The impact of superstition on corporate tax avoidance: How do CEOs trade off risks associated with tax avoidance?

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ABSTRACT

Purpose

We examine how superstition shapes corporate tax avoidance and do so by taking a risk perspective and focusing on the zodiac-year belief prevalent in China.

Design/methodology/approach

We adopt a difference-in-differences research design to compare the degree of corporate tax avoidance in the CEOs' zodiac year with that in the adjacent years. We do propensity-score matching to form a sample of Chinese listed firms for the regression analysis.

Findings

We find causal evidence that firms exhibit a greater magnitude of tax avoidance in the CEOs' zodiac years, a result attributable to relatively weak tax enforcement in the Chinese context. We also find that the zodiac-year effect on corporate tax avoidance is more pronounced for firms with tight financial constraints, firms with high business risk, firms headquartered in regions with a high degree of superstition, and non-state-owned firms.

Originality/value

This study is the first to show that superstition is a determinant factor of tax avoidance, and contributes to the tax literature by shedding light on the behavioral risk factors that shape corporate tax avoidance. We take the perspective of CEOs' risk appetite to analyze how tax avoidance is influenced by the CEOs' trade-off between the costs and benefits of avoiding taxes. Our results suggest that, when CEOs in the Chinese firms are more risk-averse, they attach more importance to financial risk than the risk of reputational losses and litigation associated with corporate tax avoidance. The findings imply that tax avoidance can be curbed via increasing (decreasing) the tax (financial) risk confronting the CEOs.

1. Introduction

Corporate tax avoidance refers to firm activities that lead to any reduction in explicit taxes, including the adoption of various legal or illegal tax strategies (Dyreng *et al.*, 2008; Hanlon and Heitzman, 2010). Despite voluminous research on the economic determinants of corporate tax avoidance, such as profitability, research and development investments, and the intensity of foreign operations (e.g., Graham and Tucker, 2006; Rego, 2003), the role of behavioral factors associated with managers has been underexplored (Hanlon *et al.*, 2022). Managerial decision-making is likely shaped by behavioral factors such as individual preferences, cognitive biases, and culture (Rodgers and Gago, 2001; Schwenk, 1986). The objective of our research is to investigate whether and how superstition, which can impact various human behaviors (e.g., Block and Kramer, 2009) and decision-making (Rice, 1985; Tsang, 2004a, 2004b), impacts corporate tax avoidance.

Superstition is defined by *Merriam-Webster Dictionary* as a belief or practice resulting from ignorance, fear of the unknown, trust in magic or chance, or a false conception of causation. Superstition prevails in human societies, even in modern times. For example, the opening ceremony of Beijing Summer Olympics began at 8 pm on 8 August 2008 because Chinese people believe that the digit 8 is associated with prosperity. In this study, we examine whether and how zodiac-year belief, a superstition upheld by a great deal of Chinese people, impacts corporate tax avoidance. In Chinese society, every individual would encounter her/his zodiac year once every 12 years. It is believed that in the zodiac year, the likelihood and degree of a person experiencing misfortune will be higher. Thus, individuals will be more risk-averse in their decision-making and behaviors.

We focus on zodiac-year belief for two reasons. First, zodiac-year belief provides a nice scenario in which to investigate how managers weigh different risks associated with corporate tax avoidance when they are risk-averse. A decision on whether and to what degree to engage

in tax avoidance results from a trade-off between the marginal benefits and costs of avoiding taxes (e.g., Hanlon and Heitzman, 2010).[1] The key benefit of tax avoidance to a firm is an increase in internal funds, which reduce potential financial constraints or financial distress (e.g., Desai and Dharmapala, 2009). However, tax avoidance, if detected, will subject firms and managers to reputational losses and legal penalties (e.g., Hanlon and Slemrod, 2009). The cost-benefit trade-off depends crucially on the risk appetites of chief executive officers (CEOs) who make the decision on tax avoidance. If CEOs are more (less) averse to the risk associated with financial constraints or distress than the reputational and legal risks arising from the revelation of tax avoidance, they will be more (less) likely to avoid taxes. We thus propose two competing hypotheses. On the one hand, CEOs with zodiac-year belief might have an incentive to avoid taxes to increase internal funds and thereby mitigate the potential financial risk. On the other hand, the CEOs might have a propensity to refrain from tax avoidance for fear of the possible reputational losses and threat of litigation.

Second, zodiac-year belief provides a reasonable setting to examine the causal relationship between superstition and tax avoidance. Some superstitious beliefs arise when an individual lacks control over an outcome (e.g., Case *et al.*, 2004; Felson and Gmelch, 1979; Jahoda, 1969; Keinan, 2002; Malinowski, 1925; Rice, 2003; Schippers and van Lange, 2005), and such beliefs are therefore endogenous. For instance, Case *et al.* (2004) discover that people are more likely to utilize superstitious explanations for a failed outcome if the failure is more salient. By contrast, zodiac-year belief is typically imprinted in a person's mindset; furthermore, zodiac years take place on a 12-year cycle for all individuals and are presumably distributed in a randomly staggered manner that is independent of the events for, and characteristics of, CEOs and their firms. Therefore, zodiac-year belief should be exogenous to the CEOs' decision-making for their firms, facilitating us to draw causal inferences from our empirical analysis.

Our empirical tests are based on a sample of publicly listed Chinese firms for the period 2009-2019. Our main measure of tax avoidance is the residual book-tax difference, which is estimated from the firm-fixed-effect regression of the total book-tax difference on the total accruals (Desai and Dharmapala, 2006). We test the competing hypotheses through difference-in-differences (DID) research design coupled with propensity-score matching. The treatment sample used in the DID regression analysis comprises firms whose CEOs are in their zodiac years for the current year but not for the previous year and following year. Each treatment firm is matched with a control firm that has similar characteristics in the same year and industry. The distribution of the CEOs' zodiac years is presumably orthogonal to corporate events and firm/CEO characteristics. That said, to ensure a clean comparison with the treatment sample (Baker *et al.*, 2022; Roth *et al.*, 2023), we require each control firm to have its CEO that is not in her/his zodiac year for the three-year period centered in the zodiac year of the CEO of the matched treatment firm. We find that the degree of tax avoidance for the treatment firms is higher in their CEOs' zodiac years, compared to the year before and after the zodiac years and relative to that of the control firms. This finding is robust to controlling for firm-fixed effects and using alternative measures of tax avoidance. We also draw the same inference after performing a placebo test to enhance the validity of the treatment effect.

We further examine whether the firm's financial constraints, business risk, the degree of superstition in different regions, and state ownership moderate the impact of zodiac-year belief on corporate tax avoidance. We expect the zodiac-year effect to be more prominent when firms face severe financial constraints, as tax avoidance is a means of generating internal cash flows pivotal for the financially constrained firms. We employ the SA index (Hadlock and Pierce 2010) and cash dividends (e.g., Denis and Sibilkov, 2010; Fazzari *et al.*, 1988) as the proxies for financial constraints, and find results consistent with the prediction.

We also expect that the relationship between the CEOs' zodiac years and tax avoidance is more pronounced for firms with high business risk, based on two grounds. First, the psychology and sociology literature documents that individuals are more likely to rely on superstition to make judgements and decisions when the risks and uncertainty of a future outcome are high. In such a case, superstition could provide individuals with a sense of control over the outcome and thus help relieve their stress. Second, superstition could provide managers with supernatural information which can help compensate for their cognitive limitations when they confront the high risk (Tsang, 2004a). Using the volatility of return on sales and that of return on assets as the proxies for the firm's business risk, we find that the zodiac-year effect on tax avoidance is evident only in cases when firms have high business risk.

Furthermore, we postulate that the zodiac-year effect is more salient for firms located in the highly superstitious regions. In these regions, superstition is spread easily through the inheritance from early generations, or via the interactions with peer groups, and is thereby embedded within the social norm of the local people. Given that individuals are likely to habitually follow the shared norms without a rational calculation (e.g., Bicchieri, 1990; Bicchieri *et al.*, 2018), we argue that CEOs have a greater tendency to engage in superstitious practices if they work in the areas with strong superstitious norms. As for the empirical tests, we employ the Baidu search index to construct the measure of the degree of zodiac-year belief for each provincial area.[2] We find evidence that the positive relationship between the CEOs' zodiac-year belief and tax avoidance is evident only for the subsample of firms headquartered in the highly superstitious provinces. In addition, we expect that CEOs in state-owned enterprises (SOEs) are unlikely to be superstitious because they are typically disciplined by the Chinese Communist Party, of which the rules oppose the superstitious beliefs and practices. Consistent with this supposition, we find that the zodiac-year effect on tax avoidance takes place only in non-state-owned enterprises.

Predominant literature documents that corporate tax avoidance is determined by economic motives associated with various firm characteristics (e.g., Graham and Tucker, 2006; Rego, 2003; Wilson, 2009), the internal and external governance (e.g., Cheng *et al.*, 2012; Desai and Dharmapala, 2006; McGuire *et al.*, 2012), the macroeconomic factors (e.g., Hong *et al.*, 2019; Katz and Owen, 2013), and the power of tax enforcement (Desai *et al.*, 2007), among others. Some studies on tax avoidance examine the cultural determinants relating to religiosity (Boone *et al.*, 2013) and cultural diversity (Lei *et al.*, 2022). Yet, much remain to learn regarding the role of social and behavioral factors in shaping tax avoidance.

To the best of our knowledge, we are the first to show that superstition is a determinant factor of tax avoidance. To this end, and unlike the related literature, we take the perspective of CEOs' risk appetite to analyze how tax avoidance is influenced by the CEOs' trade-off between the costs and benefits of avoiding taxes, and provide causal evidence that superstition increases tax avoidance. From this evidence, we infer that in cases when CEOs are risk-averse, they are apt to weigh the risk of financial constraints and financial distress more than the reputational and legal risks arising from tax avoidance. As such, our paper contributes to the tax literature by shedding light on the behavioral risk factors that shape corporate tax avoidance. It also responds to the call of Hanlon *et al.* (2022) for more research on behaviorial economics of accounting.

Our paper is related to two prior studies on corporate tax avoidance. Badertscher *et al.* (2013) find that managers in the firms with greater concentrations of ownership and control are likely to be more risk averse and avoid less income taxes. Boone *et al.* (2013) show that firms headquartered in more religious counties are more risk averse and less aggressive in tax avoidance. Both studies imply a negative relationship between corporate tax avoidance and managerial risk aversion. Yet, their research is based on the U.S. setting where tax enforcement is stronger, and the legal and reputational risks are higher for tax-avoiding firms (e.g., Graham

et al., 2014; Hanlon and Slemrod, 2009; Lee *et al.*, 2021), compared to the Chinese context (Brondolo and Zhang, 2016). Our paper complements the two studies by accounting for the risk-related benefits of tax avoidance and showing that the tax misconduct could be more intensive for risk-averse managers in a country where tax risk is lower for firms due to relatively weaker tax enforcement.

In addition, our study contributes to the scarce literature on the effect of superstition on managerial decision-making and corporate business activities, such as recruiting staff (Tsang, 2004a), pursuing research and development, and engaging in mergers and acquisitions (Fisman *et al.*, 2023). We focus on tax avoidance and find that it increases with the degree of superstition. This finding reconciles with the previous studies which show the dark side of superstition (e.g., Bai *et al.*, 2020; Bhattacharya *et al.*, 2018; Li *et al.*, 2021).

The remainder of the paper is organized as follows. Section 2 develops hypotheses. Section 3 discusses the sample and variable measurements. Section 4 explains the research design and discusses the results. Section 5 concludes the study.

