Three Essays on Corporate Tax Avoidance

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Thesis Declaration

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Table of Contents

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Thesis Abstract

This thesis includes three essays on the determinants and the implications of firms' engagement in corporate tax avoidance.

The first essay examines the relationship between corporate tax avoidance and corporate bond liquidity. Using a comprehensive bond-year dataset, we provide suggestive empirical results to indicate that firms that aggressively engage in corporate tax avoidance improve their corporate bond liquidity. This finding is found to be robust to a quasi-experiment with a plausible exogenous shock, *Xilinx, Inc. v. Commissioner*, to alleviate the omitted variable concern. In addition, we also use the adoption of *Financial Accounting Standards Board Interpretation Number 48* (FIN 48) to address the endogeneity issue existing in the baseline results. Furthermore, we use two shareholder governance proxies, namely Cain *et al.* (2017) Takeover Index and Coles *et al.* (2014) Co-option, to investigate the effect of corporate governance, and we find that the improvement in bond liquidity resulting from aggressive tax avoidance is more pronounced for firms with a lower level of shareholder governance relative to their well-governed counterparts.

The second essay explores the effect of federal-level disaster relief support on corporate tax avoidance engagement. In the wake of Hurricane (Tropical Storm) Michael, we find that firms headquartered in the states that are eligible to receive Department of Homeland Security Federal Emergency Management Agency (FEMA) Assistance engage in more aggressive tax avoidance than their non-receiving counterparts. We perform the difference-in-differences procedure and propensity score match each receiving firm in municipalities in Florida, Georgia, Virginia, and North Carolina to companies in municipalities that are not eligible for the disaster relief package. We find that the aggressive engagement in tax avoidance resulting from FEMA Assistance takes place not only in receiving firms relative to non-receiving firms, but also in more-receiving firms compared with less-receiving firms when Hurricane Michael was

downgraded to Tropical Storm Michael. In addition, we also find that social capital is a possible channel to affect the positive association between FEMA Assistance and corporate tax avoidance for firms located in states that possess a higher level of social capital. Our findings are found to be robust to the different tax avoidance measures and show that larger companies, highly levered firms, and firms with higher equity income in earnings have a tendency to be more aggressive in tax avoidance engagement.

The third essay investigates the effect of geopolitical risk on corporate tax avoidance. Using US data from 2005 to 2019, we find that increased geopolitical risk leads to more aggressive tax avoidance engagement, and this finding persists in the short and long run at both firm and industry level. In addition, we find that this positive relationship between geopolitical risk and corporate tax avoidance is more pronounced for firms that are financially constrained. Furthermore, we use an exogenous geopolitical shock, the 2016 Organization of Petroleum Exporting Countries (OPEC) agreement, and find that firms that operate in the oil-related industries engage in more aggressive tax avoidance than their non-oil-related counterparts. Our findings are robust to an alternative measure of industry exposure, and also robust with controlling for firm-level political risk.

Chapter 1: Thesis Introduction

1. Thesis Overview

This thesis comprises three essays on the determining factors and the consequences of firms' corporate tax avoidance engagement.

In the first essay, we examine how aggressive corporate tax avoidance engagement affects corporate bond liquidity. We analyze a vast dataset of 21,032 corporate bond-year observations from the United States and discover that companies that engage in more aggressive tax avoidance practices have improved corporate bond liquidity. This finding remains robust even when we used quasi-experimental methods, such as examining the *Xilinx Inc. v. Commissioner* legal case and applying the *Financial Accounting Standards Board Interpretation Number 48* (FIN 48) in difference-in-differences settings. Additionally, we observe that the positive impact of aggressive tax avoidance on corporate bond liquidity is more pronounced for firms with weaker shareholder governance mechanisms.

In the second essay, we explore the impact of Department of Homeland Security Federal Emergency Management Agency (FEMA) Assistance on corporate tax avoidance. We propensity score match companies in municipalities that received relief assistance with those in municipalities that did not receive relief support and find that firms that received FEMA Assistance engage in more aggressive tax avoidance than their non-receiving counterparts. In a subsequent analysis, we also looked at the response of companies in North Carolina and Virginia that received less relief support due to Hurricane Michael being downgraded to Tropical Storm Michael. The result is robust to the channel analysis, in which we use social capital as a possible channel for the positive relationship between FEMA Assistance and corporate tax avoidance. Our findings are consistent across various measures of tax avoidance and demonstrate that larger companies, those with higher leverage, and those with more equity income in earnings are more likely to engage in tax avoidance.

In the third essay, we focus on the relationship between geopolitical risk and corporate tax avoidance, using US data spanning from 2005 to 2019. We discover that an increase in geopolitical risk leads to more aggressive tax avoidance engagement, which is measured by a decline in the cash effective tax rates, in both the short and long term. Additionally, we find that this effect was more pronounced for companies facing greater financial constraints. Using the 2016 Organization of Petroleum Exporting Countries (OPEC) agreement as a geopolitical shock, we observe that oil-related companies engaged in more aggressive tax avoidance compared to non-oil-related companies. We find that our findings are robust to an alternative measure of industry exposure, and also robust with controlling for firm-level political risk.

2. Corporate Tax Avoidance and Corporate Bond Liquidity

Corporate tax avoidance is a commonly used strategy by firms to reduce their tax obligations through various transactions, as noted by Dyreng *et al.* (2008). Recent studies have identified two motivations for corporate tax avoidance: financial interest and social responsibility (Wang *et al.* 2020). Shackelford and Shevlin (2001) discuss the financial interest motivation and suggest that the primary goal of tax avoidance is to maximize the value of the firm, rather than solely minimizing tax payments. Desai and Dharmapala (2009) support this idea by showing a positive relationship between tax avoidance and firm value for well-governed firms. Davis *et al.* (2016) focus on social responsibility motivation and argue that resources retained through tax avoidance can be used for socially responsible activities.

The existing literature on corporate tax avoidance has examined its influence on shareholders, companies, and banks. On one hand, tax avoidance has been found to potentially enhance value by increasing firm values and reducing cash outflows (Graham & Tucker 2006), lowering the cost of equity (Goh *et al.* 2016), and making companies less susceptible to accounting fraud (Lennox *et al.* 2013). On the other hand, tax avoidance has been recognized

as value-destroying by increasing agency costs (Desai & Dharmapala 2009), declining stock prices (Hanlon & Slemrod 2009), increasing costs of bank loans (Hasan *et al.* 2014), and increasing firm risk (Kim *et al.* 2011). While the literature has well-documented the impacts of corporate tax avoidance on corporate value, its influence on the bond market has received less attention. This study seeks to investigate the effect of corporate tax avoidance from the perspective of bondholders by examining the relationship between tax avoidance and corporate bond liquidity.

Corporate bondholders may have different perceptions of tax avoidance than shareholders due to their differing risk preferences and return expectations (Hasan *et al.* 2014). This study focuses on corporate bond liquidity for two reasons. Firstly, prior research shows that corporate bond yield spreads cannot be fully explained by credit quality (Elton *et al.* 2001; Chen *et al.* 2007; Beber *et al.* 2008), and liquidity is an important factor that affects bond pricing (Lin *et al.* 2011; De Jong & Driessen 2012; Acharya *et al.* 2013; Friewald *et al.* 2013). Secondly, the preference for liquidity in the corporate bond market varies over time and increases during periods of market volatility (Vayanos 2004). During market stress, liquidity largely determines cash flows in the bond market (Beber *et al.* 2008). Therefore, corporate bond liquidity is an appropriate context to examine how corporate bondholders perceive tax avoidance activities.

Although previous studies have not directly explored the link between corporate tax avoidance and bond liquidity, there are conflicting views on this relationship in the literature. Some studies suggest that aggressive tax avoidance could negatively affect corporate bond liquidity. According to Kim *et al.* (2011), aggressive tax avoidance strategies can increase the risk of stock price crashes and enable rent extraction for managers. Furthermore, option theory suggests that fixed claimants like bondholders and residual claimants like shareholders may have conflicting interests in situations of heightened firm risk (Hasan *et al.* 2014). This suggests that corporate bondholders may bear the negative consequences of higher risk, without

necessarily benefiting from tax planning as shareholders do. As a result, corporate bondholders become more risk-averse and tend to shift towards more liquid assets, also known as the 'flight to liquidity' phenomenon, as suggested by Vayanos (2004), Chen *et al.* (2007), Baele *et al.* (2010), and Hotchkiss and Jostova (2017). Therefore, tax avoidance is likely to harm corporate bond liquidity. Other studies suggest that aggressive tax avoidance may improve corporate bond liquidity. Based on Lambert *et al.* (2007) derivation of the cost of equity regarding expected cash flows, Goh *et al.* (2016) find that tax-avoiding firms have a lower cost of equity. (Lim 2011) shows that there is a negative association between tax avoidance and the cost of debt, which aligns with the trade-off theory. Hotchkiss and Jostova (2017) use trading volume as a proxy for corporate bond liquidity and find that companies with more equity trading have more actively traded bonds. In addition, Beneish (2001) proposes that a lower cost of equity enables equity trading and lower cost of debt empowers bond issuance. Therefore, firms with more equity trading and more bond issuance tend to have more corporate bond trading, which suggests an improvement in corporate bond liquidity. Nonetheless, given the mixed findings presented in the current literature, further research is necessary to determine the direct impact of tax avoidance on corporate bond liquidity.

We use 21,032 bond-year observations from 2002 to 2018 to examine the relationship between tax avoidance engagement and corporate bond liquidity. We include four aggressive tax avoidance measures, namely book-tax difference (Manzon Jr & Plesko 2001), the permanent book-tax difference (Frank *et al.* 2009), cash effective tax rate (Wilson 2009), and long-run effective tax rate (Dyreng *et al.* 2008). In addition, we use four transaction cost-based proxies to measure corporate bond illiquidity, which includes TC_Roll (Dick-Nielsen *et al.* 2012), TC_IQR (Han & Zhou 2016), $TC\_AvgBidAsk$ (Hong & Warga 2000), and $TC\_Roundtrip$ (Feldhütter 2012). We find that statistically significant evidence suggests that

aggressive tax avoidance improves bond liquidity. This finding suggests that bondholders benefit from aggressive engagement in tax avoidance.

To mitigate the omitted variable concern, we use the 9th Circuit Court decision as an exogenous shock. We find that firms located in the 9th Circuit that engage in aggressive tax planning exhibit greater improvement in corporate bond liquidity relative to firms headquartered in other circuits. In addition, we use the implementation of *Financial Accounting Standards Board Interpretation Number 48* (FIN 48) to address the endogeneity concern. We discover that firms that report positive FIN 48 tax reserves have a higher level of corporate bond liquidity relative to firms that do not report positive tax reserves. Furthermore, we use the Takeover Index (Cain *et al.* 2017) and $Co-option$ data (Coles *et al.* 2014) to proxy the shareholder governance mechanisms. We find that the improvement in corporate bond liquidity due to aggressive engagement in tax avoidance is more pronounced for firms with weak shareholder governance.

Overall, our empirical analyses suggest that aggressive tax avoidance improves corporate bond liquidity.

3. FEMA Assistance and Corporate Tax Avoidance

As of September 2022, FEMA had declared $91,854.3M in disaster relief support since 2017 (RSFLG 2022). The considerable cost of the post-disaster relief package is due to the increased financial costs of domestic natural disasters. According to Eco-Business, the financial costs of natural disasters increased for the third consecutive year and cost $280 billion in 2021 alone (Eco-Business 2022). Natural disasters not only have direct impacts on property and infrastructure destruction, but also indirect effects, such as on production networks, suppliers, and supply chains (Botzen *et al.* 2020). The significant impacts of natural disasters

call for a disaster relief package; however, a comprehensive understanding of the effect of disaster relief on corporate decisions is less explored. The effect of natural disasters on corporate risk management, investment policy, and investment strategies has been extensively discussed in the existing literature, including Corporate Social Responsibility (CSR) performance (He *et al.* 2022; Mbanyele & Muchenje 2022; Malik *et al.* 2023), Environmental, Social and Governance (ESG) disclosures (Huang *et al.* 2022), corporate tax avoidance (Adrian *et al.* 2022; Ni *et al.* 2022), insurance risk control measures (Chen *et al.* 2012), investment and capital expenditure (Feng *et al.* 2022) and trade credit (Lai *et al.* 2022). However, there is limited research on the impact of subsequent disaster relief support on corporate strategies.

This study aims to fill the gap in the literature by examining how FEMA Assistance affects corporate tax avoidance. As FEMA provides disaster relief to affected areas for recovery purposes, FEMA Assistance is considered an appropriate measure to investigate the relationship between disaster relief and tax avoidance. Tax avoidance refers to the legal practice of restructuring business operations to minimize tax payments in comparison to pre-tax income (Dyreng *et al.* 2010; Wang *et al.* 2020). The literature on corporate tax avoidance extensively explores the determinants of companies' decisions to engage in this practice, including internal factors like information quality (Gallemore & Labro 2015), pre-tax income (Rego 2003), reputational concerns (Gallemore *et al.* 2014), executive incentives (Desai & Dharmapala 2006), and corporate governance mechanisms (Armstrong *et al.* 2015), as well as external market factors like tax enforcement (Desai *et al.* 2007), media attention (Kanagaretnam *et al.* 2018), supplier ties (Cen *et al.* 2017), public pressure (Dyreng *et al.* 2016), and political connections (Kim & Zhang 2016). Even though firms in disaster-stricken regions receive disaster recovery support, they still face significant operational and investment challenges. Thus, they may resort to aggressive tax planning to alleviate their financial burden. Therefore, our study aims to investigate how FEMA Assistance, as an external recovery plan,

influences firms' engagement in tax avoidance, as they may restructure their operations to minimize their tax liability.

The considered corporate strategy is tax avoidance. The underlying assumption is that firms that are heavily affected by natural disasters and are eligible to receive FEMA Assistance may still have insufficient cash. Therefore, they may tend to engage in aggressive tax planning activities. The current literature mainly focuses on the internal determinants of corporate tax avoidance, such as internal information quality (Gallemore & Labro 2015), pre-tax income of the firms (Rego 2003), reputational concerns (Gallemore *et al.* 2014), executive incentives (Desai & Dharmapala 2006) and corporate governance mechanisms (Armstrong *et al.* 2015). However, not many studies have examined the effect of external factors on tax avoidance. Therefore, in this paper, we examine the causal relationship between FEMA Assistance and corporate tax avoidance.

The post-disaster recovery plan typically consists of three components: Individual Assistance, Public Assistance, and Hazard Mitigation Assistance. In this study, we employ the FEMA Assistance provided in response to Hurricane (Tropical Storm) Michael as an exogenous shock to investigate the impact of varying levels of relief support in different regions. As Hurricane Michael and Tropical Storm Michael are essentially the same disaster in different forms, this approach allows for the examination of the effects of different levels of FEMA Assistance in different areas. FEMA Assistance for Hurricane Michael was introduced on October 11, 2018, in Florida (FEMA 2018a) and October 14, 2018, in Georgia (FEMA 2018b), while FEMA Assistance for Tropical Storm Michael was implemented in North Carolina and Virginia when Hurricane Michael weakened and was downgraded to Tropical Storm Michael. The monetary amounts for FEMA Assistance varied among the four states, with substantially smaller amounts offered to North Carolina and Virginia for Tropical Storm Michael compared to Florida and Georgia for Hurricane Michael. Overall, the ultimate goal of

FEMA Assistance for Hurricane (Tropical Storm) Michael was to enhance the resilience of the affected regions. Based on (Ni *et al.* 2022) argument that firms have a greater incentive to maintain cash reserves when faced with climate risks and tightened financial constraints, we hypothesize that the engagement in corporate tax avoidance will become more aggressive for firms headquartered in states that are eligible to receive FEMA Assistance for Hurricane (Tropical Storm) Michael, even with the presence of FEMA Assistance, due to obstructed investment and operations and tightened financial constraints resulting from the natural disaster.

Social capital is an important concept in sociology (Coleman 1988) and economics research (Hasan *et al.* 2017) that refers to the set of beliefs and values that promote social cooperation within a community. Previous research has found a negative correlation between social capital and corporate tax avoidance (Hasan *et al.* 2017), and that social capital is consumed more heavily by low-status participants in the post-disaster period (Elliott *et al.* 2010). Aldrich (2014) argues that the use of social capital is as heavy as the 'external aid' (i.e., FEMA Assistance) in the post-disaster period. Therefore, we hypothesize that the implementation of FEMA Assistance leads to a decline in social capital, which in turn results in more aggressive tax avoidance engagement by firms headquartered in states eligible for FEMA Assistance.

We use a sample consisting of 12,206 firms from 2016 to 2020, which is two years before and after FEMA Assistance is implemented in each affected state. We find statistically significant evidence supporting our hypothesis that firms receiving FEMA Assistance engage in more aggressive tax avoidance than their non-receiving counterparties. Furthermore, we match each firm that receives more FEMA Assistance (in Florida and Georgia) to a firm that receives less FEMA Assistance (in North Carolina and Virginia). We find that firms located in states that are eligible to receive more relief support tend to engage in more aggressive tax avoidance than firms located in states that receive less FEMA Assistance. We also provide

suggestive evidence that social capital could be a potential channel through which FEMA Assistance affects corporate tax avoidance.

4. Geopolitical Risk and Corporate Tax Avoidance

In 2020, geopolitical risk was recognized to surpass cyber risk and become the number one global corporate risk (WTW 2022). Unlike political risk that arises from political uncertainty, geopolitical risk captures adverse geopolitical events, such as wars, military attacks, and terrorist acts, as well as diplomatic conflicts across the globe (Wang *et al.* 2019), that threaten the financial stability of global corporates (Caldara & Iacoviello 2022). Given the importance of geopolitical risk, burgeoning research has examined the adverse impacts of geopolitical risk, such as the price of essential food commodities (Ma *et al.* 2022), common business cycles (Gupta *et al.* 2018), corporate cash reserves (Lee & Wang 2021), bank stability (Phan *et al.* 2022), the prices of oil and gold (Bouoiyour *et al.* 2019; Su *et al.* 2019; Gkillas *et al.* 2020), as well as excess stock return predictability (Ma *et al.* 2022). However, the existing literature is limited in examining the influence of geopolitical risk on corporate decision-making, particularly on tax avoidance behavior. Therefore, our study addresses this gap by examining the impact of geopolitical risk on corporate tax avoidance using data from all US firms between 2005 and 2019.

We develop two sets of hypotheses to investigate the impact of geopolitical risks on corporate tax avoidance and its potential channels. Firstly, we propose that geopolitical risks can influence firms' involvement in tax avoidance. Firms tend to maintain higher cash reserves when faced with greater geopolitical risks and also as a precautionary procedure against any future geopolitical effects (Lee & Wang 2021). Therefore, higher geopolitical risks may lead to an increase in tax avoidance, as firms seek to bolster their cash holdings. However, Hanlon *et al.* (2017) indicate that there are significant differences in cash holdings between

multinational and domestic firms, despite facing similar geopolitical risks. This suggests that while geopolitical risks may impact a firm's tax avoidance strategies, the direction of the impact is uncertain. Therefore, our study aims to provide empirical evidence to answer this research question.

Secondly, we propose that the impact of geopolitical risks on corporate tax avoidance varies depending on the financial constraints of the firm. Previous research suggests that it is more valuable for financially constrained firms to have higher cash reserves compared to unconstrained firms (Almeida *et al.* 2004; Faulkender & Wang 2006). Additionally, financially constrained firms tend to engage in more aggressive tax planning relative to their unconstrained counterparts (Chen & Lai 2012; Law & Mills 2015). As geopolitical risks influence a firm's tax avoidance strategies through their impact on cash holdings, the effect of geopolitical risks on tax avoidance is likely to differ depending on a firm's level of financial constraint. However, despite the apparent benefits of high cash holdings for financially constrained firms, Denis and Sibilkov (2009) found that some of these firms had low cash reserves due to consistently low cash flows. Consequently, the literature lacks an explanation for how financial constraints can either enhance or dampen the impact of geopolitical risks on corporate tax avoidance, which we aim to address in this study.

Using US publicly listed firms from 2005 to 2019, we find that geopolitical risk increases the engagement in corporate tax avoidance in the short and long run at both firm and industry levels. Furthermore, this effect is more pronounced for firms with higher financial constraints. In addition, we use the 2016 OPEC agreement as a geopolitical shock to address potential concerns about the endogeneity issue in our empirical setting. Using a propensity score matching procedure and difference-in-differences methods, we find that firms operating in oil-related industries tend to engage in more aggressive tax planning than firms in non-oil-related sectors. Our findings are robust with alternative measures of financial constraints and industry

exposure, and also robust when we control for firm-level political risk. Overall, our empirical results provide robust evidence that firms engage in more aggressive tax avoidance when facing increased geopolitical risk.

5. Thesis Contributions

This thesis makes several contributions to the existing literature. First, to the best of our knowledge, this thesis is the first to explore the effect of tax avoidance on the corporate bond market. Corporate bonds are traded in decentralized over-the-counter markets, making it difficult to estimate their liquidity (Schestag *et al.* 2016; Hotchkiss & Jostova 2017). Previous studies have extensively examined the determinants of corporate bond liquidity because liquidity is priced into corporate bond pricing (Lin *et al.* 2011; De Jong & Driessen 2012; Acharya *et al.* 2013; Friewald *et al.* 2013). The determinants of corporate bond liquidity include issue size (Hong & Warga 2000), bond age (Warga 1992; Alexander *et al.* 2000), (Hotchkiss & Jostova 2017), credit risk (Alexander *et al.* 2000; Hotchkiss & Ronen 2002; Jostova *et al.* 2013), price volatility (Harris & Raviv 1993; Alexander *et al.* 2000), publicly or privately traded equity (Alexander *et al.* 2000; Fenn 2000), equity trading volume and equity returns (Hotchkiss & Ronen 2002; Avramov *et al.* 2007), equity market conditions (Gallant *et al.* 1992; Engle III & Lange 1997; Chordia *et al.* 2000), embedded options (Hotchkiss & Jostova 2017) and issuer industry (Hotchkiss & Jostova 2017). This study emphasizes the significance of tax avoidance, a commonly used corporate strategy, on corporate bond liquidity. The findings offer bond investors a thorough understanding of how bond liquidity reacts to aggressive tax planning practices.

Second, this thesis is the first to provide direct empirical evidence of how post-disaster relief support affects corporate tax avoidance behavior. Previous research in climate finance and natural disasters has primarily focused on the direct effects of climate changes and natural

disasters, such as the effect of beliefs about climate change on real estate prices (Baldauf *et al.* 2020), the occurrence of natural disasters on energy technology innovation (Zhao *et al.* 2022), the effect of different types of natural disasters on firms' ESG disclosures (Huang *et al.* 2022), the effect of urban floods on trade credit (Lai *et al.* 2022), firms' investment and R&D engagement in the post-disaster period (Feng *et al.* 2022), the effect of extreme weathers on corporate tax avoidance (Adrian *et al.* 2022; Ni *et al.* 2022), the effect of aggregated temperature exposures on establishment sales (Addoum *et al.* 2020), the misestimation of climatic disasters in portfolio management (Alok *et al.* 2020), the effect of disaster mitigation on insurance risk control measures (Chen *et al.* 2012), and the effect of temperature change on stock performance (Choi *et al.* 2020). Our study differs from prior studies by examining the effects of FEMA Assistance for Hurricane (Tropical Storm) Michael, a disaster relief package, on corporate tax avoidance rather than exploring the direct impact of climate change or natural disasters.

Third, this thesis is related to the recent burgeoning literature on geopolitical risk. Geopolitical risk is recognized to be the number one global corporate risk, and the adverse impacts threaten the financial stability of global enterprises (WTW 2022). Recent studies have examined the effect of geopolitical risk on bank stability (Phan *et al.* 2022), cash holdings (Lee & Wang 2021), excess stock return predictability (Ma *et al.* 2022), firm investment (Wang *et al.* 2019), food prices (Saâdaoui *et al.* 2022), macroeconomics (Clance *et al.* 2019), as well as the price of commodities (Bouoiyour *et al.* 2019; Su *et al.* 2019; Gkillas *et al.* 2020). This thesis differs from the prior literature by investigating the effect of geopolitical risk on corporate tax avoidance at the firm and industry levels in both the short and long run.

Fourth, Hasan *et al.* (2014) state that the burgeoning studies on the consequences of tax avoidance focus on the effect of tax avoidance on firms' and banks' perspectives. The consequences of corporate tax avoidance include executive incentives (Desai & Dharmapala

2006; Dyreng *et al.* 2010), financial reporting behavior (Hope *et al.* 2013), corporate governance (Minnick & Noga 2010; Khan *et al.* 2017), the level of pre-tax income (Rego 2003), cost of equity (Goh *et al.* 2016), stock price variation (Hanlon & Slemrod 2009), market responses (Frischmann *et al.* 2008), agency risk (Desai & Dharmapala 2009), the possibility of committing accounting fraud (Lennox *et al.* 2013), audit fees (Donohoe & Robert Knechel 2014) and cost of bank loans (Hasan *et al.* 2014). This thesis, however, sheds light on the corporate bond market by documenting that the improvement in corporate bond liquidity is one of the consequences of engaging in corporate tax avoidance.

Fifth, this thesis provides additional empirical evidence to the existing literature on the determinants of tax avoidance, which are the motivations and the incentives that drive firms in such corporate decisions. Existing literature has already explored determinants of tax avoidance such as analyst coverage (Allen *et al.* 2016), executive incentives (Desai & Dharmapala 2006; Dyreng *et al.* 2010), financial reporting behavior (Hope *et al.* 2013), institutional ownership (Khan *et al.* 2017), IRS audit (Hoopes *et al.* 2012), labor unions (Chyz *et al.* 2013), public pressure (Dyreng *et al.* 2016), shareholder activism (Cheng *et al.* 2012) and the level of pre-tax income (Rego 2003). This thesis contributes to this area of the literature by providing consistent evidence supporting that increased geopolitical risk, an external risk factor, leads to more aggressive tax avoidance engagement. In addition, Adrian *et al.* (2022) examine the effect of drought on corporate tax avoidance and suggest that firms engage in less aggressive tax avoidance when they experience drought. This thesis differs from Adrian *et al.* (2022) because current literature proposes that different natural disasters have different impacts depending on their formation and severity. Rosselló *et al.* (2020) find that tsunamis, floods, and volcanic eruptions have a negative effect on international tourism, but droughts promote international tourism. Panwar and Sen (2019) discover that the effect of different natural disasters on agricultural growth can be different as well. Therefore, to differentiate from

previous studies that analyze the impact of natural disasters on corporate tax avoidance, which may vary depending on the type of disaster, our study takes a unique approach by examining how companies engage in tax avoidance after receiving post-disaster relief support from FEMA.

6. Thesis Structure

The rest of this thesis is organized as follows: Chapter 2 examines the effect of corporate tax avoidance on corporate bond liquidity; Chapter 3 investigates the impact of FEMA Assistance on corporate tax avoidance; Chapter 4 explores the effect of geopolitical risk on corporate tax avoidance; and Chapter 5 summarizes the thesis by providing the empirical findings and the contributions to the literature.

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Chapter 2: The Effect of Aggressive Tax Avoidance on Corporate Bond Liquidity

1. Introduction

Corporate tax avoidance, a widely used corporate strategy, refers to all transactions that can reduce firms' tax obligations (Dyreng *et al.* 2008). Recent studies propose two motivations for corporate tax avoidance engagement, namely financial interest motivation and social responsibility motivation (Wang *et al.* 2020). Shackelford and Shevlin (2001) discuss the financial interest motivation and find that the objective of tax avoidance is to maximize the firm value rather than minimize the tax payments. Desai and Dharmapala (2009) support this finding by showing a positive relationship between tax avoidance and firm value for well-governed firms. Davis *et al.* (2016) investigate the social responsibility motivation and find that resources retained from tax avoidance can be invested in socially responsible activities.

The extant literature examines the influence of corporate tax avoidance on shareholders, companies, and banks. On one hand, tax avoidance is found to be potentially value-enhancing, due to factors including increased firm values and reduced cash outflows (Graham & Tucker 2006), lower cost of equity (Goh *et al.* 2016), and less susceptibility to accounting fraud (Lennox *et al.* 2013). On the other hand, tax avoidance is recognized to be value-destroying, due to factors including increased agency cost (Desai & Dharmapala 2009), decreased stock price (Hanlon & Slemrod 2009), higher cost of bank loans (Hasan *et al.* 2014), and increased firm risk (Kim *et al.* 2011). Overall, the impacts of corporate tax avoidance on corporate value are well-documented in the existing literature, whilst the influence on the bond market is less explored. This study considers the effect of corporate tax avoidance from the perspective of bondholders by investigating the relationship between tax avoidance and corporate bond liquidity.

Hasan *et al.* (2014) state that in contrast to shareholders, fixed claimants, like banks and bondholders, experience an uneven distribution of outcomes of corporate tax avoidance engagement. While shareholders might enjoy tax savings from corporate tax avoidance, corporate bondholders, who have fixed claims, do not necessarily gain from these tax advantages. Fixed claimants typically receive a predetermined future income stream but are exposed to significant potential losses given tax avoidance can be potentially value-destroying. Due to different risk preferences and return expectations existing between shareholders and bondholders, corporate debtholders may recognize tax avoidance differently relative to shareholders (Hasan *et al.* 2014). We specifically focus on corporate bond liquidity for two reasons. Firstly, prior literature finds that the corporate bond spreads are not fully explained by credit quality (Elton *et al.* 2001; Chen *et al.* 2007; Beber *et al.* 2008). Specifically, Covitz and Downing (2007) find that short-term corporate yield spreads are determined by credit quality and bond liquidity. Surprisingly, the primary factor influencing short-term corporate yield spreads, even when considering periods shorter than one month, is the credit risk. As for corporate bonds with maturity exceeding one year, the liquidity components explain the variation in yield spreads better than credit quality, and this is because liquidity is priced into corporate bond pricing (Lin *et al.* 2011; De Jong & Driessen 2012; Acharya *et al.* 2013; Friewald *et al.* 2013). In addition, Shevlin *et al.* (2020) investigate the interaction between corporate tax avoidance and corporate bond yield spreads. They find that around half of the overall impact of tax avoidance on bond yields can be attributed to its adverse effects on future pre-tax cash flows and volatility, with a somewhat smaller contribution from reduced information quality. This finding underscores the connection between corporate tax avoidance and bond yield spreads. Considering that bond liquidity is factored into bond yield spreads and plays a pivotal role in bond pricing, the interaction between corporate tax avoidance and bond liquidity warrants further investigation and research. Secondly, the preference for liquidity in

the corporate bond market is time-varying and increases with volatility (Vayanos 2004). In times of market stress or firms facing higher levels of macroeconomic constrains, liquidity almost exclusively determines the cash flows in the bond market (Beber *et al.* 2008), and companies are incentivized to increase their tax avoidance engagement (Hsu *et al.* 2023). Given the potential interaction among macroeconomic factors, corporate bond liquidity, and corporate tax avoidance and the importance of liquidity in the corporate bond market, corporate bond liquidity provides an ideal setting to investigate how corporate bondholders perceive tax avoidance activities.

Although the existing literature does not directly examine the relationship between corporate tax avoidance and bond liquidity, the literature seems to imply conflicting hypotheses about this relationship. A stream of prior studies suggests that aggressive tax avoidance may *deteriorate* corporate bond liquidity. Aggressive tax avoidance engagement leads to greater stock price crash risk and increased managerial rent extraction (Kim *et al.* 2011) and increased audit fees and more IRS audit risk (Donohoe & Robert Knechel 2014). According to option theory, there is a conflict of interests between fixed claimants (i.e., bondholders) and residual claimants (i.e., shareholders) when facing heightened firm risk. Therefore, corporate bondholders may bear the consequences of higher firm risk, but not necessarily enjoy the reward of tax planning. Corporate bondholders then become more risk averse, which leads to the well-known phenomenon of 'flight to liquidity' (Vayanos 2004; Chen *et al.* 2007; Baele *et al.* 2010; Hotchkiss & Jostova 2017), such that tax avoidance deteriorates corporate bond liquidity. Another stream of existing literature implies that aggressive tax avoidance may *improve* corporate bond liquidity. According to Lambert *et al.* (2007) derivation of the cost of equity regarding the expected cash flows, Goh *et al.* (2016) find that tax-avoiding firms have a lower cost of equity. In addition, Lim (2011) finds that there is a negative association between tax avoidance and the cost of debt, which is in line with the trade-off theory. Hotchkiss and

Jostova (2017) use trading volume to proxy corporate bond liquidity and find that companies with more equity trading have more actively traded bonds. Given a lower cost of equity promotes equity trading and a lower cost of debt enables bond issuance (Beneish 2001), firms with more equity trading and more bond issuance are likely to have more corporate bond trading, which in turn indicates an improvement in corporate bond liquidity. In conclusion, the impact of corporate tax avoidance on corporate bond liquidity is undetermined. Therefore, it is important to conduct a thorough analysis to examine the direct relationship between tax avoidance and corporate bond liquidity.

