accounting numbers.

The central point of information-based theory is the significance of managers' capability and inducement to conceal very important information from investors (Kim, Li, Lu, and Yu, 2016). Comparability enables information about similar peers to be available to external investors and, hence, makes it stress-free for investors to assess financial statement information from similar firms (Kim, Kraft, & Ryan, 2013). De Franco, Kothari, and Verdi (2011) argue that accounting comparability lowers the cost of information acquisition and increases the overall quantity and quality of information accessible to decision-makers. This should help firm managers to make better investment decisions and to be more efficient in research and development (R&D) investments. Chen, Collins, Kravet, and Mergenthaler (2018) find that more profitable acquisition choices are made by acquirers when the selected

firms' financial statements are more comparable with those of rival firms in the industry. Habib, Hasan, and Al-Hadi (2017) show that financial statement comparability significantly reduces corporate cash holdings. Sohn (2016) finds that the level of real earnings management (REM) by managers increases with the degree of their firms' accounting comparability with other firms whereas the level of accrual-based earnings management (AEM) decreases. Kim et al. (2016) observe that predictable crash risk decreases with financial statement comparability.

Desai and Dharmapala (2006) develop a theoretical agency framework in which information asymmetry gives managers greater opportunities to engage in more tax avoidance activities. Armstrong et al. (2010) argue that high quality accounting information can reduce information asymmetry and alleviate agency problem. Chen and Lin (2017) shows that restraining agency costs will simultaneously reduce the degree of corporate tax avoidance because it is easier to recognise tax avoidance transactions in a greater information transparency environment. Higher financial statement comparability results in lower information acquisition and processing costs and increases the quality and quantity of available information regarding the firm (De Franco et al., 2011; Kim et al., 2016; Kim et al., 2013). Therefore, it is expected that higher financial statement comparability is associated with higher financial reporting transparency and lower information asymmetry, which in turns lower the agency cost of tax avoidance. Qingyuan and Lumeng (2018), in a study of non-financial Chinese listed firms, find the higher level of financial statement comparability results in the lower the degree of corporate tax avoidance. On the basis of the arguments above, I develop the following hypothesis:

*H3: Financial statement comparability mediates the association between corporate tax avoidance and investment inefficiency.*

### 2.2.4 Product market competition

Resource-based theory proposes that resources are the definitive source for the creation and preservation of competitive advantage (Wernerfelt, 1984). If the entry of any new firms into the market weakens the competitive advantage of existing rival firms, then those firms may engage in actions to discourage the new firm from entering the industry (Darrough & Stoughton, 1990). Helfat and Peteraf (2003) contend that the resource-based perspective needs to include the beginning, growth and advancement of organisational resources and competencies, gradually. Therefore, they present an all-inclusive and exciting perspective: the 'dynamic resource-based theory', in which the basis of a firm's competitive advantage (i.e.,

its resource base) develops over a period and may also shift over time. Consequently, firms may forgo positive NPV projects and invest inefficiently, in order to become competitive.

The separation of ownership and control will induce managers to divert firms' resources for managements' own benefit (Jensen & Meckling, 1976). Greater competition may induce firm management to engage in tax avoidance to facilitate the funding of financing and investment activities so that the firm can perform or, in fact, survive, in such a competitive market. According to Valta (2012), when product market competition is strong, the cost of borrowing for publicly traded manufacturing firms is raised. Consequently, competition may force managers to accumulate cash flows to create enough internal liquidity for firms' operations. As a result, firm investment may decline with an increase in competition.

When firms have superior product market control, failed tax strategies are less likely to influence their competitive positions. Product market control, thus, facilitates more risk-taking behaviour. For instance, firms with superior product market control have the ability to carry less cash and pay higher dividends than firms operating in a more competitive market, because extreme competition acts as a barrier to firms with lower market power, making them hold more cash to meet competitive pressures (Hoberg, Phillips, & Prabhala, 2014). Consequently, Schmidt (1997) establishes that an intensification of competition escalates the probability of liquidation with greater inducements to managers, making them work harder in a bid to retain their positions. Moreover, competition may induce managers make unprofitable investments to increase the size of the firm for their personal gain or for "empire building" (Jensen, 1986).

Competition in the product market can also be viewed as a governance mechanism that compels managers to restrain from engaging in conflict with shareholders. Extreme competition has the potential to decrease managerial inefficiency and make managers increase firm efficiency (Alchian, 1950; Stigler, 1958). Nickell (1996) finds that when competition is measured using the numbers of competing firms, or the levels of rent that monopolists take, the competitive process becomes linked to a considerably higher rate of growth in total factor productivity. In addition, extreme competition can aid in monitoring and appraising managers (Hart, 1983; Holmstrom, 1982; Nalebuff & Stiglitz, 1983) as managers are persuaded to increase the profits of the firm (Fee & Hadlock, 2004; Giroud & Mueller, 2010). Guadalupe and Pérez-González (2006) posit that extreme competition in the product market limits the degree of private control gains that corporate insiders extract. In sum, these arguments put forward that extreme competition in the product market will constrain managers from acting in ways that conflict with the interests of shareholders (Hart, 1983). Based on the aforementioned evidence, product market competition may have mediating effects on the relation between investment inefficiency and tax avoidance. On the basis of the analysis above, I state my hypothesis as follows:

*H4: Product market competition mediates the association between corporate tax avoidance and investment inefficiency.*

## 2.3 Research design

### 2.3.1 Sample selection

My sample initially consists of all firms from the Compustat database from 1993 to 2016. The commencement year of my sample is 1993 which the year that the U.S. Financial Accounting Standards Board (FASB) published FAS 109 regarding the accounting for income taxes. This originally results in 277,692 firm-year observations. The sample is subsequently reduced to 190,663 firm-year observations after taking out utility industries two-digit code 49 (9,885 observations) and financial firms two-digit code 60–69 (77,144 observations). Utility firms are eliminated, since their capital structures are usually associated with greater amounts of debt and, thus, the calculation of the numerous tax avoidance proxy methods is affected. Financial firms are taken out due to the key variances in their utilisation of accounting guidelines and derivation of accounting approximations in relation to other firms and the dissimilar supervisory restrictions they face.

The sample is then reduced to 69,332 firm-year observations after leaving 121,331 firm-year observations due to missing financial data for calculating variables in the main regression. A summary of my sample selection is presented in Panel A of Table 2-1, and the year distribution of firms is in Panel B. I winsorize the data at the 1st and 99th percentiles to decrease the probability that outliers affect the results.

### 2.3.2 Investment efficiency measure

Following Eisdorfer et al. (2013), I estimate investment efficiency by using the difference between real and predictable investment to measure the degree to which a firm departs from its optimal investment strategy (Richardson, 2006). The real investment of a firm is calculated by dividing gross capital expenditures by book value of total assets at the commencement of the year. I also estimate a firm's predictable investment using the midpoint investment in the industry (using the four-digit SIC code) during the year. If the four-digit group comprises less than five observations, I use a three-digit code, and if that new group comprises less than five observations, I use a two-digit code. I adopt three measures of investment efficiency: (1) ABS_INV refers the absolute value of the difference between the firm's actual investment and its industry median investment; (2) Underinvestment if this difference is negative; (2) Overinvestment if this difference is positive.

**Table 2-1: Sample description**

| **Panel A: Sample selection** | |
|---|---|
| Total number of firm-year observations from Compustat (1993-2016) | 277,692 |
| Less: Utility industries (SIC 49) | (9,885) |
| Less: Financial institutions (SIC 60–69) | (77,144) |
| | 190,663 |
| Less: missing values to compute the variables | (121,331) |
| Final sample | 69,332 |

**Panel B: Year distribution**

| Year | N | Percent |
|---|---|---|
| 1993 | 2,640 | 3.81% |
| 1994 | 2,738 | 3.95% |
| 1995 | 2,892 | 4.17% |
| 1996 | 3,210 | 4.63% |
| 1997 | 3,344 | 4.82% |
| 1998 | 3,392 | 4.89% |
| 1999 | 3,673 | 5.30% |
| 2000 | 3,572 | 5.15% |
| 2001 | 3,346 | 4.83% |
| 2002 | 3,364 | 4.85% |
| 2003 | 3,331 | 4.80% |
| 2004 | 3,177 | 4.58% |
| 2005 | 3,060 | 4.41% |
| 2006 | 3,021 | 4.36% |
| 2007 | 2,866 | 4.13% |
| 2008 | 2,732 | 3.94% |
| 2009 | 2,571 | 3.71% |
| 2010 | 2,494 | 3.60% |
| 2011 | 2,526 | 3.64% |
| 2012 | 2,427 | 3.50% |
| 2013 | 2,296 | 3.31% |
| 2014 | 2,264 | 3.27% |
| 2015 | 2,225 | 3.21% |
| 2016 | 2,171 | 3.13% |
| Total | 69,332 | 100% |

### 2.3.3 Tax avoidance measure

Hanlon and Heitzman (2010) contend that the most frequently used proxies for tax avoidance are tax expenses and book–tax differences projected from financial reports. They also claim that actual business choices, like investment and capital structure, are affected by taxable income, taxes, and book–tax differences. I employ the accounting effective tax rate

($GAAP\_ETR_{i,t}$), which has been used extensively in previous studies (e.g. Dyreng et al., 2010; Hoi et al., 2013; Rego, 2003; Wilson, 2009) as the key proxy estimation of tax avoidance. Furthermore, in discussing the recent studies of Graham et al. (2014), Armstrong et al. (2012), and Robinson et al. (2010), Edwards et al. (2016) suggest that managers who engage in tax avoidance usually tend to focus on strategies that reduce financial statement expense. $GAAP\_ETR_{i,t}$ has a direct impact on earnings and is the most commonly used measure of tax avoidance. This measure of effective tax rate captures a broad range of tax strategies including those with both highly certain and uncertain outcomes. $GAAP\_ETR_{i,t}$ is computed as total tax expense (consisting of current and deferred tax expenditure) scaled by pre-tax book income minus special items. This particular tax avoidance proxy is based on firms' net income (Robinson et al., 2010) and is used to evaluate the firm's overall tax burden and level of tax avoidance (e.g., Dyreng et al., 2010; Hoi et al., 2013; Rego, 2003; Wilson, 2009). Lower $GAAP\_ETR_{i,t}$ values denote higher amounts of tax avoidance (Dyreng et al., 2010).

### 2.3.4 Financial statement obscurity measure

I follow Bonsall and Miller (2017) and Bonsall, Leone, Miller, and Rennekamp (2017) and used the Bog Index (BOG) as my measure of financial statement obscurity[8]. High levels of BOG indicate less readable documents (i.e. more obscurity). The Bog Index is reported by Editor Software's plain English software, StyleWriter. The Bog Index is measured as the sum of three multifaceted components:

Bog Index = sentence Bog + Word Bog - Pep

### 2.3.5 Product market competitive measure

I determine product market competition (PMC) using the fluidity measure of Hoberg et al. (2014), which estimates variation in the product space of a firm as a result of decisions made by rivals. This estimation is formulated by analysing words in the product description section of a firm from its 10-K, and how they compare to the changes in the 10-K product words of competitor firms. Precisely, fluidity is the "cosine" relationship between a firm's identifiable word use vector and the total competitor firms' word modification vector. Hence, fluidity concentrates on product space undercurrents and variations in the products of competitor firms as well as how these variations are related to the present product offerings of a firm (Hoberg et al., 2014)[9].

[8] I thank Brian P. Miller for making this data available. https://kelley.iu.edu/bpm/activities/bogindex.html
[9] I thank the authors for make this data publicly available. https://hobergphillips.tuck.dartmouth.edu/

### 2.3.6 Financial statement comparability measure

I employ the financial statement comparability estimation of De Franco et al. (2011), in which they define comparability as the familiarity connecting the accounting systems of two firms in plotting economic phenomena into financial statements[10]. Following De Franco et al. (2011), I run the following model using the preceding 16 quarters of data:

$$\text{EARNINGS}_{it} = \alpha_1 + + \beta_1 \text{RETURN}_{it} + \varepsilon_{it} \quad (1)$$

where EARNINGS refers to the quarterly net income before extraordinary items deflated by the market value of equity in the preceding quarter. RETURN refers to the firm's stock return during the quarter. The estimated coefficients ($\alpha\hat{}_i$ and $\beta\hat{}_i$) and ($\alpha\hat{}_j$ and $\beta\hat{}_j$) refer to the accounting functions of firm i and firm j, respectively. In measuring the similarity of accounting functions between firm i and firm j, De Franco et al. (2011) assume that firm i and firm j have the same return, i.e. they experience the same economic events ($RETURN_{it}$). They compute accounting reactions of firms i and j to the same economic phenomena ($\text{RETURN}_{it}$) as follows:

$$E(EARNINGS)_{iit} = \widehat{\alpha_i} + \widehat{\beta_i} RETURN_{it} \quad (2)$$

$$E(EARNINGS)_{ijt} = \widehat{\alpha_i} + \widehat{\beta_j} RETURN_{it} \quad (3)$$

where $E(EARNINGS)_{iit}$ denotes the forecast earnings of firm i given firm i's accounting function and the returns of firm i in quarter t. $E(EARNINGS)_{iit}$ is the forecast earnings of firm j given firm j's accounting function and firm i's returns in quarter t. Following De Franco et al. (2011), the comparability score between firm i and firm j ($COMP_{ijt}$) is computed as negative one (−1) times the average absolute difference between the forecast earnings of firm i and of firm j over the previous 16 quarters:

$$COMP_{ijt} = -\frac{1}{16} \times \sum_{t-15}^{t} \left| E(EARNINGS)_{iit} - E(EARNINGS)_{ijt} \right| \quad (4)$$

Greater values of $COMP_{ijt}$ indicate smaller difference between $E(EARNINGS)_{iit}$ and $E(EARNINGS)_{ijt}$, that is, higher financial statement comparability between firms i and j (De Franco et al., 2011). Following De Franco et al. (2011), I use the average of all of firm i's comparability scores during the whole year to measure comparability of firm i's financial statements[11].

[10] I thank Rodrigo Verdi for make the data and SAS code available. https://mitmgmtfaculty.mit.edu/rverdi/

[11] I also use a different measure of firm-year level accounting comparability. It is calculated as the average of the largest four and ten comparability combinations for firm *i* and other firms in the same 2-digit SIC in a given year. The results are very much similar.

### 2.3.7 Control variables

Following the previous literature (e.g. Bae et al., 2017; Biddle & Hilary, 2006; Biddle et al., 2009; Cheng et al., 2013; Eisdorfer et al., 2013; Lara et al., 2016), I include control variables that are related to investment efficiency. Precisely, I include SIZE, MTB, Z-SCORE, Tangible, K, K_IND, CFOSale, SLACK, DIV, AGE, LOSS, CFO5SD, SALE5SD, INV5SD, CASH, and OP_CY. I compute SIZE by using natural logarithm of total assets. MTB is a firm's market-to-book ratio, calculated as the ratio of the market value of equity scaled by the book value of equity. Z-SCORE refers to financial distress by means of Altman's (1968), an extensively used model of bankruptcy forecast. Tangible is the ratio of property, plant and equipment (PPE) to total assets. K is the ratio of long-term debt to the summation of long-term debt and the market value of equity. K_IND is the mean of K values of firms in the similar SIC 3-digit industry. I compute CFOSale, as operating cash flows over sales. SLACK is the ratio of cash to property, plant and equipment (PPE). DIV is an indicator variable equal to one when the firm paid a dividend, and zero otherwise. AGE refers to firm age, calculated as the natural logarithm of difference between the first year when the firm appears in the CRSP database and the current year. LOSS is an indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. CFO5SD refers to the standard deviation of a firm's scaled operating cash flows computed over the prior five years. SALE5SD is the standard deviation of a firm's scaled sales calculated over the prior five years. INV5SD indicates the standard deviation of a firm's scaled investment computed over the prior five years. I require three out of five observations for CFO5SD, SALE5SD, and SINV5SD to be included in my sample. I measure CASH as the ratio of cash and short-term investments to assets. OP_CY refers to the log of receivables to sales plus inventory to cost of goods sold (COGS) multiplied by 360.

### 2.3.8 Regression model

In order to determine whether corporate tax avoidance increases investment inefficiency, I employ the following baseline model:

$$\begin{aligned} INVEFF_{i,t} = \alpha_0 + \beta_1 GAAP\_ETR_{it} + \beta_2 SIZE + \beta_3 MTB + \beta_4 ZSCORE + \beta_5 Tangible + \beta_6 K \\ + \beta_7 K\_IND + \beta_8 CFOSALE + \beta_9 SLACK + \beta_{10} DIV + \beta_{11} AGE + \beta_{12} LOSS \\ + \beta_{13} CFO5SD + \beta_{14} SALE5SD + \beta_{15} INV5SD + \beta_{16} CASH + \beta_{17} OPCY + Firm \\ + Year + \varepsilon \end{aligned} \quad (5)$$

where INVEFF refers to investment inefficiency, and can take three measures: ABS_INV, Underinvestment, and Overinvestment. GAAP_ETR is total tax expense (consisting of current and deferred tax expenditure) scaled by pre-tax book income minus special items. All control variables are defined in the previous section (Section 2.3.7)

Following Robin and Zhang (2015), Habib et al. (2017) for testing mediation effects, I estimate the following regressions to differentiate the direct effects of corporate tax avoidance on investment inefficiency from the indirect effects (i.e. through financial statement obscurity (BOG), financial statement comparability (COMP) and product market competition (PMC)):

$$INVEFF_{i,t} = \alpha_0 + \beta_1 MV_{it} + \beta_2 GAAP\_ETR_{it} + \sum_{j=2}^{m} \beta_j Control\ Variables_{it} + \sum \beta_t Firm_t + \sum \beta_t Year_t + \varepsilon_{it} \quad (6)$$

$$MV_{i,t} = \alpha_0 + \alpha_1 GAAP\_ETR_{it} + \sum_{j=2}^{n} \alpha_j Control\ Variables_{it} + \sum \alpha_t Firm_t + \sum \alpha_t Year_t + \varepsilon_{it} \quad (7)$$

Equation (6) shows how the mediation variables (MV) affect investment inefficiency. There are three mediation variables: BOG, COMP and PMC. The presence of GAAP_ETR in Equation (6) allows for the possibility that GAAP_ETR may have a direct effect on investment inefficiency. Equation (7) illustrates how GAAP_ETR can affect investment inefficiency through the mediating variable channels (indirect effects).

## 2.4 Results

### 2.4.1 Descriptive statistics

Table 2-2 reports the descriptive statistics of the variables I used in the baseline model of regression (5). The mean (median) of the dependent variable (ABS_INV) is 0.04 (0.02). The median value of the ABS_INV variable is very close to the median value of 0.013 reported in Eisdorfer et al. (2013). I find that the mean (median) value of my GAAP_ETR variable is 0.24 (0.29) which is consistent with prior studies (Bird & Davis-Nozemack, 2016; Gaertner, 2014; Hasan, Hoi, Wu, & Zhang, 2017). Finally, the mean (median) values of the control variables are similar to those reported in the previous tax avoidance literature (Bae et al., 2017; Biddle et al., 2009; Cheng et al., 2013; Lara et al., 2016).

**Table 2-2: Descriptive Statistics**

| Variable | N | Mean | S.D. | 1st quartile | Median | 3rd quartile |
|---|---|---|---|---|---|---|
| ABS_INV | 69,332 | 0.04 | 0.07 | 0.01 | 0.02 | 0.04 |
| GAAP_ETR | 69,332 | 0.24 | 0.18 | 0.04 | 0.29 | 0.37 |
| SIZE | 69,332 | 5.36 | 2.43 | 3.63 | 5.31 | 7.02 |
| MTB | 69,332 | 2.40 | 3.78 | 1.11 | 1.54 | 2.43 |
| Z-SCORE | 69,332 | 0.88 | 4.64 | 0.59 | 1.44 | 2.26 |
| Tangible | 69,332 | 0.27 | 0.23 | 0.09 | 0.20 | 0.40 |
| K | 69,332 | 0.16 | 0.21 | 0.00 | 0.08 | 0.25 |
| K_IND | 69,332 | 0.18 | 0.09 | 0.09 | 0.16 | 0.24 |
| CFOSALE | 69,332 | -0.54 | 3.95 | 0.00 | 0.07 | 0.14 |
| SLACK | 69,332 | 2.80 | 10.02 | 0.08 | 0.36 | 1.51 |
| DIV | 69,332 | 0.37 | 0.48 | 0.00 | 0.00 | 1.00 |
| AGE | 69,332 | 2.48 | 0.85 | 1.88 | 2.53 | 3.11 |
| LOSS | 69,332 | 0.30 | 0.46 | 0.00 | 0.00 | 1.00 |
| CFO5SD | 69,332 | 0.13 | 0.33 | 0.03 | 0.06 | 0.11 |
| SALE5SD | 69,332 | 0.23 | 0.27 | 0.08 | 0.15 | 0.28 |
| INV5SD | 69,332 | 0.46 | 1.29 | 0.06 | 0.14 | 0.34 |
| CASH | 69,332 | 0.19 | 0.21 | 0.03 | 0.10 | 0.27 |
| OP_CY | 69,332 | 4.66 | 0.85 | 4.24 | 4.74 | 5.16 |

This table shows the descriptive statistics of all variables used in the analysis. The variables are defined in Appendix 2-A.

The Pearson correlation results are presented in Table 2-3. I observe that ABS_INV is correlated with GAAP_ETR significantly and negatively ($p < 0.01$), thus, providing some preliminary support for H1 that corporate tax avoidance is positively related to investment inefficiency. Moreover, the control variables (SIZE, MTB, Z_SCORE, Tangible, K, K_IND, CFOSALE, SLACK, DIV, AGE, LOSS, CFO5SD, SALE5SD, INV5SD, CASH, and OP_CY) are also correlated significantly with the dependent variable, ABS_INV, at $p < 0.01$.

## Table 2-3: Pearson correlation results

| | -1 | -2 | -3 | -4 | -5 | -6 | -7 | -8 | -9 | -10 | -11 | -12 | -13 | -14 | -15 | -16 | -17 | -18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) ABS_INV | 1 | | | | | | | | | | | | | | | | | |
| (2) GAAP_ETR | -0.054*** | 1 | | | | | | | | | | | | | | | | |
| (3) SIZE | -0.101*** | 0.349*** | 1 | | | | | | | | | | | | | | | |
| (4) MTB | 0.096*** | -0.192*** | -0.253*** | 1 | | | | | | | | | | | | | | |
| (5) Z-SCORE | -0.050*** | 0.303*** | 0.282*** | -0.537*** | 1 | | | | | | | | | | | | | |
| (6) Tangible | 0.306*** | 0.088*** | 0.209*** | -0.116*** | 0.030*** | 1 | | | | | | | | | | | | |
| (7) K | -0.014*** | 0.073*** | 0.209*** | -0.190*** | 0.018*** | 0.323*** | 1 | | | | | | | | | | | |
| (8) K_IND | 0.087*** | 0.212*** | 0.294*** | -0.183*** | 0.135*** | 0.467*** | 0.408*** | 1 | | | | | | | | | | |
| (9) CFOSALE | -0.015*** | 0.211*** | 0.180*** | -0.218*** | 0.284*** | 0.085*** | 0.084*** | 0.148*** | 1 | | | | | | | | | |
| (10) SLACK | -0.059*** | -0.155*** | -0.170*** | 0.110*** | -0.147*** | -0.271*** | -0.156*** | -0.196*** | -0.188*** | 1 | | | | | | | | |
| (11) DIV | -0.066*** | 0.223*** | 0.446*** | -0.092*** | 0.123*** | 0.171*** | 0.053*** | 0.243*** | 0.105*** | -0.120*** | 1 | | | | | | | |
| (12) AGE | -0.114*** | 0.147*** | 0.237*** | -0.063*** | 0.049*** | 0.037*** | 0.037*** | 0.091*** | 0.084*** | -0.063*** | 0.322*** | 1 | | | | | | |
| (13) LOSS | 0.036*** | -0.457*** | -0.411*** | 0.165*** | -0.378*** | -0.061*** | 0.053*** | -0.194*** | -0.250*** | 0.139*** | -0.299*** | -0.197*** | 1 | | | | | |
| (14) CFO5SD | 0.039*** | -0.244*** | -0.317*** | 0.377*** | -0.500*** | -0.129*** | -0.103*** | -0.158*** | -0.227*** | 0.170*** | -0.149*** | -0.119*** | 0.252*** | 1 | | | | |
| (15) SALE5SD | 0.020*** | -0.128*** | -0.345*** | 0.161*** | -0.109*** | -0.196*** | -0.070*** | -0.089*** | 0.013*** | 0.091*** | -0.199*** | -0.192*** | 0.153*** | 0.298*** | 1 | | | |
| (16) INV5SD | 0.067*** | -0.176*** | -0.195*** | 0.092*** | -0.117*** | -0.053*** | -0.063*** | -0.099*** | -0.146*** | 0.092*** | -0.143*** | -0.191*** | 0.201*** | 0.206*** | 0.172*** | 1 | | |
| (17) CASH | -0.042*** | -0.273*** | -0.230*** | 0.195*** | -0.137*** | -0.401*** | -0.387*** | -0.411*** | -0.266*** | 0.461*** | -0.222*** | -0.177*** | 0.224*** | 0.195*** | 0.073*** | 0.153*** | 1 | |
| (18) OP_CY | -0.092*** | -0.028*** | -0.068*** | 0.010*** | -0.039*** | -0.301*** | -0.131*** | -0.267*** | -0.153*** | -0.006 | -0.037*** | 0.034*** | 0.030*** | 0.005 | -0.130*** | -0.001 | -0.025*** | 1 |

### 2.4.2 Regression results

The regression results of investigating the relationship between tax avoidance and investment inefficiency are presented in Table 2-4. In this table, GAAP_ETR is used as a proxy for tax avoidance, the dependent variable in Column (1) is ABS_INV, whereas the dependent variables in Columns (2) and (3) are Underinvestment and Overinvestment, respectively. As evidenced in Column (1) of Table 4, the coefficient of the GAAP_ETR variable is -0.0082 with p-value < 0.01, signifying that the accounting effective tax rate is associated negatively with the absolute value of the difference between the real and predicted investment. In other words, firms having higher levels of tax avoidance show a greater propensity for investment inefficiency. Similar results are observed in Columns (2) and (3) where the coefficient of the GAAP_ETR variable is significantly negative with p-value < 0.01, for both Underinvestment and Overinvestment. Lower accounting effective tax rates are correlated with higher levels of both under-investment and over-investment. In terms of economic significance, decreasing the accounting effective tax rate (GAAP_ETR) by 1% (i.e. higher tax avoidance) increases firm investment by 2.51% among firms that are over-investing. This results support the first hypothesis H1 that there is a positive correlation between corporate tax avoidance and investment inefficiency. For the control variables, the coefficient estimates are consistent with prior studies (Bae et al., 2017; Biddle et al., 2009; Cheng et al., 2013; Lara et al., 2016).

### 2.4.3 Mediation results

In this section, I test the mediation effects of three variables, i.e., financial statement obscurity (BOG), financial statement comparability (COMP) and product market competition (PMC), on the relationship between tax avoidance (GAAP_ETR) and investment inefficiency. Mediation is said to happen when (i) the independent variable (GAAP_ETR) has a considerable effect on the mediators (BOG, COMP, and PMC); (ii) the independent variable (GAAP_ETR) has a considerable effect on the dependent variable (ABS_INV, Underinvestment, and Overinvestment) when excluding the mediators; (iii) the mediator (BOG, COMP, or PMC) yields a considerable and distinctive influence on the dependent variable (ABS_INV, Underinvestment, and Overinvestment); and (iv) the influence of the independent variable (GAAP_ETR) on the dependent variable (ABS_INV, Underinvestment, and Overinvestment) is diminished considerably when the mediator (BOG, COMP, or PMC) is included in the model. A reduction of the significant relationship between the independent variable (GAAP_ETR) and dependent variable (ABS_INV, Underinvestment, and Overinvestment) in path (iv) is consistent with partial mediation (Baron & Kenny, 1986;

Fairchild & MacKinnon, 2009; Wood, Goodman, Beckmann, & Cook, 2008). The significance of the partial mediation effect is tested using the Sobel test (Sobel, 1982).

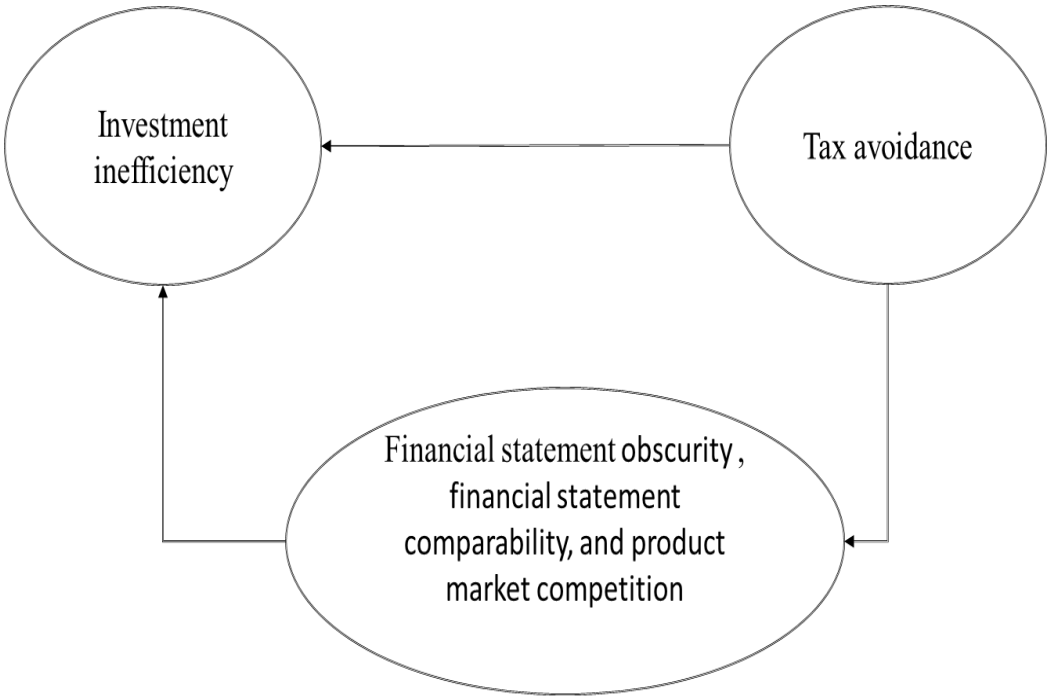


**Figure 2-1: Indicate the mediation effect of (financial statement obscurity, financial statement comparability, and product market competition on the association between tax avoidance and investment inefficiency.**

**Table 2-4: Regression result – Association between tax avoidance and investment inefficiency**

| | (1) ABS_INV | (2) Underinvestment | (3) Overinvestment |
|---|---|---|---|
| **GAAP_ETR** | **-0.0082*** ** | **-0.0055*** ** | **-0.0251*** ** |
| | **(-4.63)** | **(-6.64)** | **(-5.29)** |
| SIZE | -0.0031*** | -0.0019*** | -0.0068*** |
| | (-20.51) | (-25.17) | (-17.08) |
| MTB | 0.0021*** | 0.0000 | 0.0036*** |
| | (10.52) | (-1.06) | (7.12) |
| Z-SCORE | 0.0005*** | 0.0000 | 0.0001 |
| | (3.66) | (1.43) | (0.11) |
| Tangible | 0.0832*** | -0.0055*** | 0.1261*** |
| | (35.42) | (-4.68) | (21.72) |
| K | -0.0243*** | 0.0014* | -0.0396*** |
| | (-16.10) | (1.89) | (-9.20) |
| K_IND | 0.0088 | 0.0277*** | 0.0226 |
| | (1.29) | (7.38) | (1.53) |
| CFOSALE | 0.0000 | 0.0000 | -0.0002 |
| | (0.35) | (-0.69) | (-0.58) |
| SLACK | -0.0001*** | 0.0000*** | -0.0006*** |
| | (-7.24) | (4.30) | (-5.28) |
| DIV | -0.0067*** | -0.0013*** | -0.0073*** |
| | (-10.68) | (-4.07) | (-5.21) |
| AGE | -0.0056*** | 0.0000 | -0.0086*** |
| | (-15.12) | (0.05) | (-10.28) |
| LOSS | -0.0046*** | 0.0035*** | -0.0028 |
| | (-5.74) | (10.33) | (-1.19) |
| CFO5SD | 0.0007 | -0.0011*** | 0.0028 |
| | (0.40) | (-2.78) | (0.50) |
| SALE5SD | 0.0027* | 0.0001 | 0.0036 |
| | (1.90) | (0.24) | (0.83) |
| INV5SD | 0.0018*** | 0.0002** | 0.0042*** |
| | (5.23) | (1.96) | (4.27) |
| CASH | 0.0101*** | -0.0006 | 0.0172*** |
| | (5.93) | (-0.90) | (3.41) |
| OP_CY | 0.0018*** | 0.0002 | 0.0029** |
| | (3.54) | (1.28) | (2.11) |
| Constant | 0.0335*** | 0.0348*** | 0.0569*** |
| | (6.09) | (11.61) | (3.29) |
| Year | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| N | 69,332 | 32,926 | 34,695 |
| adj. R-sq | 0.185 | 0.407 | 0.183 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test). The variables are defined in Appendix 2-A.

Following previous literature (e.g. Habib et al., 2017; Robin & Zhang, 2015), I tabulate the direct and indirect effects of tax avoidance on investment inefficiency. Table 2-5 presents the mediation test of financial statement obstruction (BOG) on the relation between tax avoidance and investment inefficiency. Model (1) indicates the regression model without the mediator whereas Model (2) indicates the regression with the mediator. In Model (1), the coefficients of GAAP_ETR are negative and statistically significant for all three measures of investment inefficiency (namely, ABS_INV, Underinvestment, and Overinvestment), indicating that more tax avoidance results in more investment inefficiency.