2. Literature Review and Hypotheses Development

2.1. Zodiac-year superstition

The Chinese zodiac is a traditional astrological scheme that assigns a distinct sign of animal to each lunar year in a recurring 12-year cycle. The cycle involves 12 animals in the sequence of Rat, Ox, Tiger, Rabbit, Dragon, Snake, Horse, Goat, Monkey, Rooster, Dog, and Pig. The lunar year with the same animal sign as an individual's birth year is known as her/his zodiac year. In traditional Chinese culture, the zodiac year is regarded as a year in which a person is likely to encounter bad luck and calamities. As such, Chinese people tend to be risk averse in their decision-making and behaviors. Recent studies (e.g., Dou *et al.*, 2024; Fisman *et al.*, 2023; Zeng *et al.*, 2022) provide evidence consistent with this notion. For instance, Fisman *et al.* (2023) document that managers reduce risky acquisition and innovation activities

in their zodiac years. Dou *et al.* (2024) show that auditors feeling higher audit risk in their zodiac years would provide higher-quality audits for their clients.

2.2. Zodiac-year superstitious belief and tax avoidance

The literature in psychology documents that the superstitious behavior will be aroused in situations in which the individuals lack control over an important outcome (e.g., Case *et al.*, 2004; Keinan, 2002; Rice, 2003; Schippers and Van Lange, 2006). No matter whether they are convinced by the superstition, individuals may still take superstitious actions as a means to preserve emotional stability and boost confidence (e.g., Bleak and Frederick, 1998; Case *et al.*, 2004). Given that firm managers often face uncertainty and risks in their business decisions, they tend to adhere to superstitious beliefs when making choices and taking actions (Liu *et al.*, 2023; Tsang, 2004a, 2004b). One such business decision that carries inherent risks is whether to pursue corporate tax avoidance. In light of this, we posit that managers' superstitious beliefs might play a role in shaping tax avoidance.

Whether to engage in tax avoidance results from a trade-off between the benefits and costs of doing so (e.g., Gallemore *et al.*, 2014; Hanlon and Heitzman, 2010). If CEOs expect the benefits outweigh the costs, they will have a tendency of going after opportunities to avoid taxes (Hanlon and Heitzman, 2010). The main benefit of tax avoidance to a firm is to reduce its tax liabilities, generating additional internal cash flows that may reduce financial risk (e.g., Cen *et al.*, 2017; Chen *et al.*, 2010; Desai and Dharmapala, 2009; Graham *et al.*, 2014; Rego and Wilson, 2012). Managing financial risk is a crucial part of risk management for Chinese listed firms. China is recognized as an investment-driven economy, where there is a considerable demand for investments, particularly among listed firms, leading to substantial capital requirements and thus the great need for financing. However, China's capital markets do not function as efficiently as those of developed countries, making it relative more difficult

to meet the financing needs by the listed firms. As a result, there is a certain degree of financial risk that managers need to navigate and address. Since the zodiac-year belief foretells that there is a high risk of unfortunate events happening in the zodiac year, CEOs may foresee that the uncertainties of investments and operation are higher, and thus financial risk is higher, in their zodiac years. As such, CEOs may intend to avoid taxes to mitigate the financial risk.

On the other hand, there are risks for conducting tax-avoidance activities. Tax avoidance, if discovered by tax authorities, will subject managers and their firms to reputational losses and legal penalties (e.g., Chen *et al.*, 2010; Desai and Dharmapala, 2009; Hanlon and Slemrod, 2009; Kim *et al.*, 2011). Thus, CEOs in their zodiac years might be averse to the risks and costs associated with tax avoidance and therefore abstain from engaging in it. Yet, provided that such risks and costs are low for the CEOs, not least in the Chinese setting in which tax enforcement is relatively weak (Brondolo and Zhang, 2016), they might be prone to pursue tax avoidance. By and large, if the CEOs are more (less) averse to the foregoing financial risk than the tax risks, they will be more (less) likely to avoid taxes in their zodiac year. Therefore, we formulate the following competing hypotheses for empirical analysis.

H1a: CEOs are more likely to engage in tax avoidance in their zodiac years.

H1b: CEOs are less likely to engage in tax avoidance in their zodiac years.

2.3. The moderating effect of financial constraints

Financially constrained firms face greater difficulty in external funding. Consequently, they might have to rely on internal funds to make necessary investments and avoid debt defaults. One potential means of generating internal cash flows is to avoid taxes. In so doing, their financial constraints would be relieved. Consistent with this notion, a number of studies (e.g., Dyreng and Markle, 2016; Edwards *et al.*, 2016; Law and Mills, 2015) provide evidence on a positive association between financial constraints and corporate tax avoidance. Since firms that

are in financial constraints tend to have higher distress risk (e.g., He and Ren, 2023), the benefits of their engagement in tax avoidance to contain the default risk would be higher. Hence, we expect that CEOs are more prone to avoid taxes in their zodiac years when their firm is in financial constraint.

H2: The positive (negative) impact of zodiac-year superstitious belief on tax avoidance, as hypothesized in H1a (H1b), is stronger (weaker) when firms face tight financial constraints.

2.4. The moderating effect of business risk

The literature relating to the psychology aspect of superstition (e.g., Keinan, 2002; Kramer and Block, 2008) documents that individuals are more likely to be superstitious when they confront greater uncertainty, and that superstitions can relieve the stress associated with the uncertainty. On this basis, we posit that the degree of business risk would moderate the effect of zodiac-year belief on corporate tax avoidance. In particular, in cases when a firm faces high business risk (i.e., when the firm's business outcome is highly uncertain), managers are under pressure to contain the risk so as to avoid increased costs of capital (e.g., Francis *et al.*, 2004), reduced business support from stakeholders (Hannan and Freeman, 1984), and heightened distress risk (e.g., Amit and Wernerfelt, 1990). Thus, we expect that CEOs are prone to resort to the superstition to obtain psychological benefits when the firm's business risk is relatively high.

Furthermore, to manage the firm's risk well, CEOs need to seek additional information (Beckman *et al.*, 2004; Lipshitz and Strauss, 1997), and may interpret ambiguity as a threat to their decision-making process (Budner, 1962). When CEOs are in bounded rationality due to the high uncertainty of the decision process, they are prone to refer to multiple sources of information and create more diverse viewpoints to help overcome their cognitive limitations (e.g., Eisenhardt and Zbaracki, 1992; Payne *et al.*, 1988; Wang *et al.*, 2012). As such, superstition could help CEOs to deal with the uncertainty and risks by providing an additional

source of information for their reference (Tsang, 2004a, 2004b). Put differently, the zodiac-year belief could provide complementary information by foretelling bad luck. As the zodiac CEOs account for the misfortune, they are apt to contain the high business risk; to this end, they might avoid taxes more aggressively to save cash. Based on the above two sets of arguments, we propose our second hypothesis as follows:

H3: The positive (negative) impact of zodiac-year superstitious belief on tax avoidance, as hypothesized in H1a (H1b), is stronger (weaker) when firms face high business risk.

2.5. The moderating effect of the region-level superstition

The degree of superstitious norms differs across regions owing to their variation in history, culture, and customs of the locals. In the highly superstitious areas, a considerable number of individuals perceive that superstition is appropriate, such that those refraining from the superstitious practice would incur higher social or economic costs than those following it; hence, the superstitious practices or beliefs become entrenched and prevail over time (Smith, 2003). According to the sociology literature (e.g., Akerlof and Kranton, 2005), individuals will seek conformity and follow social norms under the peer pressure and influences. As such, a person tends to engage in superstitious practices in the region with strong superstitious norms, no matter whether s/he is convinced. In this sense, CEOs might be affected by the social environment in which their firms are headquartered (e.g., Dyreng *et al.*, 2012; Hilary and Hui, 2009; McGuire *et al.*, 2012). Put differently, for firms located in a region that features strong superstitious norms, CEOs are likely to act in ways that conform with the norms. On this basis, we expect that the zodiac-year effect on corporate tax avoidance is more prominent in regions where zodiac-year belief is more pervasive, and propose the fourth hypothesis as follows:

H4: The positive (negative) impact of zodiac-year superstitious belief on tax avoidance, as hypothesized in H1a (H1b), is stronger (weaker) for firms that are headquartered in regions with a high degree of superstition.

2.6. The moderating effect of state ownership

There is substantial difference in the organizational culture between state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs). For SOEs, their corporate culture is deeply shaped by the Chinese Communist Party, since each SOE establishes a communist-party committee to take the responsibility for the managerial appointments and promotions, the implementation of the government's propositions, and the party disciplines for the firm (Hu and Xu, 2022; Yu, 2019). The CEOs of SOEs are typically the Communist Party members and/or government officials. Their work performance, ideology, and even lifestyles are regularly inspected by the Party Committee. Since superstition is repressed under the communist rules (Tsang, 2004b), we expect that the CEOs of SOEs are less likely to pursue superstitious practices. On the contrary, the corporate culture of non-SOEs is more inclusive, and their CEOs are more open-minded and should be more likely to embrace the superstition. We therefore expect the zodiac-year effect on corporate tax avoidance to be more pronounced for non-SOEs than SOEs, and accordingly, put forward the fifth hypothesis as follows:

H5: The positive (negative) impact of zodiac-year superstitious belief on tax avoidance, as hypothesized in H1a (H1b), is stronger (weaker) for non-state-owned firms than state-owned firms.

3. Variable Measurements and Samples

3.1.Variable measurements

3.1.1. *Measurement of zodiac-year belief*

We focus on chief executive officers (CEOs) for our hypothesis tests because CEO is the ultimate person who is in charge of corporate tax planning and responsible for tax avoidance. CEOs typically have a broader and more encompassing authority over corporate decision-making, including tax planning/reporting. Their position at the helm of organization empowers them to navigate the risks and potential rewards associated with tax avoidance. They can affect tax avoidance by setting the "tone at the top" with regard to the firm's tax activities (Dyreng *et al.*, 2010). Much literature has provided evidence that tax avoidance is associated with CEO compensation (e.g., Armstrong *et al.*, 2015; Gaertner, 2014; Powers *et al.*, 2016; Rego and Wilson, 2012), CEO turnover (Chyz and Gaertner, 2018), and various personal characteristics of CEOs (e.g., Duan *et al.*, 2018; Law and Mills, 2017; Olsen and Stekelberg, 2016). In the specific context of our study, CEOs have an incentive to avoid taxes for more internal funds to mitigate financial risk associated with perceived uncertainties of investments and operation. But chief financial officers (CFOs) do not have such an incentive to do so, as they hold responsibility for making corporate tax payments comply with tax laws. Therefore, we exclude the observations of CFOs' zodiac years in the sample selection process.[3] We do not examine the effect of the board chairmen's zodiac-year beliefs either, because the chairmen tend to be concerned mainly with the strategic decision-making on their firm's business activities rather than with corporate tax planning/reporting.

The zodiac year starts from a day in January or February and ends in the next January or February of the Gregorian calendar, resulting in one or two months of a calendar year not being in the zodiac year. Therefore, to accurately capture the zodiac-year effect on superstition for CEOs, we create an indicator variable, *Zodiac_ceo*, based on two conditions, respectively. First, if the CEO was born on a day between the start date of the Chinese Lunar new year and 31 December, *Zodiac_ceo* equals 1 for cases in which a CEO is at the age of a multiple of 12, and 0 otherwise. Second, if the CEO was born on a day between 1 January and the start date of the

Chinese Lunar new year, *Zodiac_ceo* equals 1 for cases in which a CEO is at the age of one year less than a multiple of 12, and 0 otherwise. Nevertheless, only a small subset of our sample includes the CEOs' birthdates, since such information is typically considered private and would not be publicly disclosed unless agreed by the CEOs. For the sample that just has the information of CEOs' birth months and birth years, we construct *Zodiac_ceo* in the following way. In the case in which the CEO was born in a month between March and December, or in February that is later than the start date of Chinese lunar new year in January, we assign a value of 1 to *Zodiac_ceo* if the CEO's age is a multiple of 12, and 0 otherwise. In the case where the CEO was born in January that precedes the start date of Chinese lunar new year in February, *Zodiac_ceo* is assigned a value of 1 if the CEO is at the age of one year less than a multiple of 12, and 0 otherwise. For the rest of cases in which we only know the birth year of the CEO, or the CEO's birth month overlaps with the start month of Chinese lunar new year, we are unable to identify whether the CEO is in the zodiac year when s/he is aged a multiple of 12 or one less than the multiple of 12. Accordingly, the observations for these CEOs are excluded from our sample.