Using a comprehensive sample of 21,032 bond-year observations in US public firms from 2002 to 2018, we investigate the potential effects of aggressive tax avoidance on corporate bond liquidity. We use four empirical proxies to capture the aggressive tax avoidance, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), as well as Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR). We measure corporate bond liquidity using four transaction cost-based measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$.

In the baseline regression, across all four measures, we find a positive and statistically significant correlation between corporate tax avoidance and bond liquidity, after controlling for firm-specific attributes, bond characteristics, and bond credit ratings. This finding suggests that bondholders indeed benefit from firm tax planning given tax avoidance promotes corporate bond liquidity.

In addition, we test the consistency of these findings by employing two quasi-experimental settings to investigate the effect of corporate tax avoidance on corporate bond liquidity. First,

we use a plausible exogenous shock to tax avoidance engagement, the 9th Circuit Court decision, to solve the omitted variable concern. We find that firms in the 9th Circuit have a higher level of corporate bond liquidity through more aggressive tax avoidance activities relative to firms headquartered in other circuits. Second, we provide further evidence to solve the potential endogeneity problem by adopting Financial Accounting Standards Board Interpretation Number 48 (FIN 48), in which firms need to apply the same tax standard when reporting uncertain tax positions. We find that firms that report positive FIN 48 tax reserves after the implementation of FIN 48 have a higher level of bond liquidity compared to firms that do not report positive FIN 48 tax reserves. Overall, two quasi-experimental settings deliver consistent and robust results to the baseline results.

Lastly, we explore possible channels through which corporate tax avoidance affects corporate bond liquidity. We use the Cain *et al.* (2017) Takeover Index and Coles *et al.* (2014) Co-option data to capture shareholder governance mechanisms. We find that the improvement in corporate bond liquidity due to aggressive tax avoidance engagement is more pronounced for firms with a lower level of shareholder governance.

Our paper contributes to the existing literature in two ways. Firstly, our study is the first to provide empirical evidence of the effect of corporate tax avoidance on corporate bond liquidity. Corporate bonds are traded in a non-centralized dealer market, and the decentralized over-the-counter features make corporate bond liquidity estimation more difficult (Schestag *et al.* 2016; Hotchkiss & Jostova 2017). In addition, prior studies have extensively explored the determinants of corporate bond liquidity given corporate bond liquidity is priced into corporate bond pricing (Lin *et al.* 2011; De Jong & Driessen 2012; Acharya *et al.* 2013; Friewald *et al.* 2013). The potential determinants of corporate bond liquidity include issue size (Hong & Warga 2000), age of bond (Warga 1992; Alexander *et al.* 2000), interest rate risk (Hotchkiss & Jostova 2017), credit risk (Alexander *et al.* 2000; Hotchkiss & Ronen 2002; Jostova *et al.*

2013), price volatility (Harris & Raviv 1993; Alexander *et al.* 2000), publicly or privately traded equity (Alexander *et al.* 2000; Fenn 2000), equity trading volume and equity returns (Hotchkiss & Ronen 2002; Avramov *et al.* 2007), equity market conditions (Gallant *et al.* 1992; Engle III & Lange 1997; Chordia *et al.* 2000), embedded options (Hotchkiss & Jostova 2017), and issuer industry (Hotchkiss & Jostova 2017). The results of this paper highlight the importance of tax avoidance, a widely used corporate strategy, on corporate bond liquidity, and give bond investors a comprehensive understanding of how bond liquidity reacts to aggressive tax planning activities.

Secondly, our work also extends the emerging literature on tax avoidance. Prior literature mainly examines the effects of corporate tax avoidance on corporate value, stock market reaction, firm risk, and accounting and auditing consequences. The consequences on corporate value include increased firm values and reduced cash outflows (Graham & Tucker 2006), increased bank loan cost (Hasan *et al.* 2014), and lower cost of equity (Goh *et al.* 2016). The impacts on stock market reaction include decreased stock price (Hanlon & Slemrod 2009) and negative market responses (Frischmann *et al.* 2008). The influence on firm risk includes increased firm risk (Kim *et al.* 2011) and increased agency risk (Desai & Dharmapala 2009). The consequences of accounting and auditing include a high possibility of committing accounting fraud (Lennox *et al.* 2013) and more audit fees (Donohoe & Robert Knechel 2014). Accordingly, this paper differs from prior literature by adding the perspective of bondholders, for whom aggressive tax avoidance improves corporate bond liquidity. To our knowledge, this paper is the first study to document the improvement in corporate bond liquidity as a consequence of aggressive tax avoidance engagement.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature and develops the main hypotheses. Section 3 introduces the research design, sample construction, corporate bond liquidity measures, corporate tax avoidance measures, baseline regression

model, and descriptive statistics. Section 4 presents empirical analyses on the relationship between tax avoidance and corporate bond liquidity, the robustness tests, as well as the possible channels through which corporate tax avoidance affects corporate bond liquidity. Section 5 summarizes the results and implications.

2. Literature Review and Hypothesis Development

This section discusses related literature and formulates the hypothesis from different predictions of the effect of aggressive tax avoidance on corporate bond liquidity and the impact on firms with different levels of corporate governance.

2.1. The Liquidity-Destroying View: Aggressive Tax Avoidance Deteriorates Corporate Bond Liquidity

There is evidence suggesting that corporate tax avoidance may result in a decline in corporate bond liquidity due to the risk-engendering nature of aggressive tax avoidance. Desai and Dharmapala (2009) find that aggressive tax avoidance activities do not increase firm value on average, and the effect of this varies with the level of corporate governance. They also propose an increased agency problem between shareholders and managers. In addition, Hasan *et al.* (2014) discover that greater tax planning leads to higher bank loan spreads given that fixed claimants bear the risks of tax avoidance engagement but do not necessarily enjoy the benefit of tax shelters. Moreover, negative market reactions and decreased stock prices on news of tax sheltering and uncertain future financial health are observed for firms engaging in aggressive corporate tax avoidance (Hanlon & Slemrod 2009). Donohoe and Robert Knechel (2014) find that tax-avoiding firms face greater Internal Revenue Service (IRS) audit risk as a challenge to their tax positions, and there are subsequent direct and indirect costs on audit fees.

Furthermore, Kim *et al.* (2011) find that corporate tax avoidance leads to firm-specific stock price crash risk. The underlying assumption is that tax avoidance increases managerial rent extraction and conceals bad news, which results in a stock price crash when the bad news is finally revealed.

Due to the risk-engendering nature of aggressive tax avoidance engagement, corporate bond liquidity drops significantly because of the well-known phenomenon of 'flight to liquidity' (Chen *et al.* 2007; Baele *et al.* 2010; Hotchkiss & Jostova 2017). Vayanos (2004) states that fund managers are likely to liquidate their holding positions at times of high volatility when portfolio performance is lower than the predetermined threshold, and a flight to liquidity increases the liquidity premium on bonds (Goyenko *et al.* 2011). With a relatively constant quantity of liquid assets available in the market, an increase in the demand for liquidating current holding positions will lead to a decline in bond liquidity (Baele *et al.* 2010). In addition, corporate bond trading volumes are found to decrease when bonds become more seasoned and are in a less actively traded portfolio (Hotchkiss & Jostova 2017).

Overall, aggressive tax avoidance practice worsens corporate bond liquidity due to the 'flight to liquidity' arising from increased firm-specific risks. We formulate the following hypothesis based on this view:

H1A: Aggressive tax avoidance engagement worsens corporate bond liquidity.

2.2. The Liquidity-Enhancing View: Aggressive Tax Avoidance Improves Corporate Bond Liquidity

The financial motivation for firms to engage in aggressive tax avoidance is tax reduction (Wang *et al.* 2020). Corporate tax avoidance brings certain benefits to the company and bondholders may enjoy the reward given an improvement in corporate bond liquidity.

Engagement in tax avoidance remains widespread among firms due to the reduced tax obligations and cash outflows from tax sheltering (Graham & Tucker 2006; Desai & Dharmapala 2009). Lim (2011) finds that tax avoidance reduces the cost of debt, which is in line with the trade-off theory. Isin (2018) supports this view and proposes that loan contracting costs associated with aggressive tax avoidance are lower, and companies do not necessarily face material agency costs when they persistently reduce corporate tax obligations. In addition, Goh *et al.* (2016) find equity investors appreciate corporate tax avoidance because of cash flow effects and require a lower expected rate on equity. This suggests that tax-avoiding firms have a lower cost of equity.

Hotchkiss and Jostova (2017) discuss potential determinants of corporate bond liquidity, among which *issue size* and *equity trading volume* are two important determinants that are affected by the cost of debt and the cost of equity, respectively. A lower cost of debt arising from aggressive tax avoidance engagement enables more bond issuance, and corporate bond liquidity increases given a significant positive impact of issue size on bond liquidity (Hotchkiss & Jostova 2017). Alexander *et al.* (2000) support this finding by examining the determinants of trading volume and find that large bond issues promote bond trading, which suggests that corporate bond liquidity increases with large bond issuance. In addition, Hotchkiss and Jostova (2017) find that stock activity and bond liquidity are positively related for firms with more publicly traded equity. Therefore, a lower cost of equity arising from aggressive tax avoidance engagement increases the amount of publicly traded equity and improves the corporate bond liquidity.

In conclusion, aggressive tax avoidance improves corporate bond liquidity due to the increased issue size and equity trading arising from the decreased cost of debt and cost of equity. We formulate the following hypothesis from this perspective:

H1B: Aggressive tax avoidance engagement improves corporate bond liquidity.

2.3. Prior Literature on the Shareholder Governance Mechanisms

Shareholder governance describes the transparency and the strength of shareholders' rights in a firm. Cremers *et al.* (2007) find that shareholder control is associated with higher yield if a firm is exposed to takeovers, and lower yield if the firm is protected from takeovers. Strong shareholder governance leads to a lower level of bondholders' control increases bond yields (Bhojraj & Sengupta 2003). In addition, Cremers and Nair (2005) propose that institutional investors such as corporate pension funds are recognized to be strong advocates of shareholders' interests, and the portfolio return is higher when they long (short) firms with high (low) takeover vulnerability. Chen *et al.* (2019) find firms with higher stock liquidity engage less in overly aggressive or overly conservative tax avoidance, and this effect is more pronounced for firms with more activist shareholders. Furthermore, Desai and Dharmapala (2009) find that agency problems arising from aggressive tax avoidance are more pronounced for firms with low corporate governance.

Overall, various corporate governance mechanisms related to tax avoidance activities may or may not benefit bondholders because of the value created and risks engendered by aggressive tax avoidance. In saying this, shareholder governance is expected to have a substantial impact on corporate bond liquidity because debtholders' perception of tax avoidance engagement varies with external governance mechanisms (Cen *et al.* 2017). We formulate the following hypothesis from this perspective:

H2: The effect of aggressive tax avoidance on corporate bond liquidity is more pronounced for firms with a lower level of shareholder governance.

3. Research Design, Sample Selection, and Summary Statistics

3.1. Sample Selection and Data Description

Our sample consists of publicly-listed firms in the US from July 2002 to June 2018. The selected sample period considers that Enhanced Trade Reporting and Compliance Engine (Enhanced TRACE) data is only available from 2002. We keep the period that overlaps with Compustat data; thus, we expect the sample to be comprehensive and representative.

We use the financial variables collected from the Compustat North America Database to generate four aggressive tax avoidance measures and firm-level controls. We collect bond characteristic variables and bond ratings from the Mergent Fixed Income Securities Database (Mergent FISD). We obtain variables to generate illiquidity measures from Enhanced TRACE, which is built upon the standard TRACE that provides detailed information for all US corporate bond market transactions.

We apply two modifications to correct the Enhanced TRACE data. First, we only keep bonds with a duration of more than one year and trade for more than 75% of their life span to avoid abnormal trading behaviors resulting from default (Bao *et al.* 2011). Second, we use Edwards *et al.* (2007) median and reversal filters to account for duplicate trades, trades occurring on holidays, trades under special conditions, and extreme outliers (Schestag *et al.* 2016).

3.2. Measures of Aggressive Tax Avoidance

Rego and Wilson (2012) propose that no single measure captures the whole involvement of aggressive tax planning, so to account for aggressive tax avoidance, we use four aggressive tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash

effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR).

Two book-tax differences measure the difference between the income reported to capital markets and the income reported to tax authorities (Desai & Dharmapala 2009). Manzon Jr and Plesko (2001) BT is defined as the difference between US domestic financial income, US domestic taxable income, income tax expenses on the state level, income tax expense on other aspects, and equity in the net income of nonconsolidated subsidiaries (Manzon Jr & Plesko 2001). The expenses on the state level and other aspects are deductible to account for the US federal taxable income, and the equity in the net income of nonconsolidated subsidiaries considers components that do not belong to taxable income. We use BT to measure the 'spread' between financial and taxable income, which is then scaled by the total asset level in the previous fiscal year. Wilson (2009) finds that the book-tax gaps are on average larger for firms that engage in tax planning relative to firms that do not conduct tax avoidance. Hope *et al.* (2013) argue that firms with a higher book-tax difference can shift earnings between different operation regions for tax avoidance purposes. Overall, prior literature does confirm that the BT measure is able to capture aggressive tax avoidance.

Frank *et al.* (2009) $DTAX$ develops BT by considering the permanent components of book-tax difference. $DTAX$ controls for nondiscretionary items that result in temporary and/or permanent book-tax differences. $DTAX$ is measured by regressing total permanent book-tax difference on nondiscretionary items, including goodwill, other intangibles, income (loss) attributable under the equity method, minority interests, current state income tax expense, and change in net operating loss carry forwards. Goodwill and other intangibles are controlled because permanent differences that are unrelated to tax planning are often created due to differences between tax accounting and financial rules. Income (loss) attributable under the equity method and minority interests are included because different financial reporting and tax

regulations apply for equity interests with less than 100% owned entities. We control for current state income tax expenses and changes in net operating loss carry forwards to account for the measure of taxable income and changes in the valuation allowance account that result in nondiscretionary permanent differences. Lastly, we include the lagged value of permanent book-tax differences to account for persistent differences across time.

Rego and Wilson (2009) cash effective tax rate (TA_CETR) is -1 times the cash effective tax rate, in which the cash effective tax rate is truncated to the range [0, 1]. TA_CETR is defined as firms' cash taxes paid divided by pre-tax accounting incomes (Dyreng *et al.* 2008, 2010).

Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) is -1 times the long-run cash effective tax rate. We use cash taxes paid to measure effective taxes instead of Generally Accepted Accounting Principles (GAAP) tax expenses for two distinct reasons. First, the tax benefits of stock options given to employees are considered in cash effective tax rates, but GAAP effective tax rates do not take stock options into account. Second, changes in the accounting estimates do not affect cash effective tax rate, but valuation allowance and tax contingency reserve may affect GAAP effective tax rates (Kim *et al.* 2011). Therefore, we follow Kim *et al.* (2011) to use a five-year horizon to account for firms' long-run tax behavior, and also require at least three consecutive years of non-missing data to calculate TA_LRETR. Moreover, relative to TA_CETR, TA_LRETR has the potential to capture firms that successfully engage in aggressive tax avoidance in the long run.

These four measures are direct aggressive tax avoidance proxies that are widely used in the existing literature on tax avoidance (Dyreng *et al.* 2008, 2010; Kim *et al.* 2011; Hope *et al.* 2013; Hasan *et al.* 2014; Gallemore & Labro 2015). The four tax avoidance measures aim to triangulate the results to avoid the potential limitations of each measure and provide more confidence if the results are consistent between different measures.

3.3. Measures of Corporate Bond Liquidity

Unlike the centralized exchange markets, the decentralized over-the-counter market makes the corporate bond liquidity estimation more complex given different trading structures (Schestag *et al.* 2016). The existing literature uses various liquidity proxies, but there was no universal consensus about the advantages and drawbacks before Schestag *et al.* (2016). Schestag *et al.* (2016) guide on the selection of liquidity measures regarding data availability and research questions. After evaluating the capability of different liquidity proxies in the prior studies, we use four intraday transaction-cost-based liquidity measures, calculated from the Enhanced TRACE intraday dataset, to capture the change in corporate bond liquidity.

The first measure, Hong and Warga (2000) $TC\_AvgBidAsk$, is the difference between the average buying price and selling price of a bond, which considers only the days when both buying and selling occur. The bid-ask spread estimator captures the transaction costs directly, so a higher value of $TC\_AvgBidAsk$ indicates a lower level of bond liquidity (Hong & Warga 2000). Second, Feldhütter (2012) $TC\_Roundtrip$ considers bonds that are traded multiple times in a short window with identical trading volumes. Those transactions are recognized as brokers taking round-trip trades to coordinate buyers and sellers. Therefore, a higher level of $TC\_Roundtrip$ denotes a lower level of bond liquidity (Feldhütter 2012). Third, Dick-Nielsen *et al.* (2012) TC_Roll accounts for transactions where there was no information available about buying and selling prices, and the negative autocovariances of bond returns from trading prices are used to capture the bid-ask bounce. Last, Han and Zhou (2016) TC_IQR uses the difference between the 25^{th} and 75^{th} percentile distribution of trading prices to capture bid-ask spread, because they find that intraday price volatility is the cause of bid-ask spreads. Therefore, a higher level of TC_Roll and TC_IQR also indicates a decline in bond liquidity. We restrict the sample of corporate bonds to fiscal years with at least 6 months of valid monthly bond liquidity observations in order to remove bonds that are only active for a short period.

Overall, the four corporate bond liquidity proxies are all monthly illiquidity measures. We then average those monthly measures on a yearly basis to match the data frequency of tax avoidance variables, bond characteristics, and firm-specific controls.

3.4. Additional Controls

We include a number of firm-specific variables that could potentially affect corporate bond liquidity. First, we control the firm size and tangible assets' payoffs. Firm size is a proxy of the degree of information (Harris 1994) and the performance on tangible assets is easier to observe. Large firms and firms with more tangible assets tend to have less information asymmetry. Second, we include research and development (R&D) and advertising expenditures because greater expenditure in those categories could increase information asymmetry (Atawnah *et al.* 2018). Third, we control for leverage, which captures the funding sources. Therefore, the firm-specific controls are the natural logarithm of assets ($Ln\,(Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$) and leverage ratio ($Leverage$).

In addition, we follow Friewald *et al.* (2013) to include bond characteristics such as amount issued, coupon, maturity, and bond age. In general, we expect bonds with a large amount of issuance to be more liquid and bonds with higher coupons to be less liquid. In addition, bonds with longer maturity are less liquid and bonds that are recently issued are more liquid (Chen *et al.* 2007).

3.5. Summary Statistics and Correlations

In this paper, we use a statutory tax rate of 35%, in line with Hasan *et al.* (2014). We winsorize variables (except ratios) for the top 1% and bottom 1% data to reduce the impact of outliers.

[Insert Table 1]

Table 1 provides summary statistics for tax avoidance measures, firm-specific controls, bond characteristics, and illiquidity proxies. For each variable, we provide relevant statistics of the total number of observations, the mean and median values, the values at the 25th and 75th percentiles, and each corresponding standard deviation. There are in total 21,032 bond-year observations in the baseline analysis, and the number of observations does decline with further analyses due to data availability. For tax avoidance measures, BT yields the fewest observations because of the missing values of the variables needed to construct BT, whilst TA_LRETR yields the greatest number of observations because we replace any missing values with zero (Kim *et al.* 2011). In addition, the mean value of TA_LRETR and TA_CETR are -0.236 and -0.205 respectively, which suggests that the average cash effective tax rate is around 22.1%. The descriptive statistics for tax avoidance measures are in line with previous literature (Dyreng *et al.* 2008; Kim *et al.* 2011; Hasan *et al.* 2014). In our sample, the average firm has a leverage ratio of 0.528, a ratio of R&D expenses to total assets of 1.44%, and a ratio of advertising expenses to total assets of around 1.10%. These results closely resemble the results from Atawnah *et al.* (2018). In addition, Table 1 also provides a cross-sectional variation of the bond characteristics with reasonable variations. For example, the amount offered varies from \$0.25 million to \$0.65 million in the range between the 25^{th} percentile and 75^{th} percentile.

Average bonds in the sample have a 13-year maturity window, with maturities ranging from 7 to 20 years between the considered percentiles. Moreover, Table 1 also provides summary statistics for illiquidity measures that are averaged on a yearly basis to match the data frequency of Compustat variables. For instance, different transaction-cost-based measures deliver an average bid-ask spread of 1.035%, which means a $100,000 worth round-trip trade of bonds could incur transaction costs of $1,035. Along with the other illiquidity measures, these results show the substantial cross-sectional variation in corporate bond liquidity.

[Insert Table 2]

Table 2 presents the correlation matrix between tax avoidance measures, firm-level controls and bond characteristics. As expected, each tax avoidance measure is positively correlated with the others, given they all measure tax avoidance directly. Control variables are systematically associated with the main dependent variables as presented in prior studies (Chen *et al.* 2007; Atawnah *et al.* 2018).

3.6. Baseline Regression Model

We examine the effect of corporate tax avoidance on corporate bond liquidity by using the following empirical model.

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (1)$$

The subscript "it" refers to bond i and year t. The dependent variable $Liquidity_{i,t}$ denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for

a bond i in any given year t. The independent variable, $Tax\ avoidance_{i,t-1}$, denotes four tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for a given firm in year $t-1$, where $t-1$ denotes the year immediately prior to the year a firm conducts tax avoidance. A higher value of tax avoidance measures indicates more aggressive tax avoidance. $Firm\ attributes_{i,t-1}$ includes the natural logarithm of assets ($Ln\ (Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$). The detailed variable descriptions are included in Appendix A. We also include bond characteristic variables in the regression, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. In addition, we include a dummy variable to account for credit rating effect, and include industry effect and year effect in the regression.

4. The Relationship Between Aggressive Tax Avoidance and Corporate Bond Liquidity

4.1. Baseline Regression Result

We use equation (1) to examine the dynamic effect of corporate tax avoidance on bond liquidity. Table 3 presents the regression results of the baseline model based on the Pooled Ordinary Least Square (Pooled OLS) estimation with heteroskedasticity-robust standard errors.

[Insert Table 3]

The estimated coefficients of four aggressive tax avoidance measures are negatively correlated with illiquidity proxies at a 1% level. We only report two illiquidity measures (TC_Roll and TC_IQR) for brevity and leave the other two illiquidity measures ($TC\_Roundtrip$ and $TC\_AvgBidAsk$) for a robustness check. In columns (1) and (4) of Table 3, based on BT, a one-unit increase in tax avoidance leads to a decrease in corporate bond illiquidity ranging from 0.0012% to 0.014% across four illiquidity measures. A higher level of tax avoidance measures is consistent with more aggressive tax avoidance engagement, and a higher level of illiquidity measures indicates lower corporate bond liquidity. Therefore, the baseline regression results suggest that firms that engage in more aggressive tax avoidance will have a higher corporate bond liquidity after controlling for firm and bond characteristics, which confirms that *H1B* is true. In addition, the coefficient estimates are also economically significant because a one-standard-deviation increase in the BT results in a 0.08[1] basis point increase in corporate bond liquidity under tc_roll measure. This improvement in corporate bond liquidity due to aggressive engagement in tax avoidance is also observed for the other three tax avoidance measures among the four illiquidity measures.

Regarding the estimated coefficients on the control variables, we find that most of them are economically significant, which is generally consistent with prior literature (Chen *et al.* 2007; Friewald *et al.* 2013; Hasan *et al.* 2014; Atawnah *et al.* 2018). We observe that some controls become insignificant in our regression, and this is because tax avoidance measures absorb casual effects from other controls, which further demonstrates that aggressive tax avoidance measures significantly improve corporate bond liquidity.

[1] A one standard deviation change in book-tax difference is associated with a 0.08 basis point increase (4.5×0.00014×127.2) in corporate bond liquidity.

In conclusion, the baseline regression results show that aggressive tax avoidance improves corporate bond liquidity. These findings suggest that bondholders perceive aggressive tax avoidance as value-enhancing since corporate bond liquidity is improved after tax planning. These results support *Hypothesis 1B.*

4.2. Evidence From Xilinx Inc. v. Commissioner

In this section, we use court case *Xilinx Inc. v. Commissioner* in a difference-in-differences setting to address potential concerns of endogeneity between tax avoidance and corporate bond liquidity. There could be correlated omitted variables that drive the effect of aggressive tax avoidance on corporate bond liquidity, and this issue could bias the results presented in baseline regression. Therefore, we use a plausible exogenous shock to tax avoidance engagement, the 9th Circuit Court decision, in order to examine the effect on corporate bond liquidity.

4.2.1. Background Information

Xilinx is in the computer software industry that manufactures integrated circuit devices and related development software systems, which requires considerable research and development expenditure (Wilkinson & Noga 2011). *Xilinx* established an Irish subsidiary to expand its European market and carry out considerable R&D for the parent company. In 1995, the parent company, *Xilinx,* and its Irish subsidiary entered into a Cost and Risk Sharing Agreement (hereinafter, the Agreement), in which the two parties allocate any incurred costs based on a predetermined percentage of their respective R&D costs (Kittle-Kamp 2009; FindLaw 2010). The Agreement failed to address whether employee stock options (ESOs) would be recognized as a cost to be shared. ESOs include incentive stock options (ISOs) and nonstatutory stock options (NSOs) (Kittle-Kamp 2009). *Xilinx* deducted as business expenses,

based on employees' NSOs exercise and ISOs disqualifying dispositions of around $41 million, $40 million, and $96 million in the tax years from 1997 to 1999, respectively. Therefore, the Commissioner of Internal Revenue Service (hereinafter, Commissioner) questioned *Xilinx* for not recognizing ESOs awarded to US-based employees who work in the R&D department as a 'cost' to be shared under the Agreement, given this permitted considerable costs of options to be deducted in the US arising from the tax rate differential between the US and Ireland (FindLaw 2010). The Commissioner sought over $120 million in taxes and penalties (Wilkinson & Noga 2011).

On 27th May 2009, the US Court of Appeals for the 9th Circuit issued its original opinion of *Xilinx Inc. v. Commissioner* under Treas. Reg. Section 1.482-7(d)(1), which was in favor of the IRS. However, in a decision filed on 22nd March 2010, the Court reversed the course under Treas. Reg. Section 1.482-7(b)(1), and affirmed a decision in favor of *Xilinx*. (Kittle-Kamp 2009). The conflict between Treas. Reg. Section 1.482-7(d)(1) and Treas. Reg. Section 1.482-7(b)(1) is that the former states that all costs should be shared under a cost-sharing agreement between the parent company and its subsidiaries parties, and the latter focuses on the act at arm's length. The Court reversed the previous ruling and curtailed the ability of the IRS to issue specific rules without due consideration of the actual activities conducted for unrelated parties (O'Scannlain 2010). Therefore, the reversion of the decision is clearly due to the primacy of the arm's length standard in the US transfer pricing regime (Wilkinson & Noga 2011).

The court ruling for *Xilinx Inc. v. Commissioner* suggests that companies in the 9th Circuit should benefit from the reduction of IRS enforcement risks by conducting a pricing-based tax avoidance method. Therefore, we expect that firms located in the 9th Circuit should employ more aggressive tax avoidance engagement after the ruling relative to firms headquartered in other circuits.

4.2.2. Underlying Assumptions

Difference-in-differences regression requires satisfying three provisions for identifying the average treatment effect. First, the Court ruling increases the tax avoidance engagement for firms headquartered in the 9th Circuit, not for firms in the regions. Second, *Xilinx* should be exogenous to the model. Last, the effect before the *Xilinx* decision should be the same for firms in the 9th Circuit (treatment group) and firms in other circuits (control group).

First of all, the US Court of Appeals for the 9th Circuit on *Xilinx* was against the Commissioner of Internal Revenue Service, and the ruling was that unrelated parties are not required to share all costs across subsidiaries (O'Scannlain 2010). Therefore, firms headquartered in the 9th Circuit could engage in more aggressive tax planning following the *Xilinx* ruling, whilst the ruling would have little to no impact on tax avoidance activities for firms not located in the 9th Circuit. There are nine states in the 9th Circuit jurisdiction, including Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, and Washington. Therefore, firms headquartered in all other states still face IRS enforcement risk on their cost and risk-sharing agreement, and this uncertainty exists even if their transfer prices comply with the arm's-length standard (Lee *et al.* 2019). Consequently, firms in other circuits are unlikely to engage in more aggressive tax avoidance activities relative to firms located in the 9th Circuit. This suggests that we are able to examine whether the *Xilinx* decision could induce more aggressive tax avoidance for firms in the 9th Circuit, but not for firms in other circuits.

Secondly, to test the exogeneity of the *Xilinx* decision, we need to make sure the *Xilinx* decision only affects the corporate bond liquidity through its impact on corporate tax avoidance. Exogeneity requires the court decision to be uncorrelated with omitted variables in the model. The effect of the *Xilinx* decision comes into force at a different time for firms in the 9th Circuit, given some firms apply the court decision and adjust their tax planning in a short period of time, while other companies may alter their tax positions later. As discussed in the prior

literature, this timing difference between the implementation and adjustment is the key to mitigating omitted variables concerns (Lee *et al.* 2019). In addition, the court decision itself can be revised. In May 2009, the original ruling was against *Xilinx Inc.* and the court reversed its ruling to be in favor of *Xilinx* (Wilkinson & Noga 2011). Overall, we conclude that *Xilinx* decision is exogenous to the model.

Thirdly, before the final ruling, which was in favor of *Xilinx Inc.*, affirmed by the US Court of Appeals for the 9th Circuit, firms in all circuits face IRS enforcement risk with respect to their cost-sharing agreement. Therefore, non-9th Circuit firms and firms in the 9th Circuit are expected to have parallel effects in regard to corporate bond liquidity before the court decision.

Overall, those three provisions provide evidence that the *Xilinx* decision can be used as an exogenous shock to the tax avoidance engagement in our model.

4.2.3. Methodology for the Xilinx Decision

We start by conducting a difference-in-differences test to examine whether firms headquartered in the 9th Circuit increased their tax avoidance engagement relative to firms in the non-9th Circuit by considering before and after the *Xilinx* decision. Following the prior literature, we restrict our sample period to the range of 2006 to 2014, since a 4-year pre-treatment and 4-year post-treatment could potentially rule out concerns about alternative shocks (Lee *et al.* 2019). The specification for the difference-in-differences test is as follows:

$$TA_{i,t} = \beta_1 Treat_{i,t} + \beta_2 Post_t + \beta_3 Treat_{i,t} * Post_t + \beta_4 FA_{i,t-1} + \beta_5 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (2)$$

The dependent variable, $TA_{i,t}$, is tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$),

Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for firm i in any given year t. $Treat_{i,t}$ is a dummy variable that equals one if the firm is located in any 9th Circuit states and equals zero if the firm is headquartered outside the 9th Circuit. $Post_t$ is a dummy variable that equals one if the bond observations are in the post-treatment period (2011–2014) and equals zero if the observations are in the pre-treatment period (2006–2009). The variable of interest in this regression model is the interaction term, $Treat_{i,t} \times Post_t$, which captures the differential effect of the court decision on tax avoidance. $FA_{i,t-1}$ is the firm attributes, including the natural logarithm of assets ($Ln\ (Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$) for firm i in any given year t−1. $BC_{i,t-1}$ denotes bond characteristics, including $Offering\ Amount$, $Coupon$, $Maturity$, and $Bond\ Age$ for firm i in any given year t−1. The credit rating, year and industry fixed effect are controlled.

We perform the second difference-in-differences test to investigate whether the 9th Circuit decision's effect on tax avoidance engagement affects corporate bond liquidity for firms headquartered in the 9th Circuit relative to non-9th Circuit companies after the *Xilinx* decision. We replace the tax avoidance measures used in the baseline regression with each three-way interaction term to see the effect of tax avoidance on corporate bond liquidity by considering different jurisdictions. Therefore, the specification for this difference-in-differences test is as follows:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} * Treat_{i,t} * Post_t + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (3)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga

(2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for a bond i in any given year t. All other variables are defined in regression model (2).

In the first difference-in-differences test, we expect the estimated coefficients on the interaction term, $Treat_{i,t} \times Post_t$, to be positive across different tax avoidance measures. This is because firms in the 9th Circuit are expected to conduct more aggressive tax planning relative to firms headquartered in other circuits. In the second difference-in-differences test, we expect the coefficient estimates on the interaction term, $TA_{i,t-1} \times Treat_{i,t} \times Post_t$, to be negative across different illiquidity measures. This is because we expect firms in the 9th Circuit to engage in more aggressive tax avoidance relative to firms headquartered in other circuits, and the former group is anticipated to have a higher level of corporate bond liquidity.

4.2.4. Regression Results

We report the regression results of two difference-in-differences tests in Table 4. Table 4 shows the difference-in-differences results for the effect of the *Xilinx* decision on firms' tax avoidance engagement. We find that the estimated coefficients on the interaction term, $Treat_{i,t} \times Post_t$, are significantly positive under tax avoidance proxies, including BT, TA_CETR, and TA_LRETR at the 1% level. This suggests that firms headquartered in the 9th Circuit engage in more aggressive tax avoidance relative to firms located in other circuits. Therefore, the *Xilinx* decision can be used as a treatment to corporate tax avoidance.

