



Competition and tax avoidance: Evidence from quasi natural experiment of the implementation of Anti-Trust Law

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ABSTRACT

This paper examines the impact of product market competition on corporate tax avoidance by constructing a difference-in-differences model using a quasi-natural experiment of the Anti-Trust Law. The results indicate that the implementation of the Anti-Trust Law significantly increases the degree of tax avoidance of monopolistic firms by more than 0.01 compared to competitive firms. The main conclusion still holds after a series of robustness tests. Declining corporate performance, increased business risk and subjective dissatisfaction towards regulatory authorities constitute the main reasons. Heterogeneity analysis reveals that the promotion effect of the Anti-Trust Law on corporate tax avoidance is more pronounced for firms located in regions with lower levels of tax administration, firms whose income tax is collected and administered by local tax bureaus, firms with lower quality of information disclosure and private firms. The results provide empirical evidence of the differentiated impact of the Anti-Trust Law on corporate tax avoidance behavior of different firms.

1. Introduction

As a global issue, tax avoidance is one considerable concern for tax agencies and academics. Excessive tax avoidance not only leads to a loss of government tax revenue but also to an unfair distribution of tax burden, which has a great negative impact on economic and social development. Previous literature considered corporate tax avoidance as one of the important components of corporate financial strategy and has examined in depth the various factors that influence corporate tax avoidance activities (Shen et al., 2021) as well as its effects (Desai & Dharmapala, 2009; Dhawan et al., 2020; Herron & Nahata, 2020).

From a competition policy perspective, Cai and Liu (2009), Kubick et al. (2015), Schmidt (1997) and Niu and Zhang (2023) have shown that product market competition has a significant positive impact on tax avoidance, and firms facing greater competitive pressure have stronger tax avoidance motivations. However, due to limited knowledge, the differentiated impact of Anti-Trust Law on tax avoidance behavior of firms with different initial status has not been closely examined. To enrich research in this field, this paper investigates how the Anti-Trust Law influences differently corporate tax avoidance of different markets and firms, both theoretically and empirically.

This paper provides a theoretical model to illustrate the impact of the implementation of the Anti-Trust Law on tax avoidance

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behaviors of firms with different initial statuses. We consider a scenario in which an initial Stackelberg leader loses its leadership and plays Cournot with the initial followers after the Anti-Trust Law. The result shows that after the Anti-Trust Law, the initial leader reports a lower level of corporate income than the initial follower. The economic intuition arises from loss aversion in prospect theory and firms' psychological factors towards regulatory authorities in tax compliance. The initial leader's oligopoly income is coded as a loss, while for the initial follower's oligopoly income is coded as a gain. Firms are risk-averse with respect to gains and risk-seeking with respect to losses. Positive fine rate and probability of detection imply that underreporting more income increases uncertainty. Loss aversion implies that the initial leader prefers to take higher risk to have a chance of avoiding large drop in income after the Anti-Trust law and obtaining an income level closer to the Stackelberg leader's income. Moreover, the subjective dissatisfaction towards regulatory authorities after the Anti-Trust Law increases the initial leader's unwillingness to pay taxes.

To empirically test the causal effect of changes in the competitive environment of product markets on tax avoidance of different firms after the implementation of the Anti-Trust Law, this paper uses the Anti-Trust Law of the People's Republic of China as a quasi-natural experiment and estimates it by constructing a difference-in-differences (DID) model using data from 2005 to 2017 for Chinese non-financial listed firms.

The baseline result shows that the Anti-Trust Law significantly increases the degree of tax avoidance of monopolistic firms, monopolistic firms are significantly increased by more than 0.01 compared to competitive firms. To illustrate the robustness of the result, we conduct a series of robustness tests. Firstly, we conduct parallel trend tests and dynamic effects tests using the event study method to test whether the key assumptions to be satisfied by DID identification are met. Secondly, we conduct a placebo test by randomly generating treatment and control groups. Thirdly, we perform sample self-selection tests using PSM-DID. Fourthly, we conduct tests using different methods to divide treatment and control groups, replacing measures of corporate tax avoidance. Finally, we exclude the effects of the financial crisis, new accounting standards, and the new corporate income tax reform. The results of a series of tests show that our conclusions are robust.

By exploring the channels through which the Anti-Trust Law has a catalytic effect on tax avoidance, we find that after the implementation of the Anti-Trust Law, compared with competitive enterprises, monopolistic enterprises face greater competitive pressure due to the loss of monopoly pricing and the ability to obtain excessive profits, and face greater operating risks due to the decline in profits and the increase in uncertainty in production and operation, and thus have a stronger incentive to avoid taxes. In addition, enterprises have subjective psychological dissatisfaction with the government due to damaged profits, which further aggravates tax noncompliance by monopolistic enterprises.

Furthermore, we also analyze the heterogeneity of the promotion effect of the Anti-Trust Law on corporate tax avoidance among firms with different characteristics. Firstly, we distinguish the level of tax administration and institutions, the results show that enterprises located in areas with a low level of tax administration and enterprises whose income taxes are collected by local tax bureaus are more significantly affected after the implementation of the Anti-Trust Law. Secondly, we distinguish the quality of corporate information disclosure, the results show that enterprises with low disclosure quality are more significantly affected by the Anti-Trust Law. Thirdly, we conduct an analysis based on the nature of enterprise property rights, we find that the promotion effect of the Anti-Trust Law on corporate tax avoidance is more significant among private enterprises.

Our marginal contribution lies in the following three aspects. Firstly, building on the existing literature (Atawnah et al., 2020; Cai & Liu, 2009; Chen et al., 2022; Kim & Lee, 2023; Kubick et al., 2015; Niu & Zhang, 2023), this paper further extends the examination of the impact of product market competition on corporate tax avoidance. Although the findings of this paper align with those of previous studies, it provides new perspectives and an analytical framework that contribute to the further exploration of this issue. This paper employs Anti-Trust Law as a policy shock, which avoids the endogeneity issue inherent in using the Herfindahl-Hirschman Index (HHI) to measure product market competition, as highlighted by Cai and Liu (2009). Additionally, while Cai and Liu (2009), Atawnah et al., 2020, and Chen et al. (2022) focus on market competition at the industry level or across industries, without accounting for the relative changes in the competitive positions of individual firms. Based on the Anti-Trust Law, this paper investigates corporate tax avoidance among firms with monopolistic positions within their industries. The sources and frameworks of competitive changes explored in this study thus differ from those employed in the above literature. Kubick et al. (2015) and Kim and Lee (2023) argue that product market competition or its threat provides firms with a comparative advantage, thereby facilitating tax avoidance. In contrast to their conclusions, this paper contends that the Anti-Trust Law serves as a regulatory mechanism against monopolistic practices, weakening