3.1.2. *Measurement of corporate tax avoidance*

To estimate the degree of corporate tax avoidance, we run the following firm-fixed-effects regression model (Desai and Dharmapala, 2006):

$$BTD_{i,t} = \alpha_1 TACC_{i,t} + \mu_i + \varepsilon_{i,t} \tag{1}$$

where $BTD_{i,t}$ is the total book-tax difference for firm *i* in year *t*, computed as pre-tax financial income minus taxable income; the latter equals income tax expense minus deferred tax expense and divided by the nominal tax rate; $TACC_{i,t}$ is the total accruals for firm *i* in year *t*, calculated as operating income minus operating cash flows. Both variables are scaled by the lagged total assets and winsorized at the 1st and 99th percentiles. Desai and Dharmapala (2006) propose that

the book-tax difference (*BTD*) is partly attributable to earnings management rather than tax avoidance. To remove the confounding effect of earnings management, they use the residual (*DD_BTD*) estimated from Model (1) to proxy for the degree of corporate tax avoidance. A higher *DD_BTD* represents a higher level of tax avoidance.

3.1.3. *Measurements of moderating variables*

The moderating variable for the test of H2 is financial constraints. It is measured by the SA index (Hadlock and Pierce, 2010) and defined as follows:

$$SA\ index = -0.737 \times size + 0.043 \times size^2 - 0.040 \times age \qquad (2)$$

where *size* is the natural logarithm of the book value of a firm's total assets, and *age* is the number of years for which the firm has been listed. A higher SA index indicates more severe financial constraints. Though SA index is arguably more advantageous than KZ index and WW index (Hadlock and Pierce, 2010), it is constructed based on U.S. market, which may not be applicable to the Chinese market. Thus, we also use cash dividends (*Dividend*) to proxy for financial constraints (e.g., Denis and Sibilkov, 2010; Fazzari *et al.*, 1988), given that financially constrained firms tend to keep the funds they generate instead of paying dividends. Lower cash dividends suggest tighter financial constraints.

The moderating variable involving the test of H3 is business risk. We measure it by the volatility of return on sales (*Std_ros*) and that of return on assets (*Std_roa*). The moderating variable used to test H4 relates to the region-level zodiac-year superstition. We utilize the Baidu search index (http://index.baidu.com/) to measure the degree of zodiac-year belief in the regions where firms are headquartered. The Baidu Index provides the search volume by keywords put in the Baidu's search engine at different regions and over different time periods. The variable for the region-level superstition (*SUP_Province*) is calculated as the moving average of daily volume of search for the keyword "zodiac year" for a province in a year, which

is scaled by the natural logarithm of the province's family households.[4] We select the top ten provincial regions that have the highest degree of zodiac-year belief (*SUP_Province*) for each year and define them as the regions of a relatively high degree of superstition. Other provincial regions are classified as having a relatively smaller extent of zodiac-year superstition. Lastly, the moderating variable for the test of H5 is the indicator variable, *SOE*, which equals 1 if the firm's ultimate controller is a central or local government or a government-controlled enterprise, and 0 otherwise.

3.1.4. Control variables

We control for firm size (*SIZE*), financial leverage (*LEV*), capital intensity (*PPE* and *Intangible*), research and development activities (*RD*), growth opportunities (*Asset_growth* and *MB*), cash holdings (*Cash*), and foreign incomes (*Foreign*), since previous studies document that these firm characteristics are associated with tax avoidance (e.g., Chen *et al.*, 2010; Guenther *et al.*, 2019; Rego, 2003). We also control for profitability (*ROA*) and net operating loss carry-forward (*NOL*) to account for the firm's need to avoid income taxes (e.g., Bradshaw *et al.*, 2019; Chen *et al.*, 2010; Rego, 2003). In addition, we control for abnormal accruals (*DA*) since prior research finds a positive relationship between financial reporting aggressiveness and tax avoidance (e.g., Frank *et al.*, 2009; McGuire *et al.*, 2012). Finally, we control for corporate governance variables and other factors that prior studies find to be correlated with corporate tax avoidance (e.g., Armstrong *et al.*, 2015; Bauer, 2016; McGuire *et al.*, 2012); these variables include managerial stock ownership (*Managerial_shareholding*), the largest shareholders' stock ownership (*Top_shareholding*), institutional shareholding (*Institution*), board size (*Boardsize*), the duality of chairman and CEO (*Duality*), board independence (*Indp*), state ownership (*SOE*), and big-4 audit (*BIG4*). The detailed definitions of all the control variables are provided in Appendix 1.

3.2. Data sources and samples

Our main data sources are the China Stock Market and Accounting Research (CSMAR) database and the Wind database. Our initial sample covers all the companies listed on the Shanghai Stock Exchange or Shenzhen Stock Exchange for the years 2009-2019. To identify the CEOs' zodiac years, we need the data on their birthdays. To this end, we collect the names of CEOs from the CSMAR database. We then manually collect the information about the birthdays of CEOs via the Baidu search engine. Our initial sample consists of 7,531 unique CEOs. We manage to obtain the data on the dates of birth for 397 CEOs, the birth years and birth months, absent the dates of the months, for 5,139 CEOs, and the birth years without birth months and birth dates for 1,995 CEOs for our sample firms. There are 343 CEOs whose birth months coincide with the start month of Chinese lunar new year in their respective birth years. With these data, we use the strategies, discussed previously in Section 3.1.1, to identify the CEOs' zodiac years for each firm-year observation.

We refine the sample through the following steps: (i) we exclude financial firms as their financial characteristics are not comparable to those of non-financial firms; (ii) we remove firm-year observations with missing data on tax expense, with negative pre-tax income, or with missing values in our measure of corporate tax avoidance; (iii) we delete observations without the information of CFOs' zodiac years as well as those that are in the CFOs' zodiac years; (iv) we eliminate observations in the year of CEO turnover; (v) we rule out observations for which we fail to identify the CEOs' zodiac years; (vi) we delete observations that have missing values in any of the variables covered in Section 3.1.4. Appendix 2 summarizes our sample selection procedure. We end up with a sample comprising 10,450 firm-year observations for 2,406 unique firms. We winsorize all continuous variables at the top and bottom 1 percentage points to mitigate the influence of outliers on our multivariate analysis.

4. Research Design and Empirical Results

4.1. Tests of the hypothesis H1

We use the following difference-in-differences (DID) ordinary least squares (OLS) regression model to test our first hypothesis regarding the effect of zodiac-year belief on corporate tax avoidance:

$$DD\_BTD_{i,t} = \alpha_0 + \alpha_1 Treated_i + \alpha_2 Treated_i \times Tzodiac_t + Controls + \varepsilon \quad (3)$$

The dependent variable, $DD\_BTD_{i,t}$, is the residual book-tax difference estimated from Model (1). The treatment indicator, $Treated_i$, is set equal to one for the treated firms and zero for the control firms. The treated firms are those whose CEOs are in their zodiac years for the current year but not for the year before or after the zodiac year. The control firms are those whose CEOs are not in the zodiac year for the consecutive three years.[5] $Tzodiac_t$ is the time indicator variable, which equals 1 for the year when the treated firm's CEO is in the zodiac year, and equals 0 for the years before and after the CEO's zodiac year. Inclusion of this time variable in the interaction term, $Treated_i \times Tzodiac_t$, helps control for the time-varying factors that are common to both the treated firms and control firms. The coefficient of interest to our hypothesis test is α_2. It captures the change in corporate tax avoidance by the same treated firms between the zodiac year and the year before or after the zodiac year, relative to that by the control firms. If the hypothesis H1a (H1b) is tenable, we expect corporate tax avoidance in the CEOs' zodiac years to be of a higher (lower) degree than that in the adjacent years. Thus, a significantly positive (negative) α_2 would be consistent with our hypothesis H1a (H1b). On top of the control variables mentioned in Section 3.1.4, year dummies and industry dummies are also included in the regression, since the degree of corporate tax avoidance varies substantially across years and industries (e.g., Becker *et al.*, 1998; He *et al.*, 2020; Jones, 1991; Teoh *et al.*, 1998). We do not include *Tzodiac* in the regression because this time indicator variable is multicollinear with year dummies.

There are a disproportionately large sample of observations that are not in the zodiac years, and thus we employ sample-matching technique to select the most comparable observations for our regression estimation. We use the propensity-score matching (PSM) to simulate the condition of random assignment of observations into the treatment and control groups, thereby reducing potential sample selection bias and eliminating any potential systematic differences between the two groups. To this end, we adopt the one-to-one nearest neighbourhood propensity-score matching approach. We match firms, which have CEOs in their zodiac years (i.e., treated firms), with firms whose CEOs are not in their zodiac years (i.e., control firms), based on the closest propensity scores derived from observable firm characteristics. Since we have a panel of firm-year observations with staggered distributions of zodiac years over the sample period, we do the propensity-score matching year by year, and then pool all the yearly-matched sample to form the final matched sample for the period 2009-2019. In specific, for each year from 2010 to 2018, we first restrict the treatment group to firms whose CEOs are in their zodiac years for the current year but not for the previous year and following year, and the control group to firms whose CEOs are not in the zodiac year for the consecutive three years. Then each treated firm is matched, without replacement, with a control firm which has the propensity score closest to that of the treated firm. The propensity scores are estimated using a logit regression, in which the binary variable (*Zodiac_ceo*), indicating whether the firm's CEO is in the zodiac year, is regressed on a set of covariates which reflect the firm's fundamental characteristics, including firm size (*SIZE*), return on assets (*ROA*), assets growth (*Asset_growth*), financial leverage (*LEV*), firm risk (*Std_return*), and board independence (*Indp*). Appendix 1 details the definitions of these variables. Panel A of Table 1 reports the descriptive statistics of variables used for the propensity-score matching. We also include industry dummies in the matching regression. After the matching, we obtain a sample comprising 470 firm-year observations associated with 415 unique firms for the zodiac year *t*.[6]

We next check whether the covariates are balanced between the treated firms and control firms for the post-matched sample. To this end, we use the two-sample t-tests and absolute standardized differences for the means of covariates to check whether observations with the closest propensity scores have similar distribution of firm characteristics (Rosenbaum and Rubin, 1983). Provided that the absolute standardized differences of the covariate means are less than 5% or that t-statistics for the mean differences in the covariates are nonsignificant post matching (D'Agostino, 1998), we may rest assured that the preexisting observed differences between the treated firms and control firms would be eliminated substantially. Panel B of Table 1 shows the results for the univariate check of covariate balance for the post-matched sample. All the mean differences in the covariates are not statistically significant, and the standardized bias is less than 5% for all the covariates. Furthermore, we run the logit regression based on the pre-matched and post-matched samples, respectively, to further check the covariate balance. Panel C of Table 1 reports the results. It is shown in Columns (2) and (3) that the coefficients for all the covariates are not statistically significant, suggesting that our post-matched sample achieves a covariate balance. Panel A of Table 2 reports the mean, standard deviation, minimum values, maximum values, and quartiles of all variables, which are based on the post-matched sample used for the difference-in-differences regression analysis. Panel B presents the Spearman correlation matrix among the variables.

The parallel trends assumption required of the difference-in-differences regression analysis is that, in the absence of the treatment event, both the treated firms and control firms exhibit similar trends in the outcome variable (Roberts and Whited, 2013). Before running the difference-in-differences regression, it is necessary to test the parallel trends assumption to avoid the possible confounding effects of other concurrent events on corporate tax avoidance in the zodiac years. To this end, we define *Pre* as a time indicator equal to 1 (0) for the year before (after) the zodiac year. We then use our post-matched sample along with the DID

regression to compare the change in tax avoidance during the pre- and post-zodiac years. In Panel A of Table 3, the coefficient on *Treated*Pre* is not statistically significant. This null result supports the assumption that the treated firms and control firms would have experienced common trends in corporate tax avoidance in a counterfactual without the zodiac year, thereby suggesting that the changes in tax avoidance, as indicated by our baseline results, are likely attributed to the zodiac-year belief rather than other potential omitted factors.