[Insert Table 4]

In Table 5, we present the effect of aggressive tax avoidance on corporate tax avoidance for firms in 9th Circuit relative to non-9th Circuit companies after the *Xilinx* decision. The variables of interest are the three-way interaction terms between $Treat$, $Post$ and each of the tax avoidance measures. The coefficient estimates of $BT \times Treat \times Post$, $TA\_CETR \times Treat \times Post$, and $TA\_LRETR \times Treat \times Post$ are significantly negative at 1%. This suggests that firms headquartered in the 9th Circuit are expected to have a higher level of corporate bond liquidity relative to firms located in other circuits in the post-treatment period after the *Xilinx* decision.

[Insert Table 5]

In conclusion, firms in the 9th Circuit conduct more aggressive tax avoidance relative to firms headquartered in other circuits after the Court decision of *Xilinx, Inc. v. Commissioner*, which is in favor of *Xilinx, Inc.* In addition, we also find suggestive evidence that firms in the 9th Circuit have a higher level of corporate bond liquidity due to conducting more aggressive tax avoidance relative to firms headquartered in other circuits after the court ruling. Overall, the tax avoidance-induced impact on corporate bond liquidity is robust in a quasi-experimental design.

4.3. Evidence From the Introduction of FIN 48

In this section, we employ another difference-in-differences analysis to further address the potential concerns of endogeneity between tax avoidance and corporate bond liquidity. We use

a plausible exogenous shock, Financial Interpretation No. 48 (FIN 48), to aggressive tax avoidance engagement, in order to examine the effect on corporate bond liquidity.

4.3.1. Introduction and Motivation of FIN 48

Financial Interpretation No. 48 (hereinafter, FIN 48) was introduced in June 2006 to eliminate the existence of uncertain tax positions in financial statements. After the implementation of FIN 48, accounting policy and field guidance were adjusted accordingly. For instance, the IRS specifically states that a taxpayer and/or its auditors should substantiate any current uncertain tax positions in financial statements. Moreover, public measurement and disclosure of income tax reserves are standardized under FIN 48 (Mills *et al.* 2010). Lisowsky *et al.* (2013) discovered that the disclosure of tax reserves determined by FIN 48 indeed reflects the aggressiveness of tax avoidance engagement, in which they find a positive correlation between FIN 48 ending balance reserves and firms' tax aggressiveness. Therefore, FIN 48 provides a distinct standard of uncertain tax benefit (UTB), in which all US firms are obligated to follow the same standard regarding uncertain tax positions and disclose the change of UTB on an annual basis (Hasan *et al.* 2014).

4.3.2. Potential Impact on Corporate Bond Liquidity After the Introduction of FIN 48

Prior research argues that FIN 48 improves the consistency of disclosure and measurement of UTB (Mills *et al.* 2010); however, FIN 48 does not affect all firms' UTB disclosure and measurement (Hasan *et al.* 2014). This suggests that firms that avoid taxes by undertaking uncertain tax positions are affected more than firms that do not undertake uncertain tax positions in their financial statements. Therefore, we employ a quasi-experiment to capture the incremental effect of the implementation of FIN 48 on corporate bond liquidity. The sample

dataset is split into two groups: treatment firms and match firms. The treatment firms are firms that avoid tax payments by undertaking an uncertain tax position and disclose the uncertain tax benefit. In this group, a positive value of UTB is expected in any given fiscal year after the implementation of FIN 48. The match firms are firms that *do not* undertake uncertain tax positions, and, in turn, are not affected by FIN 48 relative to the treatment firms. In this group, firms do not file a positive value of UTB in any given fiscal year after the implementation of FIN 48. We hypothesize that, holding all else the same, treatment firms are expected to have higher corporate bond liquidity relative to their matched counterparts. Given FIN 48 was initiated and implemented in 2006, we follow Hasan *et al.* (2014) to use two three-year periods (2003–2005 and 2007–2009) to find the potential impact of corporate bond liquidity after the introduction of FIN 48. The specification for this test is as follows:

$$Liquidity_{i,t} = \beta_1 AF_{i,t} + \beta_2 Post48_t + \beta_3 AF_{i,t} * Post48_t + \beta_4 FA_{i,t-1} + \beta_5 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (4)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures for the firm i in any given year t. Affected firm, $AF_{i,t}$, equals one if firms report positive UTB from 2007 to 2009 and equals zero otherwise. Post FIN 48, $Post48_t$, equals one if there was any bond issuance in a given firm between 2007 to 2009, and equals zero if any bond issuance occurred from 2003 to 2005. The variable of interest is the interaction term, $AF_{i,t} * Post48_t$, which captures the incremental effect of FIN 48 on corporate bond liquidity. $FA_{i,t-1}$ is the firm attributes and $BC_{i,t-1}$ denotes bond characteristics. The credit rating, year and industry fixed effect are also included.

Following Rego and Wilson (2012), we perform logistic regression, in which the dependent variable is $AF_{i,t}$ and independent variables are the variables that can explain the variation of UTB. The variables include firm size, return on assets, market-to-book ratio,

leverage, and R&D expenditure. Rego and Wilson (2012) use these variables to explain UTB variation because larger ($Size$) firms, with greater profitability (ROA), higher leverage (LEV), more research and development expenditures ($R\&D$), and higher market-to-book ratios (MTB) report larger UTBs. A logistic regression that quantifies UTB variation is used to indicate the probability of firms reporting a positive UTB after the implementation of FIN 48. We then use the predicted propensity score from the logistic regression for propensity score matching, because it minimizes the bias existing in non-randomized and observational research (Stuart 2010). In the propensity score matching, we match without replacement of each treatment firm with a matching firm. Following the prior literature, we set a 10% level caliper, that is, a 10% difference in the predicted probabilities between treatment and match firms, to get a closer match (Hasan *et al.* 2014). In addition, we only consider firms with bond issuance in any two three-year periods in order to capture the effect of FIN 48 on corporate bond liquidity more precisely. We have a maximum 8,903 matched observations, and we use difference-in-differences estimation for the analysis. In addition, we expect to have negative estimated coefficients on the interaction term $AF_{i,t} * Post48_t$, since a decrease in corporate bond illiquidity (i.e., an increase in corporate bond liquidity) after the implementation of FIN 48 for affected firms is expected relative to firms that are unaffected post FIN 48.

[Insert Table 6]

In Table 6, we report the effect of the implementation of Financial Standards Board Interpretation No.48 (FIN 48) on corporate bond liquidity. Under the four illiquidity measures, the estimated coefficients on the interaction term $AF_{i,t} * Post48_t$ are all significantly negative at 1% levels. Under tc_roll measure, the coefficient estimate of $AF_{i,t} * Post48_t$ is −0.006.

Despite the negative signs due to indirect measurements of corporate bond liquidity, this suggests that the implementation of FIN 48 delivers an incremental increase on corporate bond liquidity of 0.6%. Therefore, we conclude that aggressive tax planning is more severe after the implementation of FIN 48 for firms undertaking uncertain tax positions, and corporate bond liquidity increases accordingly.

4.3.3. Using the Income Tax Reserves Under FIN 48 to Proxy Aggressive Tax Avoidance

In this section, we use the actual amount of income tax reserves under FIN 48 to capture the effect of aggressive tax avoidance on corporate bond liquidity, because the end-of-UTB balance precisely captures the tax reserves resulting from the implementation of FIN 48. The specification for this test is as follows:

$$Liquidity_{i,t} = \beta_1 Ln(UTB)_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (5)$$

[Insert Table 7]

Following Lisowsky *et al.* (2013), we use $Ln\ (UTB)$ to capture aggressive tax avoidance. We define $Ln\ (UTB)$ as the natural logarithm of $(1 + TXTUBENT_{t-1})$, in which $TXTUBENT_{t-1}$ represents the unrecognized tax benefit of any given firm at the end of year $t-1$. We modify the baseline regression model by replacing all tax avoidance variables with $Ln\ (UTB)$, and we expect to have negative estimated coefficients on $Ln\ (UTB)$ to show that aggressive tax avoidance engagement improves corporate bond liquidity. We only account for the bonds issued during the second three-year period (2007–2009). In Table 7, the coefficient estimates on $Ln\ (UTB)$ are significantly negative at 1% level across all four illiquidity

measures. This suggests that the improvement in corporate bond liquidity due to aggressive tax avoidance is more pronounced for firms using uncertain tax positions for avoiding taxes.

In summary, we conclude that aggressive tax avoidance indeed improves the corporate bond liquidity given the change of UTB levels in capturing aggressive tax avoidance. These results confirm the evidence from baseline regression.

4.4. Evidence of the Impact of Corporate Governance on Aggressive Tax Avoidance and Corporate Bond Liquidity

Bondholders factor corporate governance into their bond valuation process (Schauten & Blom 2006). Strong bondholder governance mechanism has been shown to mitigate default risk (Switzer *et al.* 2018; Ballester *et al.* 2020) and enhance disclosure quality (Sengupta 1998; Beekes & Brown 2006). Consequently, strong corporate governance practices lead to a reduction in the cost of debt (Byun 2007; Aldamen & Duncan 2012). Moreover, firms with a lower cost of debt have more bond issuance, which leads to improved corporate bond liquidity (Hotchkiss & Jostova 2017). Given the divergence between shareholder governance and bondholder governance (Cremers *et al.* 2007), the evidence suggests that firms with a lower level of shareholder governance mechanism on average exhibit a lower cost of debt, which in turn improves the corporate bond liquidity.

Existing literature extensively investigates the influence of corporate governance on corporate tax avoidance, covering various aspects such as ownership structure (Badertscher *et al.* 2013; McGuire *et al.* 2014), board independence (Richardson *et al.* 2016; Lanis *et al.* 2017), management compensation (Armstrong *et al.* 2012; Rego & Wilson 2012), and external auditing (Kanagaretnam *et al.* 2016; Klassen *et al.* 2016). Our analysis focuses on corporate governance factors that can yield immediate and comprehensive effects on the firm. As a result,

we incorporate takeover threat and board independence into our empirical examination to capture the influence of shareholder governance on the relationship between aggressive tax avoidance and corporate bond liquidity. The first shareholder governance proxy, Cain *et al.* (2017) $Takeover\ Index$, represents firms' takeover susceptibility level. They find a positive relationship between firm value and susceptibility to hostile takeovers. This suggests that a higher (lower) value of the $Takeover\ Index$ indicates better (worse) shareholder governance. We use Coles *et al.* (2014) $Co-option$ as the second proxy to capture shareholder governance. The board of directors are expected to perform the role of monitoring and advising, and some literature also shows a connection between corporate performance and board independence (Coles *et al.* 2014). In addition, $Co-option$ measures the proportion of direct appointment of the board after the CEO assumes office. This suggests that an increase in $Co-option$ data indicates a lower level of shareholder governance.

As formulated in *Hypothesis 2*, we expect that the improvement in corporate bond liquidity due to aggressive tax avoidance engagement should be more pronounced in poorly governed firms. To further explore and substantiate this hypothesis, we have conducted an additional analysis, categorizing the baseline regression into two groups based on the $Takeover\ Index$ and $Co-option$. The specification for this test is as follows:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \qquad (6)$$

Panel A of Table 8 illustrates the sub-sample regression results of the effect on shareholder governance observed from the Takeover Index. Panel B of Table 8 shows the regression results of the effect on shareholder governance observed from Co-option. For both panels of Table 8, we only report one corporate bond illiquidity measure for presentation purposes; however, all the other measures deliver similar results.

[Insert Table 8 Panel A]

In Panel A of Table 8, all estimated coefficients on the low $Takeover\ Index$ group are negative and statistically significant at a 1% level. As expected, we observe negative coefficient estimates on those coefficients, given that we use the illiquidity measure as the dependent variable. For example, in the low $Takeover\ Index$ sample, the effect of BT on the corporate bond illiquidity that is captured by tc_roll has an estimated coefficient of −0.013. This suggests that a one-unit increase in aggressive tax avoidance leads to a total increase of 2.7%[2] in corporate bond liquidity for firms with lower shareholder governance. Conversely, the results are not statistically meaningful for the group with a higher $Takeover\ Index$. This distinction between the two groups is notably significant, emphasizing that the improvement in corporate bond liquidity due to aggressive tax avoidance engagement is more pronounced for firms with shareholder governance mechanisms (measured by the $Takeover\ Index$) relative to their well-governed counterparts.

[Insert Table 8 Panel B]

In Panel B of Table 8, six of eight estimated coefficients on tax avoidance measures in a high $Co-option$ sample are significantly negative. For instance, in the high $Co-option$ sample, the effect of BT on the corporate bond illiquidity that is captured by tc_roll has an estimated coefficient of −0.016. This suggests that a one-unit increase in aggressive tax

[2] The aggregate effect of BT on tc_roll in Panel A of Table 8 consists of two parts: (1) the effect of BT on tc_roll observed in baseline regression (−0.014), and (2) the effect of $BT \times LOW$ on tc_roll (−0.013).

avoidance results in a total increase of 3.0%[3] in corporate bond liquidity for firms with low shareholder governance relative to firms that are well-governed.

Overall, we conclude that the improvement in corporate bond liquidity from aggressive tax avoidance engagement is more pronounced in firms with weak shareholder governance. These results are in line with *Hypothesis 2*.

4.5. Additional Analysis: Corporate Bond Rating Scales

Major credit rating agencies like Standard & Poor's, Moody's, and Fitch play a critical role in providing bond ratings and updates to cater to the diverse risk preferences of investors. However, it is important to note that these agencies utilize distinct rating scales, as highlighted by Wang and Zhang (2014). Consequently, we cross-reference the rating scales of each agency to categorize baseline corporate bond samples into two main groups: investment-grade bonds and non-investment-grade bonds as per Moody's (2021), S&PGlobal (2022), and FitchRatings (2023) criteria.

The concept of investment grade carries significant weight in the realm of bonds, symbolizing the creditworthiness and dependability of the issuing company (Wang & Zhang 2014). Credit ratings, especially those denoting investment-grade bonds, often exhibit unique market behaviors and appeal to distinct investor preferences. By factoring in the investment grade of bonds as a moderating variable, we aim to unveil nuanced patterns and gain deeper insights into the interplay between tax avoidance, bond liquidity, and credit ratings.

[3] The aggregate effect of BT on tc_roll in Panel B of Table 6 consists of two parts: (1) the effect of BT on tc_roll observed in baseline regression (−0.014), and (2) the effect of $BT \times HIGH$ on tc_roll (−0.016).

To investigate how corporate tax avoidance impacts bond liquidity differently across firms with investment and non-investment grades, we segment our baseline sample into two categories using the rating scales provided by the three rating agencies. Intriguingly, the results, outlined in Appendix A2, suggest that non-investment grade corporate bonds tend to experience enhanced liquidity when firms engage in aggressive tax avoidance practices, across all four tax avoidance measures. However, only two estimated coefficients yield statistically significant results for investment-grade bonds.

In summary, while there are indications of a relationship between bond ratings, tax avoidance, and bond liquidity, our findings do not consistently support a definitive link between these factors. This calls for further exploration and in-depth analysis to better understand the intricate dynamics at play in this complex landscape.

5. Conclusion

We provide comprehensive empirical results that firms engaging in aggressive tax avoidance improve their corporate bond liquidity. This particular relationship is examined based on four tax avoidance measures and four illiquidity proxies, and the evidence suggests that bondholders should appreciate aggressive tax avoidance since corporate bond liquidity increases accordingly.

We conduct several tests to provide robustness to the baseline relationship between aggressive tax avoidance and corporate bond liquidity. We perform difference-in-differences regression in quasi-experimental estimations to capture the incremental effect of tax avoidance on bond liquidity after the introduction of the law case *Xilinx Inc. v. Commissioner* and the implementation of Financial Accounting Standards Board Interpretation No. 48. Furthermore, we use two corporate governance proxies to capture the effect of corporate governance on our

baseline relationship. We find that the improvement in corporate bond liquidity due to aggressive tax avoidance is more prominent in firms with weak shareholder governance relative to their well-governed counterparts. Overall, there is no evidence from any of the analyses to suggest aggressive tax avoidance worsens corporate bond liquidity.

Table 1 Summary Statistics

The sample contains 21,032 bond-year observations from 2002 to 2018. This table provides descriptive statistics for tax avoidance variables, firm attribute variables and bond characteristics. Detailed variable descriptions can be found in Appendix A.

Variable	N	Mean	S.D.	P25	Median	P75
Tax avoidance measures						
BT	8,526	0.008	0.045	-0.001	0.011	0.032
$DTAX$	12,199	0.008	0.006	0.003	0.007	0.011
TA_CETR	15,698	-0.205	0.144	-0.284	-0.190	-0.097
TA_LRETR	16,943	-0.236	0.132	-0.147	-0.234	-0.310
Firm attributes						
$Ln\ (Assets)$	21,032	9.605	1.344	8.771	9.768	10.59
$Asset\ tangibility$	21,032	0.428	0.180	0.316	0.429	0.515
$R\&D/Assets$	21,032	0.014	0.034	0.000	0.000	0.013
$Advertising/Assets$	21,032	0.011	0.022	0.000	0.000	0.013
$Leverage$	21,032	0.528	0.219	0.358	0.513	0.692
Bond Characteristics						
$Offering\ amount\ (in\ bln)$	21,032	0.527	0.416	0.250	0.400	0.650
$Coupon$ (%)	21,032	5.975	2.169	4.850	6.200	7.375
$Maturity\ (yr)$	21,032	13.840	9.834	7.000	10.000	20.000
$Bond\ age\ (yr)$	21,032	4.213	3.975	1.000	3.000	6.000
Liquidity measures						
TC_Roll (%)	21,031	1.272	0.830	0.672	1.068	1.658
TC_IQR (%)	20,996	0.899	0.639	0.442	0.724	1.183
$TC\_Roundtrip$ (%)	20,916	1.128	0.730	0.585	0.951	1.493
$TC\_AvgBidAsk$ (%)	20,882	1.035	0.922	0.383	0.731	1.395

Table 2 Pairwise Correlation

This table reports the correlation between tax avoidance measures, firm-level controls, and bond characteristics.

Variables	BT	$DTAX$	TA_CETR	TA_LRETR	$Ln\ (Assets)$	$Asset\ tangibility$	$R\&D\ /Assets$	$Advertising\ /Assets$	$Leverage$	$Coupon$	$Maturity$	$Bond\ age$
BT	1.000											
$DTAX$	0.025	1.000										
TA_CETR	0.335	0.075	1.000									
TA_LRETR	0.123	0.111	0.555	1.000								
$Ln\ (Assets)$	0.155	0.005	0.151	0.042	1.000							
$Asset\ tangibility$	-0.007	-0.096	0.058	0.020	0.077	1.000						
$R\&D/Assets$	-0.182	0.298	0.145	0.167	0.065	0.072	1.000					
$Advertising\ /Assets$	0.023	0.038	-0.048	-0.094	-0.172	-0.118	-0.040	1.000				
$Leverage$	-0.152	-0.243	-0.099	-0.029	0.046	0.113	-0.438	-0.253	1.000			
$Coupon$	0.087	0.053	0.140	0.005	0.478	0.005	0.190	-0.056	-0.163	1.000		
$Maturity$	-0.044	-0.161	-0.102	-0.049	-0.121	0.011	-0.222	-0.080	0.334	-0.247	1.000	
$Bond\ age$	-0.008	-0.057	-0.022	-0.010	0.138	0.030	-0.001	-0.010	0.035	-0.083	0.257	1.000

Table 3 Baseline Regression

This table presents the regression results of the following regression models from 2002 to 2018:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (1)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for the firm i in any given year t. We only report TC_Roll and TC_IQR for presentation. $TA_{i,t-1}$ denotes tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for the firm i in any given year t−1. $FA_{i,t-1}$ are the firm attributes including the natural logarithm of assets ($Ln\,(Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$). $BC_{i,t-1}$ denotes bond characteristic variables, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. The credit rating, year and industry effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are presented in parentheses. The standard errors are also clustered for industry and year to control for standard error existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	*tc_roll*	*tc_roll*	*tc_roll*	*tc_roll*	*tc_iqr*	*tc_iqr*	*tc_iqr*	*tc_iqr*
Tax avoidance measures								
BT	-0.014***				-0.012***			
	(-7.81)				(-8.64)			
DTAX		-0.285***				-0.177***		
		(-6.18)				(-4.97)		
TA_CETR			-0.001***				-0.001***	
			(-3.22)				(-3.27)	
TA_LRETR				-0.001***				-0.001***
				(2.75)				(3.78)
Firm attributes								
Ln (Assets)	-0.001***	-0.001***	-0.001***	-0.001***	-0.000***	-0.001***	-0.000***	-0.000***
	(-6.31)	(-10.45)	(-9.81)	(-10.31)	(-5.20)	(-9.64)	(-8.92)	(-9.67)
Asset Tangibility	0.003***	-0.002***	0.000	-0.000	0.003***	-0.001***	0.001**	-0.000
	(4.82)	(-4.56)	(1.01)	(-1.13)	(6.76)	(-2.70)	(2.13)	(-0.79)
R&D/Assets	0.010***	0.019***	0.012***	0.016***	0.009***	0.014***	0.012***	0.014***
	(3.84)	(7.66)	(5.12)	(6.87)	(4.51)	(4.86)	(6.64)	(7.94)
Advertising/Assets	0.008**	0.017***	0.013***	0.012***	0.010***	0.015***	0.010***	0.009***
	(2.52)	(5.47)	(4.79)	(4.62)	(3.51)	(6.22)	(4.78)	(4.55)
Leverage	0.008***	0.008***	0.006***	0.008***	0.006***	0.006***	0.005***	0.006***
	(16.13)	(19.74)	(17.65)	(22.96)	(16.04)	(19.59)	(17.26)	(22.69)
Bond characteristics								
Offering Amount	-0.000	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***	-0.000***	-0.000***
	(-0.99)	(-4.82)	(-7.84)	(-7.23)	(-2.15)	(-6.36)	(-9.92)	(-8.56)
Coupon	-0.000***	-0.000***	-0.000**	-0.000***	-0.000**	-0.000**	-0.000	-0.000
	(-2.78)	(-3.22)	(-2.35)	(-2.77)	(-2.29)	(-2.13)	(-1.28)	(-1.01)
Bond Maturity	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(40.20)	(47.42)	(55.24)	(55.55)	(37.44)	(43.67)	(51.34)	(51.48)
Bond Age	0.000	0.000*	0.000	0.000***	-0.000	0.000	-0.000	0.000
	(0.99)	(1.78)	(0.64)	(2.75)	(-0.80)	(0.65)	(-1.07)	(1.60)
Credit Rating	YES	YES	YES	YES	YES	YES	YES	YES
Other controls								
Industry and year effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	8,526	12,198	15,697	16,943	8,507	12,178	15,663	16,912
Adjusted R-squared	0.499	0.461	0.457	0.466	0.471	0.434	0.430	0.438

Table 4 9th Circuit Ruling to Corporate Tax Avoidance

This table presents the effect of the 9th Circuit Ruling on corporate tax avoidance. The regression model for this table is:

$$TA_{i,t} = \beta_1 Treat_{i,t} + \beta_2 Post_t + \beta_3 Treat_{i,t} * Post_t + \beta_4 FA_{i,t-1} + \beta_5 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (2)$$

The dependent variable, $TA_{i,t}$, denotes tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for the firm i in any given year t. $Treat_{i,t}$ is a dummy variable which equals one if the firm is located in any 9th Circuit state and equals zero if the firm headquartered outside the 9th Circuit. $Post_t$ is a dummy variable that equals one if the bond observations are in the post-treatment period (2011–2014) and equals zero if the observations are in the pre-treatment period (2006–2009). $FA_{i,t-1}$ is the firm attributes, including the natural logarithm of assets ($Ln\,(Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$) for the firm i in any given year $t-1$. $BC_{i,t-1}$ denotes bond characteristics, including $Offering\ Amount$, $Coupon$, $Maturity$, and $Bond\ Age$. The credit rating, year and industry fixed effect are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$DTAX$	BT	TA_CETR	TA_LRETR
$Treat$	0.000	-0.019***	-0.017*	-0.012
	(0.04)	(-4.45)	(-1.89)	(1.53)
$Post$	0.005***	0.002	0.036***	0.014***
	(80.92)	(0.61)	(6.41)	(-2.87)
$Treat \times Post$	-0.000	0.014***	0.032***	0.035***
	(-1.02)	(2.89)	(3.36)	(-4.15)
Firm attributes				
$Ln\,(Assets)$	-0.000***	0.006***	0.014***	0.001
	(-12.27)	(7.40)	(8.15)	(0.91)
Asset Tangibility	-0.003***	0.007	0.125***	-0.024***
	(-17.56)	(1.28)	(14.44)	(-3.09)
R&D/Assets	-0.004***	-0.210***	0.483***	-0.463***
	(-4.81)	(-3.32)	(7.88)	(-10.59)
Advertising/Assets	0.007***	0.065*	-0.364***	0.342***
	(6.61)	(1.65)	(-5.04)	(5.51)
Leverage	-0.001***	-0.086***	-0.057***	-0.015*
	(-10.88)	(-17.13)	(-5.57)	(-1.75)
Bond characteristics				
Offering Amount	0.000	-0.000*	0.000*	0.000***
	(1.27)	(-1.65)	(1.78)	(2.94)
Coupon	-0.000	0.000	0.000	-0.001
	(-0.34)	(1.22)	(0.57)	(-0.91)
Bond Maturity	-0.000	0.000	0.000	-0.000
	(-0.29)	(0.96)	(0.70)	(-1.23)
Bond Age	-0.000***	-0.000	-0.002***	0.001***
	(-4.43)	(-0.97)	(-4.07)	(3.85)
All control variables	YES	YES	YES	YES
Observations	8,473	6,023	11,268	11,826
Adjusted R-squared	0.952	0.257	0.199	0.229

Table 5 9th Circuit Ruling to Corporate Bond Liquidity Through the Effect on Corporate Tax Avoidance

This table presents the effect of corporate tax avoidance on corporate bond liquidity for firms headquartered in the 9**th** Circuit relative to firms located in other circuits after the 9th Circuit Ruling. The regression model for this table is:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} * Treat_{i,t} * Post_t + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \qquad (3)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$. $TA_{i,t-1}$ denotes tax avoidance measures, Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for firm i in any given year $t-1$. $Treat_{i,t}$ is a dummy variable that equals one if the firm is located in any 9th Circuit state and equals zero if the firm is headquartered outside the 9th Circuit. $Post_t$ is a dummy variable that equals one if the bond observations are in the post-treatment period (2011–2014) and equals zero if the observations are in the pre-treatment period (2006–2009). The credit rating, year and industry fixed effect are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard error existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	tc_roll	tc_iqr	$tc\_roundtrip$	$tc\_avgbidask$
$DTAX \times Treat \times Post$	0.002			
	(0.10)			
$BT \times Treat \times Post$		-0.008***		
		(-2.70)		
$TA\_CETR \times Treat \times Post$			-0.002**	
			(-2.05)	
$TA\_LRETR \times Treat \times Post$				-0.003***
				(3.38)
Firm attributes				
$Ln\ (Assets)$	-0.001***	-0.000***	-0.000***	0.000
	(-9.25)	(-5.68)	(-5.29)	(1.18)
Asset Tangibility	-0.001***	0.003***	0.001***	0.000
	(-2.96)	(7.18)	(2.95)	(0.23)
R&D/Assets	0.020***	0.012***	0.011***	0.022***
	(7.96)	(4.12)	(3.83)	(6.05)
Advertising/Assets	0.016***	0.010***	0.018***	0.020***
	(5.06)	(3.52)	(6.68)	(5.98)
Leverage	0.008***	0.007***	0.006***	0.007***
	(20.07)	(17.26)	(16.73)	(17.50)
Bond characteristics				
Offering Amount	-0.000***	-0.000	-0.000***	-0.000***
	(-4.34)	(-0.66)	(-6.96)	(-9.00)
Coupon	-0.000***	-0.000**	-0.000	0.000***
	(-2.78)	(-2.16)	(-0.48)	(9.33)
Bond Maturity	0.000***	0.000***	0.000***	0.000***
	(44.71)	(34.92)	(38.92)	(29.68)
Bond Age	0.000**	-0.000	0.000***	0.000***
	(2.11)	(-0.83)	(2.65)	(14.59)
All control variables	YES	YES	YES	YES
Observations	11,245	7,752	14,548	15,476
Adjusted R-squared	0.461	0.466	0.316	0.321

Table 6 The Implementation of Financial Standards Board Interpretation No. 48 (FIN 48) to Tax Avoidance Engagement

This table presents the regression results of the effect of the implementation of the *FIN 48* on tax avoidance. The regression model for this table is:

$$Liquidity_{i,t} = \beta_1 AF_{i,t} + \beta_2 Post48_t + \beta_3 AF_{i,t} \times Post48_t + \beta_4 FA_{i,t-1} + \beta_5 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (4)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for the firm i in any given year t. Affected firm, $AF_{i,t}$, equals one if firms report positive UTB from 2007 to 2009 and equals zero otherwise. Post FIN 48, $Post48_t$, equals one if there was any bond issuance in a given firm between 2007 to 2009, and equals zero if any bond issuance occurred from 2003 to 2005. The variable of interest is the interaction term, $AF_{i,t} * Post48_t$, which captures the incremental effect of the implementation of FIN 48 on corporate bond liquidity. $FA_{i,t-1}$ is the firm attributes, including the natural logarithm of assets ($Ln\,(Assets)$), asset tangibility ($Asset\,Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$) for the firm i in any given year t−1. $BC_{i,t-1}$ denotes bond characteristics, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. The credit rating, year and industry fixed effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. The significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	tc_roll	tc_iqr	$tc\_roundtrip$	$tc\_avgbidask$
AF	0.006***	0.005***	0.006***	0.006***
	(4.05)	(3.83)	(5.52)	(4.57)
$Post48$	0.008***	0.008***	0.009***	0.013***
	(3.32)	(3.70)	(3.81)	(3.79)
$AF \times Post48$	-0.006**	-0.006***	-0.007***	-0.011***
	(-2.49)	(-2.74)	(-2.93)	(-3.26)
Firm attributes				
$Ln\,(Assets)$	-0.001***	-0.000***	-0.000***	0.000***
	(-6.21)	(-4.54)	(-3.56)	(4.57)
Asset Tangibility	0.001	0.001***	0.002***	0.004***
	(0.98)	(3.58)	(3.24)	(5.85)
R&D/Assets	0.020***	0.014***	0.014***	0.021***
	(6.84)	(4.44)	(4.90)	(5.45)
Advertising/Assets	0.020***	0.018***	0.023***	0.031***
	(5.43)	(6.04)	(6.63)	(6.73)
Leverage	0.008***	0.007***	0.007***	0.008***
	(17.55)	(17.29)	(15.70)	(14.53)
Bond characteristics				
Offering Amount	-0.000***	-0.000***	-0.000***	-0.000***
	(-3.10)	(-3.55)	(-3.47)	(-4.57)
Coupon	-0.000	0.000	0.000***	0.000***
	(-1.06)	(0.12)	(3.03)	(9.90)
Bond Maturity	0.000***	0.000***	0.000***	0.000***
	(39.29)	(35.22)	(31.18)	(21.77)
Bond Age	-0.000**	-0.000***	-0.000**	0.000***
	(-2.05)	(-3.17)	(-2.04)	(6.95)
All control variables	YES	YES	YES	YES
Observations	8,903	8,886	8,872	8,839
Adjusted R-squared	0.443	0.419	0.347	0.351

Table 7 Using the Income Tax Reserves Under FIN 48 to Proxy the Effect of Aggressive Tax Avoidance on Corporate Bond Liquidity

This table presents the regression results of the effect of FIN48 on corporate bond liquidity. The regression model for this table is:

$$Liquidity_{i,t} = \beta_1 Ln(UTB)_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \qquad (5)$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for the firm i in any given year t. $Ln\ (UTB)$ is the natural logarithm of $(1 + TXTUBENT_{t-1})$. For a bond issued in year t, the variable $TXTUBENT_{t-1}$ represents the unrecognized tax benefit of the firm at the end of year t−1. $FA_{i,t-1}$ is the firm attributes, including the natural logarithm of assets ($Ln\ (Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$) for the firm i in any given year t−1. $BC_{i,t-1}$ denotes bond characteristics, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. The credit rating, year and industry fixed effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	tc_roll	tc_iqr	$tc\_roundtrip$	$tc\_avgbidask$
$Ln\ (UTB)$	-0.0002***	-0.0002***	-0.0003***	-0.0004***
	(-3.54)	(-3.90)	(-5.02)	(-4.93)
Firm attributes				
$Ln\ (Assets)$	-0.0005***	-0.0004***	-0.0002*	0.0004***
	(-5.33)	(-4.90)	(-1.80)	(2.61)
Asset Tangibility	0.0005	0.0008***	0.0007	0.0017***
	(1.31)	(2.69)	(1.62)	(3.03)
R&D/Assets	0.0102***	0.0120***	0.0117***	0.0225***
	(2.98)	(4.12)	(3.83)	(6.05)
Advertising/Assets	0.0168***	0.0140***	0.0191***	0.0303***
	(5.14)	(5.30)	(5.47)	(6.34)
Leverage	0.0079***	0.0063***	0.0076***	0.0100***
	(17.10)	(16.74)	(16.50)	(15.75)
Bond characteristics				
Offering Amount	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(-6.53)	(-7.96)	(-5.54)	(-11.34)
Coupon	-0.0001***	-0.0001***	-0.0001*	0.0001***
	(-2.71)	(-2.62)	(-1.84)	(2.72)
Bond Maturity	0.0003***	0.0003***	0.0003***	0.0003***
	(47.39)	(44.94)	(32.95)	(25.53)
Bond Age	-0.0000	-0.0001***	-0.0001***	0.0003***
	(-1.33)	(-5.23)	(-2.83)	(12.04)
All control variables	YES	YES	YES	YES
Observations	7,893	7,889	7,892	7,825
Adjusted R-squared	0.514	0.535	0.400	0.438

Table 8 The Effect of Shareholder Governance Mechanism on the Relationship Between Corporate Tax Avoidance and Corporate Bond Liquidity

This table presents the regression results for baseline sample divided by the median of two shareholder governance measures. The regression model is as follows:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t \quad (6)$$

Panel A shows the regression results of the effect of shareholder governance observed from the takeover index. The regression results for subsamples divided by the median takeover index. LOW denotes a lower level of shareholder governance. HIGH denotes a lower level of shareholder governance.