The coefficients of BOG in Model (2) are positively and statistically significant for all measures of investment inefficiency (ABS_INV, Overinvestment and Underinvestment), implying that financial statement obscurity increases investment inefficiency. The coefficients of GAAP_ETR in Model (2), which includes the mediator BOG, are significantly negative at $p<0.01$ and slightly lower compared to those in Model (1) for all measures of investment inefficiency, indicating a significant mediation effect of BOG on the relationship between tax avoidance and investment inefficiency. The coefficient of indirect effect is also negative and significant at ($p<0.05$ or better) for all three measures of investment inefficiency which supports my second hypothesis H2. The Sobel test is significant at the 5% level or better for all measures of investment inefficiency. In summary, I find that a lower accounting effective tax rate (GAAP_ETR) directly and indirectly increases the level of investment inefficiency. The results in Table 2-5 indicate a statistically significant mediation influence of financial statement obscurity (BOG) on the association between tax avoidance and investment inefficiency.

**Table 2-5: Mediation test of financial statement obscurity (BOG) on the association between tax avoidance and investment inefficiency**

| | (1) ABS_INV | (2) Underinvestment | (3) Overinvestment |
|---|---|---|---|
| BOG index as the mediator | | | |
| **Model (1) (without the mediator)** | | | |
| **GAAP_ETR** | **-0.0063*** ** | **-0.0040*** ** | **-0.0199*** ** |
| | **(-3.40)** | **(-4.71)** | **(-4.55)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 54,971 | 26,086 | 27,485 |
| Adj. R-squared | 0.19 | 0.41 | 0.19 |
| **Model (2) (with the mediator)** | | | |
| **GAAP_ETR** | **-0.0057*** ** | **-0.0039*** ** | **-0.0189*** ** |
| | **(-2.68)** | **(-4.59)** | **(-4.30)** |
| **BOG** | **0.0208*** ** | **0.0040** ** | **0.0391*** ** |
| | **(5.57)** | **(2.23)** | **(4.68)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 54,971 | 26,086 | 27,485 |
| Adj. R-squared | 0.19 | 0.41 | 0.19 |
| **Direct effect** | **-0.0057*** ** | **-0.0039*** ** | **-0.0189*** ** |
| **Indirect effect** | **-0.0005*** ** | **-0.0001** ** | **-0.0010*** ** |
| **Total effect** | **-0.0063*** ** | **-0.0040*** ** | **-0. 0199*** ** |
| Sobel Z | -0.0005*** | -0.0001** | -0.0010*** |
| Z | (-5.06) | (-2.15) | (-4.12) |
| (p-value) of Sobel Z | 0.00 | 0.03 | 0.00 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

Table 2-6 presents the mediation test of financial statement comparability (COMP) on the relation between tax avoidance and investment efficiency. In Model (1) which does not include the mediator (COMP), the coefficients of GAAP_ETR are negative and statistically significant for ABS_INV, Underinvestment, and Overinvestment. This suggests that a high level of tax avoidance results in a high level of investment inefficiency. When I include the mediator COMP in Model (2), the coefficients of COMP are significantly negative at $p < .05$ and slightly smaller compared to those in Model (1) for all three measures of investment inefficiency, suggesting a significant mediation effect of COMP on the relationship between tax avoidance and investment inefficiency. This finding implies that a high level of financial statement comparability decreases the level of investment inefficiency. The coefficient of indirect effect is significantly negative at the 5% significance level or better for all three measures of investment inefficiency. The Sobel test is significant at the 5% level or better for ABS_INV, Overinvestment, and Underinvestment. This finding supports the third hypothesis H3 that financial statement comparability significantly mediates the relationship between tax avoidance and investment inefficiency significantly.

Table 2-7 presents the mediation test of product market competition (PMC) on the relationship between tax avoidance and investment efficiency. There are two models presented in Table 2-7: Model (1) shows the regression model without the mediator, while Model (2) refers to the regression that includes the mediator. As can be seen from Model (1), the coefficients of GAAP_ETR are negative and statistically significant for all measures of investment inefficiency, indicating that more tax avoidance results in more investment inefficiency. The coefficient of the mediating variable (PMC) in Model (2) is positive and statistically significant ($p < .01$) for ABS_INV and Overinvestment, implying that product market competition increases the level of overinvestment. However, the coefficient is negative and statistically significant ($p < .10$) for Underinvestment, indicating that product market competition decreases the level of underinvestment. The coefficient for the indirect effect is significant at p-value<0.10 or better and the Sobel test is also significant at the 10% level or better for all three measures of investment inefficiency. This results provide evidence to support the final hypothesis, H4, that product market competition mediates the association between tax avoidance and investment inefficiency significantly.

**Table 2-6: Mediation test of financial statement comparability (COMP) on the association between tax avoidance and investment inefficiency**

| | (1) ABS_INV | (2) Underinvestment | (3) Overinvestment |
|---|---|---|---|
| COMP as the mediator | | | |
| **Model (1) (without the mediator)** | | | |
| GAAP_ETR | **-0.0073*** ** | **-0.0040*** ** | **-0.0215*** ** |
| | **(-3.22)** | **(-3.42)** | **(-4.41)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 32,523 | 14,518 | 17,167 |
| Adj. R-squared | 0.22 | 0.40 | 0.22 |
| **Model (2) (with the mediator)** | | | |
| **GAAP_ETR** | **-0.0063*** ** | **-0.0035*** ** | **-0.0197*** ** |
| | **(-2.74)** | **(-2.98)** | **(-4.01)** |
| **COMP** | **-0.0006*** ** | **-0.0002** ** | **-0.0011*** ** |
| | **(-3.48)** | **(-2.50)** | **(-3.14)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 32,523 | 14,518 | 17,167 |
| Adj. R-squared | 0.22 | 0.40 | 0.22 |
| **Direct effect** | **-0.0063*** ** | **-0.0035*** ** | **-0.0197*** ** |
| **Indirect effect** | **-0.0010*** ** | **-0.0005** ** | **-0.0018*** ** |
| **Total effect** | **-0.0073*** ** | **-0.0040*** ** | **-0.0215*** ** |
| Sobel Z | -0.0010*** | -0.0005** | -0.0018*** |
| Z | (-3.44) | (-2.48) | (-3.08) |
| (p-value) of Sobel Z | 0.00 | 0.01 | 0.00 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

**Table 2-7: Mediation test of product market competition (PMC) on the association between tax avoidance and investment inefficiency**

| | (1) ABS_INV | (2) Underinvestment | (3) Overinvestment |
|---|---|---|---|
| PMC as the mediator | | | |
| **Model (1) (without the mediator)** | | | |
| GAAP_ETR | **-0.0054*** ** | **-0.0037*** ** | **-0.0176*** ** |
| | **(-2.87)** | **(-4.02)** | **(-4.34)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 42,615 | 19,580 | 21,942 |
| Adj. R-squared | 0.21 | 0.37 | 0.22 |
| **Model (2) (with the mediator)** | | | |
| **GAAP_ETR** | **-0.0048**** | **-0.0038*** ** | **-0.0170*** ** |
| | **(-2.55)** | **(-4.13)** | **(-4.18)** |
| **PMC** | **0.0006*** ** | **-0.0001*** | **0.0007*** ** |
| | **(5.08)** | **(-1.70)** | **(2.88)** |
| Other controls | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes |
| Observations | 42,615 | 19,580 | 21,942 |
| Adj. R-squared | 0.21 | 0.37 | 0.22 |
| **Direct effect** | **-0.0048**** | **-0.0038*** ** | **-0.0170*** ** |
| **Indirect effect** | **-0.0006*** ** | **0.0001*** | **-0.0006*** ** |
| **Total effect** | **-0.0054*** ** | **-0.0037*** ** | **-0.0176*** ** |
| Sobel Z | -0.0005*** | -0.0001* | -0.0006*** |
| Z | (-4.72) | (1.68) | (-2.71) |
| (p-value) of Sobel Z | 0.00 | 0.09 | 0.00 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

## 2.5 Additional analysis

### 2.5.1 Corporate Tax Avoidance Alternative Methods

To check for the robustness of the empirical results reported in Table 2-4, I use alternative tax avoidance measures (CASH_ETR and SHELTER) to investigate the relationship between investment inefficiency and tax avoidance.

#### 2.5.1.1 Cash_ETR

CASH_ETR is computed as the cash tax paid (as disclosed in the cash flow statement) scaled over pre-tax accounting profit. This variable measures the proportion of cash tax paid in a particular year relative to a firm's profit. In accordance with Dyreng et al. (2010), low CASH_ETR values signify high levels of tax avoidance. I replace GAAP_ETR by CASH_ETR, and re-run Equation (5). The results are presented in Panel A of Table 2-8.

In Column (1) of Panel A, I observe that the coefficient of CASH_ETR is -0.0087 with p-value < 0.01, signifying that lower CASH_ETR is significantly correlated with higher ABS_INV. In another words, the higher the firm's level of tax avoidance, the greater its propensity for investment inefficiency. In Columns (2) and (3) which includes only observations of Underinvestment and Overinvestment, I also find that the coefficients of CASH_ETR are -0.0014 and -0.0148, respectively with p-value < 0.10 or better. The results suggest that lower CASH_ETR (i.e. higher tax avoidance) is associated with higher levels of underinvestment and overinvestment. In short, the results in Table 2-8 Panel A are very much similar to those reported in Table 2-4, giving more evidence to support the first hypothesis H1.

#### 2.5.1.2 SHELTER

SHELTER is computed using Wilson's Tax Shelter model which examines how the firm-level features are connected with tax sheltering actions (Wilson, 2009). In his model, he runs a logistic regression of a binary variable (SHELTER = 1, 0) against a set of independent variables that are correlated with tax sheltering, such as book–tax differences, discretionary accruals, leverage, total assets, return on assets, foreign pre-tax income and R&D expenditure. While it is likely that Wilson's Tax Shelter model produces noisy (i.e. out-of-sample) estimates, previous studies find that it offers a realistic proxy measure of tax avoidance (Hoi et al., 2013; Kim et al., 2011; Rego & Wilson, 2012). I consider a firm to participate in tax sheltering actions when the forecasted shelter odds can be found in the top quintile of the distribution. In line with Wilson (2009), a higher value of SHELTER signifies a higher chance

of engaging in tax avoidance. I replace GAAP_ETR variable in Equation (5) is by the SHELTER variable, and re-estimate the regression model, presenting the results in Panel B of Table 2-8. It is found that the coefficients of SHELTER for ABS_INV, Underinvestment and Overinvestment are 0.0037, 0.0007 and 0.0074, respectively, with p-value < 0.10 or better. The findings suggest that firms with higher tax sheltering actions (i.e. higher tax avoidance) exhibit greater propensity for investment inefficiency. My first hypothesis H1 is still supported using a different measure of tax avoidance[12].

**Table 2-8: Additional tests - Alternative proxies of tax avoidance**

| **Panel A: CASH_ETR as a new proxy of tax avoidance** | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | ABS_INV | Underinvestment | Overinvestment |
| **CASH_ETR** | **-0.0087*** ** | **-0.0014*** | **-0.0148*** ** |
| | **(-5.34)** | **(-1.72)** | **(-3.70)** |
| Constant | 0.0434*** | 0.0330*** | 0.0760** |
| | (4.22) | (5.41) | (2.48) |
| Controls | Yes | Yes | Yes |
| Year | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| N | 30,777 | 13,808 | 16,191 |
| adj. R-sq | 0.189 | 0.384 | 0.175 |

| **Panel B: SHELTER as a new proxy of tax avoidance** | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | ABS_INV | Underinvestment | Overinvestment |
| **SHELTER** | **0.0037*** ** | **0.0007*** | **0.0074*** ** |
| | **(5.16)** | **(1.72)** | **(5.08)** |
| Constant | 0.0331*** | 0.0337*** | 0.0513*** |
| | (7.00) | (12.89) | (3.46) |
| Controls | Yes | Yes | Yes |
| Year | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| N | 86,486 | 42,529 | 41,889 |
| adj. R-sq | 0.182 | 0.404 | 0.179 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

[12] I apply another test by using a subsample of the total number of subsidiaries of a firm incorporated in an OECD (2006) listed tax haven scaled by the total number of subsidiaries. The findings provide further support for H1.

### 2.5.2 Alternative measure of investment efficiency

In this section, I use a different measure of investment efficiency as a robustness test. Following Biddle et al. (2009), I use the residuals from the regression model below to measure the level of investment inefficiency.

$$Investment_{i,t} = \beta_0 + \beta_1\ REVGRWTH\%_{i,t-1} + \varepsilon_{i,t} \quad (8)$$

where Investment is the sum of the current year R&D expenditure, capital expenditure, and acquisition expenditure, less cash receipts from sale of property, plant, and equipment, scaled by total assets at the beginning of the year. REVGRWTH is the firm's sales growth at year t-1.

Following Biddle et al. (2009), Equation (8) is estimated for each industry-year, and the residuals from Equation (8) are sorted into quartiles. Firms are then classified into three groups: underinvestment firms (firms with residuals in the bottom quartile, i.e., the most negative residuals), overinvestment firms (firms with residuals in the top quartile, i.e., the most positive residuals), and the benchmark group (firms with residuals in the middle two quartiles). A multinomial logit model is subsequently estimated to predict the likelihood that a firm will be in one of the two extreme quartiles as opposed to the middle quartiles.

Using the alternative measure of investment inefficiency of Biddle et al. (2009), I re-estimate the regression model (5) and present the results in Table 2-9. It is clear that the GAAP_ETR variable is significantly negative with p-value <0.01 for firms with underinvestment and overinvestment. The results show that firms that engage in tax avoidance activities are more prone to overinvestment and underinvestment. These results confirm that firms with a high levels of tax avoidance exhibit greater propensity for investment inefficiency. The results are similar to those reported in Table 2-4, and robust to a different measure of investment efficiency.

**Table 2-9: Additional test - Alternative measure of investment inefficiency using Biddle et al. (2009)**

| | (1) Underinvestment | (2) Overinvestment |
|---|---|---|
| **GAAP_ETR** | **-0.2855*** ** | **-0.4925*** ** |
| | **(-2.94)** | **(-5.69)** |
| SIZE | -0.0646*** | -0.0425*** |
| | (-5.12) | (-4.54) |
| MTB | 0.0073 | 0.0743*** |
| | (0.83) | (8.59) |
| Z-SCORE | -0.0202*** | -0.0178*** |
| | (-3.83) | (-3.31) |
| Tangible | 0.4914*** | 1.2915*** |
| | (4.55) | (15.15) |
| K | 0.6295*** | -1.3932*** |
| | (6.85) | (-14.82) |
| K_IND | -7.3311*** | -1.0468*** |
| | (-23.02) | (-4.53) |
| CFOSALE | 0.0016 | -0.0173*** |
| | (0.41) | (-4.63) |
| SLACK | 0.0100*** | -0.0003 |
| | (6.09) | (-0.18) |
| DIV | -0.0355 | -0.1729*** |
| | (-0.82) | (-4.62) |
| AGE | 0.004 | -0.1878*** |
| | (0.16) | (-9.75) |
| LOSS | 0.1642*** | -0.0906*** |
| | (4.55) | (-2.58) |
| CFO5SD | -0.0593 | 0.0666 |
| | (-1.03) | (1.28) |
| SALE5SD | 0.1421** | 0.0552 |
| | (2.24) | (0.98) |
| INV5SD | 0.0298*** | 0.0033 |
| | (2.83) | (0.32) |
| CASH | -0.2117* | 0.7358*** |
| | (-1.90) | (8.23) |
| OP_CY | -0.0868*** | -0.1118*** |
| | (-3.81) | (-5.91) |
| Firm Cluster | YES | |
| Year | YES | |
| N | 53,451 | |
| Pseudo R2 | 0.0784 | |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

### 2.5.3 Propensity score matching (PSM)

Armstrong et al. (2010) contend that propensity score matching (PSM) decreases the prospect for bias owing to confounding variables. The objective of propensity score matching is to attain covariate equilibrium between treatment and control groups. I divide my sample into two groups based on the yearly mean level of GAAP_ETR. Firms below the median of ETR form the treatment group (ETR_DM =1) and those above the median of ETR form a control group (ETR_DM = 0). Covariate equilibrium is attained when the determinants of the treatment group (ETR_DM = 1) are comparable between the two groups (ETR_DM = 0 or 1). As a robustness check of my main regression results detailed in Table 2-4, I apply a propensity matching analysis in two main stages (see, e.g., Armstrong et al., 2012; Lennox, Lisowsky, & Pittman, 2013; Rosenbaum & Rubin, 1983; Shipman, Swanquist, & Whited, 2017). First, I run logit regression models for ETR_DM with the same set of control variables as in Equation (5). Essentially, the addition of these controls guarantees accurate equilibrium between treated and untreated subjects in the matched sample, which is one of the main principles of PSM (Austin, 2011; Shipman et al., 2017). The regression results of the first-stage logit model is presented in Panel A of Table 2-10. In Table 2-10 Panel B, none of the added covariates is remarkably distinct between the treatment (ETR_DM=1) and the control (ETR_DM=0) sub-samples, suggesting strong corroboration for my estimates.

Second, I form "nearest-neighbour" matched pairs for ETR_DM based on the propensity scores. The estimated coefficients in Panel A are used to calculate the propensity score for each firm-year observation. In a majority of the cases, the propensity scores are matched to two decimal places in the analysis. In Panel C of Table 2-10, it is shown that there is a statistically significant difference between the treated and control groups across all measures of investment inefficiency. I report the regression results based on the matched samples in Panel D of Table 2-10. Consistent with the results presented in Table 4, I continue to find that the coefficient of GAAP_ETR is significantly negative with p-value < 0.01 (being -0.0092, -0.0057, and -0.0266 for ABS_INV, Underinvestment, and Overinvestment, respectively). This implies that the higher a firm's level of tax avoidance, the greater its propensity for investment inefficiency. Consequently, this result supports my conjecture for H1 that there is a positive correlation between corporate tax avoidance and investment inefficiency.

**Table 2-10: Additional test - Propensity score matching (PSM) analysis**

| **Panel A: First stage logit regression** | |
|---|---|
| | First Stage ETR |
| SIZE | -0.1353*** |
| | (-27.78) |
| MTB | -0.0000 |
| | (-0.02) |
| Z-SCORE | -0.1830*** |
| | (-30.30) |
| Tangible | 0.1998*** |
| | (3.60) |
| K | 0.2061*** |
| | (4.70) |
| K_IND | -0.2171 |
| | (-1.26) |
| CFOSALE | -0.0489*** |
| | (-8.61) |
| SLACK | -0.0017 |
| | (-1.39) |
| DIV | 0.0743*** |
| | (3.63) |
| AGE | -0.0253** |
| | (-2.34) |
| LOSS | 0.1260*** |
| | (5.89) |
| CFO5SD | 0.2821*** |
| | (6.71) |
| SALE5SD | 0.1573*** |
| | (4.41) |
| INV5SD | 0.0456*** |
| | (6.56) |
| CASH | 0.6634*** |
| | (11.75) |
| OP_CY | 0.0166 |
| | (1.18) |
| Constant | -0.2172 |
| | (-1.32) |
| Year | Yes |
| Industry | Yes |
| N | 76,229 |
| Pes_Adj_R-square | 0.0860 |

**Panel B. Covariate balance more ETR versus less ETR sub-samples**

| | NN Treated | NN Control | %bias |
|---|---|---|---|
| SIZE | 4.67 | 4.66 | 0.10 |
| MTB | 2.64 | 2.55 | 2.40 |
| Z_SCORE | 0.00 | 0.05 | -1.20 |
| Tangible | 0.27 | 0.26 | 2.80 |
| K | 0.18 | 0.18 | -0.50 |
| K_IND | 0.18 | 0.18 | -0.90 |
| CFOSALE | -0.60 | -0.51 | -3.20 |
| SLACK | 2.80 | 3.05 | -3.00 |
| DIV | 0.29 | 0.29 | 0.80 |
| AGE | 2.40 | 2.39 | 0.30 |
| LOSS | 0.47 | 0.48 | -2.20 |
| CFO5SD | 0.17 | 0.19 | -5.50 |
| SALE5SD | 0.28 | 0.29 | -4.70 |
| INV5SD | 0.61 | 0.65 | -2.90 |
| CASH | 0.19 | 0.19 | -1.20 |
| OP_CY | 4.66 | 4.67 | -1.50 |

**Panel C: Average Treatment Effects for PSM approach.**

| | Sample | Treated | Controls | Difference | S.E. | T-stat |
|---|---|---|---|---|---|---|
| ABS_INV | Unmatched | 0.04 | 0.04 | 0.01 | 0.00 | 10.86 |
| | ATT | 0.04 | 0.04 | 0.00 | 0.00 | 4.07 |
| Underinvestment | Unmatched | 0.03 | 0.02 | 0.00 | 0.00 | 14.33 |
| | ATT | 0.03 | 0.03 | 0.00 | 0.00 | 3.30 |
| Overinvestment | Unmatched | 0.07 | 0.05 | 0.01 | 0.00 | 10.65 |
| | ATT | 0.07 | 0.06 | 0.01 | 0.00 | 3.40 |

**Panel D: Second Stage - Regression result – PSM**

| | (1) | (2) | (3) |
|---|---|---|---|
| | ABS_INV | Underinvestment | Overinvestment |
| **GAAP_ETR** | **-0.0092*** ** | **-0.0057*** ** | **-0.0266*** ** |
| | **(-4.85)** | **(-6.48)** | **(-5.10)** |
| SIZE | -0.0034*** | -0.0020*** | -0.0074*** |
| | (-19.94) | (-24.26) | (-16.56) |
| MTB | 0.0023*** | -0.0001 | 0.0039*** |
| | (9.74) | (-0.88) | (6.34) |
| Z_SCORE | 0.0006*** | 0.0000 | 0.0001 |
| | (3.63) | (0.50) | (0.12) |
| Tangible | 0.0844*** | -0.0058*** | 0.1298*** |
| | (33.18) | (-4.48) | (20.34) |
| K | -0.0244*** | 0.0019** | -0.0409*** |
| | (-15.20) | (2.30) | (-8.95) |
| K_IND | 0.0103 | 0.0287*** | 0.0261* |
| | (1.47) | (7.40) | (1.68) |
| CFOSALE | -0.0001 | -0.0001** | -0.0008 |
| | (-0.71) | (-2.21) | (-1.00) |
| SLACK | -0.0001*** | 0.0001*** | -0.0007*** |
| | (-4.06) | (3.56) | (-3.22) |
| DIV | -0.0066*** | -0.0012*** | -0.0074*** |
| | (-9.99) | (-3.54) | (-4.93) |
| AGE | -0.0057*** | 0.0001 | -0.0091*** |
| | (-14.32) | (0.27) | (-9.77) |
| LOSS | -0.0034*** | 0.0037*** | -0.0006 |
| | (-3.94) | (10.22) | (-0.23) |
| CFO5SD | -0.0002 | -0.0012** | 0.0000 |
| | (-0.13) | (-2.34) | (0.00) |
| SALE5SD | 0.0013 | -0.0003 | 0.0004 |
| | (0.84) | (-0.43) | (0.09) |
| INV5SD | 0.0021*** | 0.0002 | 0.0051*** |
| | (5.12) | (1.44) | (4.17) |
| CASH | 0.0102*** | 0.0001 | 0.0205*** |
| | (5.27) | (0.16) | (3.53) |
| OP_CY | 0.0012* | 0.0000 | 0.0014 |
| | (1.90) | (0.17) | (0.81) |
| Constant | 0.0367*** | 0.0361*** | 0.0662*** |
| | (6.20) | (11.38) | (3.57) |
| Year | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| N | 60,989 | 29,206 | 30,174 |
| adj. R-sq | 0.193 | 0.403 | 0.192 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

### 2.5.4 Difference-in-Difference analysis

It is possible that the main regression results reported in Table 2-4 could be affected by endogeneity (e.g. direction of causality) leading to biased regression coefficients. I conduct a difference-in-difference (DID) test to address the potential issue of endogeneity in this study (e.g., Roberts & Whited, 2013; Wooldridge, 2010). I use the introduction of Schedule *Uncertain Tax Positions* (UTP) in 2010 as the exogenous event. Schedule UTP requires corporations that disclose uncertain tax positions in their financial statements and to provide additional information in their income tax returns regarding uncertain tax positions that affect US federal income tax liabilities. Schedule UTP (effective from 15th December, 2010) should be lodged with a corporation's income tax return for the 2010 tax year onwards under Treasury Regulation Section 1.6012-2(a)(4) and (5).

To apply the DID test based on the Schedule UTP event, I split my sample into two sub-period groups initially by creating an indicator variable UTP_10 equal to 1 if the sample period is post the event (i.e. 2010-2016) and 0 if pre the event (1993-2009). The UTP_10 variable distinguishes the consequence of tax avoidance on investment inefficiency before the Schedule UTP event (control group) and after the Schedule UTP event (treatment group). I then create interaction terms GAAP_ETR*UTP_10, GAAP_ETR*UTP_10*BOG, and estimate the following regression model:

$$\begin{aligned} INVEFF_{i,t} = {} & \alpha_0 + \beta_1 GAAP\_ETR_{it} + \beta_2\, UTP_{10} + \beta_3\, GAAP\_ETR_{it} * UTP_{10} + \beta_4\, BOG \\ & + \beta_5\, GAAP\_ETR_{it} * UTP_{10} * BOG + \beta_{11} SIZE + \beta_{12} MTB + \beta_{13} ZSCORE \\ & + \beta_{14} Tangible + \beta_{15} K + \beta_{16} K\_IND + \beta_{17} CFOSALE + \beta_{18} SLACK \\ & + \beta_{19} DIV + \beta_{20} AGE + \beta_{21} LOSS + \beta_{22} CFO5SD + \beta_{23} SALE5SD \\ & + \beta_{24} INV5SD + \beta_{25} CASH + \beta_{26} OPCY + Firm + Year \\ & + \varepsilon \end{aligned} \quad (9)$$

The regression results for the DID test are shown in Table 2-11. I find that GAAP_ETR is negatively associated with each of the three measures of investment inefficiency. Firms that engage in more tax avoidance are more likely to invest inefficiently. Implementation of the Schedule UTP requirements means that there will be a greater nexus between financial reporting and tax reporting as firms will have to provide data and information in their financial statements aligned with what they are reporting in their tax filings. The coefficient on the interaction term between GAAP_ETR*UTP_10, which represents the DID, is negative and significant in all three models with p-value < 0.05 or better. Despite the greater nexus between financial and tax reporting following the Schedule UTP reporting requirements, the negative relationship between GAAP_ETR and each of measures of investment inefficiency are magnified. For instance, in Column (1) of Table 2-11, the coefficient of GAAP_ETR in the period post implementation of UTP is -0.0070 + (-0.2707) =

-0.2777 for ABS_INV. Similar results are reported in Columns (2) and (3) for Underinvestment and Overinvestment.

The coefficient of the BOG variable is significantly positive for ABS_INV, Underinvestment, and Overinvestment with p-values < 0.10 or better, indicating that the higher the level of BOG (i.e., financial statement obscurity), the more likely the firm will invest inefficiently. In addition, the interaction variable GAAP_ETR*UTP10*BOG is positively significant (p-value < 0.10 or better) for all three measures of investment efficiency. This result suggests that BOG is driving an outcome where the lower the effective tax rate and the higher the level of financial statement obscurity, the greater the increase in investment inefficiency for the post UTP period. Finally, for the control variables, I find that the signs of the regression coefficients for SIZE, Tangible, K, SLACK, DIV, AGE, LOSS and INV5SD are consistent with the predicted signs and are statistically significant with p-values < 0.10 or better.

**Table 2-11: Additional test - Difference-in-Difference (DID) analysis**

| | (1) ABS_INV | (2) Underinvestment | (3) Overinvestment |
|---|---|---|---|
| **GAAP_ETR** | **-0.0070*** ** | **-0.0036*** ** | **-0.0212*** ** |
| | **(-3.18)** | **(-3.64)** | **(-3.38)** |
| UTP10 | -0.004 | -0.0108*** | -0.0052 |
| | (-1.49) | (-6.16) | (-0.90) |
| GAAP_ETR*UTP10 | -0.2707*** | -0.1167** | -0.5439*** |
| | (-2.79) | (-1.97) | (-2.74) |
| BOG | 0.0112*** | 0.0037* | 0.0189** |
| | (2.80) | (1.91) | (2.02) |
| **GAAP_ETR*UTP10*BOG** | **0.0615*** ** | **0.0258* ** | **0.1235*** ** |
| | **(2.81)** | **(1.93)** | **(2.77)** |
| Constant | -0.0141 | 0.0235** | -0.0211 |
| | (-0.76) | (2.48) | (-0.46) |
| Controls | Yes | Yes | Yes |
| Year | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| N | 50,023 | 24,656 | 26,044 |
| adj. R-sq | 0.195 | 0.415 | 0.192 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

### 2.5.5 Two-stage least squares (2SLS) regression analysis

I conduct a 2SLS test to address the potential issue of endogeneity (e.g., Wooldridge, 2010). Hasan, Hoi, Wu, and Zhang (2014) propose that a firm's engagement in tax avoidance activities relies on the tax avoidance practices of its industry peers. Following Hasan et al. (2014) and Cook, Moser, and Omer (2017), I use industry-median tax avoidance (ETR_MEDIAN) as the instrumental variable to capture the endogenous variable (GAAP_ETR). ETR_MEDIAN is measured as the median value of GAAP_ETR in a two-digit SIC code industry and year. For the first-stage regression, I use the following equation to predict GAAP_ETR:

$$\begin{aligned} GAAP\_ETR_{it} = {} & \alpha_0 + \beta_1 \text{ETR\_MEDIAN}_{it} + \beta_2 SIZE + \beta_3 MTB + \beta_4 ZSCORE \\ & + \beta_5 Tangible + \beta_6 K + \beta_7 K\_IND + \beta_8 CFOSALE + \beta_9 SLACK \\ & + \beta_{10} DIV + \beta_{11} AGE + \beta_{12} LOSS + \beta_{13} CFO5SD + \beta_{14} SALE5SD \\ & + \beta_{15} INV5SD + \beta_{16} CASH + \beta_{17} OPCY + Firm \\ & + Year \end{aligned} \quad (10)$$

Table 2-12 Column (1) reports the regression result of the first-stage regression model. I find that $ETR\_MEDIAN_{it}$ is significantly associated with $GAAP\_ETR_{it}$ (p<0.01). The second-stage regression results are shown in Table 2-12 Columns (2)-(4). I continue to find that the coefficient of $GAAP\_ETR_{it}$ is significantly negative with p-values < 0.01 for all measures of investment inefficiency (ABS_INV, Underinvestment, and Overinvestment). This implies that the higher a firm's level of tax avoidance, the greater its propensity for investment inefficiency. Consequently, this result provides further evidence to support H1 in that there is a positive relationship between corporate tax avoidance and investment inefficiency.

**Table 2-12: Additional test - Two-stage least squares (2SLS) regression analysis**

| | (1) First-stage model | (2) ABS_INV | (3) Underinvestment | (4) Overinvestment |
|---|---|---|---|---|
| **GAAP_ETR** | | **-0.1405*** ** | **-0.0836*** ** | **-0.0251*** ** |
| | | **(-5.89)** | **(-6.81)** | **(-5.29)** |
| ETR_MEDIAN | 0.2270*** | | | |
| | (22.70) | | | |
| SIZE | 0.0134*** | -0.0014*** | -0.0006*** | -0.0043*** |
| | (37.69) | (-4.15) | (-2.94) | (-6.87) |
| MTB | -0.0003 | 0.0020*** | -0.0001 | 0.0035*** |
| | (-1.62) | (10.39) | (-1.26) | (6.97) |
| Z-SCORE | 0.0028*** | 0.0009*** | 0.0002*** | 0.0009 |
| | (14.86) | (5.44) | (4.97) | (1.58) |
| Tangible | -0.0260*** | 0.0791*** | -0.0092*** | 0.1183*** |
| | (-6.43) | (31.65) | (-6.83) | (18.76) |
| K | -0.0120*** | -0.0259*** | 0.0012 | -0.0447*** |
| | (-3.05) | (-16.02) | (1.40) | (-9.39) |
| K_IND | -0.0367*** | 0.0059 | 0.0279*** | 0.0125 |
| | (-2.88) | (0.86) | (6.76) | (0.85) |
| CFOSALE | 0.0011*** | 0.0002 | 0.0001* | -0.0000 |
| | (11.12) | (1.49) | (1.940 | (-0.11) |
| SLACK | 0.0002** | -0.0001*** | 0.0001*** | -0.0006*** |
| | (2.45) | (-5.58) | (4.98) | (-4.82) |
| DIV | 0.0009 | -0.0066*** | -0.0010*** | -0.0078*** |
| | (0.60) | (-10.18) | (-2.71) | (-5.26) |
| AGE | 0.0034*** | -0.0051*** | 0.0004** | -0.0076*** |
| | (4.37) | (-13.15) | (1.99) | (-8.61) |
| LOSS | -0.1099*** | -0.0194*** | -0.0048*** | -0.0315*** |
| | (-54.03) | (-6.96) | (-3.52) | (-4.62) |
| CFO5SD | -0.0159*** | -0.0014 | -0.0025*** | 0.0001 |
| | (-8.96) | (-0.81) | (-5.28) | (0.02) |
| SALE5SD | -0.0082*** | 0.0014 | 0.0001 | -0.0019 |
| | (-3.11) | (0.94) | (0.18) | (-0.39) |
| INV5SD | -0.0053*** | 0.0010*** | -0.0002 | 0.0025** |
| | (-11.26) | (2.69) | (-1.30) | (2.20) |
| CASH | -0.0870*** | -0.002 | -0.0062*** | -0.0121 |
| | (-22.79) | (-0.73) | (-5.37) | (-1.47) |
| OP_CY | -0.001 | 0.0016*** | 0.0004* | 0.0016 |
| | (-1.18) | (3.13) | (1.78) | (1.08) |
| Constant | 0.1961*** | 0.0668*** | 0.0503*** | 0.1343*** |
| | (15.82) | (8.07) | (11.67) | (5.45) |
| Year | Yes | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes | Yes |
| N | 69,332 | 69,332 | 32,926 | 34,695 |
| adj. R-sq | 0.306 | 0.109 | 0.224 | 0.084 |

***, **, and * represent statistical significance at the 1%, 5%, and 10% level respectively (two-tailed test).

## 2.6 Conclusion

Prior studies suggest that firms use the cash tax savings from tax avoidance activities to fund their investments. However, there is a lack of research as to whether firms use cash tax savings from tax avoidance activities to fund their investments efficiently. I add to the literature by examining how efficiently this internally-generated cash is invested. Using different measures of tax avoidance and investment efficiency, I show that the there is a positive association between cash tax savings from tax avoidance activities and investment inefficiency. This study provides evidence that firms' cash tax savings from avoidance activities are not efficiently used. I also contribute to the literature by examining the direct and indirect (i.e. mediation) effects of corporate tax avoidance on investment efficiency. I find that the effect of cash tax savings from tax avoidance activities on investment inefficiency is mediated by financial statement readability, financial statement comparability, and product market competition. The results are robust to endogeneity tests that control for omitted variables, reverse causality, or model misspecification problems.