Panel B of Table 3 shows the regression results for the hypothesis H1. Column (1) reports the OLS regression result. The coefficient on the interaction term, *Treated*Tzodiac*, is positive (0.004) and statistically significant at the 5% level (*t*-stat. = 2.01). It is possible that some unobserved firm-specific factors happen by chance in the CEOs' zodiac years to affect corporate tax avoidance. To deal with this issue, we run firm-fixed-effects regression for Model (3). We omit the treatment indicator variable and the industry dummies to avoid their potential multicollinearity with the included firm-fixed effects. Instead, we interact industry dummies with year dummies to control for potential industry shocks that can affect the magnitude of tax avoidance across different industries and years. The firm-fixed-effects regression result is shown in Column (2) under Panel B of Table 3. The coefficient for the interaction term, *Treated*Tzodiac*, is significantly positive at the 5% level (0.004 with *t*-stat. = 2.20). The degree of corporate tax avoidance is higher by 12.74% of its standard deviation in the CEOs' zodiac years. Collectively, our results are both statistically and economically significant in supporting the hypothesis H1a that CEOs are more likely to avoid taxes in their zodiac years. CEOs in their zodiac years appear more averse to their firms' financial risk than the legal and reputational risks associated with tax avoidance. Such finding and inference are in line with some prior research which finds no evidence of significant reputational costs to firms for pursuing tax avoidance (Gallemore *et al.*, 2014), and reconcile with the view that the tax enforcement by Chinese tax authorities is inadequate (Brondolo and Zhang, 2016). In addition,

we conduct a test of variance inflation factors (VIF). The un-tabulated results show that the VIF values for all independent variables are less than 5, suggesting that multicollinearity does not pose a threat to our regression analysis.

4.2. Further analyses for the hypothesis H1

We conduct further analyses for the hypothesis H1 in the following. First, to reinforce the treatment effect of zodiac-year belief on corporate tax avoidance, we conduct a placebo test, where we re-do our baseline regression with a pseudo-treatment sample. Specifically, we randomly select a number of firms, which equals the number of treatment firms, from the unmatched control group to create a pseudo-treatment group for each year. These selected samples are merged with the previously matched control group. We then use this combined sample to run the DID regression model (3). We repeat this process for 1,000 times. As shown in Figure 1, the coefficients for the placebo DID estimator are normally distributed and concentrated around zero. The majority of them have p-values greater than the significance level of 0.1 and are located to the left of the baseline DID coefficient (0.004 as depicted by the dotted vertical line). These results indicate that the effect of zodiac superstition on corporate tax avoidance vanishes after the randomization and placebo processes, which in reverse, corroborates the treatment effect implied by our baseline results.

Second, the standard errors of the coefficients in our baseline results are clustered by firm. We also cluster the standard errors by industry to account for potential cross-correlations of regression residuals within each industry, and report the results in Panel A of Table 4. They are qualitatively the same as those reported in Panel B of Table 3.

Lastly, we check the robustness of our baseline results to using an alternative measure of corporate tax avoidance that involves the effective tax rate (e.g., Bradshaw *et al.*, 2019; Chen *et al.*, 2010; Dyreng *et al.*, 2010). The China's local governments generally employ tax

incentives to encourage investments, leading to effective tax rates lower than the statutory tax rate (e.g., He, 2016; Shevlin *et al.*, 2012; Wu *et al.*, 2007). Therefore, we measure corporate tax avoidance by taking the difference between the nominal tax rate and the effective tax rate (*Adj_ETR*) (Amiram *et al.*, 2019; Cen *et al.*, 2017; Chan *et al.*, 2016; Tang, 2020). We also follow Balakrishnan *et al.* (2019) to derive an industry-adjusted measure of effective tax rate (*Ind_adj_ETR*). The higher *Adj_ETR* and *Ind_adj_ETR*, the greater the tax avoidance. We substitute *DD_BTD* for *Adj_ETR* or *Ind_adj_ETR* in Model (3) and re-estimate the regression. Panel B of Table 4 shows the results, which elicit the same inferences as do our baseline results and are both statistically and economically significant.

4.3. Tests of the hypotheses H2-H5

To test the hypothesis H2, we partition the pre-matched sample into subsamples with tighter financial constraints and those with lower financial constraints, based on the medians of *SA_index* and *Dividend*, respectively. We then redo the propensity-score matching and the DID regression for each subsample. Columns (1) and (3) of Table 5 display the results for the subsample firms that confront relatively severe financial constraints, as indicated by higher *SA_index* and lower *Dividend*. The coefficients on the interaction term amount to 0.006 (*t*-stat. = 1.97) and 0.005 (*t*-stat. = 2.11), indicating that the degree of tax avoidance is higher in the CEOs' zodiac years in cases when the firms are in the financial constraints. But regarding the results in Columns (2) and (4) for the low-financial-constraints subsample, *Treated*Tzodiac* does not take on a statistically significant coefficient. The hypothesis H2 is thus supported.

To test the hypothesis H3, we divide our pre-matched sample into two subsamples based on the medians of *Std_ros* and *Std_roa*, respectively. Then for each subsample, we match each treatment firms, without replacement, with a control firm utilizing the same propensity-score-matching approach as described previously, and re-run the difference-in-differences regression.

Table 6 presents the results. The coefficients of the interaction term, *Treated*Tzodiac*, are significantly positive at the 5% level for the high-risk firms, whereas the coefficients are not statistically significant for the low-risk firms. These results are consistent with H3, indicating that the positive relationship between zodiac-year belief and tax avoidance is evident only among firms with relatively higher business risk.

To test the hypothesis H4, we re-run our matching process and DID regression based on the subsample of firms that are headquartered in the more-superstitious regions, which are defined in Section 3.1.3, and those in the other regions, respectively. Table 7 provides the regression results. For the subsample of firms headquartered in the highly superstitious provinces, the interaction term, *Treated*Tzodiac*, is positive and significantly associated with tax avoidance (0.005 with *t*-stat. = 2.06), implying that for these provinces, the magnitude of corporate tax avoidance is greater in the CEOs' zodiac years compared to the years before and after the zodiac years. However, for the low-regional-superstition subsample, the coefficient of the interaction term is not statistically significant (0.005 with *t*-stat. = 1.18). These subsample regression results are therefore consistent with H4 - that the positive link between tax avoidance and the CEOs' zodiac years is more pronounced for firms headquartered in highly superstitious regions.

To test the hypothesis H5, we split the pre-matched sample into the SOE subsample and non-SOE subsample, re-do the matching for each subsample, and then run subsample regressions based on Model (3). As shown in Table 8, the coefficient of *Treated*Tzodiac* is significantly positive at the 1% level for non-SOEs (0.008 with *t*-stat. = -2.97) whereas the coefficient is not statistically significant for SOEs (-0.001 with *t*-stat. = -0.43). These results lend support to H5 and reconcile with Fisman *et al.* (2023) which find that the effect of zodiac-year belief on corporate investments exists only in non-state-owned firms.

5. Conclusion

The literature on psychology and sociology documents that superstition prevails astonishingly in the modern societies, influencing the attitudes and decisions of people in their daily lives. In this paper, we examine the role played by zodiac-year belief in shaping corporate tax avoidance. We postulate that CEOs trade-off between the benefits and costs of pursuing tax avoidance. The benefits (costs) are associated with the decreased (increased) risk of financial constraints and/or distress (legal penalties and/or reputational losses). The zodiac-year belief provides a nice setting to investigate whether CEOs perceive the benefits as exceeding the costs when they are risk-averse. Under the zodiac-year belief, individuals are likely to confront misfortune in their zodiac years and tend to be more cautious and risk-averse in their decision-making and behaviors. Our empirical results indicate that CEOs are more likely to avoid taxes in their zodiac years, suggesting that they attach more importance to containing financial risk than the exposure of legal and reputational risks as a result of tax avoidance. We also find that the effect of zodiac-year belief on corporate tax avoidance is stronger in cases in which (i) the firm faces tight financial constraints; (ii) the firm's business risk is high; (iii) the firm is headquartered in the highly superstitious areas; and (iv) the firm is non-state-owned. It is worth noting that our findings are not generalizable to other types of superstition, which is a limitation of the paper. Yet, as mentioned in Section 1, focusing on zodiac-year superstitious belief for the study facilitates us to draw casual inferences and enhance the internal validity of results.

Our paper has important implications for practitioners. From our baseline results, it can be inferred that, to curb corporate tax avoidance, we ought to increase the legal and reputational risks to firms for their tax avoidance. This emphasizes the need for policymakers to improve tax regulations, for tax authorities to enhance tax law enforcements, and for the media and market participants to increase coverage and oversight on tax avoidance. It is also important to

provide appropriate training and education to CEOs in order to increase their understanding of tax laws and ethical codes and raise their awareness of potential negative consequences of tax avoidance. In so doing, CEOs are more likely to abstain from avoiding taxes, thereby contributing to more equitable market and society. Meanwhile, it is imperative to enhance the efficiency of capital markets, thereby reducing the financial risk for listed firms and lessening their incentives to avoid taxes.

Notes

[1] According to the Enterprise Income Tax Law of the People's Republic of China, firms are required to submit a prepayment of income taxes to tax authorities within fifteen days following the end of the month or quarter, which implies that, if a firm avoids income taxes, any such activity may come to light within the same fiscal year. Therefore, the benefits and costs of avoiding taxes have to be traded-off in the same year by managers and their firms.

[2] Baidu is the search engine most widely used in China. Google is not available for search in mainland China.

[3] In an unpresented analysis, we test the effects of CEOs' and CFOs' zodiac years jointly, and obtain qualitatively the same results consistent with the stated hypotheses.

[4] The Baidu search index begins to provide the moving average of daily search volumes from 2013. We therefore define the region-level superstition between 2009 and 2012 to be in line with that in 2013.

[5] Each treated firm involves the CEO's zodiac year alongside two adjacent years for a time-series comparison, and is matched with a control firm that involves the three firm-year observations for a cross-sectional comparison in the DID regression analysis.

[6] In our matching process, some treated firms for a year could be the control firms for another year when the CEOs are not in their zodiac years. Thus, the number of firm-year observations is higher than that of unique firms after the matching.