Panel B shows the regression results of the effect of shareholder governance observed from co-option data. The regression results for subsamples divided by the median co-option data. HIGH denotes a lower level of shareholder governance. LOW denotes a lower level of shareholder governance.

The dependent variables, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for the firm i in any given year t. $TA_{i,t-1}$ denotes tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for the firm i in any given year t−1. $FA_{i,t-1}$ is the firm attributes, including the natural logarithm of assets ($Ln\ (Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$) for the firm i in any given year t-1. $BC_{i,t-1}$ denotes bond characteristics, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. The credit rating, year and industry fixed effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

Panel A: The Effect of Shareholder Governance Proxied by Takeover Index

VARIABLES	*tc roll*							
	Takeover Index		Takeover Index		Takeover Index		Takeover Index	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
BT	-0.013***	-0.007						
	(-7.02)	(-1.06)						
DTAX			-0.050***	0.002				
			(-2.72)	(0.09)				
TA_CETR					-0.001***	0.001		
					(-3.79)	(0.80)		
TA_LRETR							-0.001***	-0.001
							(3.44)	(-1.28)
Observations	4,253	4,222	6,083	6,017	7,852	7,804	8,445	8,432
Adjusted R-squared	0.437	0.470	0.452	0.464	0.498	0.567	0.469	0.471

Panel B: The Effect of Shareholder Governance Proxied by Co-option

VARIABLES	*tc roll*							
	Co-option		Co-option		Co-option		Co-option	
	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW
BT	-0.016***	-0.004						
	(-7.33)	(-0.98)						
DTAX			0.000	0.002				
			(0.01)	(0.09)				
TA_CETR					-0.001***	-0.003		
					(-3.61)	(0.92)		
TA_LRETR							-0.001**	-0.001
							(2.48)	(-1.33)
Observations	4,253	4,222	6,083	6,017	7,852	7,804	8,445	8,432
Adjusted R-squared	0.433	0.463	0.452	0.465	0.488	0.567	0.500	0.473

Appendix A1: Variable Definition

Variables	Acronym	Description	Data Sources
Measures of tax avoidance:			
Book-tax difference	BT	Manzon and Plesko's (2002) book-tax difference is defined as the difference between US domestic financial income, US domestic taxable income, income tax expenses on the state level, income tax expense on other aspects, and equity in the net income of nonconsolidated subsidiaries. $BT =$ [US domestic financial income $(PIDOM)$ − US domestic taxable income $(TXFED/STR)$ − State income taxes (TXS) − Other income taxes (TXO) − Equity in Earnings $(EUSB)]/AT_{t-1}$	Compustat
Permanent book-tax difference	$DTAX$	Frank, Lynch and Rego's (2009) permanent book-tax difference is measured by regressing the total permanent book-tax difference on the non-discretionary items. The residual of the below regression equation accounts for the discretionary permanent differences. $PERMDIFFS = \beta_0 + \beta_1 INTANG + \beta_2 UNCON + \beta_3 MI + \beta_4 CSTE + \beta_5 \Delta NOL + \beta_6 LAGPERM + \varepsilon$ where: $PERMDIFFS = PI - [(TXFED + TXFO)/STR] - (TXDI/STR)$ PI: the pre-tax income $TXFED$: the federal income taxes $TXFO$: the foreign income taxes STR: the statutory tax rate $TXDI$: the deferred income taxes $INTANG$: the total intangible assets scaled by the lagged total asset $UNCON$: the equity in earnings scaled by the lagged total asset MI: the non-controlling interest scaled by the lagged total asset $CSTE$: the state income taxes scaled by the lagged total asset ΔNOL: the tax loss carry forward scaled by the lagged total asset $LAGPERM$: one-year lagged $PERMDIFFS$	Compustat
Cash effective tax rate	TA_CETR	-1 times the cash effective tax rate, where cash effective tax rate is defined as the income taxes paid $(TXPD)$ divided by pre-tax income (PI) less the special items (SPI). $TA\_CETR = -1 \times CETR = -1 \times TXPD/(PI - SPI)$.	Compustat
Long-run cash effective tax rate	TA_LRETR	Dyreng, Hanlon and Maydew's (2008) long-run cash effective tax rate is defined as the cash tax paid divided by the difference between pre-tax income and special items in a five-year window. This	Compustat

		measure requires at least three consecutive years with non-missing data. TA_LRETR for any firm in a given year is measured as follows: $TA\_LRETR_{it} = -1 \times \frac{\sum_{k=t-4}^{t} Cash\_tax\_paid_{ik}}{\sum_{k=t-4}^{t}(Pretax\_income_{ik} - Special\_items_{ik})}$	
Liquidity measures:			
Intraday Roll estimator	TC_Roll	Dick-Nielsen, Feldhütter and Lando (2012) generate an intraday version of the Roll (1984) estimator for effective spreads, which measures the bid-ask spread as follows: $TC\_Roll = \begin{cases} 2 \cdot -\sqrt{Cov(r_i, r_{i-1})} & if\ Cov(r_i, r_{i-1}) < 0 \\ 0 & otherwise \end{cases}$ where r_i is the discrete return on i_{th} trade.	Enhanced TRACE
Bid-ask spread estimator	TC_IQR	Han and Zhou's (2008) bid-ask spread estimator is calculated by the interquartile distribution of trade prices, whereas the difference between the 75th percentile and the 25th percentile of prices is divided by the average trading price on day t, and the formula is: $TC\_IQR = \frac{p_t^{75th} - p_t^{25th}}{\bar{P}_t}$ We keep daily TC_IQR, which has at least three observations, and then average the daily measures to get the monthly measure.	Enhanced TRACE
Round-trip estimator	$TC\_Roundtrip$	Feldhütter (2012) computes the round-trip transaction costs based on trade prices. We consider a round-trip transaction as all trades per bond in every 15-minute window with the same trading volumes. The estimator is then projected by the doubled difference between the highest and lowest trading prices for each round-trip transaction. The estimator is then divided by the average of the maximum and the minimum price to account for the spread proxy. The monthly round-trip measure ($TC\_Roundtrip$) is calculated by taking the mean of all round-trip trades that occur in a one-month period.	Enhanced TRACE
Average bid-ask estimator	$TC\_AvgBidAsk$	Hong and Warga (2000) use the difference between the average buying and selling price of bonds on each business day to quantify transaction costs using the following formula: $TC\_AvgBidAsk = \frac{\overline{P_t^{buying}} - \overline{P_t^{selling}}}{0.5(\overline{P_t^{buying}} + \overline{P_t^{selling}})}$ where the $\overline{P_t^{buying}}$ and $\overline{P_t^{selling}}$ represent the average buying and selling price of all trades on day t. We use the mean of average buying and selling price as the monthly transaction measure.	Enhanced TRACE
Firm-level controls:			
Asset	$Ln\ (Assets)$	The natural logarithm of the total asset (at).	Compustat
Asset tangibility	$Asset\ Tangibility$	Calculated with the formula $[(0.715 \times rect + 0.547 \times invt + 0.535 \times ppent) + che]/at$.	Compustat

R&D expenditures	$R\&D/Assets$	R&D expenditures is calculated by dividing the R&D expenses (xrd) by the total assets (at). We set the missing values of R&D expenses to zero.	Compustat
Advertising expenditures	$Advertising/Assets$	Advertising expenditures is calculated by dividing advertising expenses (xad) by the total assets (at). We set the missing values of advertising expenses to zero.	Compustat
Leverage	$Leverage$	Leverage is calculated as total liabilities divided by the sum of market value of equity, total liabilities, preferred stock, and subtract the deferred taxes. $lt/[(prcc_f \times csho) + lt + pstk - (txditc + itcb)]$.	Compustat
Bond characteristics:			
Offering amount	$Offering\ amount$	The amount of bonds offered by a firm in a given year.	Mergent FISD
Coupon	$Coupon$	The current applicable annual interest rate (coupon) that bondholders are expected to receive from the bond issuers.	Mergent FISD
Maturity	$Maturity$	The date that issuers are obligated to repay issue's principal ($Maturity = the\ year\ of\ maturity - the\ year\ of\ delivery\_date$).	Mergent FISD
Bond age	$Bond\ Age$	The period since issuance, measured in years.	Mergent FISD

Appendix A2: Corporate Bond Rating Scales

This table presents the below baseline regression results for subsamples divided by the corporate bond rating scales. The regression models are as follows:

$$Liquidity_{i,t} = \beta_1 TA_{i,t-1} + \beta_2 FA_{i,t-1} + \beta_3 BC_{i,t-1} + \theta_t + \vartheta_k + \varepsilon_t$$

The dependent variable, $Liquidity_{i,t}$, denotes four illiquidity measures, including Dick-Nielsen *et al.* (2012) TC_Roll, Han and Zhou (2016) TC_IQR, Hong and Warga (2000) $TC\_AvgBidAsk$, and Feldhütter (2012) $TC\_Roundtrip$ for the firm i in any given year t. We only report TC_Roll and TC_IQR for presentation. $TA_{i,t-1}$ denotes tax avoidance measures, including Manzon Jr and Plesko (2001) book-tax difference (BT), Frank *et al.* (2009) permanent book-tax difference ($DTAX$), Rego and Wilson (2009) cash effective tax rate (TA_CETR), and Dyreng *et al.* (2008) long-run cash effective tax rate (TA_LRETR) for the firm i in any given year t−1. $FA_{i,t-1}$ are the firm attributes including the natural logarithm of assets ($Ln\,(Assets)$), asset tangibility ($Asset\ Tangibility$), R&D intensity ($R\&D/Assets$), advertising intensity ($Advertising/Assets$), and leverage ratio ($Leverage$). $BC_{i,t-1}$ denotes bond characteristic variables, including $Offering\ Amount$, $Coupon$, $Maturity$ and $Bond\ Age$. The year and industry effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are presented in parentheses. The standard errors are also clustered for industry and year to control for standard error existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	*tc roll*							
	Bond Rating		Takeover Index		Takeover Index		Takeover Index	
	Investment Grade	Non-Investment Grade	Investment Grade	Non-Investment Grade	Investment Grade	Non-Investment Grade	Investment Grade	Non-Investment Grade
BT	-0.017***	-0.009***						
	(-6.82)	(-3.96)						
DTAX			-0.215***	-0.146**				
			(-3.08)	(-2.08)				
TA_CETR					-0.000	-0.001**		
					(-0.93)	(-2.00)		
TA_LRETR							-0.001	-0.001*
							(-1.57)	(-1.88)
Firm attributes								
Ln (Assets)	-0.000***	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***
	(-4.01)	(-3.60)	(-6.68)	(-4.06)	(-8.98)	(-3.10)	(-8.71)	(-2.95)
Asset Tangibility	0.003***	0.006***	0.001	0.002	0.002***	0.001	0.003***	0.002**
	(3.97)	(6.17)	(1.36)	(1.37)	(4.19)	(1.01)	(5.20)	(2.18)
R&D/Assets	-0.001	0.009**	0.007*	0.019***	0.007**	0.009**	0.008***	0.018***
	(-0.34)	(2.50)	(1.74)	(6.78)	(2.46)	(2.15)	(2.83)	(4.16)
Advertising/Assets	0.003	0.016***	0.020***	0.014***	0.007**	0.015***	0.010***	0.013***
	(0.73)	(2.64)	(5.22)	(2.70)	(2.34)	(3.26)	(3.27)	(2.73)
Leverage	0.004***	0.011***	0.005***	0.010***	0.004***	0.009***	0.004***	0.010***
	(6.38)	(13.25)	(9.27)	(15.28)	(8.76)	(15.51)	(9.43)	(17.77)
Bond characteristics								
Offering Amount	-0.000***	0.000*	-0.000***	0.000	-0.000***	-0.000	-0.000***	-0.000
	(-2.79)	(1.71)	(-4.70)	(0.16)	(-7.94)	(-1.53)	(-6.30)	(-1.03)
Coupon	-0.000*	-0.000***	-0.000***	-0.000***	-0.000	-0.000***	-0.000***	-0.000***
	(-1.86)	(-4.36)	(-4.53)	(-5.17)	(-0.06)	(-5.60)	(-3.17)	(-5.15)
Bond Maturity	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(44.14)	(20.31)	(51.29)	(18.33)	(62.88)	(24.52)	(61.86)	(23.86)
Bond Age	0.000	0.000	0.000	0.000***	-0.000	-0.000	0.000*	0.000
	(0.43)	(0.05)	(0.91)	(2.94)	(-0.11)	(-1.59)	(1.80)	(1.41)
Other controls								
Industry and year effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,634	2,853	6,694	4,072	11,151	4,735	9,977	5,276
Adjusted R-squared	0.532	0.499	0.519	0.437	0.503	0.404	0.522	0.426

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Chapter 3: Disaster Relief Moderates Tax Avoidance in Communities with High Social Capital: The Case of Hurricane Michael

1. Introduction

Department of Homeland Security Federal Emergency Management Agency (FEMA) divulged that, as of 30th September 2022, the obligated relief support package amounted to $91,854.3M since 2017 (RSFLG 2022). Direct monetary compensation becomes a considerable burden on the government due to the loss and damages resulting from natural disasters. In January 2022, Eco-Business revealed that severe natural disasters cost US$280 billion in 2021, and the financial costs of natural disasters have increased for the third consecutive year (Eco-Business 2022).[4] Botzen *et al.* (2020) state that the indirect economic impacts of natural disasters, such as trade and gross domestic product growth, outweigh the direct (e.g., property and infrastructure damage) economic impacts. Furthermore, Barrot and Sauvagnat (2015) find that production networks, suppliers and supply chains are significantly obstructed by serious natural disasters. Given the intensity of destructive natural disasters, the existing literature has extensively discussed the impact of natural disasters on corporate risk management, investment policy, and investment strategies, including insurance risk control measures (Chen *et al.* 2012), energy technology innovation (Zhao *et al.* 2022), ESG disclosures (Huang *et al.* 2022), CSR performance (He *et al.* 2022; Mbanyele & Muchenje 2022; Malik *et al.* 2023), investment and capital expenditure (Feng *et al.* 2022), trade credit (Lai *et al.* 2022) and corporate tax avoidance (Adrian *et al.* 2022; Ni *et al.* 2022). Whilst the impact of natural disasters on corporate activities has been well documented, there is scant attention paid to the effect of the subsequent disaster relief support on corporate strategies.

[4] https://www.eco-business.com/news/natural-disasters-cost-world-us280-billion-in-2021-a-third-more-than-in-2020/

In this paper, we address this void by investigating the effect of the Federal Emergency Management Agency (FEMA) Assistance on corporate tax avoidance. FEMA Assistance is arguably the ideal measure to answer this research question, given that FEMA supplies disaster relief support directly to affected regions for recovery. We use FEMA Assistance instead of 'natural disasters' for two reasons. Firstly, conflicting results are proposed in the current literature regarding the effect of extreme weather and natural disasters on corporate tax avoidance (Adrian *et al.* 2022; Ni *et al.* 2022). Secondly, different corporate impacts are observed when examining different types of disasters (Panwar & Sen 2019; Rosselló *et al.* 2020). Therefore, we distinguish ourselves from previous literature by focusing on post-disaster relief support - specifically, FEMA Assistance - to examine its effect on corporate tax avoidance. Corporate tax avoidance, a legal tax planning strategy, is conducted by restructuring business activities to reduce the tax burden relative to the pre-tax income (Dyreng *et al.* 2010; Wang *et al.* 2020). We are interested in corporate tax avoidance because this specific corporate strategy has shown a consistent upward trend for decades in the United States. Additionally, approximately 60 tax strategy patents have been granted since the turn of the century (Lambert 2007), leading some U.S. companies to pay corporate tax rates as low as 2.4 percent (Thomsen & Watrin 2018). Moreover, while FEMA Assistance may aid in the recovery of corporations, the extent of support firms may receive remains unclear. In the recent, rapidly growing literature on tax avoidance, scholars have extensively explored the decision to engage in tax avoidance. The determinants of corporate tax avoidance relate to internal company characteristics, including internal information quality (Gallemore & Labro 2015), pre-tax income of the firms (Rego 2003), reputational concerns (Gallemore *et al.* 2014), executive incentives (Desai & Dharmapala 2006), and corporate governance mechanisms (Armstrong *et al.* 2015). Furthermore, the existing literature proposes several external market factors that could affect tax avoidance engagement, such as tax enforcement (Desai *et al.* 2007), media

attention (Kanagaretnam *et al.* 2018), supplier ties (Cen *et al.* 2017), public pressure (Dyreng *et al.* 2016) and political connections (Kim & Zhang 2016). Given that companies in the regions eligible to receive disaster relief support face severe operation and investment obstructions, aggressive tax planning may be employed. Therefore, a largely ignored issue is whether FEMA Assistance could affect engagement in tax avoidance. Therefore, we examine how FEMA Assistance, an exogenous relief recovery plan, affects corporate tax avoidance engagement, given that firms would divert and/or re-arrange their operations for tax purposes.

To better understand the relationship between FEMA Assistance and corporate tax avoidance, we investigate the tax avoidance engagement for firms in states that receive federal relief packages (i.e., FEMA Assistance) relative to firms headquartered in states that do not receive disaster relief support. FEMA has the sole authority to adjust and distribute the three-fold federal-level disaster relief support (FAC 2019). The three aspects of post-disaster recovery plans include Individual Assistance, Public Assistance, as well as Hazard Mitigation Assistance, and the monetary support varies for different regions due to the level of damages caused by given natural disasters. In this paper, we use FEMA Assistance to Hurricane (Tropical Storm) Michael as the exogenous factor because Hurricane Michael and Tropical Storm Michael were the same natural disaster in different formations, which allows us to investigate the effects of different levels of FEMA Assistance in different regions. Specifically, FEMA Assistance for Hurricane Michael was tailored for Hurricane Michael only, and was introduced on October 11, 2018 in Florida (FEMA 2018a) and October 14, 2018 in Georgia (FEMA 2018b). FEMA Assistance for Tropical Storm Michael was implemented in North Carolina and Virginia when Hurricane Michael weakened and was downgraded to Tropical Storm Michael. Among the four states that were eligible to receive FEMA Assistance, FEMA Assistance to Tropical Storm Michael (in North Carolina and Virginia) offered substantially smaller monetary amounts compared to FEMA Assistance to Hurricane Michael (in Florida

and Georgia). Overall, FEMA Assistance to Hurricane (Tropical Storm) Michael, as federal-level disaster relief support, aimed to build up resilience in the disaster-affected regions. Besides federal-level disaster relief support, on May 15, 2019, Governor Ron DeSantis signed CS/HB 7123: Taxation at the 33rd Annual Governor's Hurricane Conference. This state-level government initiative aims to provide temporary tax relief to help people alleviate the pressure of tax payments. This bill includes three significant tax cuts: property tax reductions, sales tax holidays, and a reduction in commercial rent taxes (Releases 2019). However, the 2% reduction in the commercial rent tax was insufficient to offset the losses and damages resulting from Hurricane Michael. In addition, the IRS announced tax relief for taxpayers affected by Hurricane Michael; however, this relief only applies to those eligible for individual assistance from FEMA (Erb 2018). Therefore, Ni *et al.* (2022) argue that firms have more incentive to maintain cash reserves (i.e., more aggressive tax avoidance) in response to tightened financial constraints resulting from climate risks, even though the federal- and state-level government tax deductions are presented. Florida, being the most affected state, has more than 22% of its industry composition and employment in primary and secondary sectors, such as agriculture and manufacturing, which yields Florida as the first in value of production in several non-food products (UFIFAS 2018). Therefore, targeted federal-level support focusing on post-disaster recovery and state-level support providing a 2% tax reduction on commercial leases are insufficient to offset the hindered investments, operations, and tightened financial constraints for most affected businesses. Thus, we hypothesize that the engagement in corporate tax avoidance becomes more aggressive for firms headquartered in states that are eligible to receive FEMA Assistance to Hurricane (Tropical Storm) Michael despite the presence of FEMA Assistance.

In addition, social capital is of particular interest in extensive sociology research (Coleman 1988) and economics research (Hasan *et al.* 2017). Social capital is recognized as a set of

beliefs and core values that could potentially enhance social cooperation within a community (Woolcock 1998). Hasan *et al.* (2017) find that social capital can significantly affect corporate tax avoidance within the same community. They discover a negative correlation between social capital and corporate tax avoidance. Moreover, Elliott *et al.* (2010) find that the consumption of social capital for low-status participants is more severe in the post-disaster period. Aldrich (2014) states that social capital is used just as heavily as 'external aid', i.e., FEMA Assistance, in the recovery period. Therefore, we further propose that social capital declines following the implementation of disaster relief support, and this decline in social capital leads to more aggressive tax avoidance engagement. Overall, the introduction of FEMA Assistance, as a post-disaster recovery plan, is conducive to engaging in more aggressive tax avoidance for firms headquartered in states eligible to receive FEMA Assistance.

We perform a series of empirical analyses to test the validity of these hypotheses using US data. We use the real dollar value of FEMA Assistance to measure the disaster relief recovery support. We follow Cen *et al.* (2017) to use effective tax rates and cash effective tax rates to measure corporate tax avoidance. Following Hasan *et al.* (2017), we use voter turnouts in presidential elections from The United States Elections Project as the proxy for social capital. Using a comprehensive sample of 12,306 firms from 2016 to 2020, we empirically examine the overall effect of FEMA Assistance on corporate tax avoidance. Across different measures of tax avoidance engagement, we find that firms receiving FEMA Assistance engage in more aggressive tax avoidance than their non-receiving counterparts after controlling for firm-level factors that are found to impact corporate tax avoidance in the literature. We further find that firms headquartered in states that are eligible for more disaster relief support engage in more aggressive tax avoidance than firms located in states that receive fewer relief support packages. Our results are robust to channel analysis, in which we provide evidence that a possible channel for FEMA Assistance to affect corporate tax avoidance is social capital.

Our research contributes to the literature in two ways. Firstly, our study is the first to provide direct empirical evidence of post-disaster relief support as an exogenous shock on corporate tax avoidance behavior. To date, a large growing climate finance and natural disaster literature focus on the direct effects of natural disaster and climate changes, including the effect of aggregated temperature exposures on establishment sales (Addoum *et al.* 2020), the effect of temperature change on stock performance (Choi *et al.* 2020), the effect of beliefs about climate change on real estate prices (Baldauf *et al.* 2020), the misestimation of climatic disasters in portfolio management (Alok *et al.* 2020), the effect of disaster mitigation on insurance risk control measures (Chen *et al.* 2012), the occurrence of natural disasters on energy technology innovation (Zhao *et al.* 2022), the effect of different types of natural disasters on firms' ESG disclosures (Huang *et al.* 2022), firms' investment and R&D engagement in the post-disaster period (Feng *et al.* 2022), the effect of urban floods on trade credit (Lai *et al.* 2022) and the effect of extreme weather on corporate tax avoidance (Adrian *et al.* 2022; Ni *et al.* 2022). Instead of investigating the direct impact of natural disasters or climate changes, our study extends the current literature by using the subsequent disaster relief package, FEMA Assistance to Hurricane (Tropical Storm) Michael, to explore the effect on corporate tax avoidance.

Secondly, our work also relates to tax avoidance studies and clarifies the differential effects of tax avoidance by documenting FEMA Assistance as an external determinant of tax avoidance engagement. The determinants of tax avoidance illustrate firms' incentives and motivations to engage in such corporate strategy (Wang *et al.* 2020). Prior research has documented *internal* determinants of tax avoidance, such as shareholder activism (Cheng *et al.* 2012), institutional ownership (Khan *et al.* 2017), executive incentives (Desai & Dharmapala 2006) and corporate governance mechanisms (Armstrong *et al.* 2015). Existing studies have also explored the *external* determinants of tax avoidance, including analyst coverage (Allen *et*

al. 2016), labor unions (Chyz *et al.* 2013), public pressure (Dyreng *et al.* 2016) and IRS audit (Hoopes *et al.* 2012). Furthermore, the existing literature proposes conflicting results on the effect of extreme weather and natural disasters on corporate tax. Adrian *et al.* (2022) find that firms headquartered in states that experience drought engage in less corporate tax avoidance. Ni *et al.* (2022) show that climate risk promotes tax avoidance engagement due to the incentive to maintain cash reserves. Therefore, our study contributes to this stream of literature by examining the effect of FEMA Assistance, a disaster relief support, on tax avoidance. In addition, current literature presents different impacts of different types of natural disasters. Rosselló *et al.* (2020) examine the effect of natural disasters on international tourism. They find that tsunamis, floods, and volcanic eruptions have negative effects on international tourism; however, droughts emerged as the sole type of natural disaster that delivers a positive motivator for international tourism. In addition, Panwar and Sen (2019) find that normal floods have a positive effect on agricultural growth; however, droughts have a negative impact on agricultural growth. Thus, instead of exploring the effect of natural disaster on corporate tax avoidance, given different types of natural disasters may have different impacts, we differ from prior literature by adding the perspective of corporate tax avoidance engagement under the post-disaster relief support – FEMA Assistance.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature and develops the main hypotheses. Section 3 discusses FEMA Assistance – Institutional Details. Section 4 introduces the research design, sample construction, FEMA Assistance measures, tax avoidance measures, firm-level controls, as well as descriptive statistics. Section 5 outlines the different methodologies used in the empirical analyses. Section 6 presents the empirical analyses, including baseline regression and moderation analysis of different samples. Section 7 summarizes the findings and implications.

2. Literature Review and Hypothesis Development

2.1. Economic Impacts of Natural Disaster and Post-Disaster Recovery Plan

Prior studies have examined the negative economic outcomes of natural disasters and the subsequent disaster relief recovery.

Barrot and Sauvagnat (2015) find that the indirect economic impacts of natural disasters include obstructions of production networks, suppliers and supply chains. Botzen *et al.* (2020) further provide evidence of the catastrophic indirect damages of natural disasters and argue that the indirect economic impacts of natural disasters (i.e., trade and gross domestic product growth) become more significant than the direct economic influences (i.e., property and infrastructure damage). In addition, Byard *et al.* (2007) find that large petroleum refining firms had abnormal income-decreasing accruals in the post-disaster periods of Hurricane Katrina and Hurricane Rita. Shan and Gong (2012) provide evidence of lower stock returns for firms located near the epicenter of an earthquake. Zhao *et al.* (2022) show that the negative impacts of natural disasters on energy technology innovation not only present in the year of the natural disaster but also persist for four years in the post-disaster period. Feng *et al.* (2022) reveal that firms reduce investment and capital expenditure in the post-disaster period. Despite the government providing federal-level disaster relief support to disaster-affected regions in the recovery period, it is still well recognized that the impacts of natural disasters are severe and long-lasting. This suggests that post-disaster relief packages are not enough for recovery purposes given these adverse effects could last for years after the natural disaster.

A strand of literature investigates the impacts of the implementation of disaster relief recovery plans on social capital. Elliott *et al.* (2010) find that communities with low local status and limited resources evacuate, on average, more than a day later compared to communities that are more prosperous and located in the center of social construction at the early warning stage of a hurricane. However, the inequality of social capital possession does not differentiate

community access to federal-level assistance (such as FEMA Assistance), and the aggregate social capital declines dramatically when deploying post-disaster emergency plans due to the transfer of social capital from high status to low status. In addition, Aldrich (2014) discusses disaster reconstruction from different aspects, such as 'quality of governance', 'external aid', 'demographics and socio-economic conditions', and social capital. He suggests that despite the fact that federal-level support is the main assistance available to survivors in the post-disaster period, social capital is important to build up resilience for 'in-group members' who have tightened social networks relative to 'excluded members'. With the implementation of federal-level recovery plans, he finds that the speed of recovery can vary between groups that possess different levels of social capital resources; however, high quality federal support and social capital work collectively to build up resilience, and the collaboration leads to a decline in aggregate social capital during and after the recovery period. Moreover, Weil *et al.* (2012) and Metaxa-Kakavouli *et al.* (2018) further support the theory by examining the exchange of social capital with the evidence of user-level behavior from social media. They evaluate the effectiveness of an emergency recovery plan and find that people with more social ties are able to make a more informed decision and contribute more social capital to build resilience. Overall, this suggests that social capital ensures the recovery plan is implemented efficiently, and this in turn makes the social capital much needed and decline dramatically afterwards.

In conclusion, the current literature proposes that the adverse impacts of natural disasters are severe and long-lasting. In addition, the post-disaster recovery plans are not enough for recovery purposes, in which social capital declines in order to help build up resilience.

2.2. Determinants of Corporate Tax Avoidance

Existing literature has extensively explored the internal and external factors that are related to a firm's choice to engage a tax avoidance strategy.

Firm internal characteristics are recognized to be the main predictors of corporate tax avoidance (Wang *et al.* 2020). Rego (2003) finds that larger firms have an incentive to engage in more aggressive tax planning. Wilson (2009) and Lisowsky *et al.* (2013) provide further evidence to support that larger companies have the monetary incentives and expertise for aggressive engagement even though they may face more scrutiny. Furthermore, Khan *et al.* (2017) reveal that there is a positive relationship between tax avoidance engagement and increased institutional ownership. Dyreng *et al.* (2010) find that individual executives have a significant influence in determining the level of tax avoidance that firms adopt, which are incremental effects that cannot be explained by firm characteristics. Law and Mills (2017) find that managers with military backgrounds engage in less tax planning because aggressive tax avoidance contradicts their common values. In addition, Armstrong *et al.* (2012) argue that corporate tax avoidance engagement is significantly associated with the compensation of tax executives. Armstrong *et al.* (2015) propose that equity incentives promote more tax planning, and the effect is more pronounced for firms with higher existing levels of tax avoidance. Gallemore and Labro (2015) find that firms with geographic dispersion or greater uncertainty adopt more aggressive tax avoidance. Desai and Dharmapala (2006) provide evidence of less tax avoidance when managers have high-powered incentives, which is supported by the feedback effect between tax sheltering and managerial diversion.

The external determinants of corporate tax avoidance are well discussed in the existing literature as well. Hoopes *et al.* (2012) find that firms have less incentive to adopt the tax avoidance strategy when they face more Internal Revenue Service (IRS) monitoring. Edwards *et al.* (2016) show that firms engage in more aggressive tax planning when facing increased

financial constraints. Desai *et al.* (2007) suggest that firms exhibit more tax payments and less tax planning when tax enforcement is tightened. Furthermore, Kanagaretnam *et al.* (2018) state that firms are more concerned about tax avoidance when media exposure may impose reputation concerns and increase the probability of detection. In addition, one important external determinant of tax avoidance discussed by Hasan *et al.* (2017) is social capital. They find that taxpayers from different social environments may have different intrinsic motivations to make tax payments, and this is likely to lead to different *tax morale* (Alm & Torgler 2006) and different *tax compliance* (Alm *et al.* 1995). Existing literature suggests that managerial decisions affect corporate tax decisions (Dyreng *et al.* 2010); however, managers are still considered social participants in the community and thus their tax-paying behaviors are impacted by their social peers where the firm headquarters (McGuire *et al.* 2012). Therefore, Hasan *et al.* (2017) argue that the firm's tax avoidance behavior relates to the level of social capital in the area of the firm's headquarters. They also state that counties with a higher level of social capital could strengthen their belief regarding the appropriateness of paying taxes relative to their low-social-capital counterparts. This suggests that there is a negative correlation between social capital and corporate tax avoidance engagement.

In conclusion, the current literature proposes several internal and external determinants of corporate tax avoidance, among which social capital, an important external determinant, limits the aggressive engagement in tax avoidance.