Future research in this area could consider the relation between investment efficiency and the propensity of firms' to retain earnings offshore in tax haven or other jurisdictions. Some two trillion USD is currently retained offshore by U.S. multinationals with flow on implications in terms of cost of capital, the ability to borrow and the liquidity risk a firm is exposed to. These factors will have flow-on implications in terms of the ability and motivation of management to fund their investments efficiently. In particular, further work in this area would be of interest to capital market participants and governments given the economic impacts relating to employment, capital growth and capital flows.

## Appendix 2-A: Chapter 2 variables definition

| Variables | Definition |
|---|---|
| **Dependent variables** | |
| ABS_INV | The absolute value of the difference between the firm's actual investment and industry-year median investment. |
| Underinvestment | If the difference between a firm's actual investment and industry-year median investment is negative. |
| Overinvestment | If the difference between a firm's actual investment and industry-year median investment is positive. |
| **Independent variables** | |
| GAAP_ETR | Total tax expense (consisting of current and deferred tax expenditure) scaled by pre-tax book income minus special items. |
| **Control variables** | |
| SIZE | Natural logarithm of market value scaled by total assets. |
| MTB | The ratio of the market value of equity scaled by the book value of equity. |
| Z-SCORE | Financial distress by Altman (1968)'s model. |
| Tangile | The ratio of property, plant and equipment (PPE) to total assets |
| K | The ratio of long-term debt to the summation of long-term debt to the market value of equity. |
| K_IND | The mean K values for all firms in the similar SIC 3-digit industry. |
| CFOSALE | The ratio of operating cash flows to sales. |
| SLACK | The ratio of cash to property, plant and equipment (PPE). |
| DIV | An indicator variable equals to one when the firm paid a dividend zero otherwise. |
| AGE | The difference between the first year when the firm appears in CRSP database and the current year. |
| LOSS | An indicator variable that takes the value of one if net income before extraordinary items is negative, and zero otherwise. |
| CFO5SD | The standard deviation of a firm's scaled operating cash flows over the prior five years. |
| SALE5SD | The standard deviation of a firm's scaled sales over the prior five years. |
| INV5SD | The standard deviation of a firm's scaled investment over the prior five years. |
| CASH | The ratio of cash and short-term investments to assets (CHE/AT) . |
| OP_CY | The log of receivables to sales plus inventory to COGS multiplied by 360. |
| **Mediating variables** | |
| BOG | The Bog Index, reported by Editor Software's Stylewriter 4, provides a comprehensive measure of a document's plain English problems, including passive voice, redundant verbs, use of jargon, and sentence complexity, among others. |
| PMC | Product market fluidity reveals variations in a firm's product space owing to decisions that the firm's product |

| | |
|---|---|
| | market rivals make. A higher value of fluidity is equivalent to the fact that a firm is faced with greater competitive pressures with respect to its product market. Following Hoberg et al. (2014), a measure of firm-level competitive pressures is built on the depiction of firms' product space and competitor moves in their 10-K's. |
| COMP | Firm-year level accounting comparability, which is the industry mean of comparability combinations for firm *i* and other firms in the same 2-digit SIC in a given year. |

# Chapter 3 Accounting Reporting Complexity, Unrecognized Tax Benefits and Industry-Specialist Auditors

## 3.1 Introduction

Accounting reporting complexity is a complication encountered by preparers in communicating the economic substance of a transaction or event and the financial outputs of a company (SEC, 2008). Over the past two decades, regulators and standard setters highlight that financial reporting has become increasingly complicated (FRC, 2009; SEC, 2008). Consequently, the Securities and Exchange Commission (SEC) and the Financial Accounting Standards Board (FASB) developed initiatives to enhance the understanding and simplification of financial reports (e.g. FASB, 2016; SEC, 2008). The adoption of the eXtensible Business Reporting Language (XBRL) for financial reporting, over three phase-in periods, became mandatory for U.S. public companies in April 2009.[13] This requires firms to file interactive financial reports by SEC registrants, using tags for financial statements, company identification information, financial schedules, and footnote disclosures with XBRL taxonomies (SEC, 2009). A crucial justification for this regulatory mandate is that XBRL reporting leads to a reduction in information processing costs relating to retrieving, processing, and analysing precise and comparable accounting information (Cox, 2008; Hodge, Kennedy, & Maines, 2004; Janvrin, Pinsker, & Mascha, 2013; SEC, 2009; XBRL U.S., 2009).

XBRL is a digital program that allows companies to tag all the quantitative components in the financial statements and footnotes. This tagging procedure is dependent on the XBRL U.S. GAAP Financial Reporting Taxonomy, a digital dictionary of computer-readable XBRL tags of GAAP accounting concepts and descriptive information. When completing 10-K reports, firms need to convert their financial statements and notes into XBRL. Increased use of accounting standards and accounting policies increases the number of XBRL tags, and this increase will translate into more complex financial statements (SEC,

[13] XBRL makes provision for a computerized language for financial reporting. When compared with other data sources, its benefit is the possibility of reading, and extracting of information in the financial reports automatically by computers in the absence of human intervention. Leaving traditional financial reports for XBRL depends on the U.S. GAAP Taxonomy, which is an electronic dictionary of business reporting that helps with the definition of tags in the representation of accounting concepts (Taxonomy tags). When there is failure of taxonomy in capturing company-specific financial reporting concepts, companies need to extend the taxonomy and create their own company-specific tags (Extended tags).

2009). Consequently, a greater number of XBRL tags results in the need for preparers to gather, classify, store, and analyse more information, and this process requires a greater knowledge of GAAP. Hoitash and Hoitash (2018), who used an ARC measure that is based on the count of XBRL accounting items, report that increased ARC creates challenges for preparers, leading to financial reports that are more vulnerable to misapplications and errors of GAAP.

In this chapter, I examine the relationship between ARC and unrecognized tax benefits (thereafter UTBs)[14]. I predict that firms with more complex annual reports report higher UTBs. Complexity is manifested through an increase in the number of XBRL tags. Obfuscated financial reports may be generated through incorrect use of extended tags instead of taxonomy tags (Debreceny et al., 2011; Guragai et al., 2017). Previous studies show that adoption of XBRL reduces information asymmetry between corporate insiders and outside stakeholders (Kim, Lim, & No, 2012), enlarges the investor base or breadth of ownership (Kim, Li, & Liu, 2019), improves analyst forecast quality (Liu, Wang, & Yao, 2014), lowers the cost of capital (Li, Ni, & Lin, 2012), increases company-specific information capitalized into stock prices (Dong, Li, Lin, & Ni, 2016), and reduces credit default swap spreads (Griffin, Hong, Kim, & Lim, 2014).

This study is motivated to examine the relationship between UTBs and ARC for a number of important reasons. Management may utilise XBRL tags to make accounting disclosures more complex in order to facilitate or preserve agency related activities designed to increase their welfare (Hoitash & Hoitash, 2018). Firms that generate financial reports characterized by high ARC have a less comparable information content (Lehavy et al., 2011; Li, 2008; Peterson, 2012; You & Zhang, 2009), increase financial misstatement risk (Filzen & Peterson, 2015; Hoitash & Hoitash, 2018), and obfuscate financial reports (Li, 2008; Lo et al., 2017). Li (2008) shows that firms characterized by comparatively less readable reports have lower and less consistent earnings. You and Zhang (2009) find that companies with longer 10-K filings experience more delays in the market reaction to credible information contained in those reports.

Consistent with Hoitash and Hoitash (2018), I measure ARC using the natural log of the total number of discrete monetary XBRL tags in Item 8 of 10-K filings. Each XBRL tag refers to an accounting standard and supporting regulations.[15] Using 22,181 U.S. firm-year

[14] The definition of ARC is provided in Section 3.2.

[15] There are three general categories of complexity utilized in accounting research. They include operating, linguistic, and accounting-based complexity. Operating complexity refers to the degree of complex business operations such as the number of business segments and the existence of foreign operations. Although these measures of operating complexity are likely to be associated with accounting complexity, they do not vary significantly across and within firms, and do not have a direct, fundamental basis in accounting disclosures. The Gunning Fog Index is commonly used as a measurement of linguistic complexity followed by the length of 10-K filings (Loughran & McDonald, 2014). While linguistic complexity captures the written record of the financial reports, there is often no difference between accounting and non-accounting information. Accounting-based

observations over the 2011-2019 period, I find that there is a significant and positive association between ARC and UTBs. In terms of economic significance, a one standard deviation increase in ARC increases UTBs by 7.13%. In addition, I find that employment of an industry-specialist auditor moderates the positive association of ARC and UTBs. The results remain robust to different components of UTBs, alternative specifications of UTBs, of ARC, and of industry-specialist auditors. Further, the baseline results are supported by endogeneity tests that comprise a difference-in-difference (DID) test using the Tax Cut Job Act (TCJA) as the exogeneous event, the number of words that comprise firms' tax footnotes, and propensity score matching (PSM).

I contribute to the literature in several ways. First, I offer a methodological contribution based on my construction and use of financial reporting complexity. In fact, my measure of ARC captures increments in complexity based on the layout and narrative of accounting and financial reporting information. Prior studies rely on linguistic complexity as a proxy for complexity (Bozanic & Thevenot, 2015; Hoitash & Hoitash, 2018; Li, 2008; Loughran & McDonald, 2014). However, linguistic complexity relies on the disclosed narrative of financial reports, and is unable to differentiate between accounting and non-accounting information.

Second, to the best of my knowledge, no prior study has tested the relationship between ARC and UTBs. My observation is that there is a positive relationship between ARC and UTBs. This relationship is important for a number of reasons. Plumlee (2003) finds that the errors in the forecasts of analysts, increase with more complex tax law changes. Peterson (2012) shows that there is an increased likelihood of revenue-related restatements as a consequence of revenue-recognition complexity increments. In order to obfuscate their rent and to increase the complexity of accounting reporting, managers can deliberately increase ARC through an increase in the number of inappropriately allocated XBRL tags. Hanlon and Heitzman (2010) argue that UTBs measure tax uncertainty and risk because higher UTBs create additional uncertainty in the tax positions of firms. If firms manipulate the way in which accounting information is reported via XBRL tags, this may exacerbate the uncertainty pertaining to UTB estimates. The reason for this is that following the introduction of Uncertain Tax Position (UTP) reporting requirements in 2010, there is a greater nexus between tax

complexity depends on accounting information for the measurement of complexity. Plumlee (2003) adopts changes in the Tax Reform Act of 1986, and reports that analysts' forecast errors increase when there are changes in complex tax law. Peterson (2012) observes an increment in the likelihood of revenue-related restatements by revenue-recognition complexity. Chang, Donohoe, and Sougiannis (2016) show precise and more dispersed earnings forecasts among companies using derivatives. Hoitash and Hoitash (2018) argue their unique measure is superior, owing to its dependence on every monetary accounting disclosure in Item 8 of the 10-K filings, and it is a broader firm-level measure of accounting complexity.

reporting and financial reporting requirements, in that firms tax filings and tax footnotes require use of both tax and financial information.

Third, I investigate the impact of industry-specialist auditor on the association between ARC and UTBs. Prior studies show that audit specialization is related to higher audit quality (Audousset-Coulier et al., 2016; Dunn & Mayhew, 2004; Ho & Kang, 2013; Reichelt & Wang, 2010). Prior researches also show that a delay in audit or diminished audit quality could arise from increased accounting complexity (Bronson et al., 2011; Ettredge et al., 2006). Increased audit risk could stem from higher financial complexity and, hence, auditors will need to put in more effort and/or charge a fee premium to compensate for the added risk (Bedard & Johnstone, 2004). Thus, it is possible that employment of industry-specialist auditors moderates the positive association between ARC and UTBs. Given that auditors are pervasive, heterogeneous in their expertise and exert considerable influence on the U.S. corporate landscape, their influence on the relationship between ARC and UTBs makes this study important.

The reminder of this chapter organised as follows. Section 3.2 provides background of UTBs and ARC. The theory and hypothesis development are provided in Section 3.3, and the research design is in Section 3.4. The empirical results reports in Section 3.5 and in Section 3.6 reports additional analyses. Section 3.7 concludes the study.

## 3.2 Background of UTBs and ARC

### 3.2.1 UTBs

Financial Interpretation No. 48 (FIN48, now ASC740-10-25) prescribes recognition, measurement, and disclosure standards for contingent tax liabilities. FIN 48 became effective for fiscal years after December 15, 2006. UTBs are a reserve disclosed in the tax footnote that accounts for the possibility that the firm's uncertain tax positions will be overturned by audit or tax authorities. In doing so, it mandates a two-step recognition and measurement procedure, with each step requiring significant managerial judgment.

In the recognition step, the firm assesses whether a given position on its tax return is more-likely-than-not to be sustained upon examination by the relevant tax authority. This assessment requires the assumption that the tax authority will audit the position and has knowledge of all relevant information, so that the likelihood assessment is made solely on the technical merits of the position. If a position does not meet the more-likely-than-not threshold, its tax benefit is not recognized in the income statement but reserved as a contingent liability in the form of an unrecognized tax benefit. If a position meets the more-likely-than-not threshold, the firm will recognize a portion or all of its tax benefit as a reduction in tax expense,

so the firm proceeds to the measurement step. In the measurement step, the firm determines the greatest amount of tax benefit that is greater than 50% likely to be "realized upon ultimate settlement with the tax authority that has full knowledge of all relevant information" (FASB, 2006). The firm recognizes the amount that meets the 50% measurement threshold as a reduction in tax expense in the financial statements. The amount that fails to meet the 50% measurement threshold is reserved as an unrecognized tax benefit.

### 3.2.2 ARC

The priority of the SEC and the FASB is to simplify reporting or to reduce the complications involved in reporting (Baudot, Demek, & Huang, 2018; FASB, 2012; Murphy, 2015; SEC, 2008 , 2016). The Advisory Committee on Improvements to Financial Reporting (ACIFR) defines accounting complexity as a complication encountered by preparers in the perfect application of normally accepted accounting principles in the U.S. (U.S. GAAP) and in communicating the economic substance of a transaction or event along with the total financial and outputs of a company. The committee highlights two origins of reporting complexity based on accounting: the inherent difficulty in understanding the application of some standards; and the number and variety of accounting standards and their reporting requirements.

### 3.2.3 Source of ARC

With the elasticity in XBRL reporting format, filers can generate their own XBRL tags to communicate unique and/or non-standard financial statement line items (SEC, 2009). Specially, managers can use the extensions to communicate unique financial concepts that are missing or inadequately reflected in standard definitions (Boritz & No, 2005) and, in doing so, increase not only the level of details, but also the relevance of the financial statement information in line with the SEC's objectives (SEC, 2004). Prior research argues that complexity in accounting reporting could come from the business operations of a company, the use of multiple accounting standards, the nature of language utilised in financial reports, and the information communication intentions of firm management. Managers may use ARC for obfuscating information communicated to the stakeholders of their companies. For instance, Li (2008) shows that managers use ARC as a strategic means for hiding unfavourable information. Similarly, Lo et al. (2017) find that companies that are about to meet or have just met the earnings of the previous years have less readable MD&A sections in the 10-K reports,

indicating that complexity of financial information can be employed by managers to obfuscate that information.

Other research argues that the major factors driving ARC include business operations and complex accounting standards and regulations. Similar to Li (2008), Bloomfield (2008) reports that firms with lower earnings quality have less readable reports in terms of difficulty in seeing losses and transient income. Guay et al. (2016) show that the managers of firms having high ARC increase non-mandatory reporting, implying that there is an opportunistic use of ARC by managers. Dyer, Lang, and Stice-Lawrence (2017) suggest that the growing trend in 10-K report length is a result of accounting standards alterations in three important areas, namely, upright value or impairments, risk factors, and internal controls. According to Bushee, Gow, and Taylor (2018), complex language in the conference call of the company earnings mitigates the provision of informative disclosure. Asay, Libby, and Rennekamp (2018) show that managers make disclosures that are more readable when good information reveals favourable performance, and their intention is to obscure poor performance by making disclosures that are less readable. Using an accounting complexity measure that is based on the count of XBRL accounting items, Hoitash and Hoitash (2018) find that increased accounting complexity presents challenges for preparers, leading to financial reports that are more susceptible to errors and misapplications of GAAP.

## 3.3 Literature review and hypothesis development

### 3.3.1 ARC and UTB

When a company adopts XBRL,[16] there are information processing cost savings through the elimination of expensive manual collection of data that facilitate comparison of financial data across firms (Cox, 2006; Hoffman & Strand, 2001; Pinsker & Li, 2008; SEC, 2009 , and more). Additionally, a reduction in external monitoring by outside users is achievable through faster access to data (Alles & Piechocki, 2012; Cohen, Schiavina, & Servais, 2005; Gray & Miller, 2009; Premuroso & Bhattacharya, 2008).

Prior studies have explored the effect of XBRL on equity markets. Kim et al. (2012) show that investors value information efficiency increment, event return volatility decrement,

[16] It was made mandatory by the SEC for companies to have a three-year phase-in outlook to adopt XBRL for the Securities Act registration statements starting from 2009. Those who file statements are also to engage in the tagging of their financial reports at various levels for the first year of adoption and beyond. Compliance with XBRL reporting requirements for fiscal periods that end on or beyond June 15, 2009 is required for companies with faster filers filing U.S. GAAP financial statements and having a global public float beyond $5 billion (Phase I filers). Companies with a global public float between $700 million and $5 billion need to comply with XBRL reporting requirements for fiscal periods that end on or beyond June 15, 2010 (Phase II filers). The rest is to comply with XBRL reporting requirements for fiscal periods that end on or beyond June 15, 2011 (Phase III filers).

and reduction in volatility of stock return changes. Similarly, Efendi, Park, and Smith (2014) find a reduction in post-earnings announcement drift for good news companies during the post-XBRL adoption era. Li et al. (2012) report a reduction in the cost of equity capital following the adoption of XBRL. Liu et al. (2014) report that for Phase I XBRL adoption companies, the relationship between XBRL reporting and analyst forecast quality is strengthened in the second year, rather than in the first year of adoption. Kim, Li, et al. (2019) show a strong impact of XBRL reporting on the investor base in post-XBRL adoption period. Furthermore, Dong et al. (2016) find that XBRL firms are characterized by a reduction in stock price synchronicity through timelier and more precise information flow. Additionally, Chen, Kim, Lim, and Zhou (2018) find that firms are charged lower loan rates by banks and other private lenders if they adopt XBRL.

Mishkin and Strahan (1999) and Ho and Mallick (2010) propose that the reduction in contracting costs through technologies could also bring a reduction in information processing costs among financial institutions, such as cost reductions in loan spread. In contrast, Blankespoor (2019) find that companies that adopt XBRL usually have higher anomalous bid-ask spreads around 10-K filing dates, as rational investors have the opportunity to use their higher-level resources and processing capabilities to obtain more trading benefits from XBRL.

Previous studies also consider elements of linguistic disclosure "readability" to estimate ARC (Bozanic & Thevenot, 2015; Li, 2008; Loughran & McDonald, 2014). Hoitash and Hoitash (2018) propose a new measure of ARC based on the number of XBRL tags disclosed in 10-K fillings. This measure weights accounting complexity, under the assumption that there is more mention of accounting standards in further accounting disclosures. Guragai et al. (2017) provide evidence that opportunistic managers can utilise the complexity of XBRL to misrepresent disclosures when they know users of the financial statements do not have experience in the interpretation of XBRL filings. The capability of opportunistic managers includes the use of extension elements in a strategic manner, which increase XBRL complexity increments (Hoitash & Hoitash, 2018; Kim, Kim, & Lim, 2019).

Desai and Dharmapala (2006) argue that complex tax transactions are able to make provision for opportunistic managerial behaviour. Desai (2005) uses a case analysis to explain how managers facilitate those opportunistic managerial behaviours through tax transactions. Although FIN 48 aims to improve the accounting for income tax uncertainty over SFAS 5, it can lead to errors in accruing the tax reserve. In particular, differences in the expected probability of outcomes relative to the accrued UTB can create an overstatement or under-statement of the reserve. A particular challenge of standardizing the measurement of UTB guidance is that considerable judgment is still required (Blouin & Robinson, 2014). As described by Lisowsky et al. (2013), the measurement of UTBs involves judgment regarding both the likelihood of sustaining a tax position in court and the assessment of the probable

amounts likely to be realized upon settlement. Moreover, the components of these judgments are not readily available to stakeholders, as only final, aggregate UTB balances are disclosed, making the UTB measurement process a relative black box.

Extant research suggests that managers' UTB judgments contain significant discretion. For example, De Simone et al. (2014) find that treatment of nearly identical tax positions within the paper products industry varies considerably, implying a lack of consistency. The variation is likely attributable to different managers holding different opinions about the same or similar facts and circumstances. Indirectly supporting this argument, Lisowsky et al. (2013) find high variance in the discretionary portion of the UTB in a broader set of firms, which supports the suggestion that managerial judgment differs considerably from firm to firm.

Prior research finds mixed evidence regarding the effects of UTBs on analyst forecast. For instance, Cazier, Rego, Tian, and Wilson (2015) show evidence that the UTB is used by managers in order to meet analyst forecasts, however, Gupta, Laux, and Lynch (2016) do not find evidence that managers use the UTB to meet analyst forecasts. Moreover, Robinson, Stomberg, and Towery (2016) provides evidence that firms' pay only $0.24 of each dollar of the UTB in settlements with tax authorities, suggesting that firms expected managers to utilize complex XBRL tags in UTB estimates to overstate reserves.

The greater the uncertainty surrounding the outcomes of corporate tax decisions, the greater the tax risk and the more likely that measures of firm risk should reflect increased tax uncertainty. Hence, managers may have incentives to increase ARC through an increase in the number of XBRL tags, or through applying inappropriate application of GAAP by using XBRL tags. As an increase in ARC potentially obfuscates information pertaining to poor performance (Li, 2008), audit risk may increase, owing to greater accounting complexity. The costs of extracting information by the IRS, auditors and shareholders can increase. By increasing the information extraction costs, firm management can get the benefit of doubt by the auditors and shareholders, in respect to the legitimacy of that firm's tax arrangements. For instance, auditors cannot ascertain the source of earnings owing to obfuscation of text within a 10-K report, which could be driven by a firm's tax arrangements. Firms with more complex financial statements will likely involve more auditor time and effort (Schelleman & Knechel, 2010). In fact, Bao, Files, and Radhakrishnan (2015) hypothesize that firms with greater financial statement complexity are likely to need more costly audit resources devoted to them by all auditors. Hence, there could be audit delays from accounting complexity increments (Bronson et al., 2011; Ettredge et al., 2006). Additionally, Hoitash and Hoitash (2018) find that ARC is associated with audit delays. They indicate that the relationship between audit delay and audit fees is incrementally stronger when ARC is used as a measure for the complexity. Since the ARC leads to greater cost for preparers, auditors may require more time

to audit, in addition to complicated regulatory efforts (SEC, 2008). Further, the amount of time and effort that users of financial information need to invest in understanding the company's financial position and performance will also be increased (SEC, 2008). This leads to the following directional hypothesis:

*H1: All else equal, there is a positive association between ARC and UTBs.*

### 3.3.2 The impact of industry-specialist auditors on the association between ARC and UTBs

Agency costs arise from information asymmetries between firm stakeholders and managers, because managers often have high-quality and high-level knowledge of firm operations and asset values ((Jensen & Meckling, 1976). Managers are given greater discretion to avoid both losses and timely reporting in environments with complex accounting estimates. The complexity and difficulty of tax expense computations, and discretion to estimate tax accruals, generate information asymmetry between managers, shareholders, and auditors (Dhaliwal, Gleason, & Mills, 2004), an essential condition for earnings management (Schipper, 1989). While many accruals facilitate earnings management, valuation allowances can be used by managers to achieve earnings targets (Frank & Rego, 2006), as well as estimates of accrued taxes (Dhaliwal et al. 2004), tax contingency reserves (Gupta et al., 2016), and the designation of permanently reinvested earnings (Krull, 2004).

Examining the decision-making process of the external auditor in the context of tax positions of the firm, offers information about the auditors' response when confronted with uncertain accounting guidance, complex assumptions, and contentious issues. The increased processing demands required in evaluating dynamic accounting standards, multiple valuation models, and numerous subjective assumptions will likely affect audit performance (Bratten, Gaynor, McDaniel, Montague, & Sierra, 2013). This estimation uncertainty creates opportunities and incentives for biased reporting and increases audit risk.

When clients aggressively avoid taxes, this will lead to an increase in audit effort and risk. Auditors must understand a client's tax positions to assess accrued taxes and related contingencies. However, as aggressive tax positions often contain complex and risky techniques (Hanlon & Heitzman, 2010), auditing requires additional research, specialized audit procedures, documentation, and consultation with tax professionals. Even with additional effort, auditing sophisticated transactions with questionable legal grounds has a high risk of error that exposes auditors to potential litigation, as well as regulatory and reputational costs (Lisowsky, 2010; Menon & Williams, 2001; O'Keefe, Simunic, & Stein, 1994; Simunic & Stein, 1996; Stice, 1991). FIN 48 standardizes the recognition, measurement, and disclosure

of unrecognized tax benefits (tax reserves), which arise when there is significant uncertainty about the sustainability of tax return positions (FASB, 2006). For auditors, the risk of earnings management and clients' tax aggressiveness requires additional audit effort when assessing FIN 48. Auditors must assess the reasonableness of clients' tax reserves to confirm that management is not recognizing tax benefits prematurely to increase earnings (e.g., Donohoe & Knechel, 2014; Frank & Rego, 2006; Graham, Raedy, & Shackelford, 2012). Because uncertainty surrounds the sustainability of aggressive tax positions (Lisowsky et al., 2013), audit effort and risk will likely increase. For example, the tax reserve represents the amount that a firm views as being at risk. To avoid weakening their case in a future tax audit, firms can use discretion in calculating uncertain tax benefits, to under-reserve for aggressive tax positions (Lisowsky et al., 2013). Thus, the auditor must consider the facts and circumstances surrounding clients' tax positions carefully.

One potential mediator of the difficulty in auditing complex UTB estimates is the development of expertise. Industry expertise allows auditors to differentiate themselves from competitors and to compete on dimensions other than price (Dunn & Mayhew, 2004). Auditors gain industry knowledge via specialized indirect experience (e.g., industry training) coupled with focused direct experience (e.g., working exclusively on engagements in a particular industry) (Solomon, Shields, & Whittington, 1999).

On the one hand, as audit firms obtain more industry experience, they create formal or informal benchmarks to test the reasonableness of firms' accounting practices and, thus, are made potentially more capable of identifying and understanding the complexity of tax reserve reconciliations (e.g. UTBs). Consistent with this notion, prior studies show that audit firms with longer tenure or industry expertise have clients with higher quality earnings (Audousset-Coulier et al., 2016; Dunn & Mayhew, 2004; Gul, Fung, & Jaggi, 2009; Ho & Kang, 2013; Myers, Myers, & Omer, 2003; Reichelt & Wang, 2010). Previous literature also finds that when a firm is audited by high quality auditors, it usually has a lower cost of debt (Mansi, Maxwell, & Miller, 2004), a lower cost of equity (Khurana & Raman, 2004), a reduction in IPO under-pricing (Willenborg, 1999), a lower impact of loan syndicate structure (Kim & Song, 2011), and a greater reduction in crash risk (Robin & Zhang, 2015).

McGuire et al. (2012) finds that clients of audit firms considered industry tax experts have lower ETRs on average than clients of audit firms having no tax expertise. Audit firms that are industry tax experts are also more likely to be able to assess the reasonableness of clients' tax accounts and provide more effective tax planning that lowers ETRs through legitimate activities. Armstrong et al. (2012) show that the higher the percentage of tax fees provided by the auditor, the lower the level of a firm's effective tax rate. This demonstrates that auditors who also provide tax-related services can use their shared knowledge of a firm's

financial accounting, tax reporting/planning, and underlying operational conditions to improve successful tax strategies, resulting in significantly lower corporate taxes payable.

Acquiring expertise is costly. Expert auditors may be able to provide higher quality audits, resulting in pricing power that allows them to recoup expertise-related investments (Klein & Leffler, 1981). (Koonce & Mercer, 2005) highlight that the benefits of expertise may not exist when tasks are extremely difficult and lack appropriate feedback. Bonner (1994) defines task complexity based on the amount and clarity of information that goes into the input, processing, and output of a particular task. However, Christensen, Glover, and Wood (2012, p. 127) also highlight the ‘‘increasingly difficult and perhaps, in some cases, unrealistic burden on auditors’’ when analysing complex accounting estimates, suggesting excessive difficulty for these tasks.

De Simone et al. (2014) provide an illustration of the inherent complexity in tax accounts by investigating 19 companies’ disclosures relating to UTBs for excise tax refunds. Despite the fact that the firms in question all entered into nearly identical transactions, they find significant differences in how the companies accounted for UTB estimates, even among companies with the same audit firm. Such variation suggests that industry expertise may not be sufficient to identify earnings management through the tax accounts consistently. Auditors must detect and propose corrective strategies for both quantitative and qualitative material errors of complex accounts at the end of the audit, when they are under significant time and budgetary constraints. This combination of task complexity and resource constraints may create a situation in which earnings management through the tax accounts may be difficult to detect even for industry-expert audit firms (Christensen, Olson, & Omer, 2015). For example, the likelihood that a tax account can produce financial restatements is more likely when the firm’s UTB estimates are high (Cheffers, Whalen, & Usvyatsky, 2011; Deloitte, 2008; Hoffelder, 2013). As prior research has provided strong evidence that UTBs are an effective proxy for a firm's tax avoidance or tax sheltering activities (e.g. Lisowsky et al., 2013; Rego & Wilson, 2012), it is likely that tax arrangements will be inherently more risky and uncertain, resulting in larger UTB estimates.

The audit of detailed XBRL data, including the numbers presented in XBRL, XBRL tags, metadata, and file structures may, thus, offer benefits to the capital markets. The AICPA stated that the use of XBRL by filers will both enable enhanced capabilities for users of financial information, and provide efficiencies for preparers. However, the AICPA also highlighted the risk that financial statement users may be under the mistaken impression that the auditor had involvement with XBRL tags embedded within the financial statements (AICPA, 2013). Because current regulations do not require an audit of XBRL filings, this may

undermine the usability of the data.[17] The structured nature of XBRL data allows for streamlined acquisition of accounting data (Debreceny & Gray, 2010; Gray & Debreceny, 2014). Thus, auditors are better able to benchmark and compare audit clients with peer firms and prior-year reporting for purposes of identifying anomalies and risks (Gambetta, García-Benau, & Zorio-Grima, 2016). However, it is expected that companies will make mistakes when they prepare their XBRL-related documents owing to their lack of XBRL knowledge and experience (Hoitash, Hoitash, & Morris, 2020). The conversion to XBRL creates opportunities for errors in the choice of taxonomy tags, metaproperties, and file structures. Concern about the reliability of information presented in XBRL files arises from managers' decisions to use taxonomy or extended tags. The use of an extended tag, or incorrect taxonomy tag, may reduce the usability, extractability, and comparability of XBRL filings by limiting users' abilities to identify and compare specific line items or footnote disclosures. For instance, the use by filers of incorrect elements for disclosing tax assets and liabilities leads to confusion amongst users of the data (Hoitash & Hoitash, 2018).

Alles and Gray (2012) argued that demand for external assurance on XBRL filings exists if the cost of the assurance service is either reduced or appears to be less significant to clients.[18] Ahn, Hoitash, and Hoitash (2020) document that firms' increase the number of FV tags following receipt of a comment letter from the SEC, and that the increase in the number of FV tags is greater among clients with FV expert auditors.

Industry specialist auditors are able to make better provision for improved assurance than auditors who are not industry specialists (Craswell, Francis, & Taylor, 1995). In addition, there is a clear tendency for industry-specialist auditors to engage in extensive investment in human capital, information technology and auditing skills (Dopuch & Simunic, 1982; Francis, Reichelt, & Wang, 2005). Therefore, the probability that a specialist auditor can detect accounting misstatement or managers' obfuscation by using XBRL tags for ARC increment is high. I state the second (non-directional) hypothesis about the moderation role of industry specialist auditors on the relationship between ARC and UTBs as follows:

*H2: All else being equal, an industry-specialist auditor moderates the positive association between ARC and UTBs.*

[17] The SEC distributes two sets of filings, one audited (HTML) and one unaudited (XBRL). This approach is concerning, because evidence suggests that many XBRL filings are inconsistent with the HTML files or contain errors (Boritz & No, 2008; Debreceny, Farewell, Piechocki, Felden, & Gräning, 2010; Farewell, Hao, Kashyap, & Pinsker, 2017).