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Figure 1: Distribution of the 1,000 coefficient estimates in a placebo test
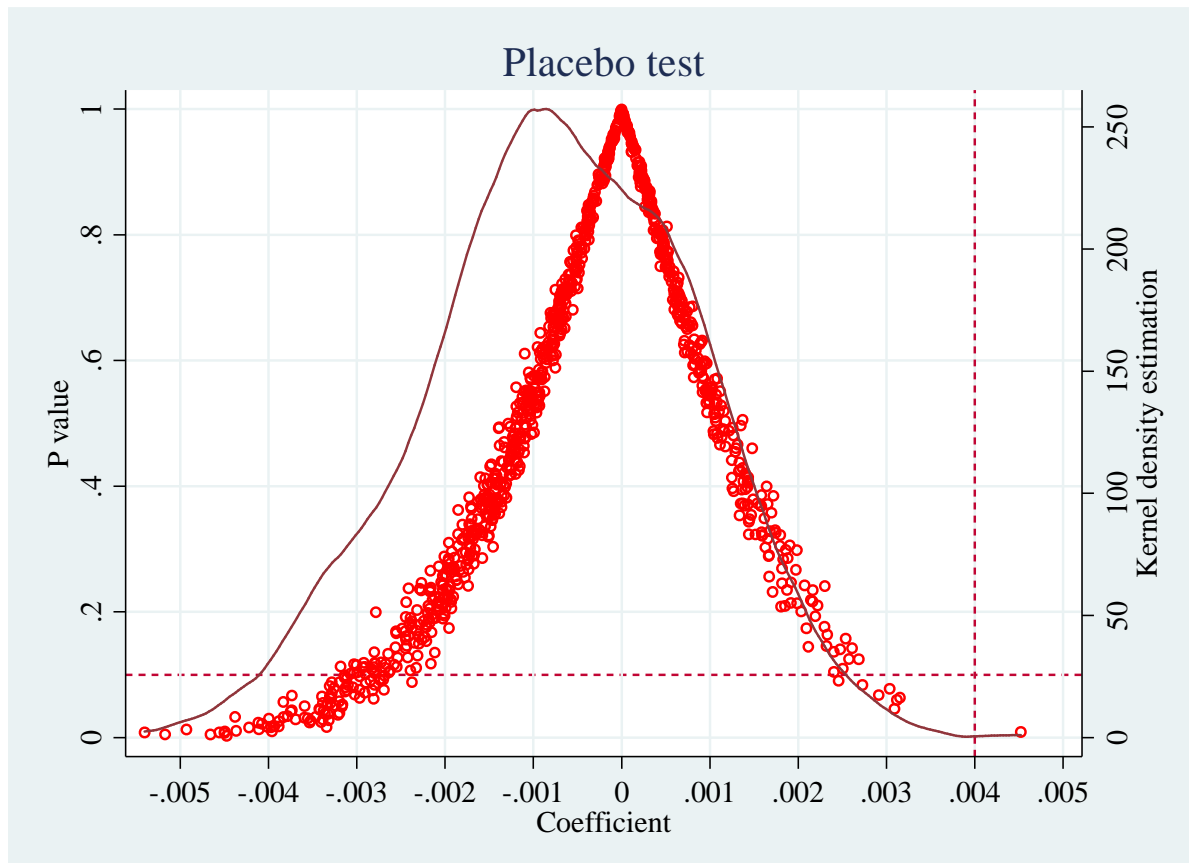
Notes: The X-axis indicates the coefficients for the interaction term that are estimated based on the pseudo sample. The left Y-axis indicates the *p*-values of the coefficients. The right Y-axis indicates the kernel density of the estimated coefficients. The red dots (solid curve) represent(s) the *p*-values (kernel density) corresponding to the estimated coefficients. The vertical dashed line represents the estimated coefficient of the interaction term in the baseline DID regression analysis. The horizontal dashed line represents the significance level of *p*=0.1 for a DID estimator.

TABLE 1: Propensity-score matching

Panel A: Descriptive statistics of variables used for propensity-score matching

Variables	n	Mean	Min.	25%	Median	75%	Max.	Std.
DD_BTD	10,450	-0.000562	-0.141	-0.0156	-0.00227	0.0119	0.104	0.0314
Zodiac_ceo	10,450	0.0600	0	0	0	0	1	0.237
SIZE	10,450	22.40	19.87	21.53	22.23	22.40	26.14	1.252
ROA	10,450	0.0642	-0.000544	0.0334	0.0533	0.0824	0.222	0.0444
Asset_growth	10,450	0.451	0.0545	0.300	0.451	0.601	0.851	0.196
LEV	10,450	0.184	-0.248	0.0277	0.109	0.231	1.617	0.314
Std_return	10,450	0.431	0.113	0.297	0.389	0.513	1.152	0.203
Indp	10,450	0.372	0.250	0.333	0.333	0.429	0.571	0.0535

Notes: This table presents descriptive statistics of the variables used for the propensity-score matching. The pre-matched sample contains 10,450 firm-years from 2009 to 2019. All the variables are defined in Appendix 1. All the continuous variables are winsorized at the 1% and 99% levels, respectively.

Panel B: Univariate tests of covariate balance

Variables	Matching statuses	No. of firm-years	No. of firms	Mean for treatment firms	Mean for control firms	Standardized bias	t-stat.
	Unmatched sample in zodiac year *t*	2,789	1,219	22.35	22.444	-7.9	-1.15
SIZE	Matched sample in zodiac year *t*	470	415	22.35	22.325	2	0.22
	Matched sample from *t-1* to *t+1*	1,410	415	22.349	22.323	2.2	0.24
	Unmatched sample in zodiac year *t*	2,789	1,219	0.0714	0.0698	3.3	0.5
ROA	Matched sample in zodiac year *t*	470	415	0.0714	0.0721	-1.5	-0.16
	Matched sample from *t-1* to *t+1*	1,410	415	0.713	0.721	-1.6	-0.18
	Unmatched sample in zodiac year *t*	2,789	1,219	0.189	0.18	3.7	0.54
Asset_growth	Matched sample in zodiac year *t*	470	415	0.189	0.177	5	0.53
	Matched sample from *t-1* to *t+1*	1,410	415	0.189	0.175	5.6	0.61
	Unmatched sample in zodiac year *t*	2,789	1,219	0.451	0.44	6.1	0.87
LEV	Matched sample in zodiac year *t*	470	415	0.451	0.448	1.5	0.16
	Matched sample from *t-1* to *t+1*	1,410	415	0.451	0.448	1.4	0.16
	Unmatched sample in zodiac year *t*	2,789	1,219	0.408	0.419	-6.1	-0.85
Std_return	Matched sample in zodiac year *t*	470	415	0.408	0.412	-2.4	-0.26
	Matched sample from *t-1* to *t+1*	1,410	415	0.408	0.412	-2.4	-0.26
	Unmatched sample in zodiac year *t*	2,789	1,219	0.371	0.371	0	-0.01
Indp	Matched sample in zodiac year *t*	470	415	0.371	0.37	1.5	0.16
	Matched sample from *t-1* to *t+1*	1,410	415	0.371	0.37	1.7	0.19

Notes: This table reports the descriptive statistics of the matching covariates for the sample of treatment firms (i.e., firms that have CEOs in their zodiac years) and the sample of control firms (i.e., firms whose CEOs are not in their zodiac years). We do the propensity-score matching year by year, and pool all the yearly-matched sample to form the sample for covariate-balance tests. For each year from 2010 to 2018, we drop the control firms that have missing observations in the consecutive three-year period centered in the zodiac year of the matched treatment firms. The results of the two-sample tests of mean differences, and the results of the standardized bias, for the covariates are provided for the pre-matched and post-matched samples, respectively, in the zodiac year, and for the post-matched sample used in the difference-in-differences regression analysis which covers the consecutive three-year period centered in the zodiac year of the matched control firm. All the covariates are defined in Appendix 1. ***, **, * denote the two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel C: Multivariate tests of covariate balance

Variables	*Zodiac_ceo*		
	Pre-matched sample in zodiac year *t*	Post-matched sample in zodiac year *t*	Post-matched sample from year *t-1* to *t+1*
	(1)	(2)	(3)
SIZE	-0.056	-0.004	-0.003
	(-0.74)	(-0.04)	(-0.04)
ROA	0.001	0.063	0.074
	(0.00)	(0.09)	(0.16)
Asset_growth	0.074	-0.606	-0.306
	(0.04)	(-0.25)	(-0.18)
LEV	0.092	0.171	0.111
	(0.31)	(0.42)	(0.39)
Std_return	-0.293	-0.277	-0.459
	(-0.57)	(-0.40)	(-0.79)
Indp	0.187	0.187	0.008
	(0.14)	(0.10)	(0.01)
Constant	-0.783	0.131	-1.538
	(-0.44)	(0.05)	(-0.99)
Observations	2,770	470	1,314
Pseudo R^2	0.032	0.003	0.013
Year-fixed effects	included	included	included
Industry-fixed effects	included	included	included

Notes: This table reports the logistic regression result for comparing firm characteristics between the treatment sample (composed of firms whose CEOs are in their zodiac years) and control sample (composed of firms whose CEOs are not in their zodiac years). The sample period for *Zodiac_ceo* in Columns (1) and (2) spans the years 2010-2018, while the sample period for *Zodiac_ceo* in Column (3) covers the years 2009-2019. Columns (1), (2), and (3) show the regression results based on the pre-matched sample in the zodiac year, the post-matched sample in the zodiac year, and the post-matched sample used for the difference-in-differences (DID) regression, respectively. The dependent variable, *Zodiac_ceo*, equals 1 if a firm's CEO is in the zodiac year, and 0 otherwise. All the determinant variables for *Zodiac_ceo* (i.e., matching covariates) are defined in Appendix 1. Year dummies and industry dummies are included in the regressions, but their results are not reported for the sake of simplicity. *t*-statistics in parentheses are based on the robust standard errors clustered by firm. ***, **, * represent the two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 2: Univariate statistics

Panel A: Descriptive statistics of variables

Variables	n	Mean	Min.	25%	Median	75%	Max.	Std.
DD_BTD	1,410	-0.001	-0.117	-0.017	-0.002	0.012	0.105	0.033
Adj_ETR	1,410	0.030	0	0	0	0.039	0.499	0.055
Ind_adj_ETR	1,410	-0.101	-1	-1	-1	0.125	8.914	1.559
Treated	1,410	0.500	0	0	0.5	1	1	0.500
Tzodiac	1,410	0.333	0	0	0	1	1	0.472
SIZE	1,410	22.330	19.890	21.490	22.200	22.980	25.790	1.200
ROA	1,410	0.071	-0.179	0.038	0.060	0.093	0.226	0.050
Asset_growth	1,410	0.179	-0.248	0.036	0.120	0.243	1.023	0.251
LEV	1,410	0.449	0.056	0.300	0.449	0.600	0.828	0.190
NOL	1,410	-0.021	-1.956	0	0	0	0	0.123
PPE	1,410	0.224	0.003	0.101	0.193	0.323	0.615	0.154
Intangible	1,410	0.044	0	0.016	0.031	0.054	0.362	0.055
RD	1,410	0.004	0	0	0	0	0.063	0.017
Capital_exp	1,410	0.050	0.000	0.017	0.039	0.070	0.194	0.044
MB	1,410	0.544	0.087	0.334	0.517	0.720	1.114	0.251
DA	1,410	0.012	-0.250	-0.029	0.009	0.049	0.207	0.073
Cash	1,410	0.162	0.010	0.091	0.139	0.210	0.498	0.099
Foreign	1,410	0.104	0	0	0.000	0.127	0.779	0.180
Managerial_shareholding	1,410	0.045	0	0	0.000	0.014	0.534	0.110
Top_shareholding	1,410	34.200	9.030	23.340	32.830	43.760	71.150	14.060
Boardsize	1,410	2.168	1.609	2.079	2.197	2.197	2.639	0.185
Duality	1,410	0.247	0	0	0	0	1	0.431
Institution	1,410	47.590	0.108	34.960	49.700	63.780	87.980	21.490
Indp	1,410	0.370	0.250	0.333	0.333	0.400	0.571	0.053
BIG4	1,410	0.055	0	0	0	0	1	0.229
SOE	1,410	0.441	0	0	0	1	1	0.497

Notes: This table tabulates descriptive statistics of the variables used for the difference-in-differences regression tests. The sample consists of a post-matched sample of 1,410 firm-years and covers the years 2009-2019. All the variables are defined in Appendix 1. All the continuous variables are winsorized at the 1% and 99% levels, respectively.