2.3. Hypothesis Development: Induced Effect of Social Capital Decline

Four implications can be derived from the literature review discussed above. Firstly, FEMA Assistance for Hurricane (Tropical Storm) Michael is only available in four states, namely Florida, Georgia, North Carolina, and Virginia, and all other states do not receive any

federal-level disaster relief support. Therefore, we can identify the effect of FEMA Assistance on corporate tax avoidance by examining the four receiving states relative to other non-receiving states. Secondly, Hawkins and Maurer (2010) and Elliott *et al.* (2010) suggest that social capital is urgently needed to efficiently build up resilience when the recovery plan proceeds, so social capital declines dramatically when disaster recovery support is adopted. Therefore, we propose that there is a negative relationship between FEMA Assistance and social capital in disaster-affected regions. Thirdly, Hasan *et al.* (2017) find a negative relationship between social capital and corporate tax avoidance engagement. Lastly, corporate tax avoidance is a strategy that could retain resources, especially when firms face severe and long-lasting adverse impacts of natural disasters and post-disaster relief plans are not enough for recovery purposes.

Overall, once the presidential declaration was made for Hurricane (Tropical Storm) Michael, FEMA Assistance took place and lead to a significant decline in social capital, while adverse impacts of the natural disaster persisted in the post-recovery period even though disaster relief support was well-provided. Under these circumstances, corporate tax avoidance engagement is expected to be more aggressive to retain more resources and mitigate negative effects on cash flows while the social capital dries up. Therefore, we formulate the following two hypotheses.

Hypothesis 1: FEMA Assistance is positively associated with corporate tax avoidance engagement for affected firms.

Hypothesis 2: The positive association in Hypothesis 1 is moderated for firms headquartered in high social capital regions.

3. FEMA Assistance – Institutional Details

Federal Emergency Management Agency (FEMA) was established by the act of executive order issued by President Jimmy Carter in 1979 (FEMA 2014). FEMA has the responsibility to allocate and distribute instant emergency relief support to regions that are severely affected by any declared natural disasters in the US. Such natural disasters include, but are not limited to, hurricanes, floods, earthquakes, fires and tornadoes (FEMA 2014). FEMA Assistance expenditure aims to help the post-disaster recovery in adversely impacted regions, and the average annual expenditure is about $3 billion for around 50 declared disasters (RSFLG 2020).

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) provides guidance on the preparation of relevant information on disasters in order to request the presidential disaster declaration (FEMA 2014). This guidance contains two main aspects that need to be fulfilled, namely the conditions of the disaster and the types of relief. The majority of FEMA Assistance funding comes from the President's Disaster Relief Fund under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), and the residual of the funding comes from other programs that can be deployed for disaster-relevant purposes, such as the US National Flood Insurance Program and the US Fire Administration. In addition, there are four committees of the House of Representatives that oversee the relief funding allocation and distribution, two of which are responsible for the Stafford Act-related funding, and two committees that are in charge of the review of non-Stafford Act funding (INSIGHT 2018). This review process ensures the relevance and appropriateness of the emergency relief support provided to affected regions.

Disaster-affected regions become eligible to receive FEMA Assistance only after the presidential declaration (FEMA 2014). Garrett and Sobel (2003) examine the political influence on the rate of presidential declarations and the allocation of FEMA disaster expenditure across different states. A potential dilemma proposed by Garrett and Sobel (2003)

is that, given the declaration is entirely up to the president to make, the president is more likely to declare a disaster in regions that are politically and economically beneficial, rather than based on the severity of disasters. In addition, unlike the FEMA relief package that needs to be reviewed by four committees of Congress, the president makes the decision without any oversight from Congress. Therefore, they state that the presidential declaration could be an avenue for the president to reward or punish the legislators who support or were against his/her administration in the past (Garrett & Sobel 2003). Of the states that received FEMA Assistance for Hurricane Michael, Florida was indeed Donald Trump's strongest swing state in 2016 given Trump's approval rate was stable and Republicans won in both governor and Senate races (Vox 2019). However, both 2018 state-wide elections were too close and went into recounts, after which Democrats made gains in the House with two seats in Florida (BBC 2018). In addition, Democrats were planning to solidify the Democratic base in Florida after Barack Obama succeed in 2008 and 2012 through an investment of $2 million in registering new Democrats (Times 2019). Therefore, a punctual presidential declaration of Hurricane Michael was desired by the Trump office to maintain the approval rate in Florida.

In this paper, we use FEMA Assistance to Hurricane (Tropical Storm) Michael to examine the effect on corporate tax avoidance for two reasons. Firstly, the widespread effects of Hurricane (Tropical Storm) Michael in four states and more than 420 counties provide considerable sample firms for our empirical analyses. Secondly, the severity of this natural disaster and Donald Trump's political needs left no room for any political manipulation, leading to a punctual presidential declaration of Hurricane (Tropical Storm) Michael and the subsequent FEMA Assistance. Overall, the selection of FEMA Assistance to Hurricane (Tropical Storm) Michael allows us to answer and solve several potential biases at once.

4. Data and Variable Measurement

4.1. Sample Selection and Data Description

Our sample consists of all firm-year observations from Compustat from 2016 to 2020. This sample period covers two years before and two years after the FEMA Assistance to Hurricane (Tropical Storm) Michael in 2018. We collect disaster emergency relief data from Federal Emergency Management Agency (FEMA). FEMA Assistance for Hurricane Michael was subject to any negative impacts caused by Hurricane Michael in Florida on October 11, 2018 and in Georgia on October 14, 2018 (INSIGHT 2018). When Hurricane Michael weakened to Tropical Storm Michael, FEMA Assistance for Tropical Strom Michael was provided in Virginia on December 18 (FEMA 2018c) and North Carolina on January 31, 2019 (FEMA 2019). The federal-level recovery assistance has three parts – Individual Assistance, Public Assistance, as well as a Hazard Mitigation Grant Program – based on the level of damage caused (PAInfo 2018). Individual Assistance corresponds to the assistance provided to individuals and households who experienced damages to their property and losses that are not claimable from insurance companies. Public Assistance provides support to the local government to rebuild the damaged social infrastructure. In addition, Public Assistance provides non-urgent support, which includes but is not limited to debris removal, and repairs of damaged public property, parks and recreation facilities. The Hazard Mitigation Grant Program is to support long-term recovery and eliminate the potential risks exposed by damaged facilities.

We collect the costs for the three parts of financial assistance in four receiving states on the FEMA website. We obtain financial data from Compustat North America Database to estimate tax avoidance measures and firm-level characteristics. We collect the voter turnouts, the percentage of eligible voters who cast a ballot in any given presidential election, from The

United States Elections Project as a social capital proxy. The United States Elections Project is sponsored by the United States Electoral System (Voter Turnout 2020).

4.2. Variable Construction

4.2.1. Measures of Tax Avoidance

We follow Cen *et al.* (2017) to use two effective tax rates to measure the engagement in tax avoidance activities. The first effective tax rate, GAAP effective tax rate ($GETR$), is measured by the total income tax expense (txt) divided by the difference between pre-tax book income (pi) and special items (spi). GAAP effective tax rate measures tax avoidance engagement resulted from permanent tax savings. According to Cen *et al.* (2017), we exclude observations with missing values for variables needed in calculating tax avoidance measures. The second effective tax rate, cash effective tax rate ($CETR$), is measured by the cash taxes paid ($txpd$) divided by the difference between pre-tax book income (pi) and special items (spi). Cen *et al.* (2017) argue that $GETR$ fails to capture the increase in deferred tax expense that can offset current tax expense (i.e., defer cash taxes), which is accounted for by $CETR$. We exclude observations with missing values of cash taxes paid ($txpd$), pre-tax book income (pi) and special items (spi). We follow Cen *et al.* (2017) to truncate both tax avoidance measures in the range from zero to one.

4.2.2. Measures of FEMA Assistance

We use the natural logarithm of the actual dollar value of FEMA Assistance to measure the emergency relief support. We impute the natural logarithm of the actual dollar value of FEMA Assistance for the four receiving states and set all other states as zero.

4.2.3. Measures of Social Capital

The existing sociology literature centers on two types of social capital proxies, namely standard surveys and official statistics. Paldam (2000) discusses the validity of measures to proxy social capital and finds that the polling method (i.e., standard surveys) is the most suitable method to analyze generalized trust, network, and voluntary organization. Moreover, Putnam's Instrument qualifies how individuals demonstrate knowledge and belonging to the communities by examining macro-series pertaining to social capital (Putnam 2001). However, survey-based data are not spread at the state level and thus are not suitable for our study. As for the official statistics, Hudson and Chapman (2002) examine 11 key dimensions of social capital in five domains, including trust, informal networks, formal networks, political involvement, and equality of civic engagement across the community. They find that the current efforts of the federal government focus on the development of short module questions, which can be added to the existing surveys. Therefore, the lack of new and independent data collection procedures makes the measure of the 'strength of community cohesion' harder (Hudson & Chapman 2002). Furthermore, nationwide data sources can measure social capital but only for specific age groups or races. For example, the National Crime Victimisation Survey (NCVS), sponsored by the Department of Justice, yields approximately 160,000 individuals nationwide. The Adult Education and Lifelong Learning Survey (AELL), sponsored by the Department of Education, has a representative sample of over 11,000 adults. However, those data sources are not suitable for our research design as we need social capital measured at the state level.

We examine the finance and economics literature to find more appropriate proxies for social capital. Hasan *et al.* (2017) use NRCRD data from Pennsylvania State University to construct social capital proxies at the county level. This data source provides the voter turnouts in presidential elections ($Pvote$), the response rates in US census surveys ($Respn$), the total

numbers of non-profit organizations ($Nccs$), and the total numbers of 10 types of social organizations for all US counties ($Assn$). The updated NRCRD is only available until 2014 at the latest; therefore, we cannot use the social capital proxy constructed from NRCRD to examine the effect of FEMA Assistance of Hurricane (Tropical Storm) Michael given the support was provided in 2018. The Federal Election Commission (FEC) publishes the Federal Elections, a certified federal result, which includes primary, runoff, and general election results for the Senate, the House of Representatives (if applicable), and the President every two years (Voter Turnout 2020). Therefore, considering the data availability, we use voter turnouts in presidential elections ($Pvote$), one of four components of social capital proxy in Hasan *et al.* (2017), as a social capital proxy in our study.

We collect the voter turnouts in presidential elections from The United States Elections Project, which is sponsored by the United States Electoral System. The project aims to deliver timely and accurate election statistics, electoral laws, and useful research reports. Voter turnout indicates the percentage of eligible voters who cast a ballot in any given presidential election (Voter Turnout 2020). According to Statista, the voter turnout in the United States presidential and midterm elections is volatile from 1789 to 2020. The voter turnout ranged from below 12% in uncontested elections to above 83% in the 1876 election. In recent decades, voter turnout becomes stable because of the increased political involvement of younger voters and ethnic minority backgrounds (Statista 2020). Specifically, we use Voting Eligible Population (VEP) Total Ballots Counted turnout rate, which is the Total Ballots Counted dividend by the voting-eligible population, to proxy social capital. Higher turnout rates in presidential elections indicate greater social capital in a given state because social capital reflects the level of participation and engagement in presidential elections.

4.2.4. Firm-Level Controls

To alleviate the concern that there are pre-existing vulnerabilities leads to more aggressive engagement in corporate tax avoidance, we follow prior literature to identify firm-level control variables that are not only correlated with corporate tax avoidance to ensure the empirical results are not driven by those controls (Manzon Jr & Plesko 2001; Dyreng *et al.* 2008; Chen *et al.* 2010; Cen *et al.* 2017), but also controls for any pre-existing vulnerabilities. The firm-level controls include firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$).

We include firm size ($SIZE$) to capture the fundamental firm characteristics. Zimmerman (1983) argues that large firms tend to engage in more aggressive tax avoidance based on the 'political cost' hypothesis because they are more sophisticated and conduct complex tax planning (Hanlon 2005). We control for cash holding ($CASH$) due to the conflicting predictions its effect on tax avoidance. Cen *et al.* (2017) suggest that the incentive of tax avoidance decreases for firms with more cash; however, Hanlon *et al.* (2017) find that tax-aggressive firms actively defer taxes as a precautionary measure for a potential settlement with the Internal Revenue Service (IRS). We include return on asset (ROA) and net loss carry-forwards (NOL) to capture the incentives and needs for aggressive tax planning (Edwards *et al.* 2016). We control the foreign income (FI) to capture the firm's ability to restructure the taxable income between jurisdictions because Rego (2003) finds that the worldwide effective tax rate is lower for multinational companies with extensive foreign operations. We also control for free cash flow (FCF) to capture the level of firm's internal fund (Atawnah *et al.* 2018). We include financial leverage (LEV) to capture the debt tax shield. Graham (1996) suggests that higher debt tax shields resulting from higher financial leverage can effectively lower the marginal tax rate and the incentives to engage in aggressive tax avoidance. In addition, we control for equity

income in earnings (EIIE) to account the effect of firms' investment activities on book-tax difference. Chen *et al.* (2010) argue that book-tax difference occurs when tax and accounting standards are different for investment activities.

4.3. Summary Statistics

We winsorize variables (except ratios) for the top 1% and bottom 1% data in order to reduce the impact of outliers.

Table 1 provides the descriptive statistics for the main regression variables, including tax avoidance variables, the natural logarithm of the actual dollar value of FEMA Assistance, and firm-level characteristics. We have 18,044 firm-year observations in the baseline regression, and the number of observations declines with different data filters and data restrictions applied under each model specification. For tax avoidance measures, the number of observations for $GETR$ is less than $CETR$ by around 800. The difference in the number of observations for the two tax avoidance measures is due to the availability of variables required to calculate the two measures. Table 1 shows that the mean value of $GETR$ is 0.228 and $CETR$ is 0.185. This suggests that the average effective tax rate for the sample is 20.7%, which aligns with Cen *et al.* (2017). In addition, the average firm in our sample has a (logarithmic scale) size of 7.261, a cash holding ratio of 0.158, a leverage ratio of 0.247, a return of asset of 8.5%, and an equity in income earnings ratio of 0.1%. The mean values of firm-level characteristics are broadly consistent with prior literature (Chen *et al.* 2010; Cen *et al.* 2017; Nguyen & Nguyen 2020).

[Insert Table 1]

Table 2 presents the pairwise correlation matrix between the tax avoidance measures, the natural logarithm of FEMA Assistance, and firm-level controls. We find that FEMA Assistance is negatively correlated with two effective tax rates given a lower effective tax rate implies more aggressive tax avoidance engagement. As expected, all control variables are systematically correlated with two tax avoidance measures and several of them are also associated with the FEMA Assistance proxy, which is in line with those presented in the prior studies (Chen *et al.* 2010; Cen *et al.* 2017).

[Insert Table 2]

5. Methodology

5.1. Baseline Specification

We examine the effect of FEMA Assistance on corporate tax avoidance in the baseline regression using the following regression equation.

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (1)$$

The subscript "j" refers to the state in the US, which includes every firm i in a given state j. The subscript "it" refers to firm i and year t. TA denotes the tax avoidance measure, including the effective tax rate ($GETR$) and cash effective tax rate ($CETR$) constructed from Cen *et al.* (2017). $FEMA\_dollar_{i,t}$ is the natural logarithm of the real dollar value of FEMA Assistance provided to four affected states in the post-disaster period, and it takes the value of zero for receiving firms in the pre-disaster period and non-receiving firms in both pre- and post-disaster periods. $FA_{i,t}$ is a vector of firm attributes for to firm i and year t, which include firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards

(NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). θ_t is the year-fixed effect which varies with time t. ϑ_k is the industry-fixed effect, which varies with industry k. Specifically, the inclusion of year- and industry-fixed effects accounts for any differences in the data that remain constant over time within and across industries at a given time. This helps rule out potential endogeneity, ensuring that the regression results are not driven by other concurrent economic, regulatory, or industry-specific changes that could confound the relationship.

5.2. Propensity Score Matching Procedure

We use matched-firm analysis by performing a propensity score matching procedure to identify a set of firms that do not receive FEMA Assistance (i.e., non-receiving firms) to match the treatment sample of firms that receive FEMA Assistance (i.e., receiving firms). The dummy variable, $Treat,$ equals one if firms headquartered in states that receive disaster relief funding and equals zero for firms headquartered in other states. In addition, we extend the propensity score matching procedure, in a sample that consists of only receiving firms, to identify a set of firms headquartered in states that receive less disaster relief funding (i.e., less-receiving firms in North Carolina and Virginia) to match the treatment group of firms headquartered in states that receive more disaster relief funding (i.e., more-receiving firms in Florida and Georgia). The dummy variable, $Treat,$ equals one for more-receiving firms and equals zero for less-receiving firms. We use a nearest-neighbor matching with no replacement and a caliper of 0.01 to ensure that the matched pairs have the closest firm attributes (defined in *Section 3.2.4.*) to control for potential selection bias (Armstrong *et al.* 2012).

5.3. Difference-in-Differences Procedure

According to the National Oceanic and Atmospheric Administration, Hurricane Michael and Tropical Storm Michael should be recognized as the same natural disaster in different formations and development (Administration 2018). FEMA Assistance provided to each state is different because the severity of Hurricane (Tropical Storm) Michael differed in each state. We perform apply a difference-in-differences analysis to examine the differential effect of FEMA Assistance on corporate tax avoidance in the treatment group (i.e., firms headquartered in states that received FEMA Assistance) relative to the control group (i.e., firms headquartered in states that did not receive FEMA Assistance) after the implementation of FEMA Assistance to Hurricane (Tropical Strom) Michael. Furthermore, we extend the difference-in-differences procedure to a sample of firms headquartered in four affected states to investigate the differential effect of FEMA Assistance on corporate tax avoidance. The treatment group becomes firms located in more-receiving states (i.e., Florida and Georgia) relative to the control group that consists of firms headquartered in less-receiving states (i.e., North Carolina and Virginia). Given the federal-level disaster relief packages were available in 2018, we perform the difference-in-differences regression for the samples from 2016 to 2020, i.e., using a two-year pre-treatment and a two-year post-treatment period.

The difference-in-differences procedure allows us to isolate and capture the differential effect of FEMA Assistance on corporate tax avoidance in two pairs of firm groups (discussed in *Section 5.1.* and *Section 5.3*).

6. Empirical Analysis

6.1. Baseline Regression Result (OLS Regression for the Full Sample)

We use regression equation (1) to investigate the dynamic effect of FEMA Assistance on corporate tax avoidance in the full sample.

Table 3 reports the estimation results for regression equation (1). The dependent variable is $GETR$ and $CETR$ in two columns. We report the estimation results for firm- and industry-fixed effects.

[Insert Table 3]

In the first column of Table 3, we find that the estimated coefficient (−0.002) of $FEMA\_dollar$ is negative and statistically significant at the 1% level. This result indicates that, with controlling fixed effects for year and industry, firms yield a 0.2% lower GAAP effective tax rate after the implementation of FEMA Assistance. Given that a lower effective tax rate implies more aggressive tax avoidance engagement, the negative and significant estimated coefficient suggests that firms on average engage in more aggressive tax avoidance when FEMA Assistance is deployed. In the second column of Table 3, the coefficient estimate (−0.001) of $FEMA\_dollar$ is negative and significant at the 5% level. This confirms the result presented in the first column.

Regarding the firm-level control variables in Table 3, we find that the coefficient estimates are in line with the prior literature (Chen *et al.* 2010; Cen *et al.* 2017; Nguyen & Nguyen 2020). For example, the estimated coefficient for $SIZE$ under GETR is negative and significant, which is supported by the 'political cost' hypothesis (Zimmerman 1983). The negative coefficient estimates of the $EIIE$ and $CASH$ suggest that tax-aggressive firms tend to avoid defer more

taxes to meet any future obligations with the Internal Revenue Service (IRS), which is supported by Hanlon *et al.* (2017).

Overall, the baseline results indicate that FEMA Assistance to firms does promote aggressive engagement in corporate tax avoidance. This particular relationship is also important as it provides additional insight into how firms modify their tax avoidance strategy when they receive FEMA Assistance.

6.2. Pairwise Difference for the Full Sample

The baseline regression illustrates a casual positive relationship between FEMA Assistance and corporate tax avoidance. In this section, we perform pairwise difference regression for the full sample in a difference-in-differences setting to examine whether the implementation of FEMA Assistance leads to receiving firms conducting more aggressive tax avoidance engagement relative to their non-receiving counterparts. We investigate *before* and *after* the implementation of FEMA Assistance in four states to estimate the average treatment effect of FEMA Assistance on corporate tax avoidance using the difference-in-difference regression (2) shown below.

$$\Delta TA_{i,g,j,k,t} = \beta_1 Event_t + \beta_2 \Delta FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (2)$$

The dependent variable ΔTA denotes the difference of tax avoidance measures between receiving firms and non-receiving firms. Similar to the baseline model, tax avoidance measures include effective tax rate ($GETR$) and cash effective tax rate ($CETR$), so the differences in tax avoidance measures, ΔTA, are denoted as $\Delta GETR$ and $\Delta CETR$, respectively. $Event_t$ denotes the time dummy that equals one for the post-period (2019–2020) when the firms receive the FEMA assistance (i.e., two years after the implementation of FEMA Assistance), and equals

zero for the pre-period (2016–2017), two years before the implementation of FEMA Assistance). ΔFA denotes the set of pairwise differences in the firm-level characteristics between the treatment group and control group. FA includes firm attributes that are defined in the baseline regression equation (1).

As discussed in *Section 4.3.*, we perform a matched-firm analysis by using a propensity score matching procedure to identify a non-receiving firm (i.e., control firms) for each firm in the treatment group, which consists of all receiving firms. The propensity score matching procedure is conducted in 2015 sample firms (i.e., one year before the pre-period) and those firms are required to exist throughout the sample period. This procedure rules out firms that exist in prior years and disappear in later years. The propensity score matching is based on a dummy variable, $treat$, that equals one for receiving firms and equals zero otherwise. We use a nearest-neighbor matching with a caliper of 0.01 to yield a sample of 227 pairs of matched firms throughout the sample period.

[Insert Table 4]

We examine the quality of the matched samples by investigating the differences in the mean value of the matching criteria variables between treatment firms and control firms. We report the test results in Table 4. The last two columns show the corresponding $t - test$ results of the mean differences. The differences in mean values of firm-level controls for matched pairs are statically insignificant, and this result indicates the high quality of our matching procedure.

[Insert Table 5]

Table 5 reports the average treatment effect of FEMA Assistance, which examines whether receiving firms have different tax avoidance behavior relative to firms that are not eligible to receive FEMA Assistance. We find that the coefficient estimates of $Event$ (−0.106) are negative and significant at the 1% level under two specifications. This result suggests that, with controlling pairwise difference in firm-level characteristics and year- and industry-fixed effects, the average matched pair difference in the effective tax rates yields 10.6% lower in the post-period relative to the pre-period. Given lower effective tax rates are associated with more aggressive tax avoidance engagement, the regression results suggest that, after the implementation of FEMA Assistance, firms that receive FEMA Assistance engage in more aggressive tax avoidance relative to their non-receiving counterparties. Overall, the pairwise difference-in-differences regression results indicate that the differentials in corporate tax avoidance behavior between the receiving firms and their non-receiving counterparties occur only after the implementation of FEMA Assistance.

Overall, the results in regression models (1) and (2) suggest that firms exhibit more aggressive tax avoidance engagement after the implementation of FEMA Assistance of Hurricane (Tropical Strom) Michael in 2018, and in particular, receiving firms conduct more aggressive tax planning relative to non-receiving firms.

6.3. OLS Regression for More- vs. Less-Receiving Firms

In this section, we extend the analysis of regression equation (1) to consider a sample of companies headquartered in four states that are eligible to receive FEMA Assistance. The

sample covers of two groups companies located in Florida and Georgia that received more FEMA Assistance (i.e., more-receiving firms) relative to companies located in North Carolina and Virginia (i.e., less-receiving firms) based on the severity of the experienced disaster. This sample consists of 383 receiving firms (216 more-receiving firms and 167 less-receiving firms) after dropping any missing values in tax avoidance measures and firm-level control. We use the below regression equation (3) to examine the effect of FEMA Assistance on corporate tax avoidance in the small sample.

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (3)$$

Similar to the baseline regression model, the dependent variable, TA, includes GAAP effective tax rate ($GETR$) and cash effective tax rate ($GETR$). FA is a vector of firm-level controls. $FEMA\_dollar_{i,t}$ is the natural logarithm of real dollar term of FEMA Assistance provided to four states.

[Insert Table 6]

In Table 6, we find that the estimated coefficients of $FEMA\_dollar$ are negative and significant at the 1% level for both tax avoidance measures. This result indicates that, with controlling fixed effects for year and industry, firms that are eligible to receive FEMA Assistance yield on average a 0.3%[5] lower effective tax rate after the implementation of FEMA Assistance. This can also be interpreted as receiving firms engaging in more aggressive tax avoidance activities when they receive FEMA Assistance, given a lower effective tax rate implies more aggressive tax avoidance engagement. In addition, the magnitude of the estimated

[5] The coefficient estimates of $FEMA\_dollar$ for $GETR$ and $CETR$ are −0.004 and −0.002, respectively.

coefficients of $FEMA\_dollar$ is larger than the baseline regression, because this sample consists of only receiving firms that engage in more aggressive tax planning than non-receiving firms.

Overall, the baseline regression results hold for the small sample of only receiving firms, in which firms that are eligible to receive disaster relief support engage in more aggressive tax avoidance after the implementation of FEMA Assistance.

6.4. Pairwise-Difference Regression for More- vs. Less-Affected Firms

In this section, we investigate if more-receiving firms exhibit different tax avoidance behavior relative to their less-receiving counterparties before and after the implementation of FEMA Assistance of Hurricane (Tropical Storm) Michael. We perform a matched-firm analysis by using a propensity score matching procedure to identify a less-receiving firm for each more-receiving firm in the treatment group. Similar to the propensity score matching used in *Section 5.2.*, we conduct the matching procedure in 2015 to keep only firms that existed throughout the entire sample period, such that we do not have firms that matched in 2015 but disappeared in later years due to merger and acquisition. We find that the sample consists of 216 firms headquartered in more-receiving states and 167 firms headquartered in less-receiving states, which is consistent with the total number of firms headquartered in affected states (383 affected firms). We use a nearest-neighbor matching with no replacement and a caliper of 0.01 to deliver 86 matched pairs for more- and less-receiving pairs, which yields around 72% of matched firms from the initial sample, and this suggests that the matched sample is representative. To examine the balance of matching results, we find a similar result in the difference of means in those two groups for all firm-level controls. This suggests that our matching procedure is of high quality.

We formulate the following regression equation (4) to examine whether more- and less-receiving firms exhibit different tax avoidance engagements after the implementation of FEMA Assistance.

$$\Delta TA_{i,g,j,k,t} = \beta_1 Event_t + \beta_2 \Delta FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (4)$$

Similar to the pairwise difference regression (2), the dependent variable, ΔTA, denotes the difference in the tax avoidance measures between more-receiving firms (firms headquartered in Florida and Georgia) and less-receiving firms (firms headquartered in North Carolina and Virginia). Tax avoidance measures, TA, include GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). $Event_t$ is the time dummy that equals one for the post-period (20192020) and equals zero for the pre-period (2016–2017). $\Delta FA_{i,t}$ denotes the set of pairwise differences in the firm attributes between more- and less-receiving firms. $FA_{i,t}$ includes firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). We include firm- and industry-fixed effects in this regression. Table 7 reports the pairwise difference regression results.

[Insert Table 7]

In Table 7, we find that the estimated coefficients of $Event$ are negative and significant for two tax avoidance measures. This result suggests that, with controlling pairwise differences in firm-level characteristics and year- and industry-fixed effects, the average matched pair

difference in the effective tax rate yields 20.85%[6] lower after the implementation of FEMA Assistance. Given that a lower value of effective tax rate is associated with more aggressive tax planning, we conclude that, after the implementation of FEMA Assistance of Hurricane (Tropical Storm) Michael in 2018, more-receiving firms engage in more aggressive tax avoidance relative to their less-receiving counterparts. Furthermore, the magnitude of the estimated coefficients of $Event$ is larger than the pairwise difference regression for the full sample. In the matched pairwise analysis for the entire sample, the coefficient estimates of $Event$ for $\Delta GETR$ and $\Delta CETR$ are −0.106 and −0.106, respectively. In the matched pairwise analysis, which consists of firms that receive more and less assistance, the coefficient estimates of $Event$ for $\Delta GETR$ and $\Delta CETR$ are −0.269 and −0.148, respectively. Dyreng *et al.* (2017) investigate the scale of the change in US domestic effective tax rates and find that, on average, effective tax rates decrease by 5 percent, going from 32% to 27%. Our regression results not only highlight a pronounced increase in aggressive tax avoidance following the FEMA Assistance implementation but also suggest that this heightened engagement in tax avoidance among receiving firms is primarily driven by firms that receive more assistance relative to their less-receiving counterparts.

Overall, the regression results of four models suggest that because of the implementation of FEMA Assistance of Hurricane (Tropical Storm) Michael, firms headquartered in states that are eligible to receive FEMA Assistance, on average, engage in more aggressive tax avoidance than their non-receiving counterparts. The small sample analysis that consists of four receiving states only indicates that more-receiving firms conduct more aggressive tax avoidance activities relative to less-receiving firms. In addition, the aggressive tax avoidance of receiving firms is mainly contributed by more-receiving firms. Therefore, by examining the pre- and

[6] The coefficient estimates of $Event$ for $\Delta GETR$ and $\Delta CETR$ are −0.269 and −0.148, respectively.

post-period in two samples, we conclude that FEMA Assistance indeed promotes corporate tax avoidance engagement.

6.5. Channel Analysis – Social Capital

In this section, we examine *Hypothesis 2* by providing suggestive evidence that a possible channel for FEMA Assistance to affect corporate tax avoidance is through the impact of social capital.

6.5.1. Methodology

Existing literature suggests that post-disaster recovery plans may have a diminishing effect on social capital. Elliott *et al.* (2010) find that federal-level disaster relief support alone is often insufficient to mitigate the damages and losses experienced in disaster-affected areas. In regions with initially high levels of social capital, social capital tends to decline dramatically compared to their low-status counterparts within the same community. Moreover, Aldrich (2014) suggests that 'in-group members', those with tightly-knit social networks, can use their social capital to build resilience more rapidly compared to 'excluded members' who lack sufficient social capital. Social resources tend to be depleted quickly for 'excluded members'. Weil *et al.* (2012) and Metaxa-Kakavouli *et al.* (2018) also support the idea that social capital declines due to inequalities in the possession of social resources among different regions or groups. Overall, current literature implies that social capital plays a critical role in ensuring the effective execution of a recovery plan, and as a consequence, the demand for social capital increases significantly before experiencing a notable decline afterward.

Hasan *et al.* (2017) describe social capital as the strength of civic norms and density of social works which act as ‘the set of values and beliefs that help cooperation’. Alm and Torgler

(2006) argue that individuals with different levels of 'social environments (capital)' have different intrinsic motivations for paying taxes. Alm *et al.* (1995) and Cummings *et al.* (2009) find individuals with different levels of disposal of social capital tend to have different tax compliance. In addition, Coleman (1988) finds that a higher level of social sanctions is associated with firms headquartered in high-social-capital communities relative to their low-social-capital counterparts. Therefore, Hasan *et al.* (2017) argue that the civic duty to pay taxes, a prevalent societal responsibility, is able to force people who possess more social capital to participate in less tax avoidance activities.

According to the United States Elections Project, the November General Election Turnout Rates for Florida were 65.6% in 2016 and 54.3% in 2018, and 59.8% in 2016 and 54.1% in 2018 for Georgia (Voter Turnout 2020). We observed declines in voter turnouts in presidential elections ($Pvote$) from 2016 to 2018 in two states that receive more FEMA Assistance, and similar declines were observed in North Carolina and Virginia as well. Overall, the voter turnouts in presidential elections ($Pvote$) for the four affected states that are eligible for FEMA Assistance indeed declined from 2016 to 2018. This data supports our initial hypothesis that the decline of social capital in firms located in states receiving FEMA assistance is the driving factor behind these firms engaging in more aggressive tax avoidance. We use the same sample in the baseline specification and add two additional variables into the baseline regression equation, which include high social capital ($High\_SC_{i,t}$) and the interaction between FEMA Assistance and high social capital ($FEMA\_dollar_{i,t} \times High\_SC_{i,t}$). The inclusion of these two variables allows us to investigate how the effect of FEMA Assistance on corporate tax avoidance changes for firms located in states that possess a different level of social capital, i.e., to explore if social capital is a possible channel for FEMA Assistance to affect corporate tax avoidance. In addition, we also perform the channel analysis on the sample consisting of only

firms headquartered in four states that receive FEMA Assistance to validate the effect only among receiving firms.

Therefore, we perform a difference-in-differences test to examine whether the baseline results between FEMA Assistance and corporate tax avoidance vary for regions with different levels of social capital.