[18] To perform an assurance engagement on the XBRL-related documents, there are six profession-generated guidelines available for auditors: (1) American Institute of Certified Public Accountants Interpretation No. 5 (AICPA, 2003); (2) Public Company Accounting Oversight Board Staff Q&A (PCAOB, 2005); (3) Assurance Working Group white paper (AWG, 2006); (4) AICPA Statement of Position 09-1 (AICPA, 2009); (5) AICPA Principles and Criteria for XBRL-Formatted Information (AICPA, 2012); and (6) AICPA Statement of Position 13-2 (AICPA, 2013).

## 3.4 Research design

### 3.4.1 Sample selection

The study's sample consists of all U.S. firms in Computstat and Audit Analytics from the period 2011-2019, and is merged with ARC data from Hoitash and Hoitash (2018)[19], resulting in 47,464 firm-year observations. I start the sample in 2011 because that was the first year that firms were required to tag their 10-Ks using XBRL. I drop firms with missing UTB values (18,430). I then exclude 3,714 firm-year observations for firms in regulated industries (utilities in SICs 4900-4999 and financial institutions in SICs 6000-6999), and 3,139 observations with data missing for my baseline regression. Therefore, there are 22,181 firm-year observations in my final sample. In order to reduce the possibility that outliers influence the results, I winsorize the continuous variables at 1st and 99th percentiles. Details of the sample reconciliation are provided in Panel A of Table 3.1 with the year distribution of my sample presented as Table 3.1, Panel B.

**Table 3-1 Sample Selection and Sample Year Distribution**

| Panel A: Sample selection | |
|---|---|
| Compustat and ARC data from 2011 to 2019 | 47,464 |
| Less: missing UTB values | (18,430) |
| Less: firms in regulated industries (utilities in SICs 4900-4999 and financial institutions in SICs 6000-6999) | (3,714) |
| Less: Firm-years with insufficient data for regression analysis | (3,139) |
| Total observation for baseline regression | 22,181 |

Panel B: Year distribution

| Year | Observations | Percent |
|---|---|---|
| 2011 | 2,295 | 10.35% |
| 2012 | 2,473 | 11.15% |
| 2013 | 2,558 | 11.53% |
| 2014 | 2,633 | 11.87% |
| 2015 | 2,571 | 11.59% |
| 2016 | 2,527 | 11.39% |
| 2017 | 2,509 | 11.31% |
| 2018 | 2,491 | 11.23% |
| 2019 | 2,124 | 9.58% |
| Total | 22,181 | 100% |

[19] I thank Rani Hoitash and Udi Hoitash for making ARC data available. http://www.xbrlresearch.com/

### 3.4.2 UTB measure

Previous studies argue that UTBs signal future tax avoidance. According to Hanlon and Heitzman (2010), higher UTBs imply greater tax uncertainty. Managerial discretion in deriving UTB estimates can lead to incorrect or deliberate increments in XBRL tags. I rely on three measures of UTBs. The first one is total UTB, scaled by the amount of common shares outstanding. UTB_PERM, my second measure, refers to permanent UTB differences, calculated as the UTBs affecting the ETR (TXTUBTXTR) scaled by the amount of common shares outstanding. As shown in Frischmann, Shevlin, and Wilson (2008), UTB_PERM is equal to UTB if TXTUBTXTR is missing. UTB_TEMP, my third measure, is the temporary UTB difference, calculated as UTB minus UTB_PERM.

### 3.4.3 ARC measure

Hoitash and Hoitash (2018) argue that each accounting concept is depicted using a tag in the XBRL U.S. GAAP taxonomy. A name and label is assigned to every tag in the taxonomy; part of the name and label are features, such as data type (monetary or string) and balance type (credit/debit) for example. The definition of tags that helps firms in reporting every accounting reporting concept in XBRL is the goal of taxonomy. Despite having more than 16,000 tags in a taxonomy, it might be necessary for firms to develop new tags. The design of XBRL is to enhance taxonomy and the creation of special tags (extended tags) in meeting their needs.

Based on Hoitash and Hoitash (2018), I measure ARC as the natural log of the total number of discrete monetary annual tags reported in item 8 of the 10-K filings. Their ARC measure captures the discrete accounting information in companies' financial statements and notes, and each XBRL tag denotes a specific accounting standard and its supporting regulations.

### 3.4.4 Measure of industry-specialist auditors

Following Audousset-Coulier et al. (2016), I use four proxy measures of audit specialization based on the three largest portfolio share approaches. The reason for choosing this approach, rather than the market share approach, is because the portfolio approach incorporates the distribution of audit services and audit fees across industries (Audousset-Coulier et al., 2016).

The first measure of audit specialization is AS_SP_COMP based on the top three clients by size as measured by ARC. AS_SP_AT is the second measure of audit specialization

based on the top three clients by size as measured by the total assets. AS_SP_SALE is the third proxy for audit specialization based on the top three clients by size as measured by the total sales. The last measure of audit specialization is AS_SP_AUD based on the top three clients by size as measured by audit fees.

### 3.4.5 Control variables

I include a set of control variables that have been widely used in previous studies of UTBs (e.g. Cazier et al., 2015; Chen, Chen, Cheng, & Shevlin, 2010; Cheng, Huang, Li, & Stanfield, 2012; Drake, Goldman, & Lusch, 2016; Gupta & Newberry, 1997; Lisowsky, 2010; McGuire et al., 2012; Rego, 2003; Rego & Wilson, 2012). I control for firm size (SIZE), because large companies are likely to report higher UTB estimates as they continue to engage in more complicated tax schemes involving multiple aspects of tax law, resulting in higher tax enforcement and planning costs (Lisowsky et al., 2013). FOR_INC controls for firms with extensive foreign operations as they are able to shift income between high and low tax jurisdictions (Rego, 2003). MTB (market-to-book) ratio controls for the growth opportunities of a company (Chen et al., 2010). I control for firm leverage (LEV) since companies with high levels of leverage can benefit from the tax shield relating to corporate debt (Lisowsky et al., 2013). I also include CASH as the demand for cash could potentially drive riskier tax positions (e.g. tax deferral strategies), and net loss carried forward (NOL and $\Delta NOL$), which could be an outcome of tax strategies (McGuire et al., 2012). Return on assets (ROA) captures the financial performance of a company (Cheng et al., 2012). I control for property, plant and equipment (CAP_INT) because of the imbalanced treatment of depreciation expenses for tax and financial reporting (Gupta & Newberry, 1997). I also control for the disparate book and tax treatments of intangible assets (INTANG), consolidated earnings stated with the aid of the equity method (EQINC) and R&D expenditure (R&D) (Chen et al., 2010; Gupta & Newberry, 1997; McGuire et al., 2012). SALES_GROWTH is included to control for the growth opportunities of a company, as there is a likelihood that companies with rapid growth in terms of sales will invest further in tax planning strategies (McGuire et al., 2012). In all my regressions, I control for the fixed effects of industry and year. Definitions of all control variables are in Appendix 3-A.

### 3.4.6 Baseline regression model

I perform an empirical test of the association between ARC and UTB estimates using OLS regression analysis with industry and year fixed effects (H1). The following is an estimation of my baseline regression model:

$$UTBs_{it} = \beta_1 ARC_{it} + \beta_2 SIZE_{it} + \beta_3 MTB_{it} + \beta_4 LEV_{it} + \beta_5 CASH_{it} + \beta_6 ROA_{it} + \beta_7 NOL_{it} + \beta_8 \Delta NOL_{it} + \beta_9 FOR\_INC_{it} + \beta_{10} CAP\_INT_{it} + \beta_{11} INTANG_{it} + \beta_{12} EQINC_{it} + \beta_{13} R\&D_{it} + \beta_{14} SALE\_GROWTH_{it} + INDU_{DUMMIES} + YEAR_{DUMMIES} \quad (1)$$

Where UTBs denotes unrecognized tax benefits and can take three measures (i.e. UTB, UTB_PERM, or UTB_TEMP); ARC is the proxy for accounting reporting complexity. The definitions of the incorporated variables in Equation (1) are in Appendix 3-A.

My regression model designed to test H2 tests the moderation effect of industry-specialist auditors on the relationship between ARC and UTB estimates as follows:

$$UTBs_{it} = \beta_1 ARC_{it} + \beta_2 AS\_SP_{it} + \beta_3 ARC_{it} * AD_{SP\,it} + \beta_4 SIZE_{it} + \beta_5 MTB_{it} + \beta_6 LEV_{it} + \beta_7 CASH_{it} + \beta_8 ROA_{it} + \beta_9 NOL_{it} + \beta_{10} \Delta NOL_{it} + \beta_{11} FOR_{INC\,it} + \beta_{12} CAP_{INT\,it} + \beta_{13} INTANG_{it} + \beta_{14} EQINC_{it} + \beta_{15} R\&D_{it} + \beta_{16} SALE_{GROWTH\,it} + INDU_{DUMMIES} + YEAR_{DUMMIES} \quad (2)$$

where $AS\_SP_{it}$ is industry-specialist auditors, and it can take four forms (i.e., AS_SP_COMP, AS_SP_AT, AS_SP_SALE, or AS_SP_AUD). AS_SP*ARC denotes the interactivity terms between industry-specialist auditors and ARC.

## 3.5 Empirical results

### 3.5.1 Descriptive statistics

The sample's descriptive statistics are presented in Table 3-2. The respective mean (median) values of dependent variables UTB, UTB_PERM and UTB_TEMP are 0.246 (0.063), 0.187 (0.039), and 0.052 (0.000), respectively. These values are similar to those in previous studies (Koester, Lim, & Vigeland, 2015; Taylor, Richardson, & Al-Hadi, 2018). The mean (median) values of independent variable ARC are 5.704 (5.759) and they are the same as those provided in Hoitash and Hoitash (2018). The mean (median) values of control

variables are in line with those recorded in previous studies (Drake et al., 2016; Lisowsky et al., 2013; McGuire et al., 2012; Rego & Wilson, 2012).

**Table 3-2: Descriptive statistics**

| Variable | N | Mean | S.D. | 0.25 | Mdn | 0.75 |
|---|---|---|---|---|---|---|
| UTB | 22,181 | 0.246 | 0.563 | 0.000 | 0.063 | 0.247 |
| UTB_PERM | 22,181 | 0.187 | 0.430 | 0.000 | 0.039 | 0.178 |
| UTB_TEMP | 22,181 | 0.052 | 0.153 | 0.000 | 0.000 | 0.029 |
| ARC | 22,181 | 5.704 | 0.460 | 5.464 | 5.759 | 6.021 |
| AS_SP_COMP | 22,181 | 0.650 | 0.477 | 0.000 | 1.000 | 1.000 |
| AS_SP_AT | 22,181 | 0.631 | 0.482 | 0.000 | 1.000 | 1.000 |
| AS_SP_SALE | 22,181 | 0.632 | 0.482 | 0.000 | 1.000 | 1.000 |
| AS_SP_AUD | 22,181 | 0.647 | 0.478 | 0.000 | 1.000 | 1.000 |
| SIZE | 22,181 | 6.580 | 2.357 | 5.105 | 6.752 | 8.151 |
| MTB | 22,181 | 3.113 | 9.938 | 1.152 | 2.190 | 4.094 |
| LEV | 22,181 | 0.326 | 0.493 | 0.037 | 0.225 | 0.426 |
| CASH | 22,181 | 0.276 | 0.439 | 0.049 | 0.137 | 0.329 |
| ROA | 22,181 | -0.141 | 1.020 | -0.072 | 0.038 | 0.102 |
| NOL | 22,181 | 0.760 | 0.427 | 1.000 | 1.000 | 1.000 |
| CHNG_NOL | 22,181 | 0.184 | 1.003 | -0.002 | 0.000 | 0.051 |
| FOR_INC | 22,181 | 0.012 | 0.047 | 0.000 | 0.000 | 0.022 |
| CAP_INT | 22,181 | 0.244 | 0.255 | 0.063 | 0.150 | 0.335 |
| INTANG | 22,181 | 0.237 | 0.275 | 0.016 | 0.144 | 0.374 |
| EQINC | 22,181 | 0.001 | 0.003 | 0.000 | 0.000 | 0.000 |
| R&D | 22,181 | 0.082 | 0.185 | 0.000 | 0.010 | 0.085 |
| SALE_GROWTH | 22,181 | 0.160 | 0.676 | -0.033 | 0.057 | 0.175 |

### 3.5.2 Correlation results

The Pearson correlation results are shown in Table 3-3. As expected, it is observed that the dependent variables (UTB, UTB_PERM, and UTB_TEMP) are correlated significantly and positively with the independent variable ARC at $p<0.01$. These results support H1, indicating that ARC is positively related to UTBs. In addition, some of the control variables are correlated with UTB ($p<0.01$) including SIZE, CASH, ROA, ΔNOL, FOR_INC, CAP_INT, INTANG, EQIC, R&D, and SALE_GROWTH. Generally, the correlations are as expected, providing strong support in validating my main constructs and measures.

## Table 3-3 Pearson correlation

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) UTB | 1.000 | | | | | | | | | | | | | | | | |
| (2) UTB_PERM | 0.915*** | 1.000 | | | | | | | | | | | | | | | |
| (3) UTB_TEMP | 0.617*** | 0.336*** | 1.000 | | | | | | | | | | | | | | |
| (4) ARC | 0.253*** | 0.264*** | 0.168*** | 1.000 | | | | | | | | | | | | | |
| (5) SIZE | 0.310*** | 0.330*** | 0.194*** | 0.548*** | 1.000 | | | | | | | | | | | | |
| (6) MTB | 0.009 | 0.013* | 0.003 | 0.027*** | 0.135*** | 1.000 | | | | | | | | | | | |
| (7) LEV | -0.005 | -0.004 | -0.001 | 0.052*** | -0.098*** | -0.087*** | 1.000 | | | | | | | | | | |
| (8) CASH | -0.081*** | -0.092*** | -0.031*** | -0.264*** | -0.099*** | 0.086*** | -0.011* | 1.000 | | | | | | | | | |
| (9) ROA | 0.081*** | 0.085*** | 0.051*** | 0.190*** | 0.303*** | 0.078*** | -0.485*** | -0.295*** | 1.000 | | | | | | | | |
| (10) NOL | 0.012* | 0.002 | 0.026*** | 0.051*** | -0.065*** | 0.024*** | 0.028*** | 0.115*** | -0.079*** | 1.000 | | | | | | | |
| (11) CHNG_NOL | -0.064*** | -0.067*** | -0.039*** | -0.178*** | -0.215*** | -0.028*** | 0.330*** | 0.274*** | -0.613*** | 0.110*** | 1.000 | | | | | | |
| (12) FOR_INC | 0.156*** | 0.180*** | 0.072*** | 0.152*** | 0.300*** | 0.010 | -0.031*** | -0.104*** | 0.128*** | -0.040*** | -0.081*** | 1.000 | | | | | |
| (13) CAP_INT | -0.040*** | -0.037*** | -0.038*** | 0.129*** | 0.109*** | -0.033*** | 0.158*** | -0.197*** | 0.044*** | -0.112*** | -0.054*** | -0.013* | 1.000 | | | | |
| (14) INTANG | 0.099*** | 0.117*** | 0.032*** | 0.244*** | 0.241*** | 0.018*** | 0.153*** | -0.156*** | 0.057*** | 0.050*** | -0.035*** | 0.068*** | -0.242*** | 1.000 | | | |
| (15) EQINC | 0.072*** | 0.078*** | 0.050*** | 0.124*** | 0.117*** | -0.006 | 0.018*** | -0.073*** | 0.044*** | -0.062*** | -0.033*** | 0.065*** | 0.066*** | -0.016** | 1.000 | | |
| (16) RND | -0.080*** | -0.095*** | -0.018*** | -0.263*** | -0.190*** | 0.044*** | 0.097*** | 0.586*** | -0.430*** | 0.149*** | 0.388*** | -0.142*** | -0.193*** | -0.113*** | -0.076*** | 1.000 | |
| (17) SALE_GROWTH | -0.051*** | -0.054*** | -0.027*** | -0.089*** | -0.021*** | 0.046*** | 0.074*** | 0.237*** | -0.127*** | 0.054*** | 0.093*** | -0.068*** | 0.024*** | 0.047*** | -0.028*** | 0.190*** | 1.000 |

***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. Variables are defined in Appendix A

### 3.5.3 The association between ARC and UTBs

The regression results obtained from the examination of the relationship between ARC and UTBs are shown in Table 3-4. The coefficient estimates of ARC are positive and significant for all measures of UTBs (UTB, UTB_PERM, and UTB_TEMP) at p<0.01, providing support for my first hypothesis H1. In terms of economic significance, one standard deviation increase in ARC leads to an average increase[20] in UTBs (UTB, UTB_PERM, and UTB_TEMP) by around 7.13%, 5.23%, and 1.77%, respectively. In addition, the coefficients of control variables SIZE, LEV, CASH, ROA, FOR_INC, CAP_INT, EQINC, R&D, SALE_GROWTH are significant at p<0.01.

### 3.5.4 The impact industry-specialist auditors on the association of ARC and UTBs

Table 3-5 presents the results of my regression model for the moderation impact of industry-specialist auditors on the relationship between ARC and UTBs (the hypothesis H2). They are presented separately when industry-specialist auditors are: based on ARC (Table 3-5 Panel A); based on total assets (Table 3-5 Panel B); based on sales (Table 3-5 Panel C); and based on audit fees (Table 3-5 Panel D).

When industry-specialist auditors are based on *ARC* (Table 5 Panel A), the coefficient estimates of ARC are positive and significant for all UTBs measures at p<0.01, these findings confirm my prediction (H1) that there is a positive association between ARC and UTBs. The coefficient of *AS_SP_COMP* are negative and significant at (p<.05 or better) and consistent with (Taylor et al., 2018) . The interaction variable *ARC*AS_SP_COMP* are positive and significant for *UTB*, *UTB_PERM*, and *UTB_TEMP* (*p*<0.10 or better). These results support hypothesis H2, that industry-specialist auditors magnify the relationship between ARC and UTBs.

[20] The calculation in UTBs increment is as follows: 0.460 (one standard deviation of ARC)*0.1551 (coefficient estimate of ARC for dependent variable UTB) = 0.073. Similar calculations are performed for UTB_PERM, and UTB_TEMP.

**Table 3-4: The association between ARC and UTBs – OLS results**

| VARIABLES | (1) UTB | (2) UTB_PERM | (3) UTB_TEMP |
|---|---|---|---|
| **ARC** | **0.1551*** ** | **0.1138*** ** | **0.0383*** ** |
| | **(6.87)** | **(6.79)** | **(5.91)** |
| SIZE | 0.0603*** | 0.0483*** | 0.0106*** |
| | (9.58) | (10.48) | (6.42) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.29) | (-2.24) | (-1.50) |
| LEV | 0.0330*** | 0.0223*** | 0.0117*** |
| | (3.01) | (2.64) | (3.37) |
| CASH | -0.0467*** | -0.0400*** | -0.0072** |
| | (-4.69) | (-5.06) | (-2.38) |
| ROA | -0.0128*** | -0.0132*** | 0.0012 |
| | (-3.17) | (-4.13) | (1.04) |
| NOL | 0.0233 | 0.0075 | 0.0098** |
| | (1.24) | (0.51) | (2.06) |
| CHNG_NOL | -0.0007 | 0.0006 | -0.0010 |
| | (-0.30) | (0.30) | (-1.43) |
| FOR_INC | 0.5620*** | 0.5961*** | 0.0090 |
| | (3.58) | (5.04) | (0.18) |
| CAP_INT | -0.2020*** | -0.1355*** | -0.0544*** |
| | (-6.78) | (-5.98) | (-5.76) |
| INTANG | -0.0290 | -0.0002 | -0.0311*** |
| | (-0.86) | (-0.01) | (-3.53) |
| EQINC | 4.6135* | 3.9845** | 0.9813 |
| | (1.84) | (2.05) | (1.30) |
| R&D | -0.0190 | -0.0520*** | 0.0337*** |
| | (-0.75) | (-2.60) | (3.54) |
| SALE_GROWTH | -0.0169*** | -0.0146*** | -0.0016 |
| | (-3.97) | (-4.75) | (-1.09) |
| Constant | -0.9269*** | -0.6963*** | -0.2115*** |
| | (-7.86) | (-7.58) | (-6.81) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.148 | 0.163 | 0.067 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at $p<0.01$, $p<0.05$, and $p<0.1$, respectively. All variables are defined in Appendix A.

In Table 3-5 Panel B (industry-specialist auditors are based on total assets), the coefficient estimate of the ARC*AS_SP_AT variable is significantly positive for all measures of UTBs at $p<0.01$. Similar results are observed when industry-specialist auditors are based on total sales (Table 3-5 Panel C). There is a positive and significant relationship between the ARC*AS_SP_SALE variable and each of the UTB measures (UTB, UTB_PERM, and UTB_TEMP) at $p<0.01$. In Table 3-5, Panel D (when industry-specialist auditors are based on audit fees), the coefficient estimates of the interaction variable ARC*AS_SP_AUD are also significantly positive for all measures of UTBs ($p<0.01$ or better).

Overall, these results consistently support hypothesis H2 in that industry-specialist auditors magnify the relationship between ARC and UTBs. Further, in all panels, there is a negative relationship between industry-specialist auditors and UTBs, and this result is in line with Taylor et al. (2018).

**Table 3-5: The impact of industry-specialist auditors on the association of ARC and UTBs**

| Panel A : Industry-specialist auditors based on ARC | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.1032*** ** | **0.0834*** ** | **0.0278*** ** |
| | **(3.44)** | **(3.41)** | **(3.78)** |
| **AS_SP_COMP** | **-0.4722*** ** | **-0.2853** ** | **-0.0879** ** |
| | **(-2.82)** | **(-2.08)** | **(-2.32)** |
| **ARC * AS_SP_COMP** | **0.0824*** ** | **0.0487* ** | **0.0163** ** |
| | **(2.66)** | **(1.90)** | **(2.35)** |
| SIZE | 0.0609*** | 0.0490*** | 0.0104*** |
| | (9.28) | (10.17) | (6.23) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.34) | (-2.29) | (-1.50) |
| LEV | 0.0320*** | 0.0217*** | 0.0114*** |
| | (2.92) | (2.58) | (3.32) |
| CASH | -0.0468*** | -0.0402*** | -0.0072** |
| | (-4.72) | (-5.09) | (-2.38) |
| ROA | -0.0128*** | -0.0133*** | 0.0013 |
| | (-3.18) | (-4.16) | (1.09) |
| NOL | 0.0244 | 0.0082 | 0.0100** |
| | (1.30) | (0.56) | (2.10) |
| CHNG_NOL | -0.0006 | 0.0007 | -0.0010 |
| | (-0.25) | (0.33) | (-1.43) |
| FOR_INC | 0.5573*** | 0.5909*** | 0.0102 |
| | (3.53) | (4.99) | (0.20) |
| CAP_INT | -0.2002*** | -0.1347*** | -0.0538*** |
| | (-6.75) | (-5.97) | (-5.70) |
| INTANG | -0.0288 | -0.0003 | -0.0309*** |
| | (-0.85) | (-0.01) | (-3.51) |
| EQINC | 4.6009* | 3.9704** | 0.9847 |
| | (1.83) | (2.04) | (1.31) |
| R&D | -0.0169 | -0.0499** | 0.0334*** |
| | (-0.67) | (-2.52) | (3.50) |
| SALE_GROWTH | -0.0169*** | -0.0146*** | -0.0015 |
| | (-3.95) | (-4.74) | (-1.06) |
| Constant | -0.6345*** | -0.5211*** | -0.1559*** |
| | (-4.05) | (-4.00) | (-4.32) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.149 | 0.164 | 0.068 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

| Panel B: Industry-specialist auditors based on total assets | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.0726*** ** | **0.0538*** ** | **0.0230*** ** |
| | **(2.75)** | **(2.60)** | **(3.36)** |
| **AS_SP_AT** | **-0.8227*** ** | **-0.6108*** ** | **-0.1359*** ** |
| | **(-5.22)** | **(-4.85)** | **(-3.48)** |
| **ARC * AS_SP_AT** | **0.1434*** ** | **0.1053*** ** | **0.0251*** ** |
| | **(5.06)** | **(4.59)** | **(3.61)** |
| SIZE | 0.0623*** | 0.0503*** | 0.0102*** |
| | (8.69) | (9.55) | (5.73) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.29) | (-2.26) | (-1.45) |
| LEV | 0.0291*** | 0.0195** | 0.0109*** |
| | (2.68) | (2.32) | (3.18) |
| CASH | -0.0427*** | -0.0370*** | -0.0066** |
| | (-4.39) | (-4.78) | (-2.22) |
| ROA | -0.0102*** | -0.0111*** | 0.0014 |
| | (-2.70) | (-3.71) | (1.29) |
| NOL | 0.0254 | 0.0091 | 0.0101** |
| | (1.35) | (0.63) | (2.11) |
| CHNG_NOL | -0.0009 | 0.0005 | -0.0010 |
| | (-0.39) | (0.24) | (-1.48) |
| FOR_INC | 0.5315*** | 0.5707*** | 0.0075 |
| | (3.37) | (4.82) | (0.15) |
| CAP_INT | -0.1964*** | -0.1315*** | -0.0533*** |
| | (-6.67) | (-5.86) | (-5.66) |
| INTANG | -0.0298 | -0.0011 | -0.0309*** |
| | (-0.88) | (-0.04) | (-3.50) |
| EQINC | 4.3044* | 3.7485* | 0.9384 |
| | (1.73) | (1.94) | (1.25) |
| R&D | -0.0155 | -0.0486** | 0.0333*** |
| | (-0.62) | (-2.49) | (3.50) |
| SALE_GROWTH | -0.0162*** | -0.0141*** | -0.0013 |
| | (-3.78) | (-4.58) | (-0.94) |
| Constant | -0.4654*** | -0.3577*** | -0.1301*** |
| | (-3.38) | (-3.20) | (-3.95) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.151 | 0.166 | 0.069 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

| Panel C: Industry-specialist auditors based on sales | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.0677*** ** | **0.0529*** ** | **0.0212*** ** |
| | **(2.67)** | **(2.62)** | **(3.28)** |
| **AS_SP_SALE** | **-0.8612*** ** | **-0.6152*** ** | **-0.1517*** ** |
| | **(-5.49)** | **(-4.95)** | **(-3.96)** |
| **ARC * AS_SP_SALE** | **0.1510*** ** | **0.1065*** ** | **0.0281*** ** |
| | **(5.37)** | **(4.70)** | **(4.12)** |
| SIZE | 0.0619*** | 0.0501*** | 0.0101*** |
| | (8.62) | (9.50) | (5.66) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.26) | (-2.23) | (-1.43) |
| LEV | 0.0291*** | 0.0196** | 0.0109*** |
| | (2.68) | (2.34) | (3.17) |
| CASH | -0.0424*** | -0.0369*** | -0.0066** |
| | (-4.36) | (-4.77) | (-2.19) |
| ROA | -0.0099*** | -0.0110*** | 0.0015 |
| | (-2.63) | (-3.65) | (1.35) |
| NOL | 0.0254 | 0.0091 | 0.0101** |
| | (1.35) | (0.63) | (2.11) |
| CHNG_NOL | -0.0010 | 0.0003 | -0.0010 |
| | (-0.48) | (0.17) | (-1.52) |
| FOR_INC | 0.5339*** | 0.5727*** | 0.0076 |
| | (3.38) | (4.84) | (0.15) |
| CAP_INT | -0.1955*** | -0.1310*** | -0.0530*** |
| | (-6.65) | (-5.85) | (-5.63) |
| INTANG | -0.0290 | -0.0006 | -0.0307*** |
| | (-0.86) | (-0.02) | (-3.48) |
| EQINC | 4.3047* | 3.7539* | 0.9377 |
| | (1.73) | (1.94) | (1.25) |
| RND | -0.0150 | -0.0483** | 0.0334*** |
| | (-0.60) | (-2.46) | (3.50) |
| SALE_GROWTH | -0.0160*** | -0.0140*** | -0.0013 |
| | (-3.73) | (-4.54) | (-0.91) |
| Constant | -0.4403*** | -0.3538*** | -0.1203*** |
| | (-3.30) | (-3.23) | (-3.89) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.152 | 0.166 | 0.069 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

| Panel D: Industry-specialist auditors based on audit fees | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.1155*** ** | **0.0864*** ** | **0.0284*** ** |
| | **(4.01)** | **(3.77)** | **(3.92)** |
| **AS_SP_AUD** | **-0.3668** ** | **-0.2607** ** | **-0.0825** ** |
| | **(-2.42)** | **(-2.10)** | **(-2.29)** |
| **ARC * AS_SP_AUD** | **0.0635** ** | **0.0442* ** | **0.0154** ** |
| | **(2.27)** | **(1.91)** | **(2.36)** |
| SIZE | 0.0609*** | 0.0490*** | 0.0104*** |
| | (9.28) | (10.20) | (6.19) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.31) | (-2.27) | (-1.49) |
| LEV | 0.0324*** | 0.0220*** | 0.0115*** |
| | (2.97) | (2.60) | (3.33) |
| CASH | -0.0467*** | -0.0401*** | -0.0072** |
| | (-4.71) | (-5.09) | (-2.39) |
| ROA | -0.0127*** | -0.0132*** | 0.0013 |
| | (-3.16) | (-4.15) | (1.11) |
| NOL | 0.0241 | 0.0081 | 0.0100** |
| | (1.28) | (0.55) | (2.10) |
| CHNG_NOL | -0.0006 | 0.0007 | -0.0010 |
| | (-0.28) | (0.31) | (-1.44) |
| FOR_INC | 0.5580*** | 0.5909*** | 0.0110 |
| | (3.53) | (4.99) | (0.22) |
| CAP_INT | -0.2005*** | -0.1347*** | -0.0537*** |
| | (-6.75) | (-5.97) | (-5.68) |
| INTANG | -0.0288 | -0.0003 | -0.0309*** |
| | (-0.86) | (-0.01) | (-3.51) |
| EQINC | 4.6026* | 3.9759** | 0.9799 |
| | (1.84) | (2.05) | (1.31) |
| RND | -0.0170 | -0.0499** | 0.0333*** |
| | (-0.68) | (-2.52) | (3.50) |
| SALE_GROWTH | -0.0168*** | -0.0146*** | -0.0015 |
| | (-3.95) | (-4.73) | (-1.06) |
| Constant | -0.7013*** | -0.5370*** | -0.1597*** |
| | (-4.69) | (-4.39) | (-4.52) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.149 | 0.164 | 0.068 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at $p<0.01$, $p<0.05$, and $p<0.1$, respectively. All variables are defined in Appendix 3-A

## 3.6 Additional analysis

### 3.6.1 Alternative measures of UTBs

In this section, I examine the relationship between ARC and UTBs using alternative measures of UTBs that include UTB_LOG, UTB-P_UTB, and UTB>P_UTB as a robustness test of the main empirical results presented in Table 3-4. The first alternative measure of UTB is UTB_LOG which is calculated as the natural logarithm of UTBs. The second measure of UTB is measured as the difference between the actual UTB amount and the predicted UTB amount (UTB-P_UTB). I used the coefficients in Table 1 of Rego and Wilson (2012) to measure the predicted UTB (P_UTB).

$$\begin{aligned} \text{P\_UTB}_{it} = \; & -0.004 + 0.011(ROA) + 0.001(SIZE) + 0.001(Foreign\_SALE) \\ & + \; 0.092(R\&D) - 0.002(DISC\_ACC) - \; 0.003(LVE) \\ & + 0.000(MTB) + 0.014(SG\&A) - 0.018(\text{SALE\_GROWTH}) \end{aligned} \qquad 3$$

The second alternative measure of UTBs (UTB-P_UTB) is calculated as the difference between UTB and P_UTB. The third alternative measure of UTBs is a dummy variable coded as 1 if the UTB is greater than P_UTB (UTB>P_UTB). These second and third proxies provide measures of underestimation or overestimation of the UTB. Lisowsky et al. (2013) find a high variance in the discretionary portion of the UTB in a broader set of firms, highlighting the variability in managerial judgment between firms.

The regression results using alternative measures of UTBs are presented in Table 3-6. I observe that there is a positive and significant relationship between ARC and UTB_LOG at $p<0.01$ (Column 1) suggesting that high accounting reporting complexity increases the absolute UTB. Column 2 shows that the coefficient of UTB-P_UTB is also significant and positive at $p<0.01$, indicating that higher values of ARC are related to higher levels of UTB-P_UTB. Column 3 presents the logit regression result of UTB>P_UTB with the coefficient of UTB>P_UTB being significantly positive at $p<0.01$, implying that high values of ARC are related to high values of UTB>P_UTB. In summary, it is evident from Table 3-6 that those firms increasing the number of XBRL tags relating to the complexity of their disclosures, have correspondingly higher levels of UTBs. The main results in Table 3-4 are robust to different measures of UTBs.[21]

21 In untabulated analyses, I used P_UTB as a dependent variable. The results show that the coefficient of ARC is positively significant at $p<0.01$, indicating that there is a positive relationship between ARC and P_UTB. However, the adjusted R2 for P_UTB is 0.91, probably owing to the multicollinearity of some variables that are included in calculating the P_UTB. Also, my results remain robust even if I exclude the dropped variables, and the adjusted R2 becomes 0.202.