Panel B: Correlation matrix

Variables	DD_BTD	SIZE	ROA	Asset_growth	LEV	NOL	PPE	Intangible	RD	Capital_exp
DD_BTD	1									
SIZE	-0.036	1								
ROA	0.153***	0.078***	1							
Asset_growth	-0.007	0.149***	0.122***	1						
LEV	-0.177***	0.471***	-0.322***	0.088***	1					
NOL	0.01	-0.098***	0.071***	0.004	-0.065**	1				
PPE	0.038	-0.073***	-0.033	-0.159***	-0.049*	-0.079***	1			
Intangible	-0.085***	-0.044*	0.031	-0.003	-0.038	0.016	0.094***	1		
RD	0.126***	0.004	0.016	-0.058**	-0.108***	0.009	-0.070***	-0.026	1	
Capital_exp	0.008	0	0.139***	0.152***	-0.045*	0.014	0.386***	0.187***	-0.042	1
MB	-0.091***	0.559***	-0.285***	-0.097***	0.550***	-0.065**	0.107***	-0.021	0.014	-0.019
DA	0.154***	0.146***	0.220***	0.149***	-0.056**	0.061**	-0.145***	-0.121***	0.038	-0.076***
Cash	-0.041	-0.121***	0.212***	0.100***	-0.273***	0.013	-0.272***	-0.084***	-0.029	-0.089***
Foreign	0.062**	-0.008	0.055**	0.003	-0.064**	-0.019	0.032	-0.006	0.013	0.117***
Managerial_shareholding	0.012	-0.191***	0.024	0.04	-0.242***	0.048*	-0.099***	-0.012	0.107***	0.016
Top_shareholding	-0.026	0.207***	0.026	0.056**	0.213***	-0.028	-0.049*	-0.035	-0.110***	-0.033
Boardsize	-0.051*	0.170***	0.090***	-0.036	0.071***	-0.054**	0.208***	0.02	-0.031	0.097***
Duality	0.075***	-0.072***	-0.006	0.029	-0.117***	0.027	-0.110***	-0.04	0.082***	-0.04
Institution	0.032	0.364***	0.198***	0.133***	0.226***	-0.047*	0.046*	0.046*	-0.132***	0.076***
Indp	0.012	0.120***	-0.028	0.022	0.062**	-0.035	-0.057**	-0.062**	-0.036	0.006
BIG4	-0.050*	0.394***	0.015	-0.002	0.147***	-0.080***	-0.024	0.006	-0.016	0.046*
SOE	0.000	0.182***	-0.158***	-0.095***	0.264***	-0.068**	0.103***	0.04	-0.115***	-0.023

Variables	MB	DA	Cash	Foreign	Managerial_shareholding	Top_shareholding	Boardsize	Duality	Institution	Indp	BIG4	SOE
MB	1											
DA	-0.02	1										
Cash	-0.243***	-0.063**	1									
Foreign	-0.046*	-0.015	0.142***	1								
Managerial_shareholding	-0.236***	0.032	0.003	0.072***	1							
Top_shareholding	0.088***	0.038	-0.026	-0.029	-0.063**	1						
Boardsize	0.109***	-0.007	-0.046*	0.028	-0.200***	-0.062**	1					
Duality	-0.158***	0.031	-0.002	0.143***	0.481***	-0.039	-0.315***	1				
Institution	0.124***	0.036	0.057**	-0.009	-0.559***	0.530***	0.170***	-0.260***	1			
Indp	0.056**	0.001	-0.041	-0.020	0.063**	0.145***	-0.411***	0.137***	0.037	1		
BIG4	0.191***	-0.030	-0.073***	-0.038	-0.095***	0.177***	0.099***	-0.081***	0.221***	0.073***	1	
SOE	0.264***	-0.010	-0.043*	-0.069***	-0.345***	0.178***	0.234***	-0.329***	0.306***	0.003	0.154***	1

Notes: This table presents the results for the Spearman correlations. The correlation matrix involves the variables used for the difference-in-differences regression tests. The sample consists of a post-matched sample of 1,410 firm-years and covers the years 2009-2019. All the variables are defined in Appendix 1. ***, **, * represent the two-tailed statistical significance at the 1%, 5%, and 10% levels, respectively, for the correlation coefficients.

TABLE 3: Baseline regression analysis for the hypothesis H1

Panel A: Tests of parallel trends assumption

Variables	DD_BTD (1)
Treated*Pre	0.002
	(0.87)
Treated	-0.001
	(-0.20)
SIZE	-0.000
	(-0.20)
ROA	0.094**
	(2.35)
Asset_growth	-0.001
	(-0.20)
LEV	-0.028**
	(-2.54)
NOL	-0.006
	(-0.98)
PPE	0.004
	(0.41)
Intangible	-0.079***
	(-2.99)
RD	0.214**
	(2.41)
Capital_exp	-0.022
	(-0.83)
MB	0.004
	(0.40)
DA	0.050***
	(2.62)
Cash	-0.048***
	(-3.08)
Foreign	0.011
	(1.57)
Managerial_shareholding	-0.006
	(-0.35)
Top_shareholding	-0.000
	(-0.72)
Boardsize	-0.017*
	(-1.78)
Duality	0.007**
	(1.98)
Institution	0.000*
	(1.83)
Indp	-0.011
	(-0.42)
BIG4	-0.005
	(-0.82)
SOE	0.004
	(1.52)
Constant	0.099**
	(2.44)
Observations	940
Adj.R^2	0.190
Year-fixed effects	included
Industry-fixed effects	included

Notes: This table presents the results for the multivariate test of the parallel trends assumption. The sample period spans the years 2009-2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which are estimated from a regression of the total book-tax difference on the total accruals. The treatment variable, *Treated*, equals 1 for the treatment firm, and 0 for the control firm. The treatment (control) firms are firms whose CEOs are (not) in their zodiac years. *Pre* equals 1 (0) for the year before (after) the zodiac year. Year dummies and industry dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel B: Baseline difference-in-differences regression on the zodiac-year effect

Variables	DD_BTD	
	OLS regression	Firm-fixed-effects regression
	(1)	(2)
*Treated*Tzodiac*	0.004**	0.004**
	(2.01)	(2.20)
Treated	0.001	
	(0.52)	
SIZE	-0.000	0.006
	(-0.03)	(0.87)
ROA	0.080**	0.007
	(2.13)	(0.19)
Asset_growth	-0.002	-0.004
	(-0.29)	(-0.64)
LEV	-0.035***	-0.046**
	(-3.48)	(-2.38)
NOL	-0.004	0.012**
	(-0.59)	(2.18)
PPE	0.002	-0.000
	(0.27)	(-0.01)
Intangible	-0.080***	0.037
	(-2.94)	(0.71)
RD	0.208***	0.074
	(2.96)	(0.82)
Capital_exp	-0.009	-0.035
	(-0.38)	(-1.03)
MB	0.007	-0.014
	(0.82)	(-1.18)
DA	0.039**	0.044***
	(2.34)	(2.70)
Cash	-0.049***	0.027
	(-3.46)	(1.45)
Foreign	0.014**	0.005
	(2.00)	(0.26)
Managerial_shareholding	-0.004	-0.006
	(-0.29)	(-0.24)
Top_shareholding	-0.000	0.000
	(-0.93)	(0.19)
Boardsize	-0.017**	0.013
	(-1.98)	(0.81)
Duality	0.006*	-0.010
	(1.74)	(-1.54)
Institution	0.000*	-0.000
	(1.68)	(-0.79)
Indp	-0.012	0.027
	(-0.47)	(0.55)
BIG4	-0.006	0.004
	(-1.11)	(0.68)
SOE	0.005*	-0.004
	(1.75)	(-0.45)
Constant	0.094**	-0.131
	(2.27)	(-0.88)
Observations	1,410	1,410
Adj.R^2	0.168	0.157
Year-fixed effects	included	
Industry-fixed effects	included	
Firm-fixed effects		included
Industry-year fixed effects		included

Notes: This table reports the results of difference-in-differences regression analysis of the effect of CEOs' zodiac years on corporate tax avoidance. The sample period ranges from 2009 to 2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which is estimated from a regression of the total book-tax difference on the total accruals. The treatment variable, *Treated*, equals 1 for a treatment firm, and 0 for a control firm. The treatment (control) firms are firms whose CEOs are (not) in their zodiac years. The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest for the main hypothesis. All the variables are defined in Appendix 1. Column (1) reports the OLS regression result. Industry dummies and year dummies are included in the regression, but their results are not reported for brevity. Column (2) reports the firm-fixed-effects regression result. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 4: Further analyses for the hypothesis H1

Panel A: Regression results based on standard errors clustered by industry

Variables	DD_BTD	
	OLS regression (1)	Firm-fixed-effects regression (2)
Treated*Tzodiac	0.004**	0.004***
	(2.29)	(4.19)
Treated	0.001	
	(0.63)	
SIZE	-0.000	0.006*
	(-0.04)	(1.90)
ROA	0.080***	0.007
	(3.75)	(0.41)
Asset_growth	-0.002	-0.004
	(-0.42)	(-0.88)
LEV	-0.035***	-0.046***
	(-8.93)	(-3.74)
NOL	-0.004*	0.012***
	(-1.92)	(5.04)
PPE	0.002	-0.000
	(0.48)	(-0.02)
Intangible	-0.080*	0.037
	(-2.16)	(1.20)
RD	0.208***	0.074*
	(5.45)	(1.84)
Capital_exp	-0.009	-0.035*
	(-0.27)	(-2.14)
MB	0.007	-0.014
	(1.06)	(-1.72)
DA	0.039**	0.044*
	(2.50)	(1.96)
Cash	-0.049***	0.027
	(-4.42)	(1.19)
Foreign	0.014**	0.005
	(2.56)	(0.59)
Managerial_shareholding	-0.004	-0.006
	(-0.83)	(-0.24)
Top_shareholding	-0.000	0.000
	(-1.34)	(0.25)
Boardsize	-0.017*	0.013
	(-1.82)	(0.83)
Duality	0.006***	-0.010
	(3.97)	(-1.61)
Institution	0.000***	-0.000
	(5.95)	(-0.71)
Indp	-0.012	0.027
	(-0.50)	(0.47)
BIG4	-0.006***	0.004**
	(-4.06)	(3.03)
SOE	0.005**	-0.004
	(2.97)	(-0.26)
Constant	0.094***	-0.132
	(3.96)	(-1.47)
Observations	1,410	1,410
Adj.R^2	0.141	0.089
Year-fixed effects	included	
Industry-fixed effects	included	
Firm-fixed effects		included
Industry-year fixed effects		included

Notes: This table reports the results of the DID regression analysis of the effect of CEOs' zodiac years on corporate tax avoidance clustering, with the coefficients' standard errors clustered by industry. The sample period ranges from 2009 to 2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which is estimated from a regression of the total book-tax difference on the total accruals. The treatment variable, *Treated*, equals 1 for a treatment firm, and 0 for a control firm. The treatment (control) firms are firms whose CEOs are (not) in their zodiac years. The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest for the main hypothesis. All the variables are defined in Appendix 1. Column (1) reports the OLS regression result. Industry dummies and year dummies are included in the regression, but their results are not reported for brevity. Column (2) reports the firm-fixed-effects regression result. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by industry. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel B: Regression results based on alternative measures of corporate tax avoidance