6.5.2. Channel Analysis for Full Sample

We perform regression equation (5) to examine whether more- and less-receiving firms exhibit different tax avoidance after the implementation of FEMA Assistance of Hurricane (Tropical Storm) Michael by comparing the two-year pre- and post-periods in a difference-in-differences regression.

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 High\_SC_{i,t} + \beta_3 FEMA\_dollar_{i,t} \times High\_SC_{i,t} + \beta_4 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (5)$$

We modify the baseline regression equation (1) by adding $High\_SC_{i,t}$ and interaction term $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$. Similar to the baseline regression model, the dependent variable, TA, includes two effective tax rates. $FEMA\_dollar$ is the natural logarithm of the actual dollar value of FEMA Assistance. FA is a vector of firm-level characteristics, including firm size ($SIZE$), cash holdings ($CASH$), net loss carry-forwards (NOL), profitability (ROA), foreign income (FI), free cash flow (FCF), financial leverage (LEV), as well as equity income in earnings ($EIIE$). The inclusion of these firm-level characteristics controls for other potential factors that affect the engagement of tax avoidance. $High\_SC$ is a dummy variable that equals one if a firm is headquartered in a state in which voter turnout in presidential elections is higher

than the median value in that year, and it equals zero otherwise. The variable of interest in the interaction term $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$.

[Insert Table 8]

In Table 8, across two specifications, we find that the estimated coefficients of $FEMA\_dollar$ are negative and significant at 1% for two tax avoidance measures. These are consistent with the baseline regression results, in which we find a positive association between FEMA Assistance and corporate tax avoidance engagement. In addition, we are particularly interested in the estimated coefficients on the interaction term, $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$, which captures the incremental effects of FEMA Assistance on corporate tax avoidance for firms headquartered in high-social-capital regions. In both specifications, we find that the coefficient of $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$ is positive and statistically significant at the 1% level. This suggests that the positive relationship between FEMA Assistance and corporate tax avoidance does attenuate for firms located in states with a higher level of social capital. This finding confirms the positive effect of FEMA Assistance on corporate tax avoidance is moderated in regions with a higher level of social capital.

As discussed by Hasan *et al.* (2017), there is a negative association between social capital and corporate tax avoidance. Therefore, the positive relationship between FEMA Assistance is expected to be moderated in high-social-capital regions. This finding suggests that federal emergency disaster relief support leads to lower corporate tax avoidance engagement for companies located in municipalities with high social capital in the wake of FEMA Assistance of Hurricane (Tropical Storm) Michael.

6.5.3. Channel Analysis for More- vs. Less-Receiving Firms

To examine the effect of social capital in the sample consisting of only firms that are eligible to receive FEMA Assistance, we extend the channel analysis by using regression model (5) for only receiving firms.

[Insert Table 9]

In Table 9, across two specifications, we observe that the estimated coefficients of $FEMA\_dollar_{i,t}$ are still negative and significant at 1% for two tax avoidance measures, such that we can still conclude a positive association between FEMA Assistance and corporate tax avoidance engagement. In addition, we find that the estimated coefficients on the interaction term, $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$, are positive and statistically significant at the 1% level. This suggests that, among receiving firms, the positive relationship between FEMA Assistance and corporate tax avoidance is moderated in states with a higher level of social capital.

Taken together, Tables 8 and 9 provide suggestive evidence that the possible channel for FEMA Assistance to affect corporate tax avoidance is through social capital, and that the effect is moderated in states with a higher level of social capital in different samples.

7. Conclusion

This paper investigates whether FEMA Assistance affects corporate tax avoidance engagement. We provide comprehensive, robust evidence that firms headquartered in states that receive FEMA Assistance exhibit more aggressive tax planning relative to firms located

in states that do not receive FEMA Assistance. We examine this relationship using two effective tax rates to measure tax avoidance and the natural logarithm of actual FEMA Assistance to proxy the federal-level disaster relief support. The results highlight the importance of an exogenous event that can alter firms' tax planning. This is the first evidence to highlight that FEMA Assistance, federal-level disaster relief support, can affect firms' tax avoidance behavior. We conduct several tests to validate the positive relationship between FEMA Assistance and corporate tax avoidance. Firstly, we employ propensity score matching and perform a difference-in-differences procedure in a quasi-experimental estimation to isolate and capture the differential effect of FEMA Assistance in two pairs of groups, namely receiving firms and non-receiving firms, and more-receiving firms and less-receiving firms. We find that the baseline results exist in both pairs of matched groups. Moreover, we perform channel analysis and find that a possible channel for FEMA Assistance to affect corporate tax avoidance is social capital, and the positive relationship between FEMA Assistance and corporate tax avoidance is moderated for firms headquartered in states with more social capital. Overall, this paper highlights novel findings on the positive association between FEMA Assistance and corporate tax avoidance and the moderation role of social capital in moderating this relationship.

Table 1 Summary Statistics

The sample contains 18,044 firm-year observations from 2016 to 2020. This table provides descriptive statistics for tax avoidance variables, firm attribute variables at the firm-year level, and the natural logarithm of the actual dollar value of FEMA Assistance. Detailed variable definitions can be found in Appendix A.

Variable	N	Mean	S.D.	P25	Median	P75
Tax avoidance measures						
$GETR$	15,858	0.228	0.143	0.142	0.220	0.300
$CETR$	16,648	0.185	0.150	0.061	0.172	0.266
Firm attributes						
$SIZE$	16,513	7.261	2.207	5.728	7.361	8.807
$CASH$	13,453	0.158	0.216	0.028	0.077	0.191
NOL	18,044	0.844	0.363	1.000	1.000	1.000
ROA	13,454	0.085	0.108	0.019	0.051	0.106
FI	18,044	0.011	0.027	0.000	0.000	0.005
FCF	16,448	0.061	0.148	0.025	0.055	0.094
LEV	13,418	0.247	0.247	0.032	0.197	0.376
$EIIE$	10,158	0.001	0.006	0.000	0.000	0.001
FEMA Assistance						
$FEMA\_dollar$	18,044	1.056	4.371	0.000	0.000	0.000

Table 2 Pairwise Correlation

This table reports the correlation between tax avoidance measures, FEMA Assistance, and all control variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) $GETR$										
(2) $CETR$	0.457*									
(3) $FEMA\_dollar$	-0.056*	-0.018*								
(4) $SIZE$	-0.053*	0.029*	-0.024*							
(5) $CASH$	-0.012	-0.018*	-0.029*	-0.102*						
(6) NOL	0.119*	0.047*	0.004	0.103*	-0.030*					
(7) ROA	-0.034*	-0.072*	-0.029*	0.024*	0.468*	-0.132*				
(8) FI	0.036*	0.064*	-0.022*	0.236*	0.110*	0.122*	0.177*			
(9) FCF	0.015*	0.024*	0.016*	-0.002	-0.013	-0.021*	-0.038*	-0.031*		
(10) LEV	-0.128*	-0.106*	0.037*	0.217*	-0.185*	-0.043*	-0.004	0.044*	-0.035*	
(11) $EIIE$	-0.047*	-0.039*	-0.032*	0.058*	-0.051*	0.006	0.071*	-0.013	-0.006	0.003

** shows significance at p<.1*

Table 3 OLS Regression for the Full Sample

This table presents the regression results of the below regression models from 2016 to 2020. The regression model is:

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (1)$$

where TA is tax avoidance measures including GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). $FEMA\_dollar_{i,t}$ is the natural logarithm of the actual dollar value of FEMA Assistance. $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). The year-fixed effect and industry-fixed effects are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$GETR$	$CETR$
$FEMA\_dollar_{i,t}$	-0.002***	-0.001**
	(-5.88)	(-2.00)
Firm-level controls		
$SIZE_{i,t}$	-0.003***	0.004***
	(-4.07)	(4.96)
$CASH_{i,t}$	-0.041***	-0.029***
	(-4.42)	(-2.90)
$NOL_{i,t}$	0.006	-0.023***
	(1.55)	(-4.36)
$ROA_{i,t}$	0.009	-0.100***
	(0.36)	(-5.04)
$FI_{i,t}$	0.193**	0.218***
	(2.45)	(4.04)
$FCF_{i,t}$	0.020	0.017
	(1.50)	(1.31)
$LEV_{i,t}$	-0.053***	-0.064***
	(-7.87)	(-9.81)
$EIIE_{i,t}$	-1.549***	-0.922***
	(-6.68)	(-4.09)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	12,358	13,174
Adjusted R-squared	0.142	0.115

Table 4 Propensity Scoring Matching Test

This table presents the propensity scoring matching test for the matching procedure in 2015, which is one year before the pre-disaster period (2016–2017). The matching procedure is based on a dummy variable, $treat$, that equals one if firms headquartered in states that receive FEMA Assistance and equals zero otherwise, with inclusion of all the firm-level controls presented in Table 1. The propensity scoring matching test is based on all the matched pairs' firm-level controls in which the mean of pairs and t-test are shown below.

VARIABLES	$Mean$		$t-test$	
	Treated	*Control*	*t*	*p>|t|*
Firm-level controls				
$SIZE_{i,t}$	6.821	6.734	0.47	0.638
$CASH_{i,t}$	0.159	0.168	-0.54	0.591
$NOL_{i,t}$	0.766	0.786	0.46	0.647
$ROA_{i,t}$	0.101	0.097	-0.42	0.673
$FI_{i,t}$	0.010	0.011	-0.25	0.804
$FCF_{i,t}$	0.052	0.055	1.31	0.190
$LEV_{i,t}$	0.291	0.260	0.66	0.509
$EIIE_{i,t}$	0.001	0.000	-0.42	0.678

Table 5 Pairwise-Difference Regression for the Full Sample

This table presents the estimation results of pairwise-difference regression from 2016 to 2020. The regression model is:

$$\Delta TA_{i,g,j,k,t} = \beta_1 Event_t + \beta_2 \Delta FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (2)$$

where ΔTA denotes the difference in tax avoidance measures between firms in the treatment group and control group. Tax avoidance measures, TA, include GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). The differences in tax avoidance measures are denoted as $\Delta GETR$ and $\Delta CETR$. $Event_t$ denotes the time dummy which equals one for the post-period (2019–2020) and equals zero for the pre-period (2016–2017). ΔFA denotes the set of pairwise differences between the treated firms and their matched counterparts for all the firm-level control variables. Each matched pair includes a receiving firm and a non-receiving firm. The year-fixed effect and industry-fixed effects are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry for standard errors existing inside industries. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$\Delta GETR$	$\Delta CETR$
$Event_t$	-0.106***	-0.106***
	(-4.57)	(-3.30)
Firm-level controls		
$\Delta SIZE_{i,t}$	0.008*	0.011***
	(1.86)	(3.71)
$\Delta CASH_{i,t}$	0.006	0.007
	(0.16)	(0.18)
$\Delta NOL_{i,t}$	-0.009	-0.079***
	(-0.45)	(-5.11)
$\Delta ROA_{i,t}$	-0.053	-0.111
	(-0.67)	(-1.20)
$\Delta FI_{i,t}$	-0.314	0.209
	(-0.97)	(0.76)
$\Delta FCF_{i,t}$	-0.008	0.100***
	(-0.10)	(2.81)
$\Delta LEV_{i,t}$	-0.085**	-0.159***
	(-2.01)	(-4.22)
$\Delta EIIE_{i,t}$	-6.302***	-3.617***
	(-3.84)	(-2.79)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	666	879
Adjusted R-squared	0.128	0.165

Table 6 OLS Regression for More- vs. Less-Receiving Firms

This table presents the regression results of the small sample consisting of all receiving firms (more-receiving firms and less-receiving firms) from 2016 to 2020. The regression model is:

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (3)$$

where TA is tax avoidance measures including GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). $FEMA\_dollar_{i,t}$ is the natural logarithm of the actual dollar value of FEMA Assistance. FA are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). The year-fixed effect and industry-fixed effect are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$GETR$	$CETR$
$FEMA\_dollar_{i,t}$	-0.004***	-0.002***
	(-11.74)	(-4.94)
Firm-level controls		
$SIZE_{i,t}$	-0.002	0.006**
	(-0.73)	(2.16)
$CASH_{i,t}$	-0.039	-0.023
	(-1.23)	(-0.84)
$NOL_{i,t}$	-0.024*	-0.094***
	(-1.85)	(-6.72)
$ROA_{i,t}$	0.042	-0.109*
	(0.68)	(-1.94)
$FI_{i,t}$	0.805***	0.812***
	(2.90)	(3.74)
$FCF_{i,t}$	-0.029	0.022
	(-0.64)	(0.75)
$LEV_{i,t}$	-0.056***	-0.063***
	(-3.19)	(-3.80)
$EIIE_{i,t}$	-3.319***	-0.983
	(-4.12)	(-1.01)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	1,170	1,279
Adjusted R-squared	0.298	0.268

Table 7 Pairwise-Difference Regression for More- vs. Less-Receiving Firms

This table presents the regression results of a pairwise-difference regression for four states that received FEMA Assistance from 2016 to 2020. The regression model is:

$$\Delta TA_{i,g,j,k,t} = \beta_1 Event_t + \beta_2 \Delta FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (4)$$

where ΔTA denotes the difference in tax avoidance measures between more-receiving firms and less-receiving firms. Tax avoidance measures, TA, include GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). The differences in tax avoidance measures are denoted as $\Delta GETR$ and $\Delta CETR$. $Event_t$ denotes the time dummy which equals one for the post-period (2019–2020) and equals zero for the pre-period (2016–2017). $\Delta FA_{i,t}$ denotes the set of pairwise differences between the treated firms and their matched firms for all the firm-level control variables. Each matched pair includes a more-receiving firm and a less-receiving firm. The year-fixed effect and industry-fixed effect are included. The year and industry fixed effect is controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry for standard errors existing inside industries. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$\Delta GETR$	$\Delta CETR$
$Event_t$	-0.269**	-0.148***
	(-3.72)	(-5.14)
Firm-level controls		
$\Delta SIZE_{i,t}$	-0.005	-0.006
	(-0.44)	(-0.57)
$\Delta CASH_{i,t}$	-0.058*	0.054
	(-2.52)	(0.99)
$\Delta NOL_{i,t}$	0.092	-0.031
	(1.56)	(-0.51)
$\Delta ROA_{i,t}$	-0.063	-0.358**
	(-0.74)	(-3.14)
$\Delta FI_{i,t}$	0.958	0.615
	(1.49)	(1.31)
$\Delta FCF_{i,t}$	0.119*	0.057
	(2.27)	(1.63)
$\Delta LEV_{i,t}$	-0.085	-0.140**
	(-0.78)	(-3.16)
$\Delta EIIE_{i,t}$	-4.036	-2.459
	(-1.61)	(-0.96)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	287	238
Adjusted R-squared	0.323	0.387

Table 8 Channel Analysis – Social Capital as a Moderation Factor for the Full Sample

This table presents the regression results of the full sample regression models from 2016 to 2020. The regression model is:

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 High\_SC_{i,t} + \beta_3 FEMA\_dollar_{i,t} \times High\_SC_{i,t} + \beta_4 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (5)$$

where TA is tax avoidance measures including GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). $FEMA\_dollar_{i,t}$ is the natural logarithm of the actual dollar value of FEMA Assistance. $High\_SC_{i,t}$ is a dummy variable that equals one if a firm is headquartered in a state with higher voter turnout in presidential elections than the median value, and it equals zero otherwise. The variable of interest is the interaction term $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$. FA are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). The year-fixed effect and industry-fixed effect are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$GETR$	$CETR$
$FEMA\_dollar_{i,t}$	-0.002***	-0.001***
	(-5.55)	(-3.08)
$High\_SC_{i,t}$	-0.048***	-0.032***
	(-15.83)	(-10.22)
$FEMA\_dollar_{i,t} \times High\_SC_{i,t}$	0.002***	0.002***
	(3.61)	(3.26)
Firm-level controls		
$SIZE_{i,t}$	-0.003***	0.004***
	(-4.29)	(4.74)
$CASH_{i,t}$	-0.044***	-0.031***
	(-4.78)	(-3.18)
$NOL_{i,t}$	0.007*	-0.022***
	(1.92)	(-4.19)
$ROA_{i,t}$	0.016	-0.092***
	(0.65)	(-4.74)
$FI_{i,t}$	0.228***	0.238***
	(2.89)	(4.35)
$FCF_{i,t}$	0.021	0.017
	(1.61)	(1.33)
$LEV_{i,t}$	-0.042***	-0.058***
	(-6.19)	(-8.61)
$EIIE_{i,t}$	-1.595***	-0.891***
	(-6.93)	(-3.95)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	12,285	13,101
Adjusted R-squared	0.157	0.119

Table 9 Channel Analysis – Social Capital as a Moderation Factor for More- vs. Less-Receiving Firms

This table presents the regression results of the small sample regression models from 2016 to 2020. The regression model is:

$$TA_{i,j,k,t} = \beta_1 FEMA\_dollar_{i,t} + \beta_2 High\_SC_{i,t} + \beta_3 FEMA\_dollar_{i,t} \times High\_SC_{i,t} + \beta_4 FA_{i,t} + \theta_t + \vartheta_k + \varepsilon_t \quad (5)$$

where TA is tax avoidance measures including GAAP effective tax rate ($GETR$) and cash effective tax rate ($CETR$). $FEMA\_dollar_{i,t}$ is the natural logarithm of the actual dollar value of FEMA Assistance. $High\_SC_{i,t}$ is a dummy variable that equals one if a firm is headquartered in a state with higher voter turnout in presidential elections than the median value, and it equals zero otherwise. The variable of interest is the interaction term $FEMA\_dollar_{i,t} \times High\_SC_{i,t}$. FA are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). The year-fixed effect and industry-fixed effect are included. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered for industry and year to control for standard errors existing inside industries and across years. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$GETR$	$CETR$
$FEMA\_dollar_{i,t}$	-0.004***	-0.001***
	(-6.89)	(-3.06)
$High\_SC_{i,t}$	-0.204**	-0.204**
	(-2.47)	(-2.14)
$FEMA\_dollar_{i,t} \times High\_SC_{i,t}$	0.010**	0.010**
	(2.26)	(1.97)
Firm-level controls		
$SIZE_{i,t}$	-0.001	0.007**
	(-0.41)	(2.43)
$CASH_{i,t}$	-0.035	-0.023
	(-1.08)	(-0.90)
$NOL_{i,t}$	-0.024*	-0.090***
	(-1.94)	(-6.79)
$ROA_{i,t}$	0.034	-0.113**
	(0.54)	(-1.98)
$FI_{i,t}$	0.776***	0.786***
	(2.81)	(3.64)
$FCF_{i,t}$	-0.011	0.020
	(-0.25)	(0.64)
$LEV_{i,t}$	-0.059***	-0.079***
	(-3.34)	(-4.50)
$EIIE_{i,t}$	-2.855***	-0.793
	(-3.64)	(-0.84)
Other controls		
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	1,169	1,277
Adjusted R-squared	0.297	0.269

Appendix A: Variable Definition

Variables	Acronym	Description	Data Sources
Measures of tax avoidance:			
CAAP effective tax rate	$GETR$	CAAP effective tax rate, denoted by $GETR$, is calculated as the total income tax expense (txt) divided by the difference between pre-tax book income (pi) and special items (spi). The data frequency is annual.	Compustat
Cash effective tax rate	$CETR$	Cash effective tax rate, denoted by $CETR$, is calculated as the cash taxes paid expense ($txpd$) divided by the difference between pre-tax book income (pi) and special items (spi). The data frequency is annual.	Compustat
Measures of FEMA Assistance:			
FEMA dollar	$FEMA\_dollar$	$FEMA\_dollar$ is the log of the real dollar value of FEMA Assistance provided to the receiving states.	FEMA
Firm-level controls:			
Firm size	$SIZE$	Firm size is the natural logarithm of the firm's market capitalization, which is calculated by multiple annual close prices ($prcc_f$) and common shares outstanding ($csho$).	Compustat
Cash holding	$CASH$	Cash holding is calculated by the cash and marketable securities (che) divided by the lagged asset (at).	Compustat
Loss carry-forward	NOL	Net loss carry-forward is a dummy variable equal to one if loss carry-forward ($tlcf$) is the position for a firm in a given year and zero otherwise.	Compustat
Return on asset	ROA	Return on asset is measured by the operating income ($pi - xi$) divided by the lagged asset (at).	Compustat
Foreign income	FI	Foreign income ($pifo$) scaled by the lagged asset (at). Set missing values to zero.	Compustat
Free cash flow	FCF	The firm's net change in cash from operating activities ($oancf$) minus capital expenditures ($capx$), scaled by the market value of equity ($prcc\_f \times csho$).	Compustat
Leverage	LEV	The firm's financial leverage at the end of the year is calculated by long-term debt ($dltt$) scaled by the lagged asset (at).	Compustat
Equity income in earnings	$EIIE$	The firm's equity income in earnings is calculated by the equity in earnings ($esub$) scaled by the lagged asset (at).	Compustat
Dummy Variables:			
Event dummy	$Event$	Event Dummy denotes the time dummy which equals one for the post-period (2018–2020) and equals zero for the pre-period (2015–2017).	Compustat
FEMA Assistance dummy	$FEMA$	$FEMA\ Assistance$ is a dummy variable that equals one if firms receive FEMA Assistance and equals zero if firms do not receive FEMA Assistance.	
FEMA Assistance×Event dummy	$FEMA \times Event$	The interaction term $FEMA\ Assistance \times Event\ dummy$ equals one only when both dummies equal to one, which indicates firm receiving FEMA Assistance in post-period, and equals to zero otherwise.	

Other Variables:			
FEMA dollar×Event dummy	$FEMA\_dollar \times Event$	The interaction term $FEMA\_dollar \times Event$ is the interaction term between the real dollar FEMA Assistance and the time dummy.	
Social capital	SC	SC the social capital variable of level of voter turnouts in presidential elections.	United States Elections Project
Social capital dummy	$High\_SC$	$High\_SC$ a dummy variable that equals one if a firm is headquartered in a state in a given year with social capital level of voter turnout in presidential elections higher than the median value, and it equals zero otherwise.	
FEMA dollar×Social capital dummy	$FEMA\_dollar_{i,t} \times High\_SC_{i,t}$	The interaction term $FEMA\_dollar \times High\_SC$ is the interaction term between the real dollar FEMA Assistance and the social capital dummy.	

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Chapter 4: Geopolitical Risk, Financial Constraints, and Tax Avoidance

1. Introduction

Geopolitical risk has surpassed cyber risk to be recognized as the foremost global corporate risk in 2020 (WTW 2022). Distinct from political risk, which primarily emanates from political uncertainty, geopolitical risk encompasses adverse events and shocks that extend beyond political borders. These shocks can dramatically influence macroeconomic variables, imperil the financial stability of global enterprises, and force businesses to navigate precarious balances concerning people, operations, and performance on a broader scale (Caldara & Iacoviello 2022). Prior literature has emphasized the adverse effects of geopolitical risk on bank stability (Phan *et al.* 2022), the price of essential commodities like food, oil, and gold (Bouoiyour *et al.* 2019; Su *et al.* 2019; Gkillas *et al.* 2020), common business cycles (Gupta *et al.* 2018), stock return predictability (Ma *et al.* 2022) and corporate cash reserves (Lee & Wang 2021). However, when discussing managerial inclinations towards tax avoidance, current literature leans more towards political than geopolitical risks. For example: Hossain *et al.* (2023) find that firms facing greater political risk tend to engage more actively in corporate tax avoidance. Liu *et al.* (2022) further highlight this by revealing how managers craftily amplify political sentiment in earnings conference calls to strategically bolster tax avoidance tactics. Yet, the influence of geopolitical risk on corporate decisions, especially tax avoidance behavior, remains an under-explored territory.[7] Thus, our study aims to bridge this gap by investigating the relationship between

[7] It is important to note that political risk describes policy uncertainty resulting from changes in monetary policy, fiscal policy, government spending, regulations, and taxation (Nguyen & Nguyen 2020), which is different from geopolitical risk that develops from geopolitical shocks such as wars, military attacks, and terrorist acts, as well as diplomatic conflicts across the globe (Wang *et al.* 2019). A couple of prior studies examine the effect of economic policy uncertainty or political risk on corporate tax avoidance (Nguyen & Nguyen 2020; Kang & Wang 2021; Liu *et al.* 2022; Hossain *et al.* 2023), but there is no research on the direct impact of geopolitical risk on corporate tax avoidance.

geopolitical risk and corporate tax avoidance, drawing on a comprehensive sample of all US firms from 2005 to 2019.

Our research contributes to the literature in two ways. Firstly, our study is the first to provide direct empirical evidence of cross-country risk factors on corporate tax avoidance behavior. Tax avoidance is of great interest to tax authorities, shareholders, and the general public because it is a firm's strategy to reduce or avoid its taxes, which might benefit shareholders, but at the expense of society (Sikka 2010; Huseynov & Klamm 2012). Prior research has documented the impact of some internal risk factors on corporate tax avoidance engagement, namely corporate governance (Minnick & Noga 2010; Khan *et al.* 2017), executive incentives (Desai & Dharmapala 2006; Dyreng *et al.* 2010), financial reporting behavior (Hope *et al.* 2013), and the level of pre-tax income (Rego 2003). Our paper extends the existing literature by exploring the direct impact of geopolitical risks, an external risk factor, on corporate tax avoidance.

Secondly, our work also extends the stream of literature on geopolitical risks by identifying the role of geopolitical risk in altering corporate management behaviors in both the long run and the short run. Thus, we complement the recent burgeoning studies in geopolitical risk that focus on the effect of the risks on the investment and the operation of financial markets (Clance *et al.* 2019; Ma *et al.* 2022; Phan *et al.* 2022; Saâdaoui *et al.* 2022).

We propose two hypotheses to examine the direct effect of geopolitical risks on corporate tax avoidance and a potential channel of the impact. First, we hypothesize that geopolitical risks affect firms' engagement in corporate tax avoidance. We begin by hypothesizing that geopolitical risks have a direct influence on firms' engagement in corporate tax avoidance. In anticipation of increased risks, firms are inclined to maintain elevated cash reserves, leveraging these holdings as a buffer against potential adverse impacts arising from geopolitical tensions (Lee & Wang 2021). This aligns with findings from Kotcharin and Maneenop (2020), who

observe that an increase in aggregate global geopolitical risk positively correlates with higher cash reserves, leading to greater cash holdings. Consequently, a rise in geopolitical risk might intensify a firm's engagement in corporate tax avoidance, a response induced by effects on cash holdings.

However, the relationship between geopolitical risk and tax avoidance is not straightforward. Hanlon *et al.* (2017) highlight substantial variations in cash holdings among both multinational and purely domestic firms, even when exposed to similar geopolitical risks. Moreover, an alternative hypothesis posits that escalating geopolitical risks at the firm level may intensify scrutiny over firms, making tax avoidance more problematic and potentially costly during these times. The risk of negative publicity in periods of heightened tensions could compel firms to abandon or alter their tax avoidance strategies. Thus, geopolitical risks might indeed influence firms' tax avoidance strategies, but the nature and direction of this impact remain elusive. Our study seeks to shed light on this intricate relationship, aiming to furnish empirical evidence that clarifies the true influence of geopolitical risks on corporate tax avoidance.

Next, we hypothesize that the impact of geopolitical risks on corporate tax avoidance varies across firms with different levels of financial constraints. Prior studies indicate that higher cash holdings are more valuable for financially constrained firms than for unconstrained firms (Almeida *et al.* 2004; Faulkender & Wang 2006). Furthermore, financially constrained firms tend to pursue more aggressive tax planning relative to their non-financially constrained counterparts (Chen & Lai 2012; Law & Mills 2015).[8] Since geopolitical risks affect corporate

[8] The literature asserts that geopolitical risk heightens corporate financial constraints. Conversely, the interplay between political risk and financial constraint remains unresolved. Ma and Hao (2022) contend that political risk intensifies these constraints, a view countered by Makosa *et al.* (2021), who argue that Chinese firms reduce investments, thereby easing financial constraints, in response to political risk. It is essential to stress that the influence of geopolitical risk on corporate tax avoidance, mediated by financial constraints, cannot be

tax avoidance strategies via their induced effect on a firm's cash holdings, the impact of geopolitical risks on tax avoidance will likely differ across firms depending on the firm's financial constraints. However, Denis and Sibilkov (2009) find that despite the apparent benefits of high cash holdings for financially constrained firms, some of these firms have low cash holdings because of persistently low cash flows. Thus, the role of financial constraints in enhancing or dampening the impact of geopolitical risks on corporate tax avoidance remains unexplained in the literature, which we aim to address in this study.

To examine the hypothesized relationships, we employ Caldara and Iacoviello's (2022) newly proposed geopolitical risk measures for all public firms in the US in the Compustat database from 2005 to 2019 and implement various empirical analyses including the ordinary least square (OLS) regression, propensity score matching, and difference-in-differences analyses. We find statistically significant evidence supporting our hypothesis that geopolitical risk increases corporate engagement in tax avoidance activities. Specifically, we observe that a one-percent increase in geopolitical risk proxy leads to higher tax avoidance, which is shown by an average 0.94 standard deviation decrease in effective tax rates.

In addition, we find that this effect is more pronounced for firms with higher financial constraints. To eliminate potential concerns about the endogeneity issue in our empirical setting, we perform an event study using the 2016 Organization of the Petroleum Exporting Countries (OPEC) agreement on cutting oil production as a quasi-natural experiment. The 2016 OPEC agreement could be seen as an exogenous shock to oil-related firms in the US because the global oil supply declined and the price of oil increased after the agreement was announced. Using a propensity score matching procedure and difference-in-differences methods, we find that US oil-related firms engaged in more aggressive tax avoidance activities than their non-

straightforwardly applied from the impact of political risk on tax avoidance. The relationships are distinct and warrant separate examination.

oil-related counterparts. This suggests that our findings in the baseline analyses are not biased by the endogeneity problem. Our findings are robust with alternative measures of financial constraints and industry exposure, and also robust with controlling for firm-level political risk.

The rest of this study is organized as follows. Section 2 discusses the literature review and hypothesis development. Section 3 outlines our sample and variable measurement. Section 4 presents empirical analyses, including our baseline regression, channel analysis, a quasi-natural experiment, as well as robustness tests. Section 5 concludes the paper.

2. Literature Review and Hypothesis Development

2.1 Geopolitical Risk versus Political Risk

External risk factors, such as *political* risk and *geopolitical* risk, are becoming an increasing concern for corporations, market participants, and central bank officials due to the potential for significant adverse economic effects (Carney 2016). However, one needs to distinguish these two types of risk factors because they refer to distinct risks and lead to different outcomes.

Political risk defines policy uncertainty surrounding monetary policy, fiscal policy, government spending, regulation, and taxation (Nguyen & Nguyen 2020). These uncertainties are also referred to as *economic policy uncertainty*. Recent studies discuss the effects of economic policy uncertainty on corporate behavior and decision-making. Hassan *et al.* (2019) find that firm-specific stock return volatility and planned capital expenditure are heavily affected by policy uncertainty. Julio and Yook (2012) indicate that firms reduce investment expenditure around election years given the uncertainty surrounding monetary policy and tax policy, as well as potential regulatory changes. The impacts of political risk on corporate

behaviors are also explored, including mergers and acquisitions (Bonaime *et al.* 2018), capital investment (Gulen & Ion 2016), and firm-level investment (Kang *et al.* 2014; Wang *et al.* 2014).

Different from political risk, geopolitical risk arises from geopolitical shocks, which include but are not limited to wars, military attacks, terrorist acts, as well as diplomatic conflicts all over the world (Wang *et al.* 2019). The adverse impacts of geopolitical risk are explored extensively in the prior literature, and the effects include the effect on the prices of oil and gold (Bouoiyour *et al.* 2019; Su *et al.* 2019; Gkillas *et al.* 2020), the price of essential food commodities (Ma *et al.* 2022), excess stock return predictability (Ma *et al.* 2022), bank stability (Phan *et al.* 2022) and common business cycles (Gupta *et al.* 2018). Overall, the current literature mainly focuses on the effect of geopolitical risk on macroeconomic factors, while research on its effect on corporate strategies is scarce.

2.2 Determinants of Corporate Tax Avoidance

Corporate tax avoidance, a corporate strategy that reduces tax payments relative to the pre-tax income, is recognized to be a valuable alternative financing method for companies (Dyreng *et al.* 2010; Edwards *et al.* 2016). Current studies have explored several firm-related factors that can have an impact on tax avoidance engagement.

Gallemore and Labro (2015) find that a higher quality of corporate internal information promotes tax avoidance, which is more pronounced for firms with geographic dispersion or greater uncertainty on their effective tax rates. In addition, Rego (2003) states that there is a negative correlation between the effective tax rate and pre-tax income. Therefore, firms with higher pre-tax income tend to have more incentives to engage in more tax planning activities.