**Table 3-6: The association between ARC and UTBs - using alternative measures of UTBs**

| VARIABLES | (1)<br>UTB_LOG | (2)<br>UTB - P_UTB | (3)<br>UTB>P_UTB |
|---|---|---|---|
| **ARC** | **1.0131*** ** | **0.1526*** ** | **1.0579*** ** |
| | **(14.57)** | **(6.10)** | **(9.59)** |
| SIZE | 0.7565*** | 0.0629*** | 0.3565*** |
| | (41.88) | (8.92) | (17.74) |
| MTB | -0.0090*** | -0.0011** | -0.0068*** |
| | (-4.89) | (-2.07) | (-2.58) |
| LEV | 0.5617*** | 0.0368*** | 0.2982*** |
| | (5.23) | (2.68) | (4.13) |
| CASH | -0.6445*** | -0.0552*** | -0.2064*** |
| | (-9.85) | (-4.31) | (-3.17) |
| ROA | -0.1752 | -0.0169*** | -0.1024*** |
| | (-1.35) | (-3.25) | (-2.78) |
| NOL | 0.1953*** | 0.0185 | 0.2037** |
| | (3.46) | (0.93) | (2.56) |
| CHNG_NOL | -0.0194 | -0.0009 | -0.0264 |
| | (-0.52) | (-0.33) | (-1.03) |
| FOR_INC | 1.3387*** | 0.5159*** | 2.0222*** |
| | (2.79) | (2.96) | (3.05) |
| CAP_INT | -1.3698*** | -0.2170*** | -1.2524*** |
| | (-8.92) | (-6.25) | (-7.66) |
| INTANG | -0.6716*** | -0.0287 | -0.0312 |
| | (-6.39) | (-0.76) | (-0.23) |
| EQINC | 9.1231 | 3.7494 | 6.5441 |
| | (1.28) | (1.38) | (0.56) |
| R&D | 1.6722*** | -0.1122*** | -0.2722 |
| | (7.02) | (-3.23) | (-1.30) |
| SALE_GROWTH | -0.1914*** | -0.0127** | 0.5187*** |
| | (-6.12) | (-2.24) | (12.74) |
| Constant | -8.3983*** | -0.9916*** | -3.9427*** |
| | (-16.66) | (-7.66) | (-3.89) |
| Observations | 16,704 | 19,370 | 21,438 |
| Adjusted R-squared | 0.590 | 0.149 | |
| Pseudo R2 | | | 0.197 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

### 3.6.2 Components of UTBs

FIN 48 requires an annual reconciliation between the beginning of the year UTB balance and the ending balance. This includes increases to the UTB reserve from current-year tax positions, increases and decreases to the UTB reserve related to prior-year tax positions, decreases to the UTB reserve for settlements with tax authorities, and decreases to the UTB reserve relating to expirations of statutes of limitations. Figure 3-1 illustrates an example of the components of UTBs for Apple Inc.[22]

| | 2019 |
|---|---|
| Beginning balances | $ 9,694 |
| Increases related to tax positions taken during a prior year | 5,845 |
| Decreases related to tax positions taken during a prior year | (686) |
| Increases related to tax positions taken during the current year | 1,697 |
| Decreases related to settlements with taxing authorities | (852) |
| Decreases related to expiration of the statute of limitations | (79) |
| Ending balances | $ 15,619 |

**Figure 3-1: Apple Inc. Components of UTBs For the Fiscal Year Ended September 28, 2019**

Following Drake et al. (2016), I estimate a regression model where the dependent variable is comprised of different components of UTBs, namely current-year increases in the UTB (UTB_CY_INC), increases in tax positions in prior periods (UTB_PY_INC), decreases in tax positions in prior periods (UTB_PY_DEC), settlements with tax authorities (UTB_Settle) and expirations of statute of limitations (UTB_Limit). I scale all of these variables by the amount of common shares outstanding. The regression results of different components of UTBs are presented in Table 3-7, Columns (1)-(5). It is evident that there is a positive and significant association between all UTB components and ARC at $p<0.01$. This evidence provides further support for H1 in that there is a positive relationship between ARC and UTBs.

[22] https://www.sec.gov/ix?doc=/Archives/edgar/data/320193/000032019319000119/a10-k20199282019.htm

**Table 3-7: The association between ARC and UTBs - using different components of UTBs**

| VARIABLES | (1) UTB_CY_INC | (2) UTB_PY_INC | (3) UTB_PY_DEC | (4) UTB_Settle | (5) UTB_Limit |
|---|---|---|---|---|---|
| **ARC** | **0.0101*** ** | **0.0144*** ** | **0.0171*** ** | **0.0078*** ** | **0.0095*** ** |
| | **(3.46)** | **(6.89)** | **(8.39)** | **(6.85)** | **(9.28)** |
| SIZE | 0.0101*** | 0.0065*** | 0.0052*** | 0.0039*** | 0.0015*** |
| | (11.47) | (11.41) | (10.88) | (13.87) | (7.59) |
| MTB | -0.0000 | -0.0001*** | -0.0001* | -0.0001** | -0.0000* |
| | (-0.29) | (-3.08) | (-1.85) | (-1.96) | (-1.65) |
| LEV | 0.0048*** | 0.0032*** | 0.0028*** | 0.0006 | 0.0004 |
| | (3.17) | (3.06) | (2.68) | (1.09) | (0.82) |
| CASH | -0.0045*** | -0.0071*** | -0.0064*** | -0.0043*** | -0.0026*** |
| | (-3.11) | (-7.13) | (-6.89) | (-7.26) | (-6.20) |
| ROA | -0.0013** | -0.0015*** | -0.0015*** | -0.0015*** | -0.0005*** |
| | (-2.47) | (-3.70) | (-3.41) | (-6.33) | (-2.78) |
| NOL | 0.0006 | 0.0023 | 0.0001 | 0.0000 | 0.0006 |
| | (0.22) | (1.51) | (0.05) | (0.03) | (0.65) |
| CHNG_NOL | 0.0002 | 0.0007* | 0.0004 | 0.0004 | -0.0001 |
| | (0.75) | (1.80) | (0.93) | (1.45) | (-0.86) |
| FOR_INC | 0.0826*** | 0.0538*** | 0.0289* | 0.0396*** | 0.0391*** |
| | (3.43) | (3.44) | (1.86) | (5.03) | (5.00) |
| CAP_INT | -0.0245*** | -0.0176*** | -0.0184*** | -0.0115*** | -0.0076*** |
| | (-5.74) | (-6.30) | (-7.11) | (-7.04) | (-5.07) |
| INTANG | -0.0068 | -0.0010 | -0.0105*** | -0.0068*** | 0.0006 |
| | (-1.44) | (-0.32) | (-4.02) | (-4.94) | (0.40) |
| EQINC | 0.6095* | 0.3495 | 0.5310* | 0.2377 | 0.3519** |
| | (1.92) | (1.43) | (1.87) | (1.53) | (2.49) |
| R&D | 0.0004 | -0.0019 | -0.0028 | -0.0030** | -0.0026** |
| | (0.11) | (-0.74) | (-1.35) | (-2.40) | (-2.20) |
| SALE_GROWTH | -0.0015*** | -0.0012*** | -0.0019*** | -0.0010*** | -0.0009*** |
| | (-2.60) | (-3.40) | (-5.51) | (-4.93) | (-6.01) |
| Constant | -0.0880*** | -0.0857*** | -0.0889*** | -0.0427*** | -0.0403*** |
| | (-5.69) | (-6.46) | (-7.63) | (-5.14) | (-6.44) |
| Observations | 21,899 | 21,892 | 21,913 | 21,868 | 21,863 |
| Adjusted R-squared | 0.118 | 0.109 | 0.091 | 0.086 | 0.084 |
| YEAR | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

### 3.6.3 Alternative measures of ARC

Following Hoitash and Hoitash (2018), I use seven alternative measures of ARC as a robustness test of the positive relationship between ARC and UTBs. The first one is ARC_ALL_FACTS, a measure that includes all facts reported in the filings, i.e. facts repeated within a disclosure and facts repeated owing to comparable financial statement disclosure. The assumption in this approach is that complexity is a combination of the number of tags utilized and their usage frequency.

The second alternative measure of ARC is ARC_UNIQUE_FACTS with a unique tag count for each 10-K filing. The assumption of this approach is that financial report complexity comes when each accounting concept is being prepared or consumed. The third and fourth measures are ARC_TAXONOMY and ARC_EXTENSIONS, respectively. Two categories for each tag can include a standard taxonomy tag or a customized extended tag that is firm specific. When firms discover that the available taxonomy tags are unable to show the exact economic transactions of their firms accurately, they create extensions tags. ARC consists of two components: ARC_TAXONOMY and ARC_EXTENSIONS. ARC_TAXONOMY is obtained by counting non-repeating monitory taxonomy facts within disclosures. ARC_EXTENSIONS is derived from the sum of non-repeating monitory extended tags.

The fifth alternative measure of ARC is PERCENT_EXTENDED, which is calculated as the ratio of ARC_EXTENSIONS to ARC. ALL_NUMBERS is the sixth measure, and is the count of ALL numerical facts in the filings, including non-monetary facts, such as percentages and shares. The last alternative measure of ARC is ALL_NUMBERS_EXTENSIONS, which is the count of ALL numerical facts that are extensions in the filings, and this count of extensions includes non-monetary facts.

Panels (A)-(G) of Table 3-8 presents the regression results that use these seven alternative measures of ARC. I observe that there is a significantly positive association between each of the seven measures of ARC and UTBs ($p<0.01$). This evidence provides further support for H1 in that there is a positive relationship between ARC and UTBs.

**Table 3-8: The association between ARC and UTBs - using alternative measures of ARC**

| Panel A: ARC_ALL_FACTS | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC (ARC_ALL_FACTS)** | **0.1293*** ** | **0.0968*** ** | **0.0290*** ** |
| | **(6.48)** | **(6.51)** | **(5.39)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.9230*** | -0.7043*** | -0.1948*** |
| | (-7.55) | (-7.35) | (-6.37) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.149 | 0.164 | 0.067 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |
| Panel B: ARC_UNIQUE_FACTS | | | |
| **ARC (ARC_UNIQUE_FACTS)** | **0.1880*** ** | **0.1372*** ** | **0.0461*** ** |
| | **(7.72)** | **(7.53)** | **(6.25)** |
| CONTROLS | YES | YES | YES |
| Constant | -1.0619*** | -0.7919*** | -0.2433*** |
| | (-8.39) | (-8.05) | (-6.98) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.150 | 0.164 | 0.068 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |
| Panel C: ARC_TAXONOMY | | | |
| **ARC (ARC_TAXONOMY)** | **0.1475*** ** | **0.1066*** ** | **0.0387*** ** |
| | **(5.89)** | **(5.76)** | **(5.60)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.8748*** | -0.6509*** | -0.2089*** |
| | (-7.11) | (-6.85) | (-6.57) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.147 | 0.162 | 0.067 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |
| Panel D: ARC_EXTENSIONS | | | |
| **ARC (ARC_EXTENSIONS)** | **0.0597*** ** | **0.0448*** ** | **0.0126*** ** |
| | **(6.95)** | **(6.69)** | **(4.95)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.3366*** | -0.2661*** | -0.0612*** |
| | (-5.25) | (-4.96) | (-4.36) |
| Observations | 22,084 | 22,084 | 22,084 |
| Adjusted R-squared | 0.146 | 0.162 | 0.064 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Panel E: PERCENT_EXTENDED

| | | | |
|---|---|---|---|
| **ARC (PERCENT_EXTENDED)** | **0.4439*** ** | **0.3507*** ** | **0.0716*** ** |
| | **(4.12)** | **(3.98)** | **(2.65)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.2657*** | -0.2137*** | -0.0446*** |
| | (-4.40) | (-4.18) | (-3.42) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.144 | 0.159 | 0.062 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Panel F: ALL_NUMBERS

| | | | |
|---|---|---|---|
| **ARC (ALL_NUMBERS)** | **0.1209*** ** | **0.0915*** ** | **0.0275*** ** |
| | **(5.93)** | **(6.06)** | **(5.02)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.9000*** | -0.6927*** | -0.1915*** |
| | (-7.09) | (-7.01) | (-6.00) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.148 | 0.163 | 0.066 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Panel G: ALL_NUMBERS_EXTENSIONS

| | | | |
|---|---|---|---|
| **ARC (ALL_NUMBERS_EXTENSIONS)** | **0.0537*** ** | **0.0421*** ** | **0.0103*** ** |
| | **(6.15)** | **(6.27)** | **(4.14)** |
| CONTROLS | YES | YES | YES |
| Constant | -0.3835*** | -0.3065*** | -0.0680*** |
| | (-5.70) | (-5.42) | (-4.61) |
| Observations | 22,111 | 22,111 | 22,111 |
| Adjusted R-squared | 0.146 | 0.161 | 0.063 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at $p<0.01$, $p<0.05$, and $p<0.1$, respectively. All variables are defined in Appendix A.

### 3.6.4 Alternative measures of industry-specialist auditors

In the main regressions reported in Table 3-5, I initially used four measures of industry-specialist auditors based on the three largest portfolio share approach by size (ARC, assets, sales and audit fees). I now use two alternative measures using the portfolio share approach by size based on tax fees (AS_SP_TAX) and audit firm specialization based on both tax fees and audit fees (AS_SP_BOTH_AUD_TAX), and present the regression results in Table 3-9 Panel A. I still find significantly positive coefficients for the interaction variables (i.e., ARC*AS_SP_TAX and ARC* AS_SP_BOTH_AUD_TAX) at p<0.05 or better. I also find that the knowledge spillover and/or reputational concerns of specialists enhance the negative association between industry-specialist auditors and UTBs. However, since firms may make mistakes when they prepare their XBRL-related documents owing to their lack of XBRL knowledge and experience (Boritz & No, 2008; Debreceny et al., 2010) or opportunistic managers may manipulate extension elements in a strategic manner (Hoitash & Hoitash, 2018; Kim, Kim, et al., 2019), regulators require an audit of XBRL filings by an external auditor.

I also utilize three more measures of industry-specialist auditors to assure that my measure of industry-specialist auditors based on the three largest portfolio share approach explains my prediction. Prior studies use industry-specialist auditor measures using two broad approaches: a portfolio share approach, which captures within-auditor differentiation across industries, and a market share approach, which captures within-industry differentiation across competing auditors. Neal and Riley (2004) and Audousset-Coulier et al. (2016) argue that both measures suffer from weaknesses. Therefore, in addition, I use three measures based on a market share cut-off approach. Reichelt and Wang (2010) provide evidence that audit quality is higher when the auditor is both a national- and city-level industry specialist. Following prior studies (e.g., Donohoe & Knechel, 2014; Francis et al., 2005; McGuire et al., 2012), I construct the city-level industry specialization measure, by defining the industry-specialist auditors' threshold at 30% of audit fees for a given industry-MSA pair[23]. AS_SP_NA_MKSH is a dummy variable equal to 1 if the auditor is a national-level industry-specialist, and 0 otherwise. AS_SP_CA_MKSH is a dummy variable equal to 1 if the auditor is a city-level industry-specialist and 0 otherwise. AS_SP_BOTH_MKSH is a dummy variable equal to 1 if the auditor is both national and city-level industry-specialist and 0 otherwise. Panels (B)-(D) of Table 3-9 show that the estimated coefficients of the interaction variables (ARC*AS_SP_NA_MKSH, ARC*AS_SP_CA_MKSH, and ARC* AS_SP_BOTH_MKSH) are significantly positive at p<.10. Overall, my findings support H2 in that employment of industry-specialist auditors magnifies the relationship between ARC and UTBs.

[23] Following (Francis et al., 2005), I exclude city-level industry observations in those city-industry combinations containing fewer than two companies.

**Table 3-9: The moderation of industry-specialist auditors on the association between ARC and UTBs - using alternative measures of industry-specialist auditors**

Panel A: Three largest portfolio share based on tax fees and both tax fees and audit fees

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| VARIABLES | UTB | UTB_PERM | UTB_TEMP | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.0771*** ** | **0.0580*** ** | **0.0231*** ** | **0.1105*** ** | **0.0811*** ** | **0.0287*** ** |
| | **(3.30)** | **(3.09)** | **(3.52)** | **(4.39)** | **(4.10)** | **(4.24)** |
| AS_SP_TAX | -0.7941*** | -0.5892*** | -0.1367*** | | | |
| | (-4.57) | (-4.30) | (-3.31) | | | |
| **ARC * AS_SP_TAX** | **0.1394*** ** | **0.1017*** ** | **0.0255*** ** | | | |
| | **(4.49)** | **(4.11)** | **(3.46)** | | | |
| AS_SP_BOTH_AUD_TAX | | | | -0.5302*** | -0.4069*** | -0.0971** |
| | | | | (-3.39) | (-3.29) | (-2.38) |
| **ARC * AS_SP_BOTH_AUD_TAX** | | | | **0.0916*** ** | **0.0687*** ** | **0.0182** ** |
| | | | | **(3.27)** | **(3.06)** | **(2.51)** |
| Constant | -0.5024*** | -0.3889*** | -0.1320*** | -0.6810*** | -0.5126*** | -0.1622*** |
| | (-4.27) | (-3.92) | (-4.27) | (-5.32) | (-4.88) | (-5.04) |
| Observations | 22,181 | 22,181 | 22,181 | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.151 | 0.166 | 0.069 | 0.150 | 0.165 | 0.068 |
| YEAR | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES |

Panel B: National industry-specialist based on largest 30% of market share of audit fees

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.1239*** ** | **0.0903*** ** | **0.0348*** ** |
| | **(5.34)** | **(5.11)** | **(5.14)** |
| AS_SP_NA_MKSH | -0.7875*** | -0.6274*** | -0.0762 |
| | (-3.55) | (-3.59) | (-1.47) |
| **ARC * AS_SP_NA_MKSH** | **0.1350*** ** | **0.1070*** ** | 0.0132 |
| | **(3.45)** | **(3.46)** | (1.45) |
| Constant | -0.7597*** | -0.5662*** | -0.1951*** |
| | (-6.33) | (-5.91) | (-6.18) |
| Observations | 22,081 | 22,081 | 22,081 |
| Adjusted R-squared | 0.151 | 0.165 | 0.067 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Panel C: City industry-specialist based on largest 30% of market share of audit fees

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
| **ARC** | **0.1130*** ** | **0.0831*** ** | **0.0312*** ** |
| | **(4.23)** | **(3.84)** | **(4.33)** |
| AS_SP_CA_MKSH | -0.3605** | -0.2680** | -0.0615 |
| | (-2.28) | (-2.11) | (-1.60) |
| **ARC * AS_SP_CA_MKSH** | **0.0661** ** | **0.0482** ** | **0.0117* ** |
| | **(2.28)** | **(2.06)** | **(1.66)** |
| Constant | -0.6784*** | -0.5098*** | -0.1730*** |
| | (-4.91) | (-4.42) | (-4.99) |
| Observations | 20,876 | 20,876 | 20,876 |
| Adjusted R-squared | 0.150 | 0.164 | 0.070 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Panel D: National and city industry-specialist based on largest 30% of market share of audit fees

| | (1) | (2) | (3) |
|---|---|---|---|

| VARIABLES | UTB | UTB_PERM | UTB_TEMP |
|---|---|---|---|
| **ARC** | **0.1306*** ** | **0.0958*** ** | **0.0351*** ** |
| | **(5.65)** | **(5.45)** | **(5.25)** |
| AS_SP_BOTH_MKSH | -0.7865*** | -0.5783*** | -0.1037* |
| | (-3.07) | (-2.91) | (-1.75) |
| **ARC * AS_SP_BOTH_MKSH** | **0.1358*** ** | **0.0997*** ** | **0.0178* ** |
| | **(3.05)** | **(2.87)** | **(1.71)** |
| Constant | -0.8062*** | -0.6079*** | -0.1959*** |
| | (-6.74) | (-6.40) | (-6.18) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.150 | 0.165 | 0.068 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

### 3.6.5 Difference-in-difference (DID) analysis

I perform supplementary analysis to consider the effect of detailed tags usage on the relationship between ARC and UTBs. The SEC allowed simple block tagging for the footnotes during the first year of XBRL adoption. Following the first year, firms were required to provide detailed tagging of their footnotes in the period 6/15/2012 and 6/14/2013. Felo, Kim, and Lim (2018) show that the number of footnote tags, both standardized and customized, increased after the time detailed tagging became mandatory. Similarly, they report an increase in the number of analysts following companies with the adoption of compulsory detailed tagging. Thus detailed tagging of footnote information brings about a reduction in the information processing cost of financial analysts. Hence, I further investigate whether the use of detailed tags helps to moderate the positive relationship between ARC and UTBs as follows:

$$UTBs_{it} = \beta_1 ARC_{it} + \beta_2 DID_{it} + \beta_3 ARC_{it} * DID_{it} + \beta_4 SIZE_{it} + \beta_5 MTB_{it} + \beta_6 LEV_{it} + \beta_7 CASH_{it} + \beta_8 ROA_{it} + \beta_9 NOL_{it} + \beta_{10} \Delta NOL_{it} + \beta_{11} FOR_{INC\,it} + \beta_{12} CAP_{INT\,it} + \beta_{13} INTANG_{it} + \beta_{14} EQINC_{it} + \beta_{15} R\&D_{it} + \beta_{16} SALE_{GROWTH\,it} + INDU_{DUMMIES} + YEAR_{DUMMIES} \quad (4)$$

where DID is a dummy variable, coded 1 if the filing date is after 6/14/2013 and 0 if the filing date was before 6/15/2012. ARC*DID is an interaction term between ARC and the event.

Table 3-10 shows the regression results for the effect of detailed tag usage on the relationship between ARC and UTBs. It is observed that the coefficient estimates of ARC are significantly positive (p<0.01) for all UTBs measures, providing support for H1 and the results

presented in Table 3-4 in that there is a positive relationship between ARC and UTBs. I find that the DID coefficient is associated with all measures of UTBs ($p<0.01$) significantly and negatively. The interaction term ARC*DID is positively significant for all measures of UTBs ($p<0.01$). Generally, the DID analysis reveals that the positive relationship between ARC and UTBs is magnified by the use of detailed tags.

**Table 3-10: Difference-in-difference (DID) test on the association between ARC and UTBs**

| VARIABLES | (1) UTB | (2) UTB_PERM | (3) UTB_TEMP |
|---|---|---|---|
| **ARC** | **0.0756*** ** | **0.0632*** ** | **0.0193*** ** |
| | **(3.97)** | **(4.43)** | **(3.24)** |
| **DID** | **-0.7821*** ** | **-0.5079*** ** | **-0.1888*** ** |
| | **(-5.34)** | **(-4.75)** | **(-4.79)** |
| **ARC * DID** | **0.1269*** ** | **0.0807*** ** | **0.0304*** ** |
| | **(4.95)** | **(4.27)** | **(4.37)** |
| SIZE | 0.0586*** | 0.0473*** | 0.0102*** |
| | (9.21) | (10.15) | (6.06) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.22) | (-2.17) | (-1.46) |
| LEV | 0.0309*** | 0.0210** | 0.0112*** |
| | (2.84) | (2.50) | (3.25) |
| CASH | -0.0418*** | -0.0370*** | -0.0060** |
| | (-4.21) | (-4.70) | (-1.97) |
| ROA | -0.0141*** | -0.0140*** | 0.0009 |
| | (-3.48) | (-4.38) | (0.76) |
| NOL | 0.0199 | 0.0054 | 0.0090* |
| | (1.07) | (0.37) | (1.90) |
| CHNG_NOL | -0.0012 | 0.0003 | -0.0011 |
| | (-0.53) | (0.14) | (-1.58) |
| FOR_INC | 0.5798*** | 0.6074*** | 0.0132 |
| | (3.69) | (5.13) | (0.26) |
| CAP_INT | -0.2034*** | -0.1364*** | -0.0547*** |
| | (-6.81) | (-6.00) | (-5.79) |
| INTANG | -0.0379 | -0.0058 | -0.0333*** |
| | (-1.13) | (-0.23) | (-3.78) |
| EQINC | 4.4739* | 3.8956** | 0.9478 |
| | (1.78) | (2.00) | (1.26) |
| R&D | -0.0117 | -0.0473** | 0.0355*** |
| | (-0.46) | (-2.36) | (3.72) |
| SALE_GROWTH | -0.0158*** | -0.0139*** | -0.0013 |
| | (-3.71) | (-4.52) | (-0.89) |
| Constant | -0.5006*** | -0.4251*** | -0.1095*** |
| | (-4.63) | (-5.05) | (-3.57) |
| Observations | 22,181 | 22,181 | 22,181 |
| Adjusted R-squared | 0.150 | 0.164 | 0.069 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

### 3.6.6 The impact of TCJA and number of words in tax footnote on the association between ARC and UTBs

The Tax Cuts and Jobs Act of 2017 (TCJA) included a corporate tax rate cut from 35% to 21%. Before the enactment of TCJA, the U.S. had one of the highest statutory tax rates among the member countries of the Organization for Economic Cooperation and Development (OECD). Two major changes brought by TCJA were: (1) the shift from a system of progressive tax rates to a flat rate of 21%, and (2) the repeal of the provision of performance-based compensation as a taxable expense and the introduction of a limit on the total executive compensation tax deduction at $1 million. The TCJA was expected to have a profound impact on publicly traded companies and consequently, to result in a broad range of economic repercussions. For example, the TCJA was expected to reduce U.S. tax revenue by nearly $1.5 trillion over the next ten years (Joint Committee on Taxation (JCT), 2017). A lower marginal tax rate creates an opportunity for tax savings for firms by reducing the tax payments to the government. The agency cost of free cash flow arises when opportunistic managers invest in projects that have negative net present value to increase the resources under their control (Jensen, 1986). As the TCJA substantially decreased the tax advantages of executive pay, managers may have opportunities to make financial reporting more difficult (e.g. high ARC) in an opportunistic manner. I examine the TCJA as an exogenous event together with ARC, and test whether managers make opportunistic use of the words in a tax footnote.

I generate a dummy variable coded as 1 if the fiscal year is later than 2017, and 0 otherwise. I interact TCJA with ARC and then interact ARC* TCJA to Num_words (the natural logarithm of the number of words included in the tax footnote).

$$UTBs_{it} = \beta_1 ARC_{it} + \beta_2 TCJA_{it} + \beta_3 ARC_{it} * TCJA_{it} + \beta_4 Num\_words_{it} + \beta_5 ARC * TCJA * Num\_words_{it} + CONTROLS + INDU_{DUMMIES} + YEAR_{DUMMIES} \quad (5)$$

The regression results of Equation (5) are presented in Table 3-11. It is found that TCJA is negatively associated with all measures of UTBs, suggesting firms are benefiting from TCJA. The coefficient of the interaction term ARC*TCJA is significantly negative only for UTB_TEMP at p<.10, but insignificantly negative (positive) for UTB (UTB_PERM). Further, it is observed that the coefficient estimates of the interaction ARC* TCJA*Num_words are significantly positive (p<0.05) for UTB and UTB_TEMP. This result suggests that the high level of ARC and of the number of words in the tax footnote increase UTBs in the post TCJA period.

**Table 3-11: The impact of TCJA and number of words in tax footnote on the association between ARC and UTBs**

| VARIABLES | (1) UTB | (2) UTB_PERM | (3) UTB_TEMP |
|---|---|---|---|
| **ARC** | **0.1042*** ** | **0.0811*** ** | **0.0261*** ** |
| | **(4.53)** | **(4.72)** | **(3.76)** |
| TCJA | -0.4271** | -0.4555*** | 0.0306 |
| | (-2.30) | (-3.25) | (0.58) |
| **ARC * TCJA** | **-0.0234** | **0.0346** | **-0.0282*** |
| | **(-0.43)** | **(0.96)** | **(-1.71)** |
| Num_words | 0.0950*** | 0.0596*** | 0.0274*** |
| | (6.02) | (5.07) | (6.01) |
| **ARC * TCJA * Num_words** | **0.0123**** | **0.0050** | **0.0029**** |
| | **(2.42)** | **(1.63)** | **(1.96)** |
| SIZE | 0.0577*** | 0.0468*** | 0.0100*** |
| | (8.52) | (9.39) | (5.72) |
| MTB | -0.0010** | -0.0007** | -0.0002 |
| | (-2.15) | (-2.11) | (-1.45) |
| LEV | 0.0389*** | 0.0270*** | 0.0122*** |
| | (3.31) | (2.99) | (3.37) |
| CASH | -0.0422*** | -0.0361*** | -0.0072** |
| | (-4.05) | (-4.38) | (-2.31) |
| ROA | -0.0160*** | -0.0153*** | 0.0002 |
| | (-3.69) | (-4.50) | (0.18) |
| NOL | 0.0026 | -0.0033 | 0.0031 |
| | (0.13) | (-0.22) | (0.62) |
| CHNG_NOL | -0.0006 | 0.0008 | -0.0010 |
| | (-0.25) | (0.34) | (-1.36) |
| FOR_INC | 0.4939*** | 0.5678*** | -0.0133 |
| | (2.94) | (4.50) | (-0.24) |
| CAP_INT | -0.1810*** | -0.1271*** | -0.0470*** |
| | (-5.70) | (-5.20) | (-4.73) |
| INTANG | -0.0421 | -0.0095 | -0.0339*** |
| | (-1.20) | (-0.35) | (-3.66) |
| EQINC | 4.1772 | 3.4172* | 1.1938 |
| | (1.63) | (1.78) | (1.50) |
| RND | -0.0296 | -0.0616*** | 0.0340*** |
| | (-1.09) | (-2.82) | (3.40) |
| SALE_GROWTH | -0.0167*** | -0.0143*** | -0.0017 |
| | (-4.78) | (-5.26) | (-1.21) |
| Constant | -1.2204*** | -0.8801*** | -0.3107*** |
| | (-8.32) | (-7.96) | (-7.86) |
| Observations | 20,369 | 20,369 | 20,369 |
| Adjusted R-squared | 0.162 | 0.173 | 0.079 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

### 3.6.7 Additional control variables

I also include some additional control variables in the main regression, such as discretionary accruals, cash effective tax rate, selling and administrative expenses, auditor-provided tax services fees, and Big 4 auditor. In untabulated analysis, I observed that the main results remain robust ($p<.01$) for all measures of UTB after controlling for additional variables.

### 3.6.8 Propensity score matching (PSM)

In addressing the likely endogeneity concerns in the baseline regression, I utilize the PSM technique. Following Shipman et al. (2017), a logistic regression model is estimated with the same set of control variables as the baseline regression model in Equation (1). The dummy variable for ARC (ARC_DM) is coded as 1 if ARC is higher than the mean value, and 0 otherwise. The predicted propensity scores from the logistic regression are matched on a one-to-one basis by industry and year for each observation in the treatment companies (i.e., company-year observations with ARC_DM equal to 1) to the control companies (i.e., company-year observations with ARC_DM equal to 0). The matched pairs are combined into pooled samples for regression analysis and the results are presented in Table 3-12.

The first-stage regression model (Table 3-12 Panel A) reveals that there is a significant association between the control variables and ARC_DM ($p<0.05$ or better). The quality of the matching process is tested using computing covariates for every variable in the logistic regression models. I applied the "Nearest-Neighbour" matching method for ARC_DM based on the propensity scores, which are calculated using the estimated coefficients from the logit regression in Panel A. Table 3-12, Panel B, shows the results of the second-stage regression model on the pooled sample. It is evident that there is a positive association between ARC and different measures of UTB ($p<0.01$), providing further evidence to support H1.

**Table 3-12: Propensity score matching (PSM) analysis**

| Panel A: First Stage logit regression - Nearest Neighbour | |
|---|---|
| | (1) |
| VARIABLES | First Stage |
| SIZE | 0.4478*** |
| | (50.68) |
| MTB | -0.0074*** |
| | (-4.53) |
| LEV | 0.5163*** |
| | (12.54) |
| CASH | -0.7853*** |
| | (-14.11) |
| ROA | 0.0135 |
| | (0.054) |
| NOL | 0.5441*** |
| | (14.55) |
| CHNG_NOL | -0.0674** |
| | (-3.02) |
| FOR_INC | 0.3998 |
| | (1.08) |
| CAP_INT | -0.0436 |
| | (-0.51) |
| INTANG | 1.0270*** |
| | (13.94) |
| EQINC | 23.1662*** |
| | (4.74) |
| RND | -1.3370*** |
| | (-9.62) |
| SALE_GROWTH | -0.0897*** |
| | (-3.65) |
| Constant | -2.7358*** |
| | (-8.64) |
| Observations | 23,412 |
| Pseudo R2 | 0.210 |
| YEAR | YES |
| INDUSTRY | YES |

Panel B: PSM second-stage regression

| VARIABLES | (1) UTB | (2) UTB_PERM | (3) UTB_TEMP |
|---|---|---|---|
| **ARC** | **0.1389*** ** | **0.0981*** ** | **0.0355*** ** |
| | **(6.60)** | **(6.69)** | **(5.46)** |
| SIZE | 0.0297*** | 0.0225*** | 0.0074*** |
| | (5.22) | (5.76) | (4.26) |
| MTB | -0.0002 | -0.0004 | 0.0000 |
| | (-0.64) | (-1.40) | (0.34) |
| LEV | 0.0239*** | 0.0156*** | 0.0082*** |
| | (2.97) | (2.63) | (2.92) |
| CASH | -0.0147* | -0.0124** | -0.0037 |
| | (-1.89) | (-2.18) | (-1.37) |
| ROA | -0.0008 | -0.0025 | 0.0016* |
| | (-0.26) | (-1.13) | (1.68) |
| NOL | -0.0020 | -0.0107 | 0.0073 |
| | (-0.11) | (-0.83) | (1.50) |
| CHNG_NOL | -0.0020 | -0.0010 | -0.0010 |
| | (-1.10) | (-0.75) | (-1.58) |
| FOR_INC | 0.4098*** | 0.4049*** | 0.0436 |
| | (3.13) | (4.66) | (0.81) |
| CAP_INT | -0.1186*** | -0.0664*** | -0.0422*** |
| | (-4.81) | (-3.85) | (-4.39) |
| INTANG | -0.0107 | -0.0109 | -0.0135 |
| | (-0.32) | (-0.46) | (-1.36) |
| EQINC | 3.2331 | 2.8916* | 0.9058 |
| | (1.38) | (1.86) | (0.98) |
| R&D | -0.0009 | -0.0302*** | 0.0283*** |
| | (-0.06) | (-2.88) | (3.26) |
| SALE_GROWTH | -0.0098*** | -0.0078*** | -0.0014 |
| | (-2.79) | (-3.27) | (-1.13) |
| Constant | -0.6478*** | -0.4613*** | -0.1706*** |
| | (-6.81) | (-6.72) | (-5.96) |
| Observations | 15,358 | 15,358 | 15,358 |
| Adjusted R-squared | 0.092 | 0.101 | 0.055 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses. ***, **, and * refer to statistical significance at p<0.01, p<0.05, and p<0.1, respectively. All variables are defined in Appendix A.