Variables	Adj_ETR		Ind_adj_ETR	
	OLS regression	Firm-fixed-effects regression	OLS regression	Firm-fixed-effects regression
	(1)	(2)	(3)	(4)
Treated*Tzodiac	0.008**	0.008**	0.248***	0.247**
	(2.22)	(1.98)	(2.61)	(2.53)
Treated	0.000		0.068	
	(0.02)		(0.62)	
SIZE	0.000	0.001	0.004	0.119
	(0.12)	(0.13)	(0.05)	(0.50)
ROA	0.029	0.085	0.877	1.099
	(0.61)	(1.37)	(0.67)	(0.78)
Asset_growth	0.002	0.001	-0.016	0.122
	(0.30)	(0.19)	(-0.10)	(0.78)
LEV	-0.040**	-0.005	-0.994*	-0.479
	(-2.22)	(-0.17)	(-1.89)	(-0.56)
NOL	-0.016	0.026	-0.442	0.371
	(-1.21)	(1.56)	(-1.18)	(1.31)
PPE	-0.003	-0.049	-0.408	-0.978
	(-0.20)	(-1.01)	(-0.88)	(-0.79)
Intangible	-0.085**	-0.031	-3.304***	-1.070
	(-1.99)	(-0.52)	(-2.68)	(-0.60)
RD	0.061	-0.149	-0.431	-7.395
	(0.58)	(-0.76)	(-0.18)	(-1.50)
Capital_exp	-0.042	-0.083	-0.895	-1.619
	(-1.01)	(-1.49)	(-0.79)	(-1.03)
MB	0.015	-0.015	0.302	-0.373
	(1.24)	(-0.77)	(0.82)	(-0.59)
DA	0.026	0.034	0.984	1.139*
	(1.13)	(1.59)	(1.41)	(1.72)
Cash	-0.082***	0.018	-2.578***	0.300
	(-4.06)	(0.83)	(-4.06)	(0.42)
Foreign	0.019	0.003	0.549*	0.161
	(1.46)	(0.16)	(1.66)	(0.29)
Managerial_shareholding	-0.038	0.016	-1.176*	0.892
	(-1.55)	(0.40)	(-1.72)	(0.70)
Top_shareholding	0.000	-0.000	0.001	-0.015
	(0.48)	(-0.92)	(0.16)	(-1.25)
Boardsize	-0.038***	-0.029	-1.179***	-1.210*
	(-3.25)	(-1.34)	(-3.35)	(-1.79)
Duality	0.009	-0.034	0.324*	-0.616
	(1.58)	(-1.62)	(1.83)	(-1.33)
Institution	-0.000	-0.000	0.001	-0.013
	(-0.06)	(-0.81)	(0.31)	(-1.52)
Indp	-0.029	-0.031	-1.162	-1.689
	(-0.71)	(-0.58)	(-1.05)	(-0.89)
BIG4	-0.008	0.011	-0.158	0.297
	(-1.16)	(0.53)	(-0.66)	(0.50)
SOE	0.009*	-0.022	0.328**	-0.431
	(1.94)	(-1.15)	(2.32)	(-1.02)
Constant	0.261***	0.167	3.577*	3.028
	(3.24)	(0.79)	(1.85)	(0.53)
Observations	1,410	1,410	1,410	1,410
Adj.R^2	0.104	0.056	0.063	0.055
Year-fixed effects	included		included	
Industry-fixed effects	included		included	
Firm-fixed effects		included		included
Industry-year fixed effects		included		included

Notes: This table reports the results of difference-in-differences regression analysis of the effect of the CEOs' zodiac-year belief on corporate tax avoidance, which are based on alternative measures of tax avoidance. The sample period spans the years 2009-2019. All the variables are defined in Appendix 1. In Columns (1) and (2), the dependent variable, *Adj_ETR*, is the difference between nominal tax rate and effective tax rate (*ETR*). *ETR* is calculated as tax expense minus deferred tax expense, deflated by profit before tax. In Columns (3) and (4), the dependent variable, *Ind_adj_ETR*, is the difference between a firm's *Adj_ETR* and the industry average of *Adj_ETR* for the same year, divided by this industry average. The treatment variable, *Treated*, equals 1 for a treatment firm, and 0 for a control firm. The treatment (control) firms are firms whose CEOs are (not) in their zodiac years. The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest. Columns (1) and (3) reports the OLS regression result. Industry dummies and year dummies are included in the regression, but their results are not reported for brevity. Columns (2) and (4) reports the firm-fixed-effects regression result. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 5: Tests of the moderating effect of financial constraints

Variables	DD_BTD			
	Tighter financial constraints (high *SA_index*)	Lower financial constraints (low *SA_index*)	Tighter financial constraints (low *Dividend*)	Lower financial constraints (high *Dividend*)
	(1)	(2)	(3)	(4)
*Treated*Tzodiac*	0.006*	0.001	0.005**	-0.001
	(1.97)	(0.42)	(2.11)	(-0.33)
SIZE	-0.001	0.009	0.004	-0.024*
	(-0.05)	(0.65)	(0.26)	(-1.66)
ROA	0.013	-0.051	-0.046	-0.028
	(0.25)	(-1.04)	(-0.72)	(-0.36)
Asset_growth	-0.001	0.003	0.004	0.003
	(-0.18)	(0.51)	(0.46)	(0.51)
LEV	-0.010	-0.086**	0.004	0.012
	(-0.43)	(-2.33)	(0.13)	(0.31)
NOL	0.020*	-0.013**	-0.002	0.017
	(1.92)	(-2.42)	(-0.46)	(0.48)
PPE	-0.038	-0.015	-0.008	0.034
	(-1.04)	(-0.46)	(-0.18)	(0.78)
Intangible	0.004	0.018	-0.022	0.028
	(0.03)	(0.15)	(-0.31)	(0.28)
RD	0.060	0.202	0.069	0.249
	(0.67)	(1.44)	(0.67)	(1.49)
Capital_exp	-0.044	-0.034	-0.060	-0.102
	(-0.93)	(-0.51)	(-1.14)	(-1.21)
MB	0.021	-0.034**	-0.014	-0.017
	(1.29)	(-2.10)	(-0.61)	(-0.92)
DA	0.020	0.038	-0.030	0.058
	(0.88)	(1.57)	(-1.42)	(1.62)
Cash	0.042*	-0.000	-0.013	0.066**
	(1.89)	(-0.10)	(-0.55)	(2.19)
Foreign	0.011	0.027	0.021	-0.011
	(0.47)	(1.27)	(0.90)	(-0.45)
Managerial_shareholding	0.029	0.037	-0.023	-0.002
	(0.89)	(0.34)	(-0.78)	(-0.02)
Top_shareholding	0.000*	0.000	0.000	-0.000
	(1.72)	(0.44)	(0.47)	(-0.17)
Boardsize	0.021	-0.033	-0.022	0.058
	(0.93)	(-0.66)	(-0.98)	(1.45)
Duality	-0.015*	-0.009	0.007	0.009
	(-1.88)	(-0.72)	(0.94)	(0.55)
Institution	-0.000	-0.000	-0.000	-0.000
	(-0.71)	(-0.32)	(-0.54)	(-0.05)
Indp	0.013	-0.072	-0.020	0.067
	(0.20)	(-0.62)	(-0.37)	(0.61)
BIG4	0.007	-0.007	-0.002	0.008
	(1.24)	(-0.56)	(-0.22)	(0.50)
SOE	-0.004	0.002	0.005	0.020**
	(-0.81)	(0.16)	(0.62)	(2.26)
Constant	-0.046	-0.023	-0.028	0.401
	(-0.21)	(-0.08)	(-0.09)	(1.34)
Observations	623	509	382	492
Adj.R^2	0.231	0.269	0.190	0.261
Firm-fixed effects	included	included	included	included
Industry-year fixed effects	included	included	included	included

Notes: This table reports the results from testing the moderating effect of financial constraints on the baseline regression results. The sample period covers the years 2009-2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which is estimated from a regression of the total book-tax difference on the total accruals. The moderating variables are the SA index (*SA_index*) and cash dividend (*Dividend*). A higher (lower) value of *SA_index* (*Dividend*) indicates that the firm faces tighter financial constraints. The difference-in-differences regressions are run separately in the high-*SA_index* (low-*Dividend*) subsample and the low-*SA_index* (high-*Dividend*) subsample, which are split based on the median of *SA_index* (*Dividend*) in the pre-matched sample. *Treated* equals 1 for the treatment firm (i.e., a firm whose CEO is in her/his zodiac year), and 0 for the control firm (i.e., a firm whose CEO is not in her/his zodiac year). The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 6: Tests of the moderating effect of business risk

Variables	DD_BTD			
	High risk (*Std_ros*)	Low risk (*Std_ros*)	High risk (*Std_roa*)	Low risk (*Std_roa*)
	(1)	(2)	(3)	(4)
*Treated*Tzodiac*	0.010**	0.001	0.008*	0.000
	(2.36)	(0.27)	(1.78)	(0.02)
SIZE	0.003	-0.006	0.010	-0.007
	(0.26)	(-0.68)	(0.74)	(-0.75)
ROA	0.031	0.074	0.065	-0.202
	(0.93)	(0.97)	(1.48)	(-1.55)
Asset_growth	0.005	0.010	-0.014	0.016**
	(0.62)	(1.39)	(-1.15)	(2.51)
LEV	-0.003	-0.002	-0.011	-0.008
	(-0.12)	(-0.12)	(-0.37)	(-0.36)
NOL	0.001	-0.128	0.001	2.210
	(0.09)	(-1.34)	(0.13)	(1.25)
PPE	-0.024	0.073**	0.010	0.030
	(-0.68)	(2.31)	(0.23)	(1.04)
Intangible	0.131*	0.104	-0.016	-0.037
	(1.69)	(1.33)	(-0.21)	(-0.72)
RD	-0.212*	0.301***	-0.074	0.231
	(-1.69)	(2.71)	(-0.66)	(1.62)
Capital_exp	-0.034	0.065	0.066	0.025
	(-0.62)	(1.16)	(1.17)	(0.74)
MB	-0.040*	-0.021*	0.007	-0.034**
	(-1.94)	(-1.76)	(0.32)	(-2.34)
DA	0.040	0.013	0.045	-0.005
	(1.57)	(0.85)	(1.50)	(-0.31)
Cash	0.013	0.046*	0.012	0.000
	(0.39)	(1.73)	(0.32)	(1.37)
Foreign	0.049	0.013	0.037	-0.011
	(0.92)	(0.56)	(1.05)	(-0.56)
Managerial_shareholding	0.028	0.008	-0.007	0.009
	(0.25)	(0.30)	(-0.04)	(0.26)
Top_shareholding	-0.000	-0.000	0.000	-0.000*
	(-0.63)	(-0.05)	(1.01)	(-1.89)
Boardsize	0.028	-0.009	-0.048***	-0.002
	(0.96)	(-0.65)	(-2.83)	(-0.12)
Duality	-0.006	0.003	0.002	-0.003
	(-0.43)	(0.47)	(0.11)	(-0.23)
Institution	0.001*	-0.000	0.000	-0.000
	(1.92)	(-1.05)	(0.74)	(-0.88)
Indp	0.105	-0.015	-0.185***	0.028
	(1.43)	(-0.49)	(-3.04)	(0.64)
BIG4	0.007	0.006		-0.004
	(0.82)	(1.19)		(-0.33)
SOE	-0.086***	-0.001	-0.091***	-0.000
	(-4.87)	(-0.39)	(-6.10)	(-0.01)
Constant	-0.124	0.138	-0.061	0.210
	(-0.43)	(0.70)	(-0.21)	(0.95)
Observations	473	624	490	510
Adj.R²	0.431	0.200	0.195	0.0802
Firm-fixed effects	included	included	included	included
Industry-year fixed effects	included	included	included	included

Notes: This table reports the results from testing the moderating effect of business risk on the baseline regression results. The sample period covers the years 2009-2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which is estimated from a regression of the total book-tax difference on the total accruals. The moderating variables are the standard deviation of a firm's return on sales (*Std_ros*) and return on assets (*Std_roa*) for the most recent five years. A higher value of *Std_ros* (*Std_roa*) indicates higher business risk for the firm. The difference-in-differences regressions are run separately in the high-*Std_ros* (high-*Std_roa*) subsample and the low-*Std_ros* (low-*Std_roa*) subsample, which are split based on the median of *Std_ros* (*Std_roa*) in the pre-matched sample. *Treated* equals 1 for the treatment firm (i.e., a firm whose CEO is in her/his zodiac year), and 0 for the control firm (i.e., a firm whose CEO is not in her/his zodiac year). The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 7: Tests of the moderating effect of the superstition in regions where firms are headquartered