Furthermore, the reputational costs of tax avoidance are also documented as an important factor to limit tax avoidance activities. Graham *et al.* (2014) utilize survey data to capture direct

information from top management groups and find that executive incentives affect the level of tax avoidance comprehensively. Graham *et al.* (2014) state that nearly half of all executives in publicly traded companies value generally accepted accounting principles effective tax rates (GAAP ETRs) more than cash taxes paid, and 37 percent of them weighted both equally. In addition, Graham *et al.* (2012) discuss the limitation of using book-tax difference as a proxy for tax avoidance, whereby they find that book-tax difference captures earnings management, tax laws, as well as differences in accounting standards. Therefore, in this study, we use effective tax rates to capture corporate tax avoidance activities.

Dyreng *et al.* (2010) find that individual executives have a statistically and economically significant impact in determining the level of tax avoidance that firms engage in, and these are incremental effects that cannot be explained by firm characteristics. Desai and Dharmapala (2006) find that increases in the high-powered incentives for managers effectively reduce tax sheltering incentives. This finding is consistent with the feedback effects between managerial diversion and tax sheltering. Furthermore, for firms with weak governance arrangements, the adverse effects of incentive compensation on tax sheltering are more pronounced relative to well-governed firms.

In summary, the prior literature has focused on the internal determinants of tax avoidance, whereas external factors, such as geopolitical risk, are limited.

2.3 Hypothesis Development: Induced Effect of Cash Reserves and Financial Constraints

The prevailing literature emphasizes that a rise in geopolitical risk corresponds with an expansion in firm cash reserves, as evidenced by studies from Lee and Wang (2021); Kotcharin and Maneenop (2020); Tekin *et al.* (2023). Tekin *et al.* (2023) further demonstrate that firms situated in countries with elevated geopolitical risks maintain more significant cash reserves,

presumably as a safeguard against such risks. A plausible rationale for this behavior is the potential escalation in external financing costs and economic instability resulting from higher geopolitical risks (Lin & Paravisini 2013). Consequently, firms may enhance their cash savings to offset these detrimental effects, possibly leading to more assertive tax avoidance strategies.

However, Hanlon *et al.* (2017) uncover substantial variations in cash holdings across multinational and purely domestic firms. The stark contrasts in cash holdings and the enduring presence of low cash reserves within certain firms over time, even within the same country, imply a multifaceted relationship. This complexity gives rise to an alternative hypothesis: escalating geopolitical risks at the firm level may intensify scrutiny over the firms, making tax avoidance during such periods more fraught with costly implications. The threat of negative publicity during periods of increased tensions may compel firms to reassess and possibly abandon their tax avoidance initiatives. Consequently, rather than pursuing aggressive tax avoidance strategies, heightened geopolitical risks might prompt firms to adopt more conservative approaches. In this intricate landscape, while it is apparent that geopolitical risks can affect firms' tax avoidance strategies, the exact nature and trajectory of this influence could not be directly derived from the existing literature. Thus, our study provides empirical evidence on whether geopolitical risks are associated with higher or lower levels of corporate tax avoidance.

Furthermore, the impact of geopolitical risk on corporate tax avoidance is likely to differ across firms with different levels of financial constraints. Chen and Lai (2012) find that financially-constrained firms engage in more aggressive tax avoidance relative to their financially-unconstrained counterparts. Law and Mills (2015) utilize firms' qualitative disclosures as a new measure of financial constraints and conclude that firms that are financially constrained use more negative words in their financial reports and practice more aggressive tax sheltering. In particular, these financially constrained firms exhibit evidence of

higher levels of unrecognized tax benefits and lower effective tax rates in both the short run and the long run.

Therefore, we can formulate the following two hypotheses.

Hypothesis 1: Geopolitical risk is statistically associated with corporate tax avoidance engagement.

Hypothesis 2: The impact of geopolitical risks on corporate tax avoidance varies across firms with different levels of financial constraints.

3. Sample and Variable Measurement

3.1. Sample Selection and Data Description

Our sample consists of all publicly listed firms in the US from 2005 to 2019. We download the daily and monthly geopolitical risk (GPR) index for the US, which is a newspaper-based index proposed by Caldara and Iacoviello (2022).[9] This GPR index is based on an automated search coverage of geopolitical-tension-related terms in about 25 million news articles from 10 foremost international newspapers, including *The Chicago Tribune, The Daily Telegraph, The Financial Times, The Globe and Mail, The Guardian, The Los Angeles Times, The New York Times, USA Today, The Wall Street Journal, and The Washington Post*. The inclusion of leading newspapers from the United Kingdom, the United States, and Canada ensures that the estimated index takes into account sufficient global coverage of important geopolitical events and their repercussions (Caldara & Iacoviello 2022). It is important to note that the GPR index is recognized to be weakly correlated with other widely-used political uncertainty indices

[9] We thanks Caldara and Iacoviello (2021) for kindly providing the data and the replication codes.

(Wang *et al.* (Forthcoming); Caldara and Iacoviello (2022)). We obtain financial data and firm-level characteristics from Compustat North America Database.

3.2. Variable Construction

3.2.1. Measures of Geopolitical Risk

The US daily and monthly country-level GPR indices are downloaded from Caldara and Iacoviello (2022). These indices are generated by jointly counting the occurrences of geopolitical-related terms and country names in the leading newspapers. Following the methodologies outlined in Caldara and Iacoviello (2021) and Caldara and Iacoviello (2022), we estimate the firm-specific and industry-specific GPR indices to capture the differential effects of geopolitical risk across firms.

We estimate the firm-level GPR index as embedding three components. The first component, GPR_t, is the average of all monthly GPR indices in quarter *t*. The second component takes into account the role of industry exposure, γ_t. And the third component, $Z_{i,t}$, is the idiosyncratic firm-level GPR index. For the second component, we estimate the industry exposure by regressing the daily portfolio returns in the 49 industry groups of Fama and French (1997) on changes in the daily GPR index, as presented in the regression equation (1).

$$R_{k,t} = \alpha_k + \beta_k \Delta GPR_t + \varepsilon_{k,t} \quad (1)$$

where $R_{k,t}$ is the annualized daily excess return in industry k over the one-month T-bill rate and ΔGPR_t is the change in the country-level daily GPR index. The estimated beta coefficient of equation (1) was demeaned and the sign was changed to get the industry exposure values. A positive value of this industry exposure indicates high exposure. The value of industry exposure in a quarter is calculated as the average of the estimated beta coefficients in

that quarter. The industry exposure is included to capture the instance that certain industries exhibit more sensitivity towards geopolitical risk.[10]

The third component, $Z_{i,t}$, is the idiosyncratic firm-level GPR index. This component is included to isolate any firm-level effects that are not captured at either the country or industry levels, which might happen in the two following situations. First, certain firms exhibit time-varying exposure to geopolitical risks due to unique political connections, risk management, trading exposure, or geographic locations (e.g., Apple in the US-China tension). Second, some firms experience significant geopolitical risks because their headquarters are in countries whose geopolitical risks are not fully captured at the country- or industry-level (e.g., a technology company in Syria). We obtain firm-level political risk (Hassan *et al.* 2019) and firm-level GPR index (Caldara & Iacoviello 2022), which is derived from textual analysis of firms' transcripts of the quarterly earnings call, to capture the time-varying exposure and location exposure. Collectively, these components consider all GPR-related words for each single firm. The calculation of the firm-level GPR index is then determined by taking the natural logarithm of the ratio of 100 times geopolitical-risk-related words divided by the total number of words in the given newspaper section. The formula for this can be expressed as ln(100 * GPR-related words / total words).

The industry-level GPR index is calculated by multiplying the logarithm of the changes in the country-level GPR index and an industry exposure dummy. This industry-level index is

[10] Harvard Business Review reports that companies in the industry of manufacturing and selling semiconductor products are heavily affected by the growing tension between the US and China. The anxieties in the US around China's manufacturing capacities lead to the US government's restriction of Chinese firms' access to US technology, which results in higher geopolitical tensions in the private sector than at the government level (Lee & Glosserman 2022).

used to quantify the differential impacts of geopolitical risk across industries (Caldara & Iacoviello 2022).[11]

3.2.2. Measures of Tax Avoidance

We use two measures of corporate tax avoidance, including the cash effective tax rate ($CETR$) and the long-run effective tax rate ($LRETR$). Following Dyreng *et al.* (2010), cash effective tax rate ($CETR$) is defined as firms' cash taxes paid divided by pre-tax accounting income in a one-year window. Long-run effective tax rate ($LRETR$) is defined as the cash tax paid dividend by the difference between pre-tax income and special items in each five-year window (Dyreng *et al.* 2008). Using these two rates as the proxies of corporate tax avoidance offers several advantages. First, Kim *et al.* (2011) state that the traditional Generally Accepted Accounting Principles (GAAP) effective tax rate does not consider the stock options in employees' compensation packages, whereby the tax benefits of stock options given to an employee are considered in cash effective tax rates. Second, changes in the accounting estimates do not affect the cash effective tax rate, while changes like valuation allowances and tax contingency reserves may affect GAAP effective tax rates (Kim *et al.* 2011). Furthermore, the two effective tax rates take into account both short- and long-run variations in the engagement in tax avoidance, aim to triangulate the results to avoid the potential limitations of each measure (Hanlon & Heitzman 2010) and provide more confidence if results are consistent between different measures.

We follow Kim *et al.* (2011) to use a five-year horizon to account for firms' long-run tax behavior. Also, we require at least three consecutive years of non-missing data to calculate the

[11] The industry exposure dummy equals one for industries with above-median industry exposure γ_t, and equals zero otherwise.

long-run cash effective tax rate ($LRETR$). Compared with the cash effective tax rate, $CETR$, the long-run cash effective tax rate ($LRETR$) has the potential to capture firms that successfully engage in tax avoidance in the long run. Both tax avoidance measures are indirect proxies of corporate tax avoidance given that a lower value for those proxies indicates more aggressive engagement in tax avoidance. We truncate tax avoidance measures to the range of 0 and 1 following Nguyen and Nguyen (2020).

3.2.3. Firm-Level Characteristics

Prior literature has extensively discussed firm-level controls that are correlated with tax avoidance (Chen *et al.* 2010; Dyreng *et al.* 2010; Gallemore *et al.* 2014; Cen *et al.* 2017). We include commonly used controls in the tax avoidance literature, including firm size ($SIZE$), cash holdings ($CASH$), net loss carry-forwards (NOL), profitability (ROA), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). In addition, we also include the lagged value of both tax avoidance proxies (LAG_CETR and LAG_LRETR) to account for the effect of prior tax avoidance engagement on future tax planning.

The firm size ($SIZE$) is constructed by taking the logarithm of the firm's market capitalization. Based on the 'political cost' hypothesis, Zimmerman (1983) states that firms behave more aggressively in tax planning if the firm size is larger than the sample average. An explanation for this finding is that larger firms are generally more sophisticated and experienced in deploying more complex tax avoidance strategies (Hanlon 2005).

The existing literature seems to propose conflicting hypotheses regarding the effect of cash holdings ($CASH$) on corporate tax avoidance. Cen *et al.* (2017) find that firms with higher levels of cash holdings are reluctant to engage in aggressive tax planning given there are

adequate cash reserves for further investment needs. However, Hanlon *et al.* (2017) state that firms always tend to harbor more cash holdings to prevent any future cash shortfalls payable to the Internal Revenue Service (IRS).

In addition, we also include ROA to account for the incentive of aggressive tax avoidance. Edwards *et al.* (2016) indicate that firms are discouraged to engage in more tax avoidance activities if they have higher profitability (ROA). Furthermore, Chen *et al.* (2010) claim that firms with higher levels of carry-forward losses (NOL) have an incentive to conduct more aggressive tax strategies than firms with lower levels of carry forward losses (NOL). We include foreign income (FI) because multinational firms have more capacity and incentives to avoid taxes due to their potential benefits from low-tax-rate foreign jurisdictions, and geographic earnings disclosure (Hope *et al.* 2013). Furthermore, Rego (2003) discusses the importance of foreign income and finds that multinational firms exhibit lower worldwide effective tax rates relative to firms that only operate domestically.

Free cash flow (FCF) is constructed as the net change in cash derived from operating activities scaled by the total equity. The inclusion of free cash flow (FCF) captures the availability of internal funding that relates to the engagement in tax avoidance (Atawnah *et al.* 2018). Financial leverage (LEV) promotes the tax shield benefit with a higher level of external borrowing. Leverage can effectively reduce the marginal tax rate and disincentivizes aggressive tax planning (Graham 1996).

Chen *et al.* (2010) argue that the book-tax difference becomes larger when accounting and tax regulations are different for investments, and this difference is captured by equity income in earnings ($EIIE$). In Table 1, we present descriptive statistics for firm-level geopolitical risk, tax avoidance measures, as well as firm-level controls. The summary statistics are in line with

prior studies (i.e., (Cen *et al.* 2017; Nguyen & Nguyen 2020). All variables are defined in Appendix A.

[Insert Table 1]

4. Empirical Analysis

4.1 Baseline Results

We examine the dynamic effect of geopolitical risk on corporate tax avoidance at both the firm and industry levels, respectively, using the following regression equations.

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$TA_{i,k,t} = \beta_3 \Delta GPR_t \times IDD_{k,t} + \beta_4 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

The subscript "k" refers to an industry in the US. The subscript "i, t" refers to firm i in year t. TA is tax avoidance measures that includes the cash effective tax rate ($CETR$) and the long-run cash effective tax rate ($LRETR$). $FA_{i,t}$ is a vector of firm-level characteristics for firm i in year t, which include firm size ($SIZE$), cash holdings ($CASH$), net loss carry-forwards (NOL), profitability (ROA), foreign income (FI), free cash flow (FCF), financial leverage (LEV), and equity income in earnings ($EIIE$). $TA_{i,t-1}$ is tax avoidance measures in the prior year for any given firm i, which are denoted as $LAG\_CETR_{i,t}$ and $LAG\_LRETR_{i,t}$ for cash effective tax rate and the long-run cash effective tax rate, respectively. We include both firm-fixed effects and year-fixed effects to take into account any trend in these factors over time and eliminate omitted variable biases.

In the regression equation (2), the variable of interest, $Firm\_GPR_{i,t}$, is a firm-specific annual GPR index, which captures three components, including the country-level GPR index, the interaction term between the country-level GPR index and industry exposure, as well as the idiosyncratic firm-level GPR index as discussed in the earlier section. In the regression

equation (3), ΔGPR_t denotes the logarithm of the change in the country-level GPR index. $IDD_{k,t}$ is an industry exposure dummy, which equals one for industries that have above-median geopolitical risk exposure and equals zero otherwise. $\Delta GPR_t \times IDD_{k,t}$ is the interaction between the log changes in the country-level GPR index, ΔGPR_t, and the industry exposure dummy.

Table 2 reports the estimation results for the regression equations (2) and (3).[12] The dependent variables are $CETR$ in columns (1) to (3) and $LRETR$ in columns (4) to (6). Following Caldara and Iacoviello (2022), we report the estimation results for firm-fixed effects and firm-year fixed effects in both firm-level and industry-level analyses.

[Insert Table 2]

The firm-level analyses show that the coefficient estimates for both tax avoidance measures are negative and statistically significant at the 5% level (see columns (1) and (4)). The coefficient estimates are also economically significant because a one-standard-deviation increase in $FIRM\_GPR$ leads to an average 0.94 standard deviation decline in effective tax rates.[13] As stated, a lower value for tax avoidance proxies implies more aggressive engagement in tax avoidance. Therefore, the negative and significant estimated coefficients of $FIRM\_GPR$ indicate that firms engage in more aggressive tax avoidance activities when they face increased geopolitical risk.

In the industry-level regression analyses, we find that the estimated coefficients for $\Delta GPR \times IDD$ are negative and significant for both tax avoidance measures as presented in

[12] The decline in the number of observations in Table 2, as compared to Table 1, stems from the significant reduction in observations due to the inclusion of lagged values in two tax avoidance measures that are used as control variables in the regressions.

[13] A one standard deviation change in firm-level geopolitical risk is associated with a 1.03 and 0.85 standard deviation decrease in the effective tax rates.

columns (2), (3), (5), and (6) at either the 1% or 5% levels. The coefficient estimates are also economically significant considering that a one-standard-deviation increase in $\Delta GPR \times IDD$ leads to an average 5.19% decrease in effective tax rates, calculated as at the relevant mean values [14]. The findings suggest that there is a positive association between geopolitical risk and corporate tax avoidance.

Regarding the firm-level control variables in Table 2, we find coefficient estimates are statistically significant and in line with the prior literature (Chen *et al.* 2010; Cen *et al.* 2017; Nguyen & Nguyen 2020). For example, the estimated coefficients for $SIZE$ are negative, and this result is supported by Zimmerman (1983) finding that larger firms are more sophisticated and engage in more tax avoidance. In addition, we observe negative estimated coefficients for FI and FCF, which is consistent with Rego (2003) and Hope *et al.* (2013). Moreover, we find the estimated coefficients for lagged tax avoidance measures, $LAG\_CETR_{i,t}$ and $LAG\_LRETR_{i,t}$, to be positively significant in all specifications. This is in line with Dyreng *et al.* (2008), who find that firms engaging in aggressive tax planning activities in the past tend to continue their participation in aggressive tax avoidance in the current period. Our regression results confirm this persistence in tax avoidance behavior, whereby the magnitude of the estimated coefficients of $LAG\_LRETR_{i,t}$, a measure of long-run tax avoidance, is larger than the estimated coefficients of $LAG\_CETR_{i,t}$ that measures short-run tax avoidance.

Overall, our regression results suggest that firms that experience increased geopolitical risk engage in significantly higher tax avoidance. This relationship is discovered at both firm and industry levels. This relationship is also important as it gives insight into how firms revise

[14] A one standard deviation change in industry-level geopolitical risk is associated with a 7.85%, 5.94%, 3.49%, and 3.49% decrease in the effective tax rates at the mean values.

their engagement in tax avoidance strategy when they experience external geopolitical events and shocks.

4.2 Channel Analysis

In this section, we explore the underlying economic channels through which geopolitical risk affects engagement in corporate tax avoidance. Lee and Wang (2021) state that firms tend to hoard more cash reserves when facing geopolitical risk. In addition, as a precautionary measure, financially constrained firms tend to maintain a certain level of cash reserves as a buffer against geopolitical risk. Prior literature examines the impact of financial constraints on corporate tax avoidance. Chen and Lai (2012) and Law and Mills (2015) find that financially-constrained firms tend to pursue more aggressive tax planning and have lower effective tax rates in both the short and long run. The internally generated funds are attained by aggressive tax planning for firms that have an increase in financial constraints (Edwards *et al.* 2016). Thus, we investigate the role of financial constraints in channelling the impact of geopolitical risks on corporate tax avoidance strategies.

Following Hasan *et al.* (2014), we use two dummy variables, $HIGH$ and LOW, to indicate the level of financial constraints in any given firm i. Firm sales and their Z-score are employed to measure the level of the firm financial constraints, following Lee and Wang (2021). We define the variable $HIGH$ as equal to one if the firm's financial constraint level is less than the sample median value and equal to zero otherwise. The variable LOW equals one minus $HIGH$, which indicates firms with a lower level of financial constraint. We then generate two interaction terms between firm-level geopolitical risk and these dummy variables, $HIGH$ and LOW. The intuition is to delineate the effect of firm-level geopolitical risk on highly financially constrained firms as opposed to less financially constrained firms. We perform a similar firm-

level regression analysis as in equation (2), but we replace firm-level geopolitical risk with the interaction terms between financial constraint dummy indicators. The regression model is written as follows:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} \times HIGH_{i,t} + \beta_2 Firm\_GPR_{i,t} \times LOW_{i,t} + \beta_3 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \quad (4)$$

where $TA_{i,t}$ is the tax avoidance measure, $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk index, and $FA_{i,t}$ is a vector of the firm characteristics. Firm and year-fixed effects are utilized in all regression specifications. We report the regression results in Panel A of Table 3 where the estimation results using Sales and Z-score are presented in Panels A1 and A2, respectively.[15]

[Insert Panel A of Table 3]

In Panel A1 of Table 3, we find that the estimated coefficients (β_1) on the interaction term $Firm\_GPR \times HIGH$ are statistically significant for both short-run and long-run tax avoidance measures. Since a lower value of the tax avoidance measure indicates more aggressive engagement in corporate tax avoidance, the regression result suggests that the geopolitical risk effect is associated with more aggressive corporate tax avoidance strategies in firms with high financial constraints, as indicated by below-median sales. The estimated coefficients (β_2) on the interaction term $Firm\_GPR \times LOW$ are insignificant for both tax avoidance measures. We find similar results when using the Z-score as a proxy for financial constraints (see Panel A2, Table 3). Furthermore, we perform the Chow test to examine whether the coefficient estimates for the interaction terms are equal. The reported F-statistics and associated *p-value* for the tests

[15] For brevity, only estimates for the interaction terms are tabulated and reported in Table 3. The full estimation results are available upon request.

in each panel of Panel A of Table 3 suggest a rejection of the null hypothesis ($\beta_1 = \beta_2$) in all four specifications.

In addition to the channelling role of financial constraints on the impact of geopolitical risk on corporate tax avoidance, the existing literature proposes that firms with foreign operations are necessarily financially constrained and engage in more tax avoidance than their domestically operated peers. Prior research has documented the home bias of investment and operations (Feldstein & Horioka 1980; Coval & Moskowitz 1999; Bun 2021). Multinational firms are likely to face more financial constraints because of cognitive bias towards lower information costs (Merton 1987) and familiar investments (Huberman 2001). Furthermore, firms with more extensive foreign operations avoid more taxes relative to their domestic-only counterparts by shifting taxable income to low-tax jurisdictions (Rego 2003; Bustos *et al.* 2019; Dyreng & Hanlon 2021). Thus, we split our sample into firms with foreign operations and firms without foreign operations to investigate if financially constrained firms with foreign operations engage in more tax avoidance activities relative to their domestic-only peers.

[Insert Panel B of Table 3]

We perform a similar firm-level regression analysis as in equation (4) in two groups. In both panels of Panel B of Table 3, we find that the estimated coefficients on the interaction term $Firm\_GPR \times HIGH$ are statistically significant for firms with foreign operations in both short-run and long-run tax avoidance measures. Since a lower value of effective tax rate suggests more aggressive engagement in corporate tax avoidance, the regression result indicates that the geopolitical risk effect is associated with more aggressive corporate tax avoidance plannings in highly financially constrained firms with foreign operations relative to their domestically operated peers.

Overall, our findings support Hypothesis 2, that the impact of geopolitical risks on corporate tax avoidance varies across firms with different levels of financial constraints. Highly financially constrained firms engage in more aggressive tax avoidance when they encounter increased geopolitical risk than their counterparts with low financial constraints. This effect is more pronounced for firms with foreign operations compared to firms that only operate domestically.

4.3 Additional Analyses: Firm-level Investment and Managerial Entrenchment

Firms that experience severe geopolitical risk suffer the effect of uncertainty on investment. Wang *et al.* (2019); Caldara and Iacoviello (2022) document that the negative consequences of geopolitical risk have a greater impact on companies operating in more vulnerable industries, and companies with a higher level of geopolitical risk experience reduced investment levels. Wang *et al.* (2019) also find that the investment rate depresses by 14% relative to the sample mean when the GPR index doubles. Using asset redeployability as a proxy for investment irreversibility, (Kim & Kung 2017) also find that the negative association between geopolitical risk and investment is more pronounced for firms with more irreversible assets. This indicates that firms with lower asset redeployability find it more challenging to shift their assets among various investment opportunities.

Despite these findings, it should not be assumed that all firms facing geopolitical risk will necessarily avoid valuable investments. Instead, the detrimental impact on investment may be more prominent in firms with higher levels of investment. These firms, when experiencing geopolitical risk, may encounter financial constraints, and their use of tax avoidance strategies might alleviate these fiscal challenges. To further explore and substantiate this hypothesis, we

have conducted an additional analysis, categorizing the firm-level baseline regressions into two groups based on investment levels.

[Insert Table 4]

To discern how the influence of geopolitical risk on corporate tax avoidance varies between firms with high and low investment levels, we categorized our baseline sample into two groups using the median investment as the threshold. The findings, detailed in Table 4, indicate that for firms with a higher investment magnitude, the coefficient estimates related to $FIRM\_GPR$ are statistically significant. Conversely, for the group with a lower investment profile, the results are not statistically meaningful. This distinction between the two groups is notably significant, emphasizing that firms with higher investments are more influenced by geopolitical risk in terms of increased engagement in corporate tax avoidance.

We also examine tax avoidance from the standpoint of agency theory, considering the possibility that managers may exploit tax benefits for their advantage, thereby diminishing the value-efficiency of avoiding taxes. This scenario might arise particularly during heightened geopolitical risks, as the turbulent environment may present more opportunities for aggressive tax avoidance, and managers may be more inclined to take such risks. Entrenched managers, those who do not provide transparent information to stakeholders, may be especially prone to this behavior.

To explore this connection, we construct the E-index as a measure to gauge a firm's level of managerial entrenchment, dividing the full sample into two subsamples: firms with high and low E-index values, using the median of the E-index as the dividing point. A higher E-index value implies weaker shareholder rights and greater managerial control within the company. The baseline regressions are then performed for both subsamples, and the results are outlined in Appendix A2. Intriguingly, the estimated coefficient of the GRP index is statistically

significant only when the cash-effective tax rate serves as the dependent variable in the high E-index sample. In summary, though there are some indications of a relationship between the degree of managerial entrenchment and geopolitical risks, our findings do not consistently support a definitive link between these two factors, calling for further exploration and analysis.

4.4 Endogeneity Issue: The Quasi-Natural Experiment of the 2016 OPEC Agreement

In the previous sections, we find that there is a positive relationship between geopolitical risk and the aggressiveness of corporate tax avoidance strategies. This relationship is more pronounced for firms with high financial constraints. Although the reverse causality issue is not a concern in our empirical setting because it is unlikely that more aggressive corporate tax avoidance will lead to higher geopolitical risk, one might raise an endogeneity problem relating to omitting variables in the model. We employed fixed effect specification to address the omitting factor concern in all of our empirical analyses. However, Caldara and Iacoviello (2022) state that a firm may encounter elevated geopolitical risks due to its operation in a specific country, and certain geopolitical events and shocks may not be fully reflected in the country- and industry-level indexes that we have previously employed. Therefore, in this section, we alleviate these endogeneity concerns by exploring an exogenous shock, the 2016 Organization of the Petroleum Exporting Countries (OPEC) agreement, to see if the impact of geopolitical risks on corporate tax avoidance strategies differs across industries.

In late 2016, OPEC reached a deal with its 14 member countries to cut oil production, aiming to protect oil prices from falling due to global oversupply. This decision was particularly driven by the imminent threat of a dramatic increase in US crude oil exports (Meredith 2016; Reuters 2020). During the OPEC Ministerial Conference on November 30th, 2016, a new production target was set at 32.5 million barrels per day, reducing the existing

output by 1.2 million barrels per day. This cut led to oil prices falling to a lower bound of $44 per barrel (Reuters 2020). The '2016 OPEC Banning US Oil Exports Agreement' subsequently constrained and limited the global crude oil supply, leading to a steady increase in crude oil prices. However, the agreement had significant repercussions on oil-related industries in the US (NASReport 2016). As geopolitical risk encompasses adverse events and shocks that affect nations beyond their political borders, the 2016 OPEC agreement stands as a prime example. It exposed certain US firms to considerable economic and financial risks, far more than others. Thus, this agreement serves as a quasi-natural experiment to address the potential endogeneity problem previously discussed because US oil-related companies faced heightened geopolitical risk from the price increase than their non-oil-related counterparts.

We perform a propensity score matching procedure to identify a set of matching non-oil-related firms for the treatment sample, which includes all oil-related firms in our sample. It is important to acknowledge the potential concern that the 2017 Tax Cuts and Jobs Act might have contributed to lower corporate taxes in the post-period and that these lower taxes could be interpreted as unrelated to geopolitical risk. However, the methodological framework of this study employs a propensity score matching procedure and difference-in-differences approach, enabling us to mitigate this concern. Specifically, this procedure identifies a set of matching non-oil-related firms for the treatment sample, which includes all oil-related firms in our sample. As both matching non-oil-related firms and oil-related firms operate within the same macroeconomic environment and are subject to identical government policies, including the 2017 Tax Cuts and Jobs Act, the effects of the Act are essentially controlled for, given the use of the difference-in-differences approach in our paper. Thus, any observed changes in tax avoidance strategies for oil-related firms following the 2016 OPEC meeting can be attributed solely to the oil supply shocks, rather than the influence of the Act.

We define a dummy variable, $Treat$, that equals one for all the treatment firms that belong to any of the oil-related Fama-French industry groups and equals zero otherwise. The oil-related Fama-French industry groups include *Petroleum and Natural Gas, Aircraft, Automobiles and Trucks, Coal, Construction, Construction Materials, Precious Metals, Rubber and Plastic Products, Shipbuilding, Railroad Equipment, Shipping Containers, Steel, and Transportation*. We use a nearest-neighbor matching with no replacement to control for differences in firm-level characteristics between the treatment and control firms before 2016.

We then apply difference-in-differences analysis to examine whether firms in oil-related industries are engaged in more aggressive tax avoidance strategies than non-oil-related firms after the 2016 OPEC agreement. We perform an event study for the samples over the investigated period of 2013–2019, i.e., we use a 3-year pre-treatment and a 3-year post-treatment period. We estimate the average treatment effect of the 2016 OPEC agreement using the difference-in-difference regression shown below:

$$TA_{i,k,t} = \beta_1 Treat \times Post + \beta_2 Post + \beta_3 Treat + \beta_4 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \quad (5)$$

Similar to the baseline regression model, the dependent variables, TA, are tax avoidance measures including the cash effective tax rate ($CETR$) and the long-run cash effective tax rate ($LRETR$); $FA_{i,t}$ is a vector of the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), net loss carry-forwards (NOL), profitability (ROA), foreign income (FI), free cash flow (FCF), financial leverage (LEV), as well as equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measures in the prior year for firms i. The dummy variable, $Treat$, equals one for the treatment firms that belong to any of the above oil-related Fama-French 49 industry groups and equals zero otherwise. The match firms are those that do not belong to any of those oil-related industries. The dummy variable *Post* equals one for the post-event period (2017–2019) and zero for the pre-event period (2013–2015). The interaction term $Treat \times Post$

captures the average treatment effect of the 2016 OPEC agreement on corporate tax avoidance. Following He and Huang (2017), we use various specifications of firm-fixed effect and industry-fixed effect in the regression analysis. The regression estimations are reported in Table 5.

We observe that the estimated coefficients of the interaction term, $Treat \times Post$, are negative and statistically significant at either the 5% or 10% level, across all model specifications. This suggests that firms in oil-related industries (i.e., firms that experience adverse effects due to the 2016 OPEC agreement) exhibit lower effective tax rates than their non-oil-related counterparties, indicating that firms in oil-related industries engage in more aggressive tax avoidance activities than firms in non-oil-related industries.

[Insert Table 5]

Overall, our analyses suggest that US oil-related firms engage in more aggressive tax planning than their non-oil-related counterparts due to heightened geopolitical risk (i.e., restricted oil supply and increased oil price) arising from the 2016 OPEC agreement. This indicates that the relationship between geopolitical risks and corporate tax avoidance strategies differs across industries, whereby firms in certain industries adjust their engagement in tax avoidance more than firms in other industries, particularly in response to geopolitical shocks.

4.5 Robustness Analyses: Industry Exposure and Firm-level Political Risk

In the baseline regression, we take into account industry exposure by including the industry exposure dummy variable (IDD) in the regression analyses because Caldara and Iacoviello (2022) suggest that the industry exposure dummy makes the regression estimations "more robust to the exact quantification of exposure".

As a robustness check for the earlier industry-level analysis, in this section, we use a continuous value of industry exposure which is the estimated beta coefficient from the regression equation (1). Industry exposure (ID) can capture stock return decreases in response to the most dramatic peaks in the GPR index for industries with higher exposure compared to the market average. We perform similar analyses as described in the regression equation (3), but we replace the industry exposure dummy (IDD) with industry exposure (ID) to examine the industry-level effect of geopolitical risk on corporate tax avoidance. The regression model is written as follows:

$$TA_{i,k,t} = \beta_1 \Delta GPR_t \times ID_{k,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \quad (6)$$

where $ID_{k,t}$ is the alternative continuous measure of industry exposure. All other variables are defined as in the baseline model (3). The variable of interest, $\Delta GPR_t \times ID_{k,t}$, is the interaction of the logarithm of the changes in the country-level geopolitical risk times the industry exposure measure. Firm-fixed effects and firm-year fixed effects are applied in the model specifications. The estimation results are presented in Table 6.

[Insert Table 6]

We find that the estimated coefficients of $\Delta GPR \times ID$ are negatively significant at the 1% or 5% levels for both tax avoidance measures. The regression results indicate that firms engage in more aggressive tax avoidance activities when they face a higher level of industry-related geopolitical risk. These results provide a robustness check to our earlier documented baseline results on corporate tax avoidance at the industry level.