## 3.7 Conclusions

This study investigates the association between ARC and UTBs. I show that ARC is positively associated with UTBs. Further, I document that industry-specialist auditors magnify the positive relationship of ARC and UTBs. The results are robust to alternative measures of ARC and UTBs, and to endogeneity concerns. In general, I show that ARC is an important determinant of UTBs.

I contribute to the literature in several ways. First, I provide a methodological contribution based on my construction and use of financial reporting complexity. In fact, my measure of ARC captures the increments in complexity, based on the layout and narrative of accounting and financial reporting information. Second, to the best of my knowledge, no prior study has tested the relationship between ARC and UTBs. My observation is that there is a positive relationship between ARC and UTBs. This relationship is important, because there is a greater nexus between tax reporting and financial reporting requirements in that firms' tax filings and tax footnotes require the use of both tax and financial information. Third, increased audit risk could stem from higher financial complexity and, hence, auditors will need to put in more effort and/or charge a fee premium to compensate for the added risk (Bedard & Johnstone, 2004). I find that employment of industry-specialist auditors moderates the positive association between ARC and UTBs.

## Appendix 3-A: Chapter 3 variables definition

| | |
|---|---|
| **Dependent variables** | |
| UTB | Unrecognized tax benefits (txtubend) scaled by outstanding common shares. |
| UTB_PERM | UTBs that affect the effective tax rate (ETR) scaled by outstanding common shares. Following (Frischmann et al., 2008), I set UTB_PERM equal to UTB if TXTUBTXTR is missing. |
| UTB_TEMP | UTB minus UTB_PERM. |
| **Independent variable** | |
| ARC | The natural logarithm of one plus the total number of monetary tags reported in Item 8 of 10-K filings, which includes the financial statements and notes (SEC filings) (Hoitash & Hoitash, 2018). |
| **Industry-specialist auditors** | |
| AS_SP_COMP | Dummy variable, coded as 1 if the audit firm is in the top three based on ARC of the client in a particular industry and year, or 0 otherwise. |
| AS_SP_AT | Dummy variable, coded as 1 if the audit firm is in the top three based on assets of the client in a particular industry and year, or 0 otherwise. |
| AS_SP_SALE | Dummy variable, coded as 1 if the audit firm is in the top three based on sales of the client in a particular industry and year, or 0 otherwise. |
| AS_SP_AUD | Dummy variable, coded as 1 if the audit firm is in the top three based on audit fees of the client in a particular industry and year, or 0 otherwise. |
| **Control variables** | |
| SIZE | The natural log of market value of equity. |
| MTB | Market-to-book ratio. |
| LEV | Total long-term debt scaled by total assets. |
| CASH | Cash and marketable securities scaled by total assets. |
| ROA | Income before extraordinary items scaled by total assets. |
| NOL | A dummy variable coded as 1 if loss carry forward, and 0 otherwise. |
| ΔNOL | Change in loss carried forward scaled by total assets. |
| FOR_INC | Foreign income scaled by total assets. |
| CAP_INT | Property, plant and equipment scaled by total assets. |
| INTANG | Total intangible assets scaled by total assets. |
| EQINC | Equity income in earnings scaled by total assets. |
| R&D | Research and development expenditure scaled by total assets. |
| SALE_GROWTH | Changes in sales scaled by lagged sales. |
| **Alternative measures of UTB** | |
| UTB_LOG | The natural log of UTB. |
| UTB - P_UTB | The difference between UTB and P_UTB. I use the coefficients in Table 1 of Rego and Wilson (2012) to measure P_UTB. |
| UTB>P_UTB | Dummy variable coded as 1 if the UTB is greater than P_UTB (UTB>P_UTB). |
| **Components of UTB** | |

| | |
|---|---|
| UTB_CY_INC | The increase amount of tax positions in the current year, scaled by outstanding common shares. |
| UTB_PY_INC | The increase amount of tax positions in the prior year, scaled by outstanding common shares. |
| UTB_PY_DEC | The decrease amount of tax positions in the prior year, scaled by outstanding common shares. |
| UTB_Settle | The decrease amount relating to tax settlements, scaled by outstanding common shares. |
| UTB_Limit | Reductions due to lapse of statute of limitations, scaled by outstanding common shares. |

**Alternative measures of ARC**

| | |
|---|---|
| ARC_ALL_FACTS | These include all facts reported in the filings which are facts that repeated within a disclosure and facts that repeated due to comparable financial statement disclosure. This approach assumes that complexity is a combination of the number of tags used and their frequency of use. |
| ARC_UNIQUE_FACTS | Counting unique tags within filings. |
| ARC_TAXONOMY | Taxonomy tags are tags approved by FASB and appear on the XBRL taxonomy at the time of the filing. |
| ARC_EXTENSIONS | Extensions are tags created by companies when firms determine that the available taxonomy tags cannot accurately capture their company-specific economic transactions. |
| PERCENT_EXTENDED | The ratio of extended tags to total tags. Specifically, it is calculated as ARC_EXTENSIONS/ARC |
| ALL_NUMBERS | The count of all numerical facts in the filings and it includes non-monetary facts such as percent, shares. |
| ALL_NUMBERS_EXTENSIONS | The count of all numerical facts that are extensions in the filings. It includes non-monetary facts such as percent, shares. |

**Alternative measures of industry-specialist auditors**

| | |
|---|---|
| AS_SP_TAX | Dummy variable, coded as 1 if the audit firm is in the top three based on tax fees of the client in a particular industry and year, 0 otherwise. |
| AS_SP_BOTH_AUD_TAX | Dummy variable, coded as 1 if SPAUD and AS_SP_TAX are 1 or 0 otherwise. |
| AS_SP_NA_MKSH | Dummy variable, coded as 1 when an audit firm has a fee market share of at least 30% in a 2-digit SIC industry, 0 otherwise. |
| AS_SP_CA_MKSH | Dummy variable, coded as 1 when an audit firm has a fee market share of at least 30% in a 2-digit SIC industry and specific city (MSA), 0 otherwise. |
| AS_SP_BOTH_MKSH | Dummy variable, coded as 1 if AS_SP_NA_MKSH and AS_SP_CA_MKSH are 1, 0 otherwise. |

**Additional variables**

| | |
|---|---|
| DID | Dummy variable, coded as 1 if the filling date is after 6/14/2013, or 0 if the filling date is before 6/15/2012. |
| TCJA | Dummy variable coded as 1 if is the fiscal year greater than 2017, 0 otherwise. |
| Num_words | The natural logarithm of the number of words included in the tax footnote (Ahn et al., 2020; Hoitash et al., 2020). |

# Chapter 4 The effect of Cybersecurity Breaches on Corporate Tax Avoidance

## 4.1 Introduction

The occurrence of cybersecurity breaches (CSBs) is a key risk that firms face in the digital world. The rise in CSBs has made cybersecurity a critical area for firms, markets, and regulators as it has been estimated that costs from CSBs may have exceeded $2 trillion in 2019 (Juniper Research, 2015). The average number of reported CSBs increased by 38 percent in 2015 compared to that recorded in 2014 with an average financial loss of $2.7m (PwC, 2016). CSBs of corporations such as Equifax, Yahoo and Target resulted in severe impacts on their market price and earnings. This study investigates whether the occurrence of CSBs is associated with corporate tax avoidance. I am motivated to examine this association because the non-disclosure of CBSs exacerbates agency costs and information asymmetry which can facilitate an environment in which tax planning can flourish (Desai & Dharmapala, 2006; Kim et al., 2011).

Based on prior research (see e.g. Dyreng et al., 2010; Frank, Lynch, & Rego, 2009; Hoi et al., 2013; Rego, 2003; Wilson, 2009), I use three measures of corporate tax avoidance as the dependent variable comprising the accounting effective tax rate (GAAP ETR), permanent book-tax differences (DTAX), and unrecognized tax benefits (UTB_TA). I utilise the Privacyrights database to obtain CSB data. The occurrence of CSB (BREACH) is measured as an indicator variable if a firm reported a breach during the fiscal year. Using a large sample of U.S. firms from 2005 to 2018, I find a positive relationship between the occurrence of CSBs and corporate tax avoidance for my full sample and for my propensity score matched (PSM) sample. My results are robust using alternative measures of tax avoidance and CSBs. In addition, I show that strength in board-level IT governance (i.e. firms with the establishment of risk committee, of compliance committee, of technology committee, and having IT officers in top management team) reduces the propensity of management to engage in corporate tax avoidance. This finding suggests that board-level IT governance plays an important role in mitigating the impact of CSBs on corporate tax avoidance. Further, my results are robust in respect to the timing of CSBs, based on a Heckman test and in models that employ additional control variables.

This study contributes to literature in several important ways. Prior research has identified that the occurrence of CSBs have a negative market reaction (Campbell et al., 2003;

Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009; Johnson et al., 2017; Telang & Wattal, 2007), result in increased risk (Gwebu et al., 2014; Romanosky et al., 2014), in higher audit fees (Li et al., 2020; Smith et al., 2019) and in an increase of cash holdings (Boasiako & Keefe, 2020). To best of my knowledge, this is the first study that show the positive association of CSBs and corporate tax avoidance. Gallemore and Labro (2015) indicate that firms with higher internal information quality are more likely to engage in tax avoidance. I extend the findings of Gallemore and Labro (2015) by providing evidence that increased CSBs result in higher levels of corporate tax avoidance.

This study also adds new evidence to the IT governance literature. Prior research shows the presence of board-level IT governance mitigates CSBs risk (e.g., Haislip, Masli, et al., 2016; Haislip, Peters, et al., 2016; Higgs et al., 2016; Smith et al., 2019) and reduces agency costs. This is achieved through monitoring and oversight IT systems designed to enhance the effectiveness and efficiency of IT systems, policies, and procedures (Fama & Jensen, 1983). In my additional analysis, I find that existence of a risk, compliance, technology committee or IT executive in top managements plays an important role in moderating the association between CSBs and tax avoidance.

The rest of this chapter is as follows. Section 4.2 provides overview of CSBs. Section 4.3 examines the theory and develops my hypotheses. Section 4.4 highlights the research design. Section 4.5 presents the empirical results and Section 4.6 reports additional analyses. Finally, the conclusion is discussed in Section 4.7.

## 4.2 Overview of CSBs

### 4.2.1 Definition and type of CSBs

Cybersecurity includes technologies, processes and controls designed to safeguard systems, networks and data from cyber-attacks (AICPA, 2020). Cybersecurity is defined by the Assurance Services Executive Committee (ASEC) as the procedure of applying and operating controls and other risk management activities to secure information and systems from security incidents that could impede the firm's cybersecurity goals of detecting, responding, mitigating, and recovering from, security incidents on a timely basis (AICPA, 2020). The Verizon (2016) defines a cybersecurity incident is an event that compromises the integrity, confidentiality, or availability of an information asset and cybersecurity breach is an incident that results in the confirmed disclosure of data to an unauthorized party.

The non-profit Identity Theft Resource Center (ITRC) defines a data breach as "an incident in which an individual's name plus a Social Security Number, driver's license number, medical record or financial record (including debit/credit cards) is potentially put at

risk because of exposure." A broader definition comes from Cannon and Kessler (2007) who defines a data breach as "the unauthorized access to and acquisition of data in any form or format containing sensitive information that compromises the security or confidentiality of such information and creates a reasonable risk of its misuse." Thus, effective cybersecurity decreases the risk of cybersecurity breaches designed to protect society, individuals and firms from the unauthorized utilization of systems, networks and technologies.

While breaches capture a large variety of system intrusions, Michel, Oded, and Shaked (2020) subdivide them into four types: traditional hacks, negligence, phishing and theft. The traditional hack is defined as the use of a computer to obtain unpermitted access to a system. Negligence arises when there is a leak of personal information due to the deficiency of company oversight. Phishing occurs when an attacker obtains sensitive information (e.g., usernames, passwords, or credit card details, etc.) for malicious means often using a skimmer or similar device to collect credit card details belonging to unsuspecting customers. Theft occurs when a document, computer, or computer file/hardware including sensitive information is stolen from a company.

### 4.2.2 Example effects of cybersecurity

Equifax is one of the largest credit bureaus in the US. The security team of Equifax observed suspicious network traffic on July 29, 2017 associated with its U.S. online dispute portal web application, and additional suspicious network traffic was also observed on the following day. On 7 September 2017, the vulnerability of the application in one of their websites resulted in a data breach that exposed approximately 147.9 million consumers. On the following day, the share price of Equifax decreased from $142.72 to $123.23. This breach event brought considerable public and regulatory consideration of the impact of CSBs. Further, the breach exposed personal information (which include social security numbers, dates of birth, addresses and in some cases driver's license numbers) of 143 million consumers; 209,000 consumers also had their credit card details disclosed. The number of Equifax customer exposed personal information was increased to 147.9 million in October 2017. In 2019, the total cost associated with the 2017 CSB of Equifax was $337.3 million. These costs were offset by $125.0 million from cybersecurity insurance (Audit Analytics, 2020). Eight days after the Equifax cybersecurity incident on 7 September 2017, the company replaced its Chief Information Officer (CIO) and Chief Security Officer (CSO)[24].

[24] For detailed see https://www.equifaxsecurity2017.com/2017/09/15/equifax-releases-details-cybersecurity-incident-announces-personnel-changes/

In September 2016, Yahoo Inc. disclosed that it had become the victim of the largest data breach in its history in 2014. This breach exposed the names, email addresses, dates of birth and telephone numbers of 500 million users. Furthermore, at the end of 2016, Yahoo disclosed breaches from 2013 by different attackers which affected more than 3 billion accounts. The delay in disclosure on breaches resulted in the Securities Exchange Commission in imposing a $35 million fine on Yahoo Inc. in 2018.

On 8 September 2014, Home Depot confirmed that payment data was breached. The company announced that this breach could possibly effect customers using payment cards. After 10 days from the announcement breach, the company indicated that approximately 56 million payment cards were exposed due to CSB. Home Depot expenses tied to its CSB incident was around $298 million. The below summary shows the trends in cybersecurity breach disclosures found in Audit Analytics database for the year 2020.

| **Audit Analytics Report (Trends in Cybersecurity Breach Disclosures), 2020** | |
|---|---|
| **Company name** | **Costs related to CBSs** |
| Equifax | $ 1.7 B |
| Home Depot | $ 298 M |
| Target | $ 292 M |
| Marriott | $ 176 M |
| Anthem | $ 131 M |
| Global Payments | $ 114 M |
| Capital one | $ 72 M |
| Corelogic | $ 17 M |
| Roadrunner Transportation | $ 7 M |

## 4.3 Literature review and hypotheses development

Cybersecurity breaches represent one of the greatest challenges in today's digital era. The average number of cybersecurity breaches reported in the U.S. increased by 38 percent in 2015 compared with 2014 and the average total financial losses due to cybersecurity breaches in 2014 were $2.7m (PwC, 2016). The Security and Exchange Commission (SEC) promoted the increased cybersecurity risk disclosure in 2011 and 2018(SEC, 2011, 2018).

Cybersecurity breaches research has grown in line with the frequency of CSB events and the increased costs associated with CSBs. Ettredge and Richardson (2003) and Campbell et al. (2003) are among the earliest studies which investigate the effect of negative cyber events using event studies and they find substantial negative market reactions. More recent studies also document significant negative market reactions to CSBs (Gatzlaff & McCullough, 2010; Gordon, Loeb, & Zhou, 2011). There is a large body of evidence that find that CSBs have a negative market reaction (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009; Johnson et al., 2017; Telang & Wattal, 2007) and a range of contingency factors that could affect the market reaction, such as announcement texts, firm

size and industry (Acquisti, Friedman, & Telang, 2006; Das, Mukhopadhyay, & Anand, 2012; Wang, Ulmer, & Kannan, 2013; Yayla & Hu, 2011).

The market impact is the most commonly studied area in respect to the effect of CSBs. However, CSBs disclosure is one of the critical determinants of risk disclosures by an SEC registrant (SEC, 2011, 2018). Hence, CSBs can have an impact on the whole financial information system (Deloitte, 2017). CSBs have broad consequences such as increased risk of firms (Gwebu et al., 2014), higher audit fees (Li et al., 2020; Smith et al., 2019) and various implications for customers, suppliers, and employees.

The reputational and operational risks posed by CSBs can have long-term effects on firms. A recent study of senior operational risk specialists found that IT obstructions from CSBs are considered to be the highest risk for firms in 2020 (Risk.net, 2020). Operational disruptions decrease productivity, create economic costs, and can adversely impact the financial performance of the firms (Bai, Kajiwara, & Liu, 2015). Firms with CSBs can incur substantial financial losses and negative reputational effects. In addition to immediate costs such as customer credit monitoring and system restoration, the indirect consequences of CSBs (e.g., lawsuits, other liabilities, and damaged customer and partner relationships) may result in an adverse effect on subsequent sales and income (Ponemon Institute, 2020). For instance, Target Corporation reported in its 2016 annual report that the cumulative expense for its 2013 data breach case had accrued to $292 million after paying a legal settlement of $153.9 million which represents 10.7 percent of their 2016 net income. The potential litigation and liability payments could be more expensive than the immediate costs mentioned. Specifically, settlements costs of Anthem Insurance Company were $115 million (4.4 percent of their 2015 net income) for its CSB[25]. Romanosky et al. (2014) investigate the effect of litigation risk resulting from CSBs and find that the settlement rate is very high at 50% for CSB firms while the average federal litigation rate for CSB firms is just 4%. They also find that firms are more likely to be sued if consumers are financially affected by the loss of CSB or there has been release of customer details.

Gwebu et al. (2014) observe a substantial decrease in profitability as a result of CSBs using a longer time horizon (one-year period). Investors expect a decline in future cash flows due to CSB which resulting in a decrease in market value (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009). Investors may therefore believe that a lack of data protection is related to ineffectiveness and inefficiency in firm operations, which would affect the firm's capability to generate profit (Benaroch, Chernobai, & Goldstein, 2012). Kamiya, Kang, Kim, Milidonis, and Stulz (2020) investigate the impact of CSBs on the credit

[25] https://www.sec.gov/Archives/edgar/data/0001156039/000115603918000013/antm-20180930x10q.htm

risk of the firm. They find that firms with CSBs incur lower probability of credit ratings, higher cash flow volatility and increased likelihood of bankruptcy. Previous studies demonstrate that CSB incidents lead to a higher level of firm risk. For instance, Lawrence et al. (2018), using CSB as one indicators of operational control risk, show that a CSB is a potential source of weaknesses or deficiencies in financial reporting which result in a positive association between audit fees and CSBs. Furthermore, recent studies document that CSBs increase audit fees (Li et al., 2020; Smith et al., 2019; Yen, Lim, Wang, & Hsu, 2018). He, Frost, and Pinsker (2020) find that CSBs are negatively associated with investment efficiency and impact R&D investment in the following year which creates future uncertainty.

According to disclosure literature, managers have incentives to withhold negative information and to disclose favourable information (Beyer et al., 2010; Verrecchia, 2001). The bias against releasing bad news arises from concerns over damaging future career opportunities, increasing cost of capital, and exposing confidential information to competitors (Ke, Huddart, & Petroni, 2003; Kothari, Li, & Short, 2009; Kothari, Shu, & Wysocki, 2009). Consequently, if the disclosure of CSBs contains unfavourable information, managers are less likely to release such information. Amir, Levi, and Livne (2018) show a considerably greater negative impact on the equity value of firms withholding CSBs than firms voluntarily reporting the CSBs. If a firm manager withholds and accumulates negative information for a long time period, the share price of the firm will be severely overvalued and thus a bubble will arise. Accordingly, Xu, Guo, Haislip, and Pinsker (2019) investigate whether managers are more likely to participate in earnings management after CSBs have been discovered. They specifically indicate that when the CSBs are related to financial information, the disclosure of CSBs is delayed, and the information environment is weaker, and firms are more likely to engage in real earnings management.

Prior studies indicate that CSBs are a signal of internal control deficiencies or weakness (Benaroch & Chernobai, 2017; Benaroch et al., 2012) and impact a firm's information environment (Wang, Kannan, & Ulmer, 2013). Internal controls weakness highlight significant negative weaknesses in policies, procedures and systems with flow-on consequences relating to the quality of financial reporting (Ashbaugh-Skaife, Collins, Kinney Jr, & LaFond, 2008; Haislip, Peters, et al., 2016; Klamm & Watson, 2009). Lawrence et al. (2018) argue that as both operational and financial reporting depend on shared controls and hence weakness in one area would affect the other. They further indicate that CSBs, as a proxy for operational control risk, are positively related to financial reporting risk. The occurrence of CSBs can infer weaknesses in internal controls, which result in poor information environments (Cheng et al., 2013) and weak governance (Chan, Farrell, & Lee, 2008; Doyle, Ge, & McVay, 2007; Larcker, Richardson, & Tuna, 2007). Bauer (2016) employ the quality of internal control as a proxy for internal governance and find firms with internal control

weakness are more likely to avoid tax. Hance, poor internal controls, poor information environment, and poor governance relating to CSBs events may exacerbate agency costs and obscurity which could assist in masking tax avoidance activities.

In an environment with less transparency and uncertainty, CSBs may enable managers to engage in tax avoidance activities (Desai & Dharmapala, 2006). Gallemore and Labro (2015) show that a poorer quality of internal information is positively associated with tax avoidance which suggests that managers withholding bad information are more likely to engage in tax avoidance activities. Kim et al. (2011) argue that tax avoidance encourages rent extraction by managers through the accumulation of negative information such as CSBs for longer periods of time. Balakrishnan et al. (2019) document that higher information uncertainty, higher information asymmetry and lower earnings quality are associated with corporate tax avoidance. This stream of research indicates that agency costs might lead to overinvestment in tax avoidance by opportunistic managers. As CSB events generate uncertain future outcomes for managers (e.g. higher cash flow volatility and litigation risk) and may hinder external financing, firms can use tax avoidance as a means to expand internal resources. Boasiako and Keefe (2020) find that firms with CSBs hold more cash as well as reduce external finance and investment. He et al. (2020) show that CSBs decrease investment efficiency and impact R&D investments in the following year which creates future uncertainty. Cash tax saving from tax avoidance activities is an important internal resource and firms in financial distress are more likely to engage in tax avoidance (Edwards et al., 2016).

On the basis of the aforementioned discussion, CSBs facilitate managers to increased tax savings through tax avoidance activities. I therefore state my hypothesis as follows:
*H1: There is a positive relationship between CSBs and corporate tax avoidance.*

## 4.4 Research design

### 4.4.1 Sample selection

I obtain CSB data from privacyrights.org (PRC)[26] over the period 2005 to 2018. PRC provides the data breach announcement date, the name of the firm, the type of data breach and the description of events that involve individuals' identity since 2005. I identify 7,387 data breaches after excluding education, government and military, medical, and non-profit organizations. I match firms with Compustat based on company name using fuzzy matching and manually verify the results. My sample includes all companies in Compustat, Audit

[26] https://privacyrights.org/data-breaches

Analytics and BoardEx databases from the period of 2005-2018. This initially results in 113,181 firm-year observations. I exclude financial firms (54,120), utility firms (5,380), and firms with missing data for control variables (15,203). I am then left with a final sample of 38,478 firm-year observations. I identify 292 breaches firms (422 firm-year observations) and 6,645 non-breach firms (38,056 firm-year observations). Panel A of Table 4.1 presents a summary of my sample selection and Panel B reports the industry distribution of all firms, CSB firms, and non-CSB firms.

**Table 4-1: Sample description.**

| **Panel A: Sample selection** | |
|---|---|
| Total Compustat data from 2005 to 2018 with state relocation | 113,181 |
| Less: Financial institutions (SIC 60–69) | (54,120) |
| Less: Utility industries (SIC 49) | (5,380) |
| Less: missing data to compute control variables | (15,203) |
| Total | 38,478 |

**Panel B: Sample distribution by industry**

| | All Firms | | Breach Firms | | Non Breach Firms | |
|---|---|---|---|---|---|---|
| SIC CODE (one digit) | Frequency | Percent | Freq. | Per. | Freq. | Per. |
| 1 | 3,379 | 8.78 | 4 | 0.95 | 3,375 | 8.87 |
| 2 | 8,485 | 22.05 | 41 | 9.72 | 8,444 | 22.19 |
| 3 | 11,338 | 29.47 | 69 | 16.35 | 11,269 | 29.61 |
| 4 | 2,305 | 5.99 | 41 | 9.72 | 2,264 | 5.95 |
| 5 | 4,405 | 11.45 | 124 | 29.38 | 4,281 | 11.25 |
| 7 | 6,227 | 16.18 | 108 | 25.59 | 6,119 | 16.08 |
| 8 | 1,978 | 5.14 | 32 | 7.58 | 1,946 | 5.11 |
| 9 | 361 | 0.94 | 3 | 0.71 | 358 | 0.94 |

Figure 4-1 presents the distribution of CSB firms by year. That Table shows that the most intense CSB period reported by firms is between 2012 and 2014. Figure 4-2 shows the distribution of CSB firms by state and indicates that California is the state which has recorded the highest level of reported CSBs[27]. Figure 4-3 presents the mean of state GAAP_ETR for CSB firms. California has the highest number of reported CSB of 0.26 compared to Tennessee with a reported CBS of 0.28.

[27] California state is the first state that pass a data breach notification law in 2002. Alabama State, South Dakota, and New Mexico implemented the data breach notification law in 2017 and 2018.

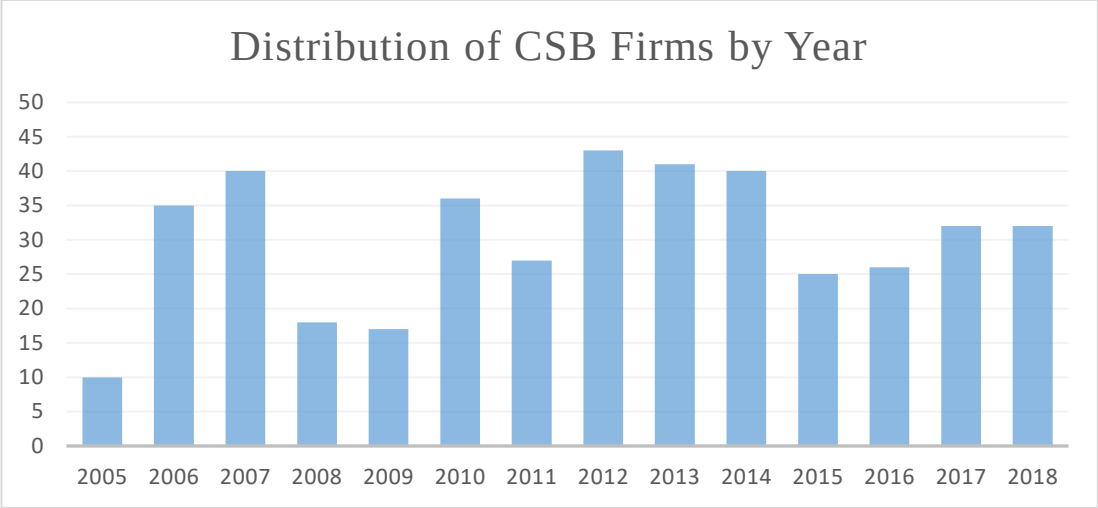


**Figure 4-1: Distribution of CSB Firms by Year**

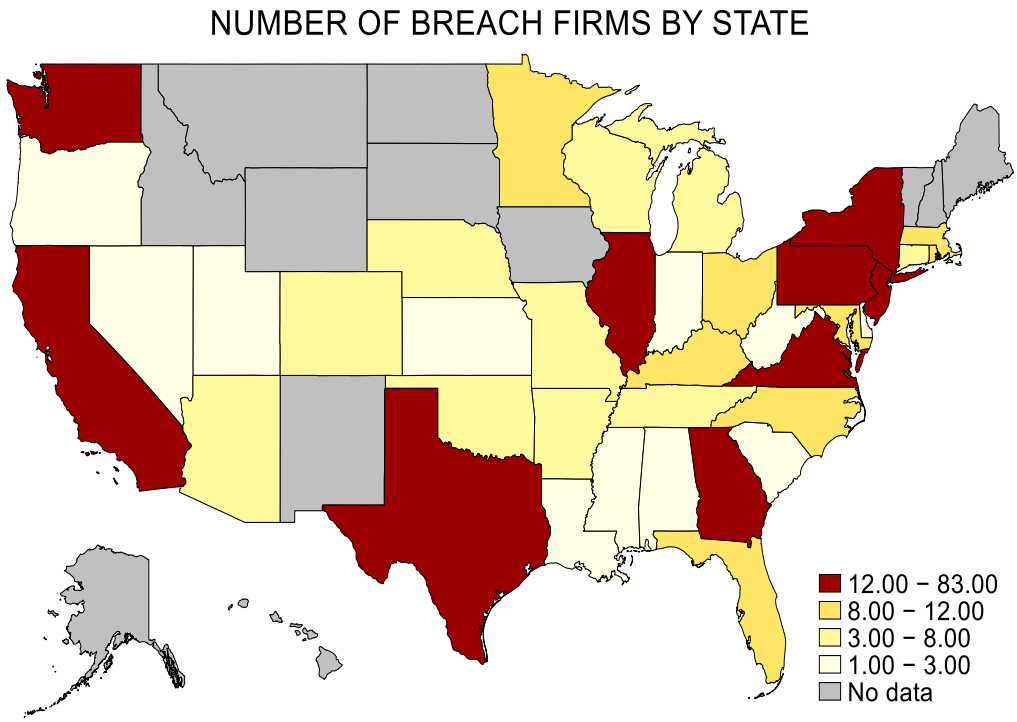


**Figure 4-2: Distribution of CSB Firms by State**

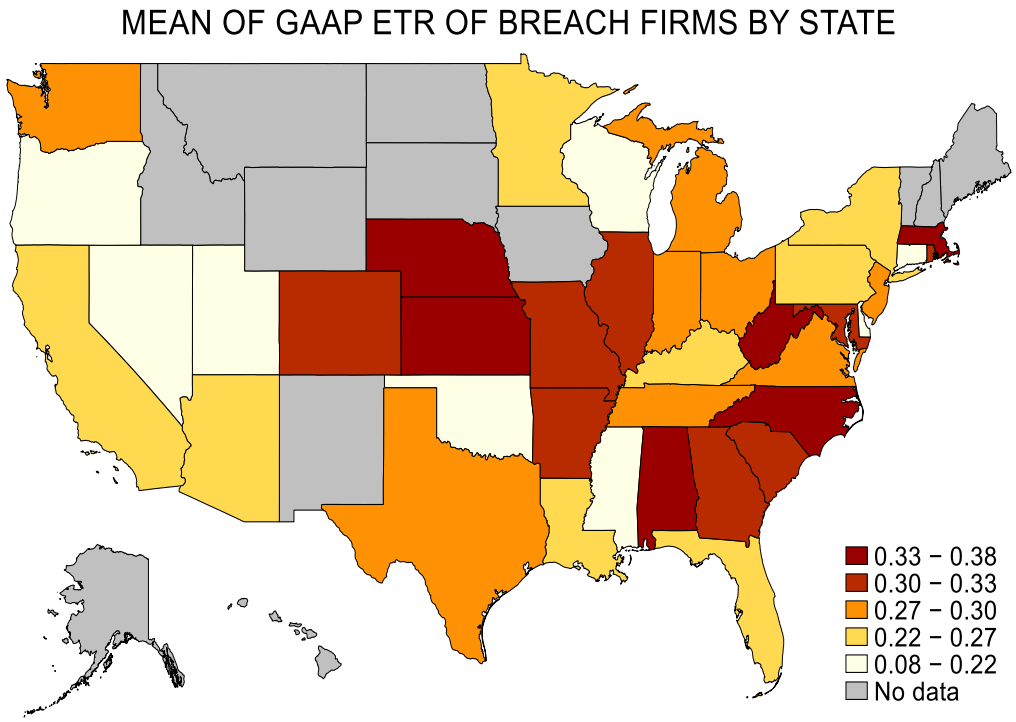


**Figure 4-3: Mean of state GAAP_ETR for CSB firms**

### 4.4.2 Tax avoidance measures

Following previous studies (e.g. Dyreng et al., 2008; Hoi et al., 2013; Rego, 2003; Wilson, 2009), I utilize GAAP_ETR, DTAX, and UTB_TA as the main proxies of my dependent variable corporate tax avoidance[28]. Managers who engage in tax avoidance usually concentrate on approaches that reduce financial statement expenses (Armstrong et al., 2012; De Simone et al., 2014; Dhaliwal et al., 2004; Edwards et al., 2016; Graham et al., 2014; Robinson et al., 2010). My first proxy of corporate tax avoidance, GAAP_ETR, is measured as the proportion of total tax expense to pre-tax book income minus special items. GAAP_ETR is truncated to the range (0, 1). Lower values of GAAP_ETR mean higher levels of corporate tax avoidance (Dyreng et al., 2008). I follow the Frank et al. (2009) model and employ DTAX as the second measure of tax avoidance that captures permanent differences that give rise to larger differences between book income and taxable income. Higher values of DTAX represent high levels of tax avoidance. The definitions of DTAX model is presented in Appendix 4-A. I use the ending value of total unrecognized tax benefits scaled by lagged total assets (UTB_TA) as the third measure of corporate tax avoidance. Higher values of UTB_TA represent more tax uncertainty and may reflect higher levels of tax avoidance.

[28] I employ three alternative measures of tax avoidance in my additional analysis section.