Variables	DD_BTD	
	High-superstition regions (1)	Low-superstition regions (2)
Treated*Tzodiac	0.005**	0.005
	(2.06)	(1.18)
SIZE	-0.010	0.030**
	(-1.37)	(2.47)
ROA	-0.005	-0.099**
	(-0.12)	(-2.23)
Asset_growth	0.006	-0.014
	(0.85)	(-1.55)
LEV	-0.041**	-0.004
	(-2.13)	(-0.16)
NOL	0.007	-0.010**
	(0.70)	(-2.41)
PPE	0.029	-0.029
	(0.95)	(-1.03)
Intangible	-0.007	0.033
	(-0.11)	(0.45)
RD	0.029	-0.537
	(0.33)	(-0.90)
Capital_exp	-0.015	0.037
	(-0.41)	(0.70)
MB	-0.016	-0.019
	(-1.27)	(-0.71)
DA	0.026	-0.013
	(1.32)	(-0.36)
Cash	0.030	0.060*
	(1.48)	(1.69)
Foreign	0.005	0.019
	(0.23)	(0.21)
Managerial_shareholding	0.003	-0.028
	(0.12)	(-0.14)
Top_shareholding	-0.000	0.000
	(-0.39)	(0.81)
Boardsize	-0.008	0.014
	(-0.35)	(0.53)
Duality	0.004	-0.009*
	(0.32)	(-1.67)
Institution	-0.000	-0.000
	(-1.23)	(-0.65)
Indp	0.055	0.019
	(0.66)	(0.33)
BIG4	0.008	-0.016
	(0.86)	(-1.29)
SOE	0.001	-0.000
	(0.14)	(-0.04)
Constant	0.257*	-0.676**
	(1.67)	(-2.49)
Observations	960	341
Adj.R^2	0.175	0.364
Firm-fixed effects	included	included
Industry-year fixed effects	included	included

Notes: This table reports the results from testing how the degree of superstition in different regions, where the sample firms are headquartered, moderates the baseline regression results. The sample period covers the years 2009-2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (*DD_BTD*) which is estimated from a regression of the total book-tax difference on the total accruals. The region-level superstition is measured by the provincial moving average of daily volume of search for the keyword "zodiac year" scaled by the natural logarithm of family households for each province. For each year, we select the top ten provincial regions that have the relatively highest degree of zodiac-year belief to form the high-regional-superstition subsample, which comprises the firms that are headquartered in the high-superstition provinces. Other provincial regions are classified as those of relatively lower zodiac-year belief to form the low-regional-superstition subsample, which consists of the firms that are headquartered in the low-superstition provinces. *Treated* equals 1 for the treatment firm (i.e., a firm whose CEO is in her/his zodiac year), and 0 for the control firm (i.e., a firm whose CEO is not in her/his zodiac year). The time indicator variable, *Tzodiac*, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, *Treated*Tzodiac*, is the variable of interest. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. *t*-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

TABLE 8: Tests of the moderating effect of state ownership

Variables	DD_BTD	
	SOEs	Non-SOEs
	(1)	(2)
Treated*Tzodiac	-0.001	0.008***
	(-0.43)	(2.97)
SIZE	-0.016*	0.011
	(-1.77)	(1.43)
ROA	-0.030	0.063
	(-0.80)	(0.92)
Asset_growth	0.004	0.003
	(0.56)	(0.35)
LEV	-0.031	-0.038**
	(-1.04)	(-1.98)
NOL	0.010	-0.010*
	(0.57)	(-1.86)
PPE	-0.010	0.003
	(-0.27)	(0.12)
Intangible	-0.152**	-0.019
	(-2.00)	(-0.27)
RD	0.396*	0.074
	(1.70)	(0.87)
Capital_exp	-0.007	0.033
	(-0.13)	(0.70)
MB	-0.012	-0.016
	(-0.67)	(-1.16)
DA	0.018	0.035
	(0.73)	(1.32)
Cash	0.056*	0.028
	(1.76)	(1.38)
Foreign	-0.009	0.006
	(-0.36)	(0.21)
Managerial_shareholding	-1.189***	0.032
	(-3.36)	(1.14)
Top_shareholding	0.000	-0.000
	(1.16)	(-0.29)
Boardsize	0.004	-0.016
	(0.29)	(-0.94)
Duality	-0.007	-0.002
	(-0.65)	(-0.35)
Institution	-0.000	-0.000
	(-0.29)	(-0.82)
Indp	0.062	-0.109
	(1.45)	(-1.61)
BIG4	-0.006	0.015
	(-0.93)	(0.73)
Constant	0.336*	-0.163
	(1.84)	(-0.90)
Observations	580	774
Adj.R²	0.249	0.232
Firm-fixed effects	included	included
Industry-year fixed effects	included	included

Notes: This table reports the results from testing the moderating effect of state ownership on the baseline regression results. The sample period covers the years 2009-2019. All the variables are defined in Appendix 1. The dependent variable is the residual book-tax difference (DD_BTD) which is estimated from a regression of the total book-tax difference on the total accruals. The moderating variable is the dummy variable, SOE, which equals 1 if a firm's largest shareholder is a central or local government or a government-controlled enterprise, and 0 otherwise. Treated equals 1 for the treatment firm (i.e., a firm whose CEO is in her/his zodiac year), and 0 for the control firm (i.e., a firm whose CEO is not in her/his zodiac year). The time indicator variable, Tzodiac, equals 1 for each year from 2010 to 2018 when the treatment firm's CEO is in her/his zodiac year, and 0 for the preceding year and the year after the zodiac year. The interaction term, Treated*Tzodiac, is the variable of interest. Firm-fixed effects and industry-year interacted dummies are included in the regression, but their results are not reported for simplicity. t-statistics in parentheses are based on robust standard errors clustered by firm. *, **, and *** indicate the two-tailed statistical significance at the 10%, 5%, and 1% levels, respectively.

Appendix 1: Variable definitions

Dependent variables in the baseline regression analysis

DD_BTD	The residual book-tax difference estimated from the following regression:

$$BTD_{i,t} = \alpha_1 TACC_{i,t} + \mu_i + \varepsilon_{i,t}$$

where *BTD* is the total book-tax difference, computed as pre-tax financial income minus taxable income scaled by the lagged total assets. Taxable income is calculated as income tax expense minus deferred tax expense, divided by the nominal tax rate. *TACC* is total accruals scaled by the lagged total assets. The total accruals are calculated as the operating income minus operating cash flows. A higher *DD_BTD* represents a higher level of tax avoidance.

Alternative measure of tax avoidance

Adj_ETR   The difference between nominal tax rate and effective tax rate (*ETR*). *ETR* is calculated as the total tax expense minus deferred tax expense, scaled by pre-tax income. Nominal tax rate is the corporate income tax rate disclosed by the firm. *Adj_ETR* equals 0 if *ETR* is higher than nominal tax rate. A higher *Adj_ETR* indicates a greater level of tax avoidance.

Ind_adj_ETR   The industry-adjusted measure of *Adj_ETR*, calculated as the difference between a firm's *Adj_ETR* and the industry average of *Adj_ETR* for the same year, divided by this industry average. The higher *Ind_adj_ETR*, the greater the tax avoidance.

Variable as to whether a CEO is in her/his zodiac year

Zodiac_ceo   If the CEO was born on a day between the start date of the Chinese Lunar new year and 31 December, *Zodiac_ceo* equals 1 for cases in which a CEO is at the age of a multiple of 12, and 0 otherwise. Provided that the CEO was born on a day between 1 January and the start date of the Chinese lunar new year, *Zodiac_ceo* equals 1 for cases in which a CEO is at the age of one year less than a multiple of 12, and 0 otherwise.

Key variables that compose the DID estimator

Treated   1 if a firm is a treatment firm, and 0 if a firm is a control firm. Treatment (control) firms are those whose CEOs are (not) in their zodiac years.

Tzodiac   1 for the zodiac year *t*, and 0 for the year before, and the year after, the zodiac year (i.e., the years *t*-1 and *t*+1).

Moderating variables

Std_ros   The standard deviation of a firm's return on sales for the most recent five years.

Std_roa   The standard deviation of a firm's return on assets for the most recent five years.

SA_index   Following Hadlock and Pierce (2010), *SA_index* is defined as follows:

$$SA\ index = -0.737 \times size + 0.043 \times size^2 - 0.040 \times age$$

where *size* is the natural logarithm of the firm's book value of the total assets, and *age* is the number of years for which the firm has been listed.

Dividend   The natural logarithm of 1 plus cash dividends paid to common shareholders in a fiscal year. Lower cash dividends indicate tighter financial constraints.

SUP_Province   The degree of zodiac-year belief for a province in a year. *SUP_Province* is calculated as the average daily volume of search for the keyword "zodiac year" in the Baidu search engine for a province over a fiscal year, which is scaled by the natural logarithm of the family households of the province in that year.

SOE   1 if a firm's largest shareholder is a central or local government or a government-controlled enterprise, and 0 otherwise.

Matching covariates

SIZE	The natural logarithm of a firm's book value of total assets at the end of a fiscal year.
Asset_growth	The change in the total assets from the previous year to the current year, deflated by the average total assets for the previous year.
ROA	Earnings before interests and taxes over a fiscal year, divided by the total assets, at the end of the year.
LEV	The sum of short- and long-term debt divided by the total assets at the end of a fiscal year.
Std_return	The annualized standard deviation of a firm's monthly stock returns over a fiscal year.
Indp	The number of independent directors as a fraction of the total directors on the board of a firm at the end of a year.

Control variables

SIZE	The natural logarithm of a firm's book value of total assets at the end of a fiscal year.
ROA	Earnings before interests and taxes over a fiscal year, divided by the total assets, at the *beginning* of the year.
Asset_growth	The change in the total assets from the previous year to the current year, deflated by the total assets for the previous year.
LEV	The sum of short- and long-term debt divided by the total assets at the end of a fiscal year.
NOL	The net operating losses. Since Chinese firms do not report the tax benefits from net operating losses in the balance sheet, we use a continuous variable, equal to accumulated pre-tax losses (in billions) reported in the last five years, to proxy for the net operating losses (Bradshaw et al., 2019). *NOL* equals 0 if the accumulated pre-tax losses are positive.
PPE	The fixed assets divided by the total assets at the end of a fiscal year.
Intangible	The intangible assets divided by the total assets at the end of a fiscal year.
RD	R&D expenses divided by net sales for a fiscal year.
Capital_exp	The capital expenditures in a fiscal year, deflated by the total assets at the end of the year.
MB	The market value of equity, divided by the book value of equity, at the beginning of a fiscal year.
DA	Abnormal accruals of a firm in a fiscal year, which is estimated using the cross-sectional version of modified Jones model with at least 20 firm-year observations for each industry-year.
Cash	The cash and cash equivalents divided by the total assets at the end of a fiscal year.
Foreign	The foreign sales scaled by the total sales over a fiscal year.
Managerial_shareholding	The shares held by a firm's executives, divided by the firm's total shares outstanding, at the end of a fiscal year.
Top_shareholding	The shares held by a firm's largest shareholder, divided by the firm's total shares outstanding, at the end of a fiscal year.
Boardsize	The natural logarithm of the number of directors on the board of a firm at the end of a fiscal year.
Duality	1 if CEO and the chairman of board of directors are the same person, and 0 otherwise.
Institution	The percentage of institutional shareholding at the end of a fiscal year.
Indp	The number of independent directors as a fraction of the total directors on the board of a firm at the end of a fiscal year.
BIG4	1 if a firm's financial statement is audited by one of the big-4 auditors, and 0 otherwise.
SOE	1 if a firm's largest shareholder is a central or local government or a government-controlled enterprise, and 0 otherwise.

Appendix 2: Sample selection procedure

Initial firm-year observations which cover companies listed on the Shenzhen or Shanghai Stock Exchange for the period 2009-2019	29,686
Less: observations in the financial industry	(902)
Less: observations with missing data on tax expense or with negative pre-tax income	(2,776)
Less: observations with missing values in the measure of corporate tax avoidance (*DD_BTD*)	(2,143)
Less: observations without information required to identify the CFOs' zodiac years	(3,496)
Less: observations which are in the CFOs' zodiac years	(1,137)
Less: observations that have CEO turnover	(2,998)
Less: observations for which we fail to identify the CEOs' zodiac years	(750)
Less: observations that are missing in the values of control variables used in the multivariate tests of hypotheses	(4,910)
Firm-year observations (unique firms) available for the propensity-score matching	10,450 (2,406)