In addition, firms operating in different countries may be subject to varying degrees of political instability, regulatory changes, and government interventions, all of which can shape their tax avoidance behaviors (Nguyen & Nguyen 2020). Prior literature focused on the impact of political uncertainty on corporate tax avoidance. Nguyen and Nguyen (2020) find that firms

reduce cash effective tax rate and engage in more aggressive tax planning and shelters when facing heightened economic policy uncertainty. Kang and Wang (2021) further examine the relationship between policy uncertainty and firms; tax avoidance engagement by using three specific aspects, which include monetary policy uncertainty, taxation policy uncertainty, and government spending policy uncertainty. They find that the time-varying cash effective tax rate impacts of monetary policy uncertainty are asymmetric, which takes time to induce firms' tax avoidance engagement in the long run. Both studies use Baker et al. (2016) index as a proxy for the policy uncertainty. Unlike the BBD index (Baker et al. 2016) that focused on the aggregate policy uncertainty, Hassan et al. (2019) develop an index to provide not only a firm-level measure of political risk, but also a flexible decomposition into topic-specific components. Therefore, we perform a robustness analysis via using Hassan et al. (2019) firm-level political risk to address a potential limitation arises from the lack of consideration for firm-level political risk as a potential confounding factor.

We include the firm-level political risk as an additional control variable in the baseline regression from 2005 to 2019. The regression model is:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 PRisk_{i,t} + \beta_3 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

As in the baseline model (1), the dependent variables, TA, are tax avoidance measurements, $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk index, and $FA_{i,t}$ is a vector of the firm characteristics. $TA_{i,t-1}$ are tax avoidance measures in the prior year for any given firm. Firm and year-fixed effects are utilized in all regression specifications. $PRisk_{i,t}$ is the firm-level political risk which is the average of the transcript-based scores of the overall political risk from Hassan et al. (2019) for a given firm and year. The firm-level political risk is standardized by its respective standard deviation.

[Insert Table 7]

We find that the estimated coefficients of $Firm\_GPR$ are negatively significant at the 1% level for both tax avoidance measures with controlling for firm-level political risk. The regression results indicate that, with consideration of the potential contribution of firm-specific political risk, firms still engage in more aggressive tax avoidance activities when they face an increased geopolitical risk. These results provide a robustness check to our earlier documented baseline results on corporate tax avoidance at the firm level.

5. Conclusion

This paper investigates whether geopolitical risk affects corporate tax avoidance. We find robust evidence that firms engage in more aggressive tax planning when facing geopolitical risk at both firm- and industry levels in both the short and long run. This is the first evidence highlighting geopolitical risk, as an external risk factor, that can affect firms' engagement in corporate tax avoidance. We also show that this effect is more pronounced for financially constrained firms. In addition, we use as an exogenous shock the 2016 OPEC Banning US Oil Exports Agreement to examine the positive association between geopolitical risk and tax avoidance for firms in different industries. Our results are also robust at the firm and industry levels with the inclusion of industry exposure beta coefficients and firm-level political risk. Overall, this paper highlights novel findings on the relationship between geopolitical risk and corporate tax avoidance and the role of firm financial constraints in enhancing this relationship.

Table 1: Summary Statistics

The sample contains 48,634 firm-year observations from 2005 to 2019. This table provides descriptive statistics for tax avoidance variables, firm attribute variables at the firm-year level, and the firm-level geopolitical risk measure. Detailed variable definitions can be found in Appendix A.

Variable	N	Mean	S.D.	P25	Median	P75
Geopolitical risk measures						
$FIRM\_GPR$	48,634	0.015	0.716	-0.355	0.000	0.000
Tax avoidance measures						
$CETR$	43,467	0.270	0.139	0.184	0.283	0.359
$LRETR$	44,682	0.210	0.168	0.067	0.195	0.308
Firm attributes						
$SIZE$	43,511	6.828	2.219	5.389	6.933	8.348
$CASH$	43,293	0.187	0.238	0.031	0.098	0.247
NOL	48,634	0.799	0.401	1.000	1.000	1.000
ROA	43,297	0.110	0.112	0.041	0.077	0.139
FI	48,632	0.015	0.033	0.000	0.000	0.013
FCF	43,457	0.043	0.138	0.010	0.046	0.084
LEV	43,175	0.223	0.237	0.010	0.175	0.336
$EIIE$	43,297	0.001	0.004	0.000	0.000	0.000

Table 2: Baseline Regression

This table presents the baseline regression results of the below regression models from 2005 to 2019. The regression models are as follows:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$TA_{i,k,t} = \beta_3 \Delta GPR_t \times IDD_{k,t} + \beta_4 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where TA is tax avoidance measures including cash effective tax rate ($CETR$) and long-run cash effective tax rate ($LRETR$). $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk; $\Delta GPR_{i,t}$ denotes the logarithm of the changes in country-level geopolitical risk. $IDD_{k,t}$, an industry exposure dummy, equals one for industries that have above-median exposure and equals zero otherwise. The firm-fixed effect and firm-year fixed effects are included, alternatively. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by firm and year-industry. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$			$LRETR$		
	(1)	(2)	(3)	(4)	(5)	(6)
$FIRM\_GPR_{i,t}$	-0.002**			-0.001**		
	(-2.07)			(-2.08)		
$\Delta GPR_t \times IDD_{k,t}$		-0.008**	-0.006***		-0.003**	-0.003***
		(-2.32)	(-2.76)		(-2.31)	(-3.46)
ΔGPR_t		0.001			-0.000	
		(0.59)			(-0.08)	
Firm-level controls						
$SIZE_{i,t}$	-0.001	-0.001**	-0.001**	0.000	-0.000	-0.000
	(-1.00)	(-2.20)	(-2.22)	(0.65)	(-0.15)	(-0.16)
$CASH_{i,t}$	-0.003	-0.006	-0.006	-0.003	-0.004	-0.004
	(-0.44)	(-1.00)	(-1.03)	(-1.13)	(-1.49)	(-1.56)
$NOL_{i,t}$	-0.011***	-0.012***	-0.012***	-0.005***	-0.005***	-0.005***
	(-4.74)	(-5.00)	(-5.02)	(-4.83)	(-5.22)	(-5.42)
$ROA_{i,t}$	-0.042***	-0.044***	-0.044***	0.009*	0.008	0.008*
	(-3.24)	(-3.57)	(-4.12)	(1.74)	(1.55)	(1.67)
$FI_{i,t}$	-0.048	-0.039	-0.039	-0.033**	-0.028**	-0.028**
	(-1.51)	(-1.39)	(-1.56)	(-2.24)	(-2.17)	(-2.46)
$FCF_{i,t}$	-0.022*	-0.025**	-0.025**	-0.006	-0.006	-0.006
	(-1.74)	(-2.26)	(-2.48)	(-1.26)	(-1.46)	(-1.44)
$LEV_{i,t}$	-0.037***	-0.042***	-0.042***	-0.014***	-0.015***	-0.015***
	(-7.06)	(-8.26)	(-9.59)	(-6.29)	(-7.36)	(-7.72)
$EIIE_{i,t}$	-1.383***	-1.495***	-1.494***	-0.374***	-0.381***	-0.381***
	(-5.66)	(-6.41)	(-6.69)	(-2.92)	(-2.96)	(-3.00)
$LAG\_CETR_{i,t}$	0.305***	0.312***	0.312***			
	(24.08)	(26.31)	(28.04)			
$LAG\_LRETR_{i,t}$				0.699***	0.697***	0.697***
				(76.98)	(80.17)	(76.88)
Other Controls						
Firm fixed effect	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	No	YES	YES	No	YES
Observations	21,004	20,987	20,987	21,561	21,547	21,547
Adjusted R-squared	0.321	0.290	0.290	0.822	0.815	0.815

Table 3: Channel Analysis: The role of Financial Constraints

This table presents the estimation results of the following regression equation for the full sample (Panel A) and for subsamples of firms with foreign operations and without foreign operations (Panel B):

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} \times HIGH + \beta_2 Firm\_GPR_{i,t} \times LOW + \beta_3 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \quad (4)$$

The dependent variables, TA, are tax avoidance measurements including cash effective tax rate (*CETR*) and long-run cash effective tax rate (*LRETR*). $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk, which counts the occurrence of mentions of geopolitical risks in the earning call. *HIGH* equals one if the firm's financial constraint is less than the sample median value. *LOW* equals one minus *HIGH*. $FA_{i,t}$ are the firm attributes including firm size (*SIZE*), cash holdings (*CASH*), firm profitability (*ROA*), net loss carry-forwards (*NOL*), foreign income (*FI*), free cash flow (*FCF*), financial leverage (*LEV*) and equity income in earnings (*EIIE*). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. In Panel B, YES indicates firms have foreign operations and NO indicates firms have no foreign operations. For brevity, only estimates for the interaction terms are tabulated. The firm and year-fixed effects are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by firm and year-industry. Chow test results are reported to examine whether interaction terms are equal. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$	$LRETR$
Panel A: Full Sample		
Panel A1: HIGH indicates highly financial constraint firms with Sales value less than the sample median		
$Firm\_GPR_{i,t} \times HIGH$ (β_1)	-0.003***	-0.001**
	(-2.69)	(-2.48)
$Firm\_GPR_{i,t} \times LOW$ (β_2)	0.000	-0.000
	(0.05)	(-0.29)
Other Controls		
All control variables	YES	YES
F (*p*-value) for test: $\beta_1 = \beta_2$	3.64 (0.03)	3.19 (0.04)
Firm fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	21,004	21,561
Adjusted R-squared	0.321	0.822
Panel A2: HIGH indicates highly financial constraint firms with Z-score less than the sample median		
$Firm\_GPR_{i,t} \times HIGH$ (β_1)	-0.004**	-0.002***
	(-2.48)	(-2.91)
$Firm\_GPR_{i,t} \times LOW$ (β_2)	-0.001	-0.000
	(-0.43)	(-0.33)
Other Controls		
All control variables	YES	YES
F (*p*-value) for test: $\beta_1 = \beta_2$	3.17 (0.04)	4.34 (0.01)
Firm fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	21,004	21,561
Adjusted R-squared	0.322	0.822

(*continued on the next page***)**

VARIABLES	$CETR$		$LRETR$	
Panel B: Sub-samples: Foreign Operations versus Non-foreign Operations				
Panel B1: HIGH indicates highly financial constraint firms with Sales value less than the sample median.				
Foreign Operations Sample	YES	NO	YES	NO
$Firm\_GPR_{i,t} \times HIGH$	-0.004***	0.000	-0.001***	0.001
	(-2.89)	(0.13)	(-3.50)	(1.27)
$Firm\_GPR_{i,t} \times LOW$	-0.001	0.000	0.000	-0.001
	(-0.31)	(0.11)	(0.03)	(-0.66)
Other Controls				
All control variables	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	12,718	6,490	12,921	6,753
Adjusted R-squared	0.313	0.410	0.817	0.848
Panel B2: HIGH indicates high financial constraint firms with Z-score less than the sample median.				
Foreign Operations Sample	YES	NO	YES	NO
$Firm\_GPR_{i,t} \times HIGH$	-0.005***	-0.001	-0.001**	-0.002
	(-3.00)	(-0.14)	(-2.55)	(-1.33)
$Firm\_GPR_{i,t} \times LOW$	-0.001	0.001	-0.001	0.001
	(-0.93)	(0.44)	(-0.88)	(1.52)
Other Controls				
All control variables	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	12,718	6,490	12,921	6,753
Adjusted R-squared	0.313	0.410	0.817	0.848

Table 4: Effects of Firm-Level Investment

This table presents the below baseline regression results for subsamples divided by the median of firm-level investment. The regression models are as follows:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t}$$

where TA is tax avoidance measures including cash effective tax rate ($CETR$) and long-run cash effective tax rate ($LRETR$). $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk. The firm-fixed effect and firm-year fixed effects are included, alternatively. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by firm and year-industry. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$		$LRETR$	
	Firm-level Investment		Firm-level Investment	
	HIGH	LOW	HIGH	LOW
$FIRM\_GPR_{i,t}$	-0.004**	-0.001	-0.002***	-0.001
	(-2.33)	(-0.96)	(-3.55)	(-0.90)
Firm-level controls				
$SIZE_{i,t}$	-0.002**	-0.001	0.000	0.000
	(-2.17)	(-1.17)	(0.26)	(0.09)
$CASH_{i,t}$	0.016	-0.013*	0.010*	-0.011***
	(1.48)	(-1.77)	(1.77)	(-3.33)
$NOL_{i,t}$	-0.010***	-0.005	-0.005***	-0.002
	(-2.85)	(-1.45)	(-3.39)	(-1.53)
$ROA_{i,t}$	-0.036**	-0.035**	0.008	0.017**
	(-2.09)	(-2.33)	(0.98)	(2.53)
$FI_{i,t}$	-0.089**	-0.035	-0.044**	-0.022
	(-1.96)	(-1.01)	(-1.99)	(-1.48)
$FCF_{i,t}$	-0.088***	0.019	-0.026***	0.008
	(-4.43)	(1.19)	(-3.21)	(1.34)
$LEV_{i,t}$	-0.032***	-0.041***	-0.014***	-0.015***
	(-4.75)	(-6.96)	(-4.64)	(-5.62)
$EIIE_{i,t}$	-1.213***	-1.486***	-0.285	-0.451***
	(-3.48)	(-4.28)	(-1.31)	(-2.93)
$LAG\_CETR_{i,t}$	0.297***	0.328***		
	(17.71)	(17.71)		
$LAG\_LRETR_{i,t}$			0.690***	0.695***
			(53.40)	(48.19)
Other Controls				
Firm fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	9,998	10,026	10,285	10,256
Adjusted R-squared	0.330	0.359	0.811	0.844

Table 5: Quasi-Natural Experiment of the 2016 OPEC Agreement

This table presents the multivariate difference-in-differences regression results on the effect of the 2016 OPEC agreement on corporate tax avoidance. The regression model is as follows:

$$TA_{i,k,t} = \beta_1 Treat \times Post + \beta_2 Post + \beta_3 Treat + \beta_4 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \qquad (5)$$

The dependent variables, TA, are tax avoidance measurements including cash effective tax rate (*CETR*) and long-run cash effective tax rate (*LRETR*). $Treat$ is a dummy variable that equals one if a firm belongs to any of the following Fama-French industry groups: Petroleum and Natural Gas, Aircraft, Automobiles and Trucks, Coal, Construction, Construction Materials, Precious Metals, Rubber and Plastic Products, Shipbuilding, Railroad Equipment, Shipping Containers, Steel, and Transportation. *Post* is a dummy variable that equals one for the post-event period (2017–2019) and zero for the pre-event period (2013–2015). $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. The firm-fixed effect and industry-fixed effect are controlled. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$			$LRETR$		
	(1)	(2)	(3)	(5)	(6)	(7)
$Treat \times Post$	-0.018**	-0.012*	-0.018**	-0.008**	-0.005*	-0.008**
	(-2.25)	(-1.66)	(-2.20)	(-2.22)	(-1.71)	(-2.30)
$Post$	-0.007	-0.010*	-0.009	-0.003	0.000	-0.003
	(-1.27)	(-1.76)	(-1.63)	(-1.17)	(0.17)	(-1.41)
$Treat$	0.003			0.001		
	(0.44)			(0.31)		
Firm-level controls						
$SIZE_{i,t}$	-0.002*	-0.025***	-0.000	-0.001	-0.011***	-0.000
	(-1.71)	(-3.92)	(-0.27)	(-1.53)	(-4.10)	(-0.17)
$CASH_{i,t}$	0.006	-0.021	0.005	-0.001	0.000	0.001
	(0.38)	(-0.76)	(0.28)	(-0.11)	(0.03)	(0.16)
$NOL_{i,t}$	-0.002	-0.037***	-0.005	-0.002	-0.006	-0.003
	(-0.38)	(-3.33)	(-0.92)	(-0.73)	(-1.35)	(-1.26)
$ROA_{i,t}$	-0.024	-0.206***	-0.035	0.038***	-0.013	0.028**
	(-0.92)	(-4.68)	(-1.30)	(3.33)	(-0.68)	(2.34)
$FI_{i,t}$	0.159**	-0.081	0.087	-0.007	-0.149**	-0.036
	(2.26)	(-0.51)	(1.16)	(-0.21)	(-2.23)	(-1.10)
$FCF_{i,t}$	-0.017	-0.070***	-0.014	-0.012	-0.025**	-0.010
	(-0.86)	(-2.88)	(-0.68)	(-1.35)	(-2.51)	(-1.12)
$LEV_{i,t}$	-0.046***	0.008	-0.037***	-0.016***	0.007	-0.014***
	(-4.81)	(0.48)	(-3.76)	(-3.73)	(0.91)	(-3.15)
$EIIE_{i,t}$	-0.999**	-2.630***	-0.905*	-0.584***	-0.907**	-0.476**
	(-2.09)	(-2.69)	(-1.84)	(-2.81)	(-2.22)	(-2.23)
$LAG\_CETR_{i,t}$	0.497***	0.049***	0.464***			
	(34.24)	(2.65)	(31.08)			
$LAG\_LRETR_{i,t}$				0.814***	0.497***	0.794***
				(109.04)	(38.60)	(101.11)
Other Controls						
Firm fixed effect	NO	YES	NO	NO	YES	NO
Industry fixed effect	NO	NO	YES	NO	NO	YES
Observations	3,500	3,464	3,500	3,464	3,233	3,294
Adjusted R-squared	0.286	0.574	0.308	0.574	0.895	0.807

Table 6: Robustness Analysis: Industry Exposure

This table presents the estimation results of the following regression equation:

$$TA_{i,k,t} = \beta_1 \Delta GPR_t \times ID_{k,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_t \qquad (6)$$

The dependent variables, TA, are tax avoidance measurements including cash effective tax rate ($CETR$) and long-run cash effective tax rate ($LRETR$). $\Delta GPR_{i,t}$ denotes the log changes in aggregate geopolitical risk. $ID_{k,t}$ is an alternative measure of industry exposure. $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by year and industry. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$		$LRETR$	
	(1)	(2)	(3)	(4)
$\Delta GPR_t \times ID_{k,t}$	-0.005**	-0.005**	-0.002**	-0.002***
	(-2.30)	(-2.50)	(-2.49)	(-2.81)
ΔGPR_t	-0.002		-0.001**	
	(-1.21)		(-2.16)	
Firm-level controls				
$SIZE_{i,t}$	-0.001**	-0.001**	-0.000	-0.000
	(-2.20)	(-2.31)	(-0.15)	(-0.28)
$CASH_{i,t}$	-0.006	-0.006	-0.004	-0.004
	(-1.02)	(-1.07)	(-1.50)	(-1.61)
$NOL_{i,t}$	-0.012***	-0.012***	-0.005***	-0.005***
	(-4.98)	(-5.05)	(-5.20)	(-5.45)
$ROA_{i,t}$	-0.044***	-0.043***	0.008	0.008*
	(-3.54)	(-4.05)	(1.58)	(1.74)
$FI_{i,t}$	-0.038	-0.037	-0.028**	-0.027**
	(-1.36)	(-1.49)	(-2.15)	(-2.38)
$FCF_{i,t}$	-0.025**	-0.024**	-0.006	-0.006
	(-2.25)	(-2.42)	(-1.46)	(-1.37)
$LEV_{i,t}$	-0.042***	-0.042***	-0.015***	-0.015***
	(-8.29)	(-9.61)	(-7.38)	(-7.75)
$EIIE_{i,t}$	-1.494***	-1.495***	-0.381***	-0.381***
	(-6.41)	(-6.69)	(-2.96)	(-3.00)
$LAG\_CETR_{i,t}$	0.312***	0.312***		
	(26.32)	(28.07)		
$LAG\_LRETR_{i,t}$			0.697***	0.697***
			(80.17)	(76.85)
Other Controls				
Firm fixed effect	YES	YES	YES	YES
Year fixed effect	No	YES	No	YES
Observations	20,987	20,987	21,547	21,547
Adjusted R-squared	0.290	0.290	0.815	0.815

Table 7: Firm-level Political Risk

This table presents the robustness results from the baseline regression of geopolitical risk and corporate tax avoidance by including the firm-level political risk as a control variable from 2005 to 2019. The regression model is:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 PRisk_{i,t} + \beta_3 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t}$$

where TA is tax avoidance measures including cash effective tax rate ($CETR$) and long-run cash effective tax rate ($LRETR$). $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk. $PRisk_{i,t}$ is the firm-level political risk which is the average of the transcript-based scores of the overall political risk from Hassan et al. (2019) for a given firm and year. The firm-level political risk is standardized by its respective standard deviation. $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. The firm-fixed effect and firm-year fixed effects are included, alternatively. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by firm and year-industry. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$GETR$	$CETR$
$FIRM\_GPR_{i,t}$	-0.004***	-0.001***
	(-6.89)	(-3.06)
Firm-level controls		
$PRisk_{i,t}$	-0.004***	-0.001*
	(-3.32)	(-1.76)
$SIZE_{i,t}$	-0.000	-0.001
	(-0.17)	(-1.00)
$CASH_{i,t}$	-0.023***	-0.023***
	(-3.59)	(-4.02)
$NOL_{i,t}$	-0.014***	-0.006***
	(-5.70)	(-3.29)
$ROA_{i,t}$	-0.005	0.048***
	(-0.40)	(4.87)
$FI_{i,t}$	-0.077**	-0.013
	(-2.58)	(-0.53)
$FCF_{i,t}$	-0.034**	0.010
	(-2.12)	(0.85)
$LEV_{i,t}$	-0.045***	-0.030***
	(-8.49)	(-7.28)
$EIIE_{i,t}$	-1.430***	-0.160
	(-5.67)	(-0.72)
$LAG\_CETR_{i,t}$	0.470***	
	(48.89)	
$LAG\_LRETR_{i,t}$		0.572***
		(68.68)
Other controls		
Firm fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	21,418	18,276
Adjusted R-squared	0.318	0.533

Appendix A1: Variable Definition

Variables	Acronym	Description	Data Sources
Measures of geopolitical risk:			
Firm-level geopolitical risk	$FIRM\_GPR$	Firm-level geopolitical risk, denoted by $FIRM\_GPR$, is calculated by the natural logarithm of 100 times geopolitical-risk-related words divided by the total number of words in the given newspaper section. The geopolitical-risk-related considers three embedded components: the average of all monthly GPR indices in quarter t, the industry exposure, and the idiosyncratic firm-level GPR index.	Caldara and Iacoviello (2022)
Measures of tax avoidance:			
Cash effective tax rate	$CETR$	Cash effective tax rate, denoted by $CETR$, is calculated as the cash taxes paid expense ($txpd$) divided by the difference between pre-tax book income (pi) and special items (spi). The data frequency is annual.	Compustat
Long-run cash effective tax rate	$LRETR$	Dyreng, Hanlon and Maydew's (2008) long-run cash effective tax rate is defined as cash tax paid dividend by the difference between pre-tax income and special items in a five-year window. This measure requires at least three consecutive years with non-missing data. $LRETR$ for any firm in a given year is measured as follows: $LRETR_{it} = \frac{\sum_{k=t-4}^{t} Cash\_tax\_paid_{ik}}{\sum_{k=t-4}^{t}(Pretax\_income_{ik} - Special\_items_{ik})}$	Compustat
Firm-level controls:			
Firm size	$SIZE$	Firm size is the natural logarithm of the firm's market capitalization, which is calculated by multiple annual close prices ($prcc_f$) and common shares outstanding ($csho$).	Compustat
Cash holding	$CASH$	Cash holding is calculated by the cash and marketable securities (che) divided by the lagged asset (at).	Compustat
Loss carry-forward	NOL	Net loss carry-forward is a dummy variable equal to one if loss carry-forward ($tlcf$) is positioned for a firm in a given year and zero otherwise.	Compustat
Return on asset	ROA	Return on asset is measured by the operating income ($pi - xi$) divided by the lagged asset (at).	Compustat
Foreign income	FI	Foreign income ($pifo$) scaled by the lagged asset (at). Set missing values to zero.	Compustat
Free cash flow	FCF	The firm's net change in cash from operating activities ($oancf$) minus capital expenditures ($capx$), scaled by the market value of equity ($prcc\_f \times csho$).	Compustat
Leverage	LEV	The firm's financial leverage at the end of the year, is calculated by long-term debt ($dltt$) scaled by the lagged asset (at).	Compustat
Equity income in earnings	$EIIE$	The firm's equity income in earnings, is calculated by the equity in earnings ($esub$) scaled by the lagged asset (at).	Compustat
Other variables:			
Firm-level political risk	$PRisk$	Average of the transcript-based scores of the overall political risk for a given firm and year. It is standardized by its respective standard deviation.	Hassan *et al.* (2019)

Variables	Acronym	Description	Data Sources
Industry exposure	ID	The industry exposure measured by using the estimated coefficients on GPR from regressing the daily industry portfolio excess returns on daily GPR.	Caldara and Iacoviello (2022)
Industry exposure	IDD	Industry exposure dummy, equals one for industries that have above-median exposure and equals zero otherwise.	Caldara and Iacoviello (2022)
Log changes in country-level geopolitical risk	ΔGPR	Log changes in country-level geopolitical risk	Caldara and Iacoviello (2022)
Change in country-level GPR× Industry exposure	$\Delta GPR \times ID$	The interaction term of the log changes in country-level geopolitical risk times the industry exposure.	Caldara and Iacoviello (2022)
Change in country-level GPR× Industry exposure dummy	$\Delta GPR \times IDD$	The interaction term of the log changes in country-level geopolitical risk times the industry exposure dummy.	Caldara and Iacoviello (2022)
Sale	$SALE$	Sale is the sales of firms (*sale*)	Compustat
Z-score	$Z - SCORE$	Z-Score=1.2(working capital (*wcap*)/total assets (*at*))+1.4(retained earnings (*re*)/total assets (*at*))+3.3(earnings before interest and tax (*ebit*)/total assets (*at*))+0.6(market value of equity (*ceq*)/total liabilities (*lt*)) + 0.99(sales (*sale*)/total assets (*at*))	Compustat
High sales than the median value	$HIGH$	*HIGH* equals one if the firm's sales value is less than the sample median value (high financial constraint) in that year and zero otherwise.	Compustat
High Z-score than the median value	$HIGH$	*HIGH* equals one if the firm's Z-score is less than the sample median value (high financial constraint) in that year and zero otherwise.	Compustat
Treat	$Treat$	$Treat$ is a dummy variable that equals one if a firm belongs to any of the following Fama-French 49 industry groups: Petroleum and Natural Gas, Aircraft, Automobiles and Trucks, Coal, Construction, Construction Materials, Precious Metals, Rubber and Plastic Products, Shipbuilding, Railroad Equipment, Shipping Containers, Steel, and Transportation.	Compustat
Post	$Post$	*Post* is a dummy variable that equals one for the post-event period (2017–2019) and zero for the pre-event period (2013–2015).	Compustat

Appendix A2: Entrenchment Manager

This table presents the below baseline regression results for subsamples divided by the median of the E-index, a measure of managerial entrenchment. The regression models are as follows:

$$TA_{i,t} = \beta_1 Firm\_GPR_{i,t} + \beta_2 FA_{i,t} + TA_{i,t-1} + \varepsilon_{i,t}$$

where TA is tax avoidance measures including cash effective tax rate ($CETR$) and long-run cash effective tax rate ($LRETR$). $FA_{i,t}$ are the firm attributes including firm size ($SIZE$), cash holdings ($CASH$), firm profitability (ROA), net loss carry-forwards (NOL), foreign income (FI), free cash flow (FCF), financial leverage (LEV) and equity income in earnings ($EIIE$). $TA_{i,t-1}$ are tax avoidance measurements in the prior year for any given firm. $Firm\_GPR_{i,t}$ is the firm-specific geopolitical risk. The firm-fixed effect and firm-year fixed effects are included, alternatively. The standard errors are corrected for heteroskedasticity and serial correlation, and the t-statistics are given in parentheses. The standard errors are also clustered by firm and year industry. Significance levels are indicated by *, **, and ***, representing significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	$CETR$		$LRETR$	
	HIGH E-INDEX	LOW E- INDEX	HIGH E- INDEX	LOW E- INDEX
$FIRM\_GPR_{i,t}$	-0.006***	-0.000	-0.001	0.000
	(-4.10)	(-0.17)	(-1.01)	(0.39)
Firm-level controls				
$SIZE_{i,t}$	-0.003**	-0.002	0.000	-0.001
	(-2.19)	(-1.00)	(0.11)	(-1.24)
$CASH_{i,t}$	-0.023**	-0.044***	-0.003	-0.003
	(-2.02)	(-3.06)	(-0.66)	(-0.36)
$NOL_{i,t}$	-0.015***	-0.016***	-0.007***	-0.003
	(-3.80)	(-3.02)	(-4.38)	(-1.23)
$ROA_{i,t}$	0.039*	0.025	0.042***	0.040**
	(1.95)	(0.93)	(4.92)	(2.41)
$FI_{i,t}$	-0.120***	-0.240***	-0.059***	-0.051
	(-2.67)	(-3.72)	(-2.96)	(-1.36)
$FCF_{i,t}$	-0.027	-0.026	-0.017	0.001
	(-0.98)	(-0.62)	(-1.23)	(0.05)
$LEV_{i,t}$	-0.027***	-0.062***	-0.007**	-0.019***
	(-3.52)	(-5.18)	(-2.15)	(-3.49)
$EIIE_{i,t}$	-0.632	-1.000*	-0.376*	-0.185
	(-1.56)	(-1.66)	(-1.85)	(-0.38)
$LAG\_CETR_{i,t}$	0.431***	0.387***		
	(26.22)	(17.50)		
$LAG\_LRETR_{i,t}$			0.832***	0.812***
			(73.37)	(37.87)
Other Controls				
Firm fixed effect	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES
Observations	7,592	3,501	7,195	2,294
Adjusted R-squared	0.362	0.353	0.852	0.835

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Chapter 5: Conclusion

This thesis provides an in-depth and comprehensive analysis of the determinants, consequences, and implications of US firms' engagement in corporate tax avoidance. In Chapter 2, we examine the causal effect of corporate tax avoidance on corporate bond liquidity. In Chapters 3 and 4, we investigate two external factors, namely FEMA Assistance and geopolitical risk, that have an impact on the engagement in corporate tax avoidance. We hypothesize that firms conducting more aggressive tax avoidance will improve corporate bond liquidity given the lower cost of debt and lower cost of equity. We also hypothesize that firms that face external risk factors will encounter financial constraints and thus tax avoidance engagement will be more aggressive. The findings in this thesis are as follows.

First, we provide robust empirical evidence supporting the hypothesis that aggressive tax avoidance strategies improve corporate bond liquidity. We perform additional tests to validate the relationship between corporate tax avoidance and corporate bond liquidity by using the law case *Xilinx Inc. v. Commissioner* and *the Financial Accounting Standards Board Interpretation No. 48* in difference-in-differences regression settings. We find that the baseline results hold under all specifications. In addition, we use the Takeover Index (Cain *et al.* 2017) and Co-option data (Coles *et al.* 2014) to proxy corporate governance, and we find that the improvement in corporate bond liquidity due to aggressive tax avoidance engagement is more pronounced for firms with weak shareholder governance. Overall, our empirical results indicate that aggressive tax avoidance improves corporate bond liquidity from all analyses.

Second, we find that firms headquartered in states that are eligible to receive FEMA Assistance engage in more aggressive tax planning activities relative to firms that do not receive FEMA Assistance. We also use a difference-in-differences procedure in a quasi-experimental estimation to propensity score match firms headquartered in states that receive more disaster relief support to firms located in states that receive less FEMA Assistance. We

find that more-receiving firms engage in more aggressive tax avoidance relative to their less-receiving counterparties. In addition, we perform the channel analysis in which we find social capital is a possible channel for the positive relationship between FEMA Assistance and corporate tax avoidance. Specifically, the positive relationship attenuates for firms located in states with a higher level of social capital. Overall, the positive relationship between FEMA Assistance and corporate tax avoidance holds in all of our analyses.

Third, we find statistically significant evidence supporting the hypothesis that firms engage in more aggressive tax avoidance when encountering increased geopolitical risk. We also find that this effect is more pronounced for firms that are financially constrained. Furthermore, we use the 2016 OPEC Agreement as a geopolitical shock to see if firms' engagement in tax avoidance differs from industry to industry. We discover that firms that operate in oil-related industries engage in more aggressive tax planning relative to their non-oil-related counterparts. In addition, we find that our results are robust to alternative measures of industry exposure, and also robust with controlling for firm-level political risk. Overall, our empirical results suggest that firms that face heightened geopolitical risk engage in more aggressive corporate tax avoidance at the firm- and industry-level in both the short and long run.

In conclusion, it is imperative to approach the critical corporate strategy of corporate tax avoidance with a nuanced consideration of its impact on various stakeholders. An overarching pattern emerges, revealing that companies often exhibit a proclivity for aggressive tax avoidance engagement when confronted with heightened external risks, despite the availability of additional support measures. To pave the way for future research, it is essential to explore the intricate interplay between other external risk factors and corporate tax avoidance.

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