### 4.4.3 Cybersecurity breaches (CBSs) measure

To identify CSBs, I follow prior studies and use the Privacy Rights Clearinghouse (PRC) database (Higgs et al., 2016; Kamiya et al., 2020; Lawrence et al., 2018; Smith et al., 2019). Specifically, I generate a dummy variable "BREACH" equals 1 if a firm reports a CSB in year t, and 0 otherwise. I perform a robustness analysis by breakdown BREACH into external and internal breaches (EXTERNAL versus INTERNAL) based on the type of breach.

### 4.4.4 Control variables

Based on previous literature (e.g. Chen et al., 2010; Dyreng et al., 2008; Gupta & Newberry, 1997; McGuire et al., 2012; Rego, 2003), I identify several control variables that could be related to corporate tax avoidance. I include firm size (SIZE) in my model as larger firms have more resources and commonly capitalize from economies of scale in tax planning (Rego, 2003). I control for market-to-book ratio of equity (MTB) in my model as growth firms invest more in tax planning (Chen et al., 2010; McGuire et al., 2012). As firms with high level of leverage can benefit from the tax shield relating to corporate debt (Gupta & Newberry, 1997), I include firm leverage (LEV) in my model. I also control for cash holdings (CASH) because firms with more cash can engage in less tax deferral (McGuire et al., 2012). In order to proxy for firms' need to avoid income taxes, I control for return on assets (ROA), firms with loss carry forward (NOL), and change in loss carried forward (ΔNOL) in my model (Chen et al., 2010; McGuire et al., 2012; Rego, 2003). Foreign operations allow firms to capitalize on their ability to shift income between high and low tax countries (Rego, 2003), thus foreign sourced income (FOR_INC) is controlled for in my model. I also control for property, plant and equipment (CAP_INT), research and development expenditure (R&D) in my model as they reflect economies of scale in tax planning (Gupta & Newberry, 1997). As tax and accounting rules are often different for investments, I include intangible assets (INTANG) and equity income in earnings (EQINC) in my model to capture for the effect of a firm's investment activities on book-tax differences (e.g. Chen et al., 2010). I also include SALE_GROWTH in my model as growth firms invest more in tax planning activities (McGuire et al., 2012). Lastly, industry fixed effects (INDUS) and year fixed effects (YEAR) are also controlled for. The definitions of all control variables are provided in Appendix 4-A.

### 4.4.5 Regression model

To investigate whether there is an association between the occurrence of CSBs and corporate tax avoidance, I estimate the following OLS regression model:

$$\begin{aligned} CTA_{it} = {} & \beta_1 BREACH_{it} + \beta_2 SIZE_{it} + \beta_3 MTB_{it} + \beta_4 LEV_{it} + \beta_5 CASH_{it} + \beta_6 ROA_{it} + \beta_7 NOL_{it} \\ & + \beta_8 \Delta NOL_{it} + \beta_9 FOR\_INC_{it} + \beta_{10} CAP\_INT_{it} + \beta_{11} INTANG_{it} + \beta_{12} EQINC_{it} \\ & + \beta_{13} R\&D_{it} + \beta_{14} SALE\_GROWTH_{it} + INDUS_{DUMMIES} \\ & + YEAR_{DUMMIES} \end{aligned} \quad (1)$$

where CTA represents my proxy of corporate tax avoidance (GAAP_ETR, DTAX, and UTB_TA). BREACH is a dummy variable that equals 1 if a firm reported that it had a cybersecurity breach in given financial year and 0 otherwise. All the control variables in Equation (1) are defined in Appendix 4-A. I winsorized all continuous variables at the 1st and 99th percentiles to reduce the probability that outliers could affect my results.

In order to mitigate the potential issue of self-selection bias and endogeneity, I employ the propensity score matching (PSM) procedure. I create a sample of control firms that most look like my sample firms with reported breaches based on all of my firm-level characteristics (Armstrong et al. 2010; Lennox et al., 2013; Rosenbaum & Rubin, 1983; Shipman et al., 2017). The purpose for this approach is to match different dimensions effectively at the company level. I use one-to-many matching to reduce the bias of matching on a 1:1 basis (Ming & Rosenbaum, 2000). Following Shipman et al. (2017), the first stage probit model is estimated with the same set of control variables as my baseline regression model in Equation (1).

$$\begin{aligned} BREACH_{it} = {} & \beta_1 SIZE_{it} + \beta_2 MTB_{it} + \beta_3 LEV_{it} + \beta_4 CASH_{it} + \beta_5 ROA_{it} + \beta_6 NOL_{it} \\ & + \beta_7 \Delta NOL_{it} + \beta_8 FOR\_INC_{it} + \beta_9 CAP\_INT_{it} + \beta_{10} INTANG_{it} \\ & + \beta_{11} EQINC_{it} + \beta_{12} R\&D_{it} + \beta_{13} SALE\_GROWTH_{it} + INDUS_{DUMMIES} \\ & + YEAR_{DUMMIES} \end{aligned} \quad (2)$$

## 4.5 Results

### 4.5.1 Descriptive statistics

Table 4-2 provides the descriptive statistics of the variables I used in Equation (1). The mean (median) of GAAP_ETR, DTAX, and UTB_TA is 0.214, 0.014, and 0.012 (0.235, 0.013, and 0.004) and they are similar to those reported in previous literature (Gaertner, 2014; Hasan et al., 2017; McGuire et al., 2012). I observe that 1.1 percent of my sample reported CSB in the current year. Finally, the mean (median) for the control variables are consistent with prior studies (Hasan et al., 2017; McGuire et al., 2012; Rego, 2003; Rego & Wilson, 2012).

### 4.5.2 Pearson correlation results

Table 4-3 reports Pearson correlation results. I find that the correlation between GAAP_ETR and BREACH is positive and significant ($p<0.01$). However, this relation becomes negative and significant in subsequent analyses after controlling for firm financial characteristics. A similar situation is observed in Lawrence et al. (2018) where the correlation between BREACH and financial reporting deficiencies in their Pearson correlation is insignificant. They subsequently report that the correlation is significant once other firm characteristics are controlled for. I also find that UTB_TA is positively and significantly correlated with BREACH ($p<0.01$) which support my first hypothesis (H1) in that CSBs are positively associated with corporate tax avoidance. Finally, the control variables SIZE, MTB, LEV, CASH, ROA, NOL, ΔNOL, FOR_INC, CAP_INT, INTANG, EQINC, R&D, and SALE_GROWTH are correlated with GAAP_ETR ($p<0.01$).

**Table 4-2: Descriptive statistics**

| | N | MEAN | S.D. | 1st quartile | Median | 3rd quartile |
|---|---|---|---|---|---|---|
| GAAP_ETR | 38,478 | 0.214 | 0.182 | 0.006 | 0.235 | 0.350 |
| DTAX | 35,898 | 0.041 | 0.945 | -0.077 | 0.013 | 0.167 |
| UTB_TA | 28,381 | 0.012 | 0.024 | 0.000 | 0.004 | 0.013 |
| BREACH | 38,478 | 0.011 | 0.104 | 0.000 | 0.000 | 0.000 |
| SIZE | 38,478 | 5.437 | 2.793 | 3.699 | 5.758 | 7.427 |
| MTB | 38,478 | 2.551 | 13.479 | 1.016 | 2.009 | 3.728 |
| LEV | 38,478 | 0.519 | 1.852 | 0.014 | 0.194 | 0.409 |
| CASH | 38,478 | 0.292 | 0.553 | 0.040 | 0.130 | 0.336 |
| ROA | 38,478 | -0.552 | 3.614 | -0.120 | 0.052 | 0.122 |
| NOL | 38,478 | 0.593 | 0.491 | 0.000 | 1.000 | 1.000 |
| ΔNOL | 38,478 | 0.332 | 2.251 | 0.000 | 0.000 | 0.027 |
| FOR_INC | 38,478 | 0.012 | 0.038 | 0.000 | 0.000 | 0.011 |
| CAP_INT | 38,478 | 0.265 | 0.301 | 0.058 | 0.157 | 0.364 |
| INTANG | 38,478 | 0.208 | 0.286 | 0.001 | 0.094 | 0.319 |
| EQINC | 38,478 | 0.001 | 0.003 | 0.000 | 0.000 | 0.000 |
| R&D | 38,478 | 0.092 | 0.256 | 0.000 | 0.000 | 0.070 |
| SALE_GROWTH | 38,478 | 0.257 | 1.139 | -0.038 | 0.071 | 0.218 |

## Table 4-3: Pearson correlation results

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) GAAP_ETR | 1.0000 | | | | | | | | | | | | | | | | |
| (2) DTAX | -0.0118** | 1.0000 | | | | | | | | | | | | | | | |
| (3) UTB_TA | -0.0842*** | 0.0173** | 1.0000 | | | | | | | | | | | | | | |
| (4) BREACH | 0.0377*** | 0.0002 | 0.0196*** | 1.0000 | | | | | | | | | | | | | |
| (5) SIZE | 0.4322*** | -0.0002 | 0.0012 | 0.1114*** | 1.0000 | | | | | | | | | | | | |
| (6) MTB | 0.0302*** | 0.0106* | 0.0134* | 0.0082* | 0.0873*** | 1.0000 | | | | | | | | | | | |
| (7) LEV | -0.1708*** | -0.1078*** | -0.0284*** | -0.0105** | -0.3097*** | -0.0947*** | 1.0000 | | | | | | | | | | |
| (8) CASH | -0.2108*** | -0.0613*** | 0.1578*** | -0.0225*** | -0.1952*** | 0.0345*** | 0.1402*** | 1.0000 | | | | | | | | | |
| (9) ROA | 0.2073*** | 0.3424*** | 0.0073 | 0.0163*** | 0.3605*** | 0.1061*** | -0.6254*** | -0.2910*** | 1.0000 | | | | | | | | |
| (10) NOL | -0.1456*** | 0.0414*** | 0.0728*** | -0.0002 | -0.0245*** | 0.0083* | 0.0312*** | 0.0765*** | -0.0555*** | 1.0000 | | | | | | | |
| (11) ΔNOL | -0.1685*** | 0.0410*** | 0.0181*** | -0.0131** | -0.2703*** | -0.0708*** | 0.3900*** | 0.2283*** | -0.5533*** | 0.1413*** | 1.0000 | | | | | | |
| (12) FOR_INC | 0.1343*** | 0.0136** | 0.1089*** | 0.0343*** | 0.2911*** | 0.0230*** | -0.0542*** | -0.0479*** | 0.0785*** | 0.0046 | -0.0564*** | 1.0000 | | | | | |
| (13) CAP_INT | 0.0687*** | -0.0421*** | -0.1465*** | -0.0090* | 0.1793*** | -0.0089* | 0.0585*** | -0.0851*** | -0.0176*** | -0.0971*** | -0.0238*** | -0.0316*** | 1.0000 | | | | |
| (14) INTANG | 0.0750*** | -0.0014 | -0.0051 | 0.0309*** | 0.1997*** | 0.0071 | 0.0458*** | -0.0570*** | -0.0229*** | 0.0675*** | 0.0073 | 0.0557*** | -0.1516*** | 1.0000 | | | |
| (15) EQINC | 0.0639*** | -0.0079 | -0.0038 | 0.0189*** | 0.1529*** | 0.0056 | -0.0163*** | -0.0589*** | 0.0358*** | -0.0431*** | -0.0288*** | 0.0869*** | 0.0591*** | -0.0038 | 1.0000 | | |
| (16) R&D | -0.2943*** | -0.0922*** | 0.2119*** | -0.0251*** | -0.2999*** | -0.0176*** | 0.2128*** | 0.4520*** | -0.3066*** | 0.1110*** | 0.2723*** | -0.1038*** | -0.1440*** | -0.0589*** | -0.0581*** | 1.0000 | |
| (17) SALE_GROWTH | -0.1296*** | -0.0005 | 0.0205*** | -0.0163*** | -0.1045*** | 0.0066 | 0.0949*** | 0.1896*** | -0.1214*** | 0.0234*** | 0.0678*** | -0.0493*** | 0.1103*** | 0.0847*** | -0.0222*** | 0.1319*** | 1.0000 |

*** p<0.01, ** p<0.05, * p<0.1

### 4.5.3 OLS regression results

Table 4-4 presents the main OLS regression results for my full sample designed to examine the association between CSBs and corporate tax avoidance. The t-statistics are based on robust standard errors and clustering by firm. Column (1) of Table 4-4 shows the result for GAAP_ETR as a measure of tax avoidance. The coefficient of my main variable of interest, BREACH, is significantly negatively associated to GAAP_ETR ($p<0.01$), implying that cybersecurity breaches are positively associated with higher levels of tax avoidance. In terms of economic significance, a one standard deviation increase in BREACH is associated with a reduction in accounting effective tax rate (GAAP_ETR) of 0.29%.[29] For the control variables, the coefficients for SIZE, LEV, CASH, NOL, FOR_INC, INTANG, R&D, and SALE_GROWTH are associated with GAAP_ETR ($p<0.1$ or better).

Table 4-4 Column (2) displays the results using DTAX as a measure of tax avoidance. The coefficient of BREACH is significantly positively associated with DTAX ($p<0.01$) which suggests that cybersecurity breaches are positively associated with higher levels of tax avoidance. DTAX is increased by 0.68% with a one standard deviation increase in BREACH. In terms of the control variables, the coefficients for SIZE, LEV, ROA, NOL, ΔNOL, FOR_INC, INTANG, R&D, and SALE_GROWTH are associated with DTAX ($p<0.05$ or better).

Column (3) reports the results for UTB_TA as a proxy for tax avoidance. The coefficient of BREACH is significantly positively associated to UTB_TA ($p<0.05$). This result indicates that cybersecurity breaches are positively associated with higher levels of corporate tax avoidance. Further, a one standard deviation increase in BREACH results an increase in UTB_TA by 0.02%. The coefficients of SIZE, ROA, NOL, FOR_INC, CAP_INT, INTANG and R&D are associated with UTB_TA ($p<0.05$ or better).

[29] It is calculated as 0.104 (one standard deviation of the *BREACH* variable) * (-0.0283) (estimated coefficient in Column (1)) = -0.0029 = -0.29%.

**Table 4-4: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance - Full sample**

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0283*** | 0.0657*** | 0.0024** |
| | (-3.98) | (3.46) | (2.55) |
| SIZE | 0.0239*** | -0.0397*** | 0.0007*** |
| | (37.93) | (-9.41) | (3.86) |
| MTB | -0.0000 | -0.0002 | 0.0000 |
| | (-0.53) | (-0.25) | (1.46) |
| LEV | -0.0016*** | 0.0949*** | 0.0000 |
| | (-3.05) | (5.49) | (0.12) |
| CASH | -0.0152*** | 0.0354 | 0.0023*** |
| | (-8.59) | (1.13) | (2.82) |
| ROA | 0.0002 | 0.2025*** | 0.0008*** |
| | (0.70) | (17.53) | (4.34) |
| NOL | -0.0370*** | 0.0424*** | 0.0029*** |
| | (-12.53) | (3.85) | (5.59) |
| ΔNOL | 0.0004 | 0.1954*** | -0.0001 |
| | (1.29) | (12.74) | (-0.62) |
| FOR_INC | 0.0679* | 0.4201*** | 0.0316*** |
| | (1.83) | (3.51) | (4.15) |
| CAP_INT | 0.0030 | -0.0334 | -0.0076*** |
| | (0.51) | (-0.87) | (-7.29) |
| INTANG | -0.0105** | 0.0819*** | -0.0023** |
| | (-2.32) | (2.59) | (-2.06) |
| EQINC | -0.0395 | -0.5973 | 0.0263 |
| | (-0.10) | (-0.48) | (0.44) |
| R&D | -0.0660*** | -0.2028** | 0.0254*** |
| | (-13.39) | (-2.17) | (7.47) |
| SALE_GROWTH | -0.0075*** | 0.0310*** | -0.0001 |
| | (-12.46) | (2.90) | (-0.28) |
| Constant | 0.0992** | 0.1716*** | -0.0121*** |
| | (2.57) | (4.25) | (-4.61) |
| Observations | 38,478 | 35,898 | 28,231 |
| Adjusted R-squared | 0.287 | 0.245 | 0.100 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are defined in Appendix 4-A.

Table 4-5 presents the main OLS regression results for my PSM sample designed to examine the association between CSBs and corporate tax avoidance. The coefficient estimates of BREACH are negative and significant with GAAP_ETR ($p<0.01$) and positive and significant with DTAX and UTB_TA ($p<0.01$, and $p<0.05$ respectively). This result is consistent with the base model results provided in Table 4-4. Overall, the results in Table 4-4 and Table 4-5 indicate that cybersecurity breaches is significantly positively associated with corporate tax avoidance which supports H1.

**Table 4-5: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance - PSM sample**

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0253*** | 0.0806*** | 0.0021** |
| | (-3.35) | (3.47) | (2.02) |
| SIZE | 0.0271*** | -0.0571*** | 0.0009*** |
| | (29.05) | (-7.22) | (3.25) |
| MTB | -0.0001 | -0.0020 | 0.0000 |
| | (-1.50) | (-1.57) | (0.21) |
| LEV | -0.0003 | 0.0998*** | -0.0002 |
| | (-0.44) | (3.91) | (-0.54) |
| CASH | -0.0181*** | 0.0535 | 0.0029*** |
| | (-6.78) | (1.01) | (2.59) |
| ROA | 0.0002 | 0.2273*** | 0.0007** |
| | (0.65) | (16.59) | (2.35) |
| NOL | -0.0369*** | 0.0515*** | 0.0034*** |
| | (-8.36) | (2.76) | (3.97) |
| ΔNOL | 0.0006 | 0.2146*** | -0.0001 |
| | (1.44) | (9.76) | (-0.16) |
| FOR_INC | -0.0681 | 0.4279** | 0.0227* |
| | (-1.28) | (2.37) | (1.94) |
| CAP_INT | -0.0046 | 0.0555 | -0.0123*** |
| | (-0.45) | (0.61) | (-7.15) |
| INTANG | -0.0025 | 0.1548*** | -0.0027 |
| | (-0.35) | (3.01) | (-1.57) |
| EQINC | 0.6798 | -0.7185 | -0.0620 |
| | (1.05) | (-0.34) | (-0.63) |
| R&D | -0.0634*** | -0.2986** | 0.0256*** |
| | (-10.20) | (-2.16) | (6.32) |
| SALE_GROWTH | -0.0064*** | 0.0561** | -0.0006 |
| | (-6.02) | (2.36) | (-1.49) |
| Constant | 0.0695*** | 0.2670 | 0.0089*** |
| | (3.36) | (1.58) | (3.08) |
| Observations | 10,288 | 12,128 | 10,100 |
| Adjusted R-squared | 0.282 | 0.287 | 0.084 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All variables are defined in Appendix 4-A.

## 4.6 Additional analyses

### 4.6.1 Test CSB by breach type

Following Higgs et al. (2016) and Smith et al. (2019), I sort CSBs into EXTERNAL and INTERNAL based on CSBs type. I define EXTERNAL equal 1 if the type of CSBs are Hack (HACK), portable device (PORT), or stationary computer loss (STAT), zero otherwise. INTERNAL, on the other hand, is scored as 1 if the type of CSBs are unintended disclosure not involving hacking (DISC), physical (PHYS), insider (INSD) and unknown (UNKN), zero otherwise30.

Table 4-6 shows the results of CSBs by breach type and their relationship with corporate tax avoidance. Columns (1)-(6) report the results based on the full sample while Columns (7)-(12) report the results based on PSM sample. The coefficients of EXTERNAL in Columns (1)-(3) indicate that there is a positive and significant association between the EXTERNAL types of CSBs and corporate tax avoidance (GAAP_ETR, DTAX, and UTB_TA) at $p<0.01$, $p<0.01$ and $p<0.05$, respectively. In addition, the coefficients of INTERNAL in Columns (4) and (5) show that the association between the INTERNAL type of CSBs and corporate tax avoidance (GAAP_ETR and DTAX) is positive and significant at $p<0.01$ and $p<0.10$. The coefficient of INTERNAL for the result of UTB_TA in Column (6) is positive but not significant. For the PSM sample, the results in Columns (7)-(12) are consistent with the findings of the full sample in Columns (1)-(6). Taken together, the results in Table 4-6 provide further support for my H1 that CSBs are positively associated with corporate tax avoidance.

[30] For further details about type of breaches https://privacyrights.org/data-breaches

**Table 4-6: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance based on type of CSBs**

| | Full Sample | | | | | | PSM Sample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| EXTERNAL | -0.0242*** | 0.0782*** | 0.0029** | | | | -0.0237** | 0.0919*** | 0.0032** | | | |
| | (-2.60) | (3.34) | (2.18) | | | | (-2.44) | (3.50) | (2.17) | | | |
| INTERNAL | | | | -0.0323*** | 0.0482* | 0.0017 | | | | -0.0245** | 0.0572* | 0.0007 |
| | | | | (-3.19) | (1.76) | (1.42) | | | | (-2.24) | (1.74) | (0.55) |
| SIZE | 0.0238*** | -0.0395*** | 0.0007*** | 0.0238*** | -0.0394*** | 0.0007*** | 0.0270*** | -0.0567*** | 0.0010*** | 0.0270*** | -0.0563*** | 0.0010*** |
| | (37.78) | (-9.42) | (3.90) | (37.82) | (-9.39) | (3.91) | (28.83) | (-7.23) | (3.29) | (28.86) | (-7.20) | (3.36) |
| MTB | -0.0000 | -0.0002 | 0.0000 | -0.0000 | -0.0002 | 0.0000 | -0.0001 | -0.0020 | 0.0000 | -0.0001 | -0.0020 | 0.0000 |
| | (-0.53) | (-0.25) | (1.46) | (-0.52) | (-0.25) | (1.46) | (-1.48) | (-1.56) | (0.21) | (-1.50) | (-1.56) | (0.22) |
| LEV | -0.0016*** | 0.0949*** | 0.0000 | -0.0016*** | 0.0950*** | 0.0000 | -0.0003 | 0.0999*** | -0.0002 | -0.0003 | 0.1000*** | -0.0002 |
| | (-3.07) | (5.49) | (0.12) | (-3.07) | (5.50) | (0.13) | (-0.48) | (3.92) | (-0.54) | (-0.50) | (3.92) | (-0.52) |
| CASH | -0.0152*** | 0.0353 | 0.0023*** | -0.0152*** | 0.0353 | 0.0023*** | -0.0180*** | 0.0532 | 0.0029*** | -0.0180*** | 0.0532 | 0.0029*** |
| | (-8.57) | (1.13) | (2.81) | (-8.58) | (1.13) | (2.81) | (-6.76) | (1.00) | (2.58) | (-6.75) | (1.00) | (2.58) |
| ROA | 0.0002 | 0.2025*** | 0.0007*** | 0.0002 | 0.2024*** | 0.0007*** | 0.0002 | 0.2272*** | 0.0007** | 0.0002 | 0.2272*** | 0.0006** |
| | (0.73) | (17.53) | (4.33) | (0.72) | (17.52) | (4.33) | (0.70) | (16.59) | (2.35) | (0.71) | (16.58) | (2.34) |
| NOL | -0.0369*** | 0.0422*** | 0.0029*** | -0.0370*** | 0.0424*** | 0.0029*** | -0.0367*** | 0.0510*** | 0.0033*** | -0.0369*** | 0.0517*** | 0.0034*** |
| | (-12.51) | (3.84) | (5.57) | (-12.54) | (3.86) | (5.59) | (-8.31) | (2.74) | (3.95) | (-8.37) | (2.77) | (3.97) |
| ΔNOL | 0.0004 | 0.1955*** | -0.0001 | 0.0004 | 0.1955*** | -0.0001 | 0.0006 | 0.2146*** | -0.0001 | 0.0006 | 0.2146*** | -0.0001 |
| | (1.27) | (12.74) | (-0.62) | (1.28) | (12.74) | (-0.61) | (1.41) | (9.76) | (-0.16) | (1.42) | (9.76) | (-0.15) |
| FOR_INC | 0.0680* | 0.4198*** | 0.0316*** | 0.0675* | 0.4209*** | 0.0316*** | -0.0684 | 0.4285** | 0.0227* | -0.0696 | 0.4299** | 0.0228* |
| | (1.83) | (3.51) | (4.15) | (1.81) | (3.52) | (4.16) | (-1.29) | (2.38) | (1.94) | (-1.31) | (2.38) | (1.95) |
| CAP_INT | 0.0031 | -0.0337 | -0.0076*** | 0.0031 | -0.0339 | -0.0076*** | -0.0041 | 0.0546 | -0.0123*** | -0.0040 | 0.0537 | -0.0123*** |
| | (0.53) | (-0.88) | (-7.30) | (0.53) | (-0.88) | (-7.31) | (-0.40) | (0.60) | (-7.15) | (-0.39) | (0.59) | (-7.18) |
| INTANG | -0.0104** | 0.0819*** | -0.0023** | -0.0104** | 0.0816** | -0.0023** | -0.0024 | 0.1546*** | -0.0027 | -0.0024 | 0.1537*** | -0.0027 |
| | (-2.30) | (2.58) | (-2.07) | (-2.31) | (2.58) | (-2.08) | (-0.32) | (3.00) | (-1.57) | (-0.32) | (2.98) | (-1.59) |
| EQINC | -0.0379 | -0.6094 | 0.0259 | -0.0465 | -0.5734 | 0.0270 | 0.6857 | -0.7513 | -0.0638 | 0.6563 | -0.6201 | -0.0597 |
| | (-0.09) | (-0.49) | (0.43) | (-0.12) | (-0.46) | (0.45) | (1.06) | (-0.35) | (-0.65) | (1.02) | (-0.29) | (-0.61) |
| R&D | -0.0661*** | -0.2026** | 0.0254*** | -0.0660*** | -0.2026** | 0.0254*** | -0.0636*** | -0.2979** | 0.0256*** | -0.0636*** | -0.2977** | 0.0256*** |
| | (-13.41) | (-2.16) | (7.47) | (-13.40) | (-2.16) | (7.47) | (-10.23) | (-2.16) | (6.32) | (-10.23) | (-2.15) | (6.32) |
| SALE_GROWTH | -0.0075*** | 0.0310*** | -0.0001 | -0.0075*** | 0.0310*** | -0.0001 | -0.0064*** | 0.0561** | -0.0006 | -0.0064*** | 0.0561** | -0.0006 |
| | (-12.46) | (2.90) | (-0.27) | (-12.46) | (2.90) | (-0.27) | (-6.02) | (2.36) | (-1.49) | (-6.01) | (2.36) | (-1.49) |
| Constant | 0.0996*** | 0.1708*** | -0.0121*** | 0.0996** | 0.1707*** | -0.0122*** | 0.0700*** | 0.2648 | 0.0088*** | 0.0698*** | 0.2650 | 0.0088*** |
| | (2.58) | (4.24) | (-4.62) | (2.58) | (4.24) | (-4.64) | (3.38) | (1.57) | (3.06) | (3.36) | (1.57) | (3.05) |
| Observations | 38,478 | 35,898 | 28,231 | 38,478 | 35,898 | 28,231 | 10,288 | 12,128 | 10,100 | 10,288 | 12,128 | 10,100 |
| Adjusted R-squared | 0.287 | 0.245 | 0.100 | 0.287 | 0.245 | 0.100 | 0.281 | 0.287 | 0.084 | 0.281 | 0.286 | 0.083 |
| YEAR | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are defined in Appendix 4-A.

### 4.6.2 Alternative measures of corporate tax avoidance

In order to validate the robustness of my results, I examine the association between CSBs and corporate tax avoidance using alternative tax avoidance measures (CASH_ETR, SHELTER and UTB_LOG). I measure CASH_ETR as the cash tax paid (as disclosed in the cash flow statement) scaled over pre-tax accounting profit. CASH_ETR represents the cash paid to the tax authorities scaled over pre-tax income (Dyreng et al., 2010; Hanlon & Heitzman, 2010). I follow the model of Wilson (2009) to measure SHELTER that observes how firm-level structures are related with tax sheltering activities. A firm is considered to engage in tax sheltering activities when the estimated shelter can be found in the top quintile of the distribution which is scored as 1, otherwise 0. The Wilson's model is provided in Appendix 4-A. According to Wilson (2009), a higher value of SHELTER reflects a higher level of tax avoidance. My third alternative measure of corporate tax avoidance, UTB_LOG, is the natural logarithm of unrecognized tax benefits at the end of the year.

The regression results for the alternative tax avoidance measures are presented in Table 4-7. Columns (1)-(3) show the result based on the full sample while the results of PSM sample are presented in Columns (4)-6). As shown in Columns (1)-(3), CSBs are significantly positively associated with all additional measures of tax avoidance (CASH_ETR, SHELTER, and UTB_LOG) at $p<0.01$. These results provide addition evidence that supports H1. Columns (4)-(6) present the results of my PSM sample and I continue to find similar results to that reported in Columns (1)-(3) for the full sample. Generally, the results provided in Table 4-7 are consistent with the main findings in Tables 4-4 and 4-5 and support H1 win that the occurrence of CSBs is positively related to corporate tax avoidance.

**Table 4-7: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance using alternative measures of corporate tax avoidance**

| | Full Sample | | | PSM Sample | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VARIABLES | CASH_ETR | SHELTER | UTB_LOG | CASH_ETR | SHELTER | UTB_LOG |
| BREACH | -0.0234*** | 0.3358*** | 0.3547*** | -0.0232*** | 0.2935** | 0.3905*** |
| | (-2.87) | (2.59) | (4.75) | (-2.74) | (2.04) | (4.59) |
| SIZE | 0.0197*** | 0.4841*** | 1.0273*** | 0.0221*** | 0.4942*** | 1.0032*** |
| | (28.09) | (25.66) | (65.02) | (19.88) | (17.82) | (41.71) |
| MTB | -0.0000 | 0.0034** | 0.0016 | -0.0002** | 0.0037 | 0.0012 |
| | (-0.41) | (2.06) | (1.35) | (-2.13) | (1.46) | (0.55) |
| LEV | -0.0023*** | 0.1609*** | 0.1742** | -0.0019** | 0.2128*** | 0.0984 |
| | (-3.95) | (3.64) | (2.55) | (-2.03) | (4.80) | (1.08) |
| CASH | -0.0126*** | 0.1206** | -0.3108*** | -0.0185*** | 0.1674** | -0.4092*** |
| | (-5.21) | (2.05) | (-5.38) | (-4.50) | (2.09) | (-5.60) |
| ROA | -0.0005** | 0.8807*** | -0.0209 | -0.0005 | 0.7992*** | -0.0331 |
| | (-2.03) | (6.08) | (-0.61) | (-1.15) | (5.00) | (-1.04) |
| NOL | -0.0515*** | 1.9792*** | 0.1772*** | -0.0425*** | 1.9937*** | 0.1957*** |
| | (-16.37) | (20.52) | (4.31) | (-8.56) | (14.29) | (3.31) |
| ΔNOL | 0.0014*** | 0.3522*** | -0.0117 | 0.0018*** | 0.2955*** | 0.0531 |
| | (4.25) | (11.56) | (-0.52) | (2.90) | (8.95) | (1.60) |
| FOR_INC | 0.0790* | 8.2851*** | 3.1639*** | -0.1692*** | 9.1965*** | 2.5565*** |
| | (1.77) | (11.98) | (7.21) | (-3.11) | (9.84) | (3.91) |
| CAP_INT | -0.0443*** | 0.8721*** | -1.6247*** | -0.0552*** | 1.1865*** | -1.8494*** |
| | (-6.67) | (6.63) | (-12.67) | (-4.58) | (5.17) | (-8.18) |
| INTANG | -0.0144*** | -0.2958*** | -0.8669*** | -0.0100 | -0.2706** | -0.8194*** |
| | (-2.89) | (-3.29) | (-10.86) | (-1.24) | (-2.15) | (-7.57) |
| EQINC | -0.4560 | 5.6248 | 8.7020 | -1.9060*** | 11.3027 | 12.3167* |
| | (-1.07) | (0.76) | (1.56) | (-2.90) | (0.91) | (1.81) |
| R&D | -0.0670*** | 1.2088*** | 2.8700*** | -0.0586*** | 1.4809*** | 3.0782*** |
| | (-10.34) | (5.44) | (12.62) | (-7.20) | (5.12) | (10.58) |
| SALE_GROWTH | -0.0087*** | 0.0344* | -0.0524*** | -0.0089*** | 0.0216 | -0.0453 |
| | (-12.61) | (1.74) | (-2.63) | (-5.92) | (0.64) | (-1.44) |
| Constant | 0.0655** | -6.4953*** | -5.7031*** | 0.0366 | -8.3269*** | -4.4819*** |
| | (2.47) | (-11.14) | (-16.20) | (1.39) | (-15.67) | (-11.35) |
| Observations | 32,321 | 49,263 | 21,286 | 7,959 | 16,480 | 7,324 |
| Adjusted R-squared | 0.191 | | 0.650 | 0.179 | | 0.623 |
| Pseudo R2 | | 0.291 | | | 0.284 | |
| YEAR | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are defined in Appendix 4-A

### 4.6.3 The presence of board-level IT governance

Cybersecurity was traditionally viewed as primarily a technology issue that the IT department could deal with. Professionals and academics have recently recognized the value of cybersecurity from a management perspective (PwC, 2016; Soomro, Shah, & Ahmed, 2016). The influence of internal corporate governance mechanisms designed to mitigate CSBs (Haislip, Masli, et al., 2016; Haislip, Peters, et al., 2016) and the presence of board-level experts such as existence of a technology committee has a major impact to prevent and detect CSBs (Haislip, Masli, et al., 2016; Haislip, Peters, et al., 2016; Higgs et al., 2016). Further, Smith et al. (2019) argue that risk committee reduces the fee premium associated with breaches suggesting that the presence of a risk committee as an internal governance mechanism mitigates the negative effects of breaches. Moreover, Kwon, Ulmer, and Wang (2013) show that CSBs are less prevalent when IT managers are part of the management team.

In additional analysis, I examine whether the presence of IT governance (RISK_COMT, COMPLIANCE_COMT, TECHNOLOGY_COMT, and IT_OFFICER) helps firms to mitigate the risk of occurrence of CSBs. Following Higgs et al. (2016) and Smith et al. (2019), I define RISK_COMT as a dummy variable scored as 1 if the firm has a "risk" committee in its proxy statement, and 0 otherwise. COMPLIANCE_COMT is scored as 1 if the firm discloses the existence of a "compliance" committee in its proxy statement, and 0 otherwise. TECHNOLOGY_COMT is scored as 1 if the firm discloses a "technology" committee in its proxy statement, and 0 otherwise. I also define IT_OFFICER as an indicator scored 1 if the Chief Information Officer (CIO), Chief Technology Officer (CTO), Chief Information Security Officer (CISO), or Chief Security Officer (CSO) is in the top management team, and 0 otherwise.

Table 4-8 provides the regression results of the effect of CSBs on corporate tax avoidance based on subsamples with strength in or weakness in board-level IT governance. Table 4-8 Panel A reports the results of the subsample based on RISK_COMT with firms that have a risk committee in Columns (1)-(6) and firms that do not have a risk committee in Columns (7)-(12). In each subsample, I present the results separately for the full sample and the PSM sample. In the presence of a RISK_COMT, the coefficient of BREACH is significantly negative in my full sample only with DTAX (Column (2)) at $p<0.10$. However, for all other measures of corporate tax avoidance, in the presence of a risk committee, the coefficient on BREACH is non-significant. For the sub-sample of firms without a risk committee, there is a significant and positive association between CSBs and all proxies of corporate tax avoidance at $p<0.10$ or better (Columns (7)-(12)).

Table 4-8 Panel B reports the results of the subsample of COMPLIANCE_COMT. For my full sample (Columns (1)-(3)) and PSM sample (Columns (4)-(6)), there is not a

statistically significant relationship between CSBs and tax avoidance in firms with the presence of compliance committee. However, Columns (7)-(12) show that there is a significantly positive association between CSBs and tax avoidance in firms with no compliance committees ($p<0.05$ or better). The findings are consistent with those reported previously in Panel A for RISK_COMT. The results in Panel C for TECHNOLOGY_COMT show similar findings reported in Panel B with $p<0.10$ or better. Overall, my findings suggest that existence of a risk, compliance, or technology committee plays an important role in moderating the association between CSB and tax avoidance.

Table 4-8 Panel D shows the results of the effect of CSBs on corporate tax avoidance where IT_OFFICER is in the top management team or not. The results in Columns (7)-(12) are in line with the argument that IT managers have the ability to mitigate and prevent potential CSBs in the future. For firms where an IT_OFFICER is not part of top management or for firms that do not have a dedicated IT_OFFICER, they are more likely to be breached and tend to engage in tax avoidance activities.

**Table 4-8: OLS regression results -the effect of CSBs on corporate tax avoidance by using subsample of the presence of board-level IT governance**

**Panel A: Subsample of *RISK_COMT***

| | RISK_COMT=1 | | | | | | RISK_COMT=0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full sample | | | PSM sample | | | Full sample | | | PSM sample | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0223 | -0.1321* | -0.0019 | 0.0061 | -0.0996 | -0.0010 | -0.0281*** | 0.0706*** | 0.0024** | -0.0246*** | 0.0849*** | 0.0021* |
| | (-0.98) | (-1.74) | (-0.31) | (0.21) | (-1.08) | (-0.23) | (-3.84) | (3.63) | (2.49) | (-3.15) | (3.57) | (1.93) |
| CONTROLS | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Constant | 0.3589*** | 0.0750 | 0.0021 | 0.1667 | -0.2853 | -0.0089 | 0.0955** | 0.1785*** | -0.0121*** | 0.0667*** | 0.2666 | 0.0090*** |
| | (9.35) | (0.34) | (0.16) | (1.15) | (-1.49) | (-0.82) | (2.45) | (4.45) | (-4.61) | (3.22) | (1.57) | (3.08) |
| Observations | 511 | 552 | 534 | 169 | 202 | 218 | 37,967 | 35,346 | 27,697 | 10,119 | 11,926 | 9,882 |
| Adjusted R-squared | 0.331 | 0.204 | 0.387 | 0.390 | 0.319 | 0.690 | 0.288 | 0.246 | 0.100 | 0.284 | 0.287 | 0.083 |
| YEAR | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

**Panel B: Subsample of *COMPLIANCE_COMT***

| | COMPLIANCE_COMT =1 | | | | | | COMPLIANCE_COMT =0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full sample | | | PSM sample | | | Full sample | | | PSM sample | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0363 | 0.0883 | 0.0012 | -0.0236 | 0.0621 | 0.0020 | -0.0270*** | 0.0627*** | 0.0027*** | -0.0248*** | 0.0780*** | 0.0025** |
| | (-1.27) | (1.02) | (0.57) | (-0.88) | (0.71) | (0.70) | (-3.66) | (3.21) | (2.76) | (-3.17) | (3.26) | (2.22) |
| CONTROLS | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Constant | 0.1641*** | 0.0734 | 0.0009 | 0.2441* | 0.2218 | 0.0066 | 0.0986** | 0.1777*** | -0.0120*** | 0.0671*** | 0.2765 | 0.0089*** |
| | (2.78) | (0.34) | (0.14) | (1.91) | (1.50) | (0.55) | (2.55) | (4.33) | (-4.35) | (3.20) | (1.61) | (3.01) |
| Observations | 835 | 853 | 790 | 250 | 318 | 306 | 37,643 | 35,045 | 27,441 | 10,038 | 11,810 | 9,794 |
| Adjusted R-squared | 0.180 | 0.159 | 0.314 | 0.189 | 0.368 | 0.412 | 0.290 | 0.246 | 0.100 | 0.284 | 0.288 | 0.082 |
| YEAR | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

**Panel C: Subsample of *TECHNOLOGY_COMT***

| | TECHNOLOGY_COMT =1 | | | | | | TECHNOLOGY_COMT =0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full sample | | | PSM sample | | | Full sample | | | PSM sample | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0052 | -0.0097 | 0.0081 | 0.0327 | -0.1247 | 0.0103 | -0.0270*** | 0.0699*** | 0.0020** | -0.0240*** | 0.0869*** | 0.0018* |
| | (-0.30) | (-0.19) | (1.33) | (1.40) | (-1.63) | (0.99) | (-3.65) | (3.53) | (2.12) | (-3.04) | (3.62) | (1.72) |
| CONTROLS | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Constant | 0.2045*** | -0.0159 | -0.0020 | 0.1288 | 0.2736 | 0.0224 | 0.1022** | 0.1499*** | -0.0117*** | 0.0692*** | 0.2664 | 0.0087*** |
| | (3.87) | (-0.11) | (-0.13) | (0.72) | (1.10) | (0.85) | (2.28) | (3.67) | (-4.11) | (3.33) | (1.57) | (3.00) |
| Observations | 791 | 839 | 824 | 228 | 292 | 314 | 37,687 | 35,059 | 27,407 | 10,060 | 11,836 | 9,786 |
| Adjusted R-squared | 0.315 | 0.248 | 0.184 | 0.198 | 0.372 | 0.187 | 0.289 | 0.245 | 0.099 | 0.285 | 0.287 | 0.083 |
| YEAR | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

**Panel D: Subsample of *IT_OFFICER***

| | IT_OFFICER=1 | | | | | | IT_OFFICER=0 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full sample | | | PSM sample | | | Full sample | | | PSM sample | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0402* | 0.0929 | 0.0035 | -0.0280 | 0.0720 | 0.0039 | -0.0266*** | 0.0633*** | 0.0020** | -0.0246*** | 0.0767*** | 0.0018* |
| | (-1.73) | (1.60) | (1.04) | (-1.10) | (0.95) | (0.81) | (-3.58) | (3.17) | (2.11) | (-3.08) | (3.18) | (1.68) |
| CONTROLS | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Constant | 0.0812* | 0.1828 | -0.0052 | 0.1400** | -0.0364 | -0.0095 | 0.1034** | 0.1642*** | -0.0113*** | 0.0709*** | 0.2805* | 0.0087*** |
| | (1.88) | (0.96) | (-0.61) | (2.47) | (-0.22) | (-0.80) | (2.39) | (4.08) | (-3.26) | (3.40) | (1.65) | (2.97) |
| Observations | 835 | 860 | 678 | 302 | 376 | 306 | 37,643 | 35,038 | 27,553 | 9,986 | 11,752 | 9,794 |
| Adjusted R-squared | 0.161 | 0.365 | 0.180 | 0.142 | 0.598 | 0.250 | 0.289 | 0.245 | 0.100 | 0.285 | 0.284 | 0.082 |
| YEAR | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are defined in Appendix A.

### 4.6.4 Timing effects of CSBs

I observe the timing effects of CSBs on corporate tax avoidance by including BREACH $_{t-1}$, BREACH $_{t}$ , and BREACH $_{t+1}$ in Equation (1). Table 4-9 shows the results of the timing effect of CSBs on tax avoidance for my full sample in Columns (1)-(3) and the PSM sample in Columns (4)-(6). Overall, the findings show that CSBs firms remain to engage in tax avoidance activities in one year prior to the cybersecurity breach, during the period of breach, and in the following year of the breach.

### 4.6.5 The Inverse Mills Ratio (IMR) method

Besides using PSM approach to control for sample selection bias, I also apply the analysis of Heckman (1979) to include the Inverse Mills Ratio (IMR) in Equation (1). The first-stage probit model of BREACH is estimated as in Equation (2), then IMR variable is computed and included in the regression analysis (1). Table 4-10 reports the results after including IMR in my main model. I still find similar results to my main findings in Table 4-4 that CSBs is positively associated with corporate tax avoidance ($p<0.05$ or better).

### 4.6.6 Additional control variables

As a robustness check, I include some additional control variables in my main model in Equation (1) such as audit fees, Big4 auditor, auditor-provide tax services fees, selling and administrative expenses, high litigation risk industries and high-technology industries. In untabulated tests, I find that my main findings consistently remain significant. The positive association of CSBs and corporate tax avoidance is robust when controlling for additional variables.

**Table 4-9: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance using BREACH $_{t-1}$, BREACH $_{t}$ , and BREACH $_{t+1}$**

| | Full sample | | | PSM sample | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VARIABLES | GAAP_ETR | DTAX | UTB_TA | GAAP_ETR | DTAX | UTB_TA |
| BREACH $_{t-1}$ | -0.0340*** | 0.0880*** | 0.0029*** | -0.0294*** | 0.1332*** | 0.0022* |
| | (-5.21) | (4.22) | (2.98) | (-3.20) | (3.68) | (1.71) |
| BREACH $_{t}$ | -0.0219*** | 0.0485*** | 0.0019** | -0.0215*** | 0.0531** | 0.0019* |
| | (-3.40) | (2.65) | (2.37) | (-2.98) | (2.40) | (1.94) |
| BREACH $_{t+1}$ | -0.0248*** | 0.0427* | 0.0017** | -0.0189* | 0.0782** | 0.0006 |
| | (-3.43) | (1.81) | (1.99) | (-1.75) | (2.22) | (0.43) |
| SIZE | 0.0228*** | -0.0403*** | 0.0007*** | 0.0257*** | -0.0562*** | 0.0009*** |
| | (32.90) | (-9.30) | (3.63) | (24.80) | (-6.90) | (2.96) |
| MTB | -0.0001 | -0.0003 | 0.0000 | -0.0002 | -0.0024* | 0.0000 |
| | (-1.13) | (-0.40) | (1.40) | (-1.40) | (-1.86) | (0.19) |
| LEV | -0.0018*** | 0.0898*** | 0.0001 | -0.0005 | 0.1112*** | -0.0001 |
| | (-2.96) | (4.82) | (0.45) | (-0.65) | (4.04) | (-0.11) |
| CASH | -0.0167*** | 0.0240 | 0.0023*** | -0.0193*** | 0.0519 | 0.0029** |
| | (-8.94) | (0.71) | (2.80) | (-6.67) | (0.94) | (2.51) |
| ROA | 0.0001 | 0.2059*** | 0.0009*** | 0.0002 | 0.2378*** | 0.0010*** |
| | (0.52) | (16.21) | (4.68) | (0.57) | (15.21) | (3.06) |
| NOL | -0.0360*** | 0.0447*** | 0.0031*** | -0.0386*** | 0.0574*** | 0.0038*** |
| | (-11.36) | (3.98) | (5.89) | (-8.23) | (3.04) | (4.55) |
| ΔNOL | -0.0000 | 0.1981*** | -0.0000 | 0.0001 | 0.2160*** | 0.0001 |
| | (-0.08) | (12.05) | (-0.04) | (0.28) | (8.94) | (0.33) |
| FOR_INC | 0.0445 | 0.3620*** | 0.0331*** | -0.0940* | 0.3211* | 0.0244** |
| | (1.13) | (2.87) | (4.32) | (-1.71) | (1.71) | (2.12) |
| CAP_INT | 0.0034 | -0.0552 | -0.0071*** | 0.0014 | -0.0180 | -0.0114*** |
| | (0.52) | (-1.40) | (-6.58) | (0.12) | (-0.20) | (-6.39) |
| INTANG | -0.0114** | 0.0648** | -0.0021* | -0.0034 | 0.1315** | -0.0022 |
| | (-2.27) | (2.06) | (-1.81) | (-0.43) | (2.55) | (-1.25) |
| EQINC | -0.0819 | -0.8546 | 0.0368 | 0.8981 | -0.6759 | -0.0483 |
| | (-0.19) | (-0.70) | (0.60) | (1.35) | (-0.30) | (-0.47) |
| R&D | -0.0670*** | -0.1950* | 0.0251*** | -0.0669*** | -0.3055** | 0.0258*** |
| | (-12.50) | (-1.91) | (7.30) | (-9.62) | (-2.04) | (6.07) |
| SALE_GROWTH | -0.0081*** | 0.0286*** | -0.0000 | -0.0072*** | 0.0589** | -0.0004 |
| | (-11.71) | (2.62) | (-0.00) | (-5.83) | (2.48) | (-0.94) |
| Constant | 0.1098*** | 0.1843*** | -0.0122*** | 0.1090*** | 0.1998 | 0.0088*** |
| | (2.60) | (4.55) | (-4.95) | (4.74) | (1.29) | (2.82) |
| Observations | 32,304 | 33,157 | 26,562 | 8,949 | 11,125 | 9,412 |
| Adjusted R-squared | 0.279 | 0.246 | 0.101 | 0.272 | 0.290 | 0.085 |
| YEAR | YES | YES | YES | YES | YES | YES |
| INDUSTRY | YES | YES | YES | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1 All variables are defined in Appendix 4-A.

**Table 4-10: OLS regression results - the effect of cybersecurity breaches on corporate tax avoidance – Heckman analysis**

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | GAAP_ETR | DTAX | UTB_TA |
| BREACH | -0.0248*** | 0.0971*** | 0.0022** |
| | (-3.58) | (4.41) | (2.39) |
| SIZE | -0.0580*** | -0.6899*** | 0.0049* |
| | (-9.45) | (-5.09) | (1.70) |
| MTB | -0.0008*** | -0.0061*** | 0.0001** |
| | (-9.22) | (-3.98) | (1.98) |
| LEV | -0.0165*** | -0.0246 | 0.0008 |
| | (-13.14) | (-0.82) | (1.37) |
| CASH | -0.0132*** | 0.0539* | 0.0023*** |
| | (-7.73) | (1.83) | (2.77) |
| ROA | 0.0077*** | 0.2623*** | 0.0004 |
| | (12.48) | (15.61) | (1.09) |
| NOL | -0.0392*** | 0.0230* | 0.0031*** |
| | (-13.43) | (1.92) | (5.70) |
| CHNG_NOL | -0.0032*** | 0.1671*** | 0.0000 |
| | (-7.69) | (10.09) | (0.20) |
| FOR_INC | 0.4293*** | 3.3239*** | 0.0125 |
| | (9.62) | (5.21) | (0.85) |
| CAP_INT | 0.1900*** | 1.4511*** | -0.0173** |
| | (12.59) | (4.60) | (-2.53) |
| INTANG | 0.0338*** | 0.4307*** | -0.0046** |
| | (6.11) | (5.26) | (-2.34) |
| EQINC | 0.2368 | 1.6661 | 0.0106 |
| | (0.59) | (1.23) | (0.17) |
| RND | 0.0315*** | 0.5755*** | 0.0199*** |
| | (3.87) | (2.81) | (4.28) |
| SALE_GROWTH | 0.0156*** | 0.2189*** | -0.0013 |
| | (8.34) | (5.42) | (-1.42) |
| IMR | -0.3893*** | -3.0913*** | 0.0203 |
| | (-13.33) | (-4.84) | (1.44) |
| Constant | 1.6328*** | 12.3602*** | -0.0922* |
| | (13.44) | (4.90) | (-1.65) |
| Observations | 38,478 | 35,898 | 28,231 |
| Adjusted R-squared | 0.292 | 0.253 | 0.100 |
| YEAR | YES | YES | YES |
| INDUSTRY | YES | YES | YES |

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. All variables are defined in Appendix 4-A.

## 4.7 Conclusion

Data breaches are of growing concern for U.S. firms as they constantly face enormous pressure to cope with cybersecurity risks. While data security breaches have attracted a significant media attention, they have received little attention in the accounting literature. This study examines the effect of CSBs on corporate tax avoidance. Prior finance literature show that firms with CSBs receive a negative market reaction (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009; Johnson et al., 2017; Telang & Wattal, 2007), increase firm risk (Gwebu et al., 2014; Romanosky et al., 2014) and hold more cash (Boasiako & Keefe, 2020). I find that there is positive association between CSBs and corporate tax avoidance. Firms with cybersecurity data breaches are more likely to engage in corporate tax avoidance. My results are robust using alternative measures of tax avoidance and CSBs, using timing effects of CSBs, the Heckman method and in models that employ additional control variables. In addition, I find that firms are less likely to engage in tax avoidance in the presence of sound board-level IT governance. The existence of a risk committee, a compliance committee, a technology committee or IT executive in top managements all play an important role in moderating the association between the occurrence of CSBs and tax avoidance.

## Appendix 4-A: Chapter 4 variables definition

| **Dependent variables** | |
|---|---|
| GAAP_ETR | The GAAP effective tax rate, calculated as total tax expense (txt) scaled by pre-tax book income (pi) minus special items (spi). I truncate GAAP_ETR to the range [0, 1]. |
| DTAX | DTAX is the residual from Frank et al. (2009) model based on year and two-digit SIC code from the following regression:<br><br>$PERMDIFF = \alpha_1 + \alpha_2 INTANG + \alpha_3 UNCON + \alpha_3 MI + \alpha_4 CSTE + \alpha_5 \Delta NOL + \alpha_6 LAG\_PERMDIFF + \varepsilon$<br><br>Where:<br>PERMDIFF is total book-tax difference – temporary book-tax difference.<br>INTANG is intangible assets.<br>UNCON is equity income in earnings.<br>MI is income (loss) attributable to minority interest<br>CSTE is current state tax rate.<br>ΔNOL is change in loss carried forward.<br>LAG_PERMDIFF is PERMDIFF in year t-1. |
| UTB_TA | Unrecognized tax benefits (txtubend) scaled by lagged total assets. |
| **Independent variable** | |
| BREACH | Dummy variable that equals 1 if a firm declared it had been breached in the financial year and 0 otherwise. |
| **Control variables** | |
| SIZE | Natural logarithm of total assets. |
| MTB | The ratio of the market value of equity scaled by the book value of equity. |
| LEV | The ratio of long-term and current debt scaled by total assets. |
| CASH | Cash and marketable securities scaled by total assets. |
| ROA | Income before extraordinary items scaled by total assets. |
| NOL | A dummy variable coded as 1 if loss carry forward, and 0 otherwise. |
| ΔNOL | Change in loss carried forward scaled by total assets. |
| FOR_INC | Foreign income scaled by total assets. |
| CAP_INT | Property, plant and equipment scaled by total assets. |
| INTANG | Total intangible assets scaled by total assets. |
| EQINC | Equity income in earnings scaled by total assets. |
| R&D | Research and development expenditure scaled by total assets. |
| SALE_GROWTH | Changes in sales scaled by lagged sales. |
| **Alternative measures of corporate tax avoidance** | |
| CASH_ETR | The cash effective tax rate, calculated as cash taxes paid (txpd) scaled by pre-tax book income (pi) minus special items (spi). I truncate GAAP_ETR to the range [0, 1]. |
| SHELTER | Dummy variable, scored as 1 if a firm's estimated sheltering probability is in the top quantile in that year, and 0 otherwise (Wilson, 2009).<br><br>SHELTER= -4.86 + (5.20 × BTD) + (4.08 × DIS_ACC) – (0.41 × LEV) + (0.76 × SIZE) + (3.51 × ROA) + (1.72 × FOR_INCO) + (2.43 × R&D)<br><br>Where:<br>BTD is book-tax difference as defined by Kim (2011).<br>DIS_ACC is discretionary accruals using modified jones model. |

| | |
|---|---|
| | LEV is ratio of long-term and current debt scaled by total assets.<br>SIZE is natural logarithm of total assets.<br>ROA is income before extraordinary items scaled by total assets.<br>FOR_INC is foreign income.<br>R&D is research and development |
| UTB_LOG | Natural logarithm of unrecognized tax benefits (txtubend). |
| **Alternative measures of CSBs based on breach type** | |
| EXTERNAL | Dummy variable score as 1 if the breach type is Hack, Stationary Computer Loss, or Portable Device, and 0 otherwise. https://privacyrights.org/data-breaches |
| INTERNAL | Dummy variable score as 1 if the breach type is Insider, Physical, Unintended Disclosure (Not Involving Hacking, Intentional Breach or Physical Loss), Fraud Involving Debit and Credit Cards Not Via Hacking, or Unknown, and 0 otherwise. https://privacyrights.org/data-breaches |
| **Additional variables** | |
| RISK_COMT | Dummy variable score as 1 if firm discloses the presence of a ‘‘Risk’’ committee in its proxy statement for the current year, and 0 otherwise. (BoardEx) |
| COMPLIANCE_COMT | Dummy variable score as 1 if firm discloses the presence of a ‘‘Compliance” committee in its proxy statement for the current year, and 0 otherwise. (BoardEx) |
| TECHNOLOGY_COMT | Dummy variable score as 1 if firm discloses the presence of a ‘‘Technology’’ committee in its proxy statement for the current year, and 0 otherwise. (BoardEx) |
| IT_OFFICER | Dummy variable score as 1 if Chief Information Officer (CIO), Chief Technology Officer (CTO), Chief Information Security Officer (CISO), or Chief Security Officer (CSO) is on the top management team, 0 otherwise. (BoardEx) |
| IMR | Inverse mills ratio from the first stage model of Equation (2). |

# Chapter 5 Conclusion and Directions for Future Research

## 5.1 Introduction

This thesis comprises three essays. **Chapter 2 (essay 1)** examines the association between corporate tax avoidance and investment efficiency. The objective of **Chapter 3 (essay 2)** is to investigate the association between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). Finally, **Chapter 4 (essay 3)** explores the association between the occurrence of cybersecurity breaches and corporate tax avoidance.

## 5.2 Summary of Findings

### Investment efficiency and corporate tax avoidance

The first essay of this thesis examines the association between corporate tax avoidance and investment efficiency. Firms use cash tax saving form tax avoidance activities (Edwards et al. 2016) as an internal source to fund their investments. Cash tax savings may be used opportunistically by firm managers to engage in rent extraction. I hypothesize that there is positive association between tax avoidance and investment inefficiency. Additionally, this essay examines whether financial statement obscurity, financial statement comparability and product market competition mediate the association between corporate tax avoidance and investment efficiency.

The findings indicate that there is a positive association between corporate tax avoidance activities and investment inefficiency, suggesting that high level of tax avoidance results in a high level of investment inefficiency. The findings support the hypothesis that there is a positive association between tax avoidance and investment inefficiency. Specifically, firms' cash tax savings from avoidance activities are not used efficiently. It is also shown that the effect of corporate tax avoidance activities on investment inefficiency is mediated by financial statement obscurity, financial statement comparability and product market competition. The findings are robust to alternative measures of both tax avoidance and investment inefficiency. This essay further addresses any potential endogeneity issues that might result from the effect of omitted variables, reverse causality or model misspecification by employing the Propensity Score Matching (PSM), Difference-in-Difference (DID) analyses, and Instrumental variables (2SLS) regression analysis and the main findings are robust.

This essay makes several contributions. First, previous research documents that investment efficiency has been associated with financial reporting quality (Biddle & Hilary, 2006; Biddle et al., 2009; Chen et al., 2011; Cheng et al., 2013; Balakrishnan et al., 2014), accounting conservatism (Lara et al., 2016), auditor characteristics (Bae et al., 2016), or corporate social responsibility (Benlemlih & Bitar, 2018). However, there is a paucity of research that examines the association between corporate tax avoidance and investment efficiency. Green and Kerr (2016) show that firms use cash tax savings from tax avoidance activities on new investments but they do not provide evidence as to whether this internally-generated cash is used efficiently. This essay contributes to the investment efficiency literature by providing evidence as to how efficiently firms use cash tax savings from tax avoidance activities to fund their investments. Second, cash generated from tax planning represents an important source of funds within corporations, and firms with financial constraints are more likely to engage in tax avoidance activities (Edwards et al. 2016). This essay contributes to the literature examining the consequences of corporate tax avoidance and provides evidence that firms' cash tax savings from avoidance activities are not used efficiently. Third, this essay contributes to the literature for the first time by providing that the association between corporate tax avoidance and investment efficiency is mediated by product market competition, financial statement obscurity and financial statement comparability. Specifically, these findings add to the literature by showing the direct and indirect (mediating) effect of corporate tax avoidance on investment efficiency.

### Unrecognized tax benefits and accounting reporting complexity

The second essay investigates the association between accounting reporting complexity (ARC) and unrecognized tax benefits (UTBs). Hoitash and Hoitash (2018) argue their unique measure (ARC) is in its dependence on every monetary accounting XBRL tags disclosure in Item 8 of the 10-K filings and it is a broader firm-level measure for accounting complexity. Hoitash and Hoitash (2018) measures of ARC (which cauterized of -accounting-based complexity) depends on accounting information for the measurement of complexity. Managers can intentionally introduce complexity by increasing the number of XBRL tags, or through intentionally obfuscating the financial reports by incorrectly using extended tags instead of taxonomy tags (Debreceny et al. 2011; Guragai et al., 2017). Managers may use XBRL tags opportunistically to make accounting disclosure more complex (Hoitash and Hoitash, 2018). UTBs measure uncertainty and risk tax. If firms manipulate the way in which accounting information is reported via XBRL tags, this may exacerbate the uncertainty pertaining to UTB estimates (Hanlon and Heitzman, 2010). I hypothesize that there is positive association between accounting reporting complexity and unrecognized tax benefits. Moreover, this essay tests a non-directional hypothesis if industry-specialist auditor moderate

the positive association of accounting reporting complexity and unrecognized tax benefits.

The results show that accounting reporting complexity is positively associated with firms' reporting of unrecognized tax benefits which implying that managers used XBRL tags opportunistically and increased the level of UTBs. The results support the main hypothesis that there is a positive association between ARC and UTBs. The results also show that industry-specialist auditors magnify the positive association between accounting reporting complexity and unrecognized tax benefits. I also find the results are robust to different components of UTBs, alternative measures of UTBs, of accounting reporting complexity, and of industry-specialist auditors. In order to mitigate any potential endogeneity concerns, I employ PSM and DID analyses and the positive association between accounting reporting complexity and unrecognized tax benefits are robust.

This essay contributes to literature in several ways. First, previous studies rely on linguistic complexity (Li, 2008; Bozanic and Thevenot, 2015; Loughran and McDonald, 2014; Hoitch and Hoitch, 2018) which do not distinguish between accounting and non-accounting information. I provide a methodological contribution by using ARC that captures increments in complexity based on the layout and narrative of accounting and financial reporting information. Second, to the best of my knowledge, no prior study has tested the relationship between accounting reporting complexity and unrecognized tax benefits. Unrecognized tax benefits is an important to measure tax avoidance due to the fact that higher UTBs mean additional uncertainty in the tax positions of the company and therefore, will possibly indicate the tax avoidance level (Hanlon and Heitzman, 2010). In addition, the quantity of unrecognized tax benefits recorded for financial accounting is an accounting accrual dependent on the management's approval. The study of Peterson (2012) involved that use of the amount of words and recognition methods in revenue-recognition disclosures and his observation is that there is increment in the likelihood of revenue-related restatements by revenue-recognition complexity increments. If firms manipulate the way in which accounting information is reported via XBRL tags, this may exacerbate the uncertainty pertaining to UTB estimates. In order to obfuscate their rent and to increase complexity of accounting reporting, managers can deliberately increase ARC through an increase in the number of inappropriately allocated XBRL tags. The reason for this is that following the introduction of Uncertain Tax Position (UTP) reporting requirements in 2010, there is greater nexus between tax reporting and financial reporting requirements in that firms tax filings and tax footnotes require both use of tax and financial information. Third, prior studies report that industry-specialist auditors are related to higher audit quality (Audousset-Coulier, Jeny, & Jiang, 2016; Dunn & Maydew, 2004; Ho & Kang, 2013; Reichelt & Wang, 2010). Prior research also show that a delay in audit or diminished audit quality could arise from increased accounting complexity (see e.g. Ettredge et al., 2006; Bronson et al., 2011). Increased audit risk could stem from higher

financial complexity and hence auditors will need to put in more effort and/or charge a fee premium to compensate for the added risk (Bedard and Johnstone 2004). Thus, it is possible that employment of industry-specialist auditors moderate the positive association between ARC and UTBs.

### Corporate tax avoidance and cybersecurity breaches

The third essay of this thesis examines the association between cybersecurity breaches and corporate tax avoidance. A large and growing body of literature has documented the adverse events of cybersecurity breaches occurrence on market reaction (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009), litigation risk (Romanosky et al., 2014), operational risk (Lawrence et al., 2018), and audit risk (Li et al., 2020; Smith et al., 2019; Yen et al., 2018). Managers withhold and accumulate negative information such as CSBs events, which make uncertain future outcomes, lead to overinvestment in tax avoidance by opportunistic managers. I hypothesize that there is a positive association between the occurrence of cybersecurity breaches and corporate tax avoidance.

The occurrence of cybersecurity breaches is positively associated with corporate tax avoidance for both full sample and PSM sample. Opportunistic managers may use cybersecurity breaches events to engage in tax avoidance activates. The result is consistent with the main hypothesis that predicts a positive association between occurrence of cybersecurity breaches and corporate tax avoidance. The results are robust using alternative measures of tax avoidance and CSBs. In addition, I find that in the presence of board-level IT governance (i.e. firms with the establishment of risk committee, of compliance committee, of technology committee, and having IT officers in top management team) reduces the propensity of management to engage in corporate tax planning. Board-level IT governance plays an important role in mitigating the impact of CSBs on corporate tax avoidance. Further, the results are robust with the timing of CSBs, with use of the Heckman test and in models that employ additional control variables.

This study contributes to literature in several important ways. First, previous research investigated the consequences of CSBs such as negative market reaction (Campbell et al., 2003; Cavusoglu et al., 2004; Garg et al., 2003; Goel & Shawky, 2009; Johnson et al., 2017; Telang & Wattal, 2007), an increased risk (Gwebu et al., 2014; Romanosky et al., 2014), in higher audit fees (Li et al., 2020; Smith et al., 2019), and in an increase of cash holdings (Boasiako & Keefe, 2020). This study is at first time to provide evidence CSBs are associated with increased levels of corporate tax avoidance. Second, a study by Gallemore and Labro (2015) indicates that firms with higher internal information quality are more likely to engage in tax avoidance. Managers have the ability to access and possess internal information such as

CSBs. This study extends the findings of Gallemore and Labro (2015) by providing evidence that increased CSBs result in higher levels of corporate tax avoidance. Finally, prior research finds that strength in board-level IT governance mitigates CSBs risk (e.g., Haislip, Masli, et al., 2016; Haislip, Peters, et al., 2016; Higgs et al., 2016; Smith et al., 2019) and reduces agency costs through monitoring and oversight IT systems designed to enhance the effectiveness and efficiency of IT systems, policies, and procedures (Fama & Jensen, 1983). The results find that existence of a risk, compliance, technology committee or IT executive in top managements plays an important role in moderating the association between CSB and tax avoidance.

## 5.3 Future Implications

This thesis provides insights that could be of interest to academics, regulators, and shareholders. First, this thesis demonstrates that there is a positive association between corporate tax avoidance and investment inefficiency. Future research in this area could consider the relation between investment efficiency and the propensity of firms' to retain earnings offshore in tax havens or other jurisdictions that provide financial or tax benefits. Approximately two trillion USD is currently retained offshore by U.S. multinationals which flows on implications in terms of cost of capital, the ability to borrow and the liquidity risk a firm exposed to. These factors will have flow-on implications in terms of the ability and motivation of management to fund their investments efficiently. In particular, further work in this area would be of interest to capital market participants and governments given the economic impacts relating to employment, capital growth and capital flows. It is shown that political economic events could potentially impact a firm's tax avoidance. The Tax Cut Jobs Act (TCJA), effective January 2018, which was signed by President Donald Trump, cut corporate tax rate from 35% to 21%. The TCJA is estimated to reduce US tax revenue by nearly $1.5 trillion over the next ten years (Joint Committee on Taxation (JCT), 2017).

Second, this thesis determines that accounting reporting complexity using XBRL tags is positively associated with unrecognized tax benefits. In 2019, the SEC adopted Inline XBRL amendments that requiring to operate firm financial statement information and fund risk/return summary information. Inline XBRL will be required for all other filers in 2021. Further research needs to be done to compare ARC before and after Inline XBRL. Finally, this thesis illustrates that there is positive association cybersecurity breaches and corporate tax avoidance. Regulators and shareholders may consider multiple ways to monitor and prevents such breaches events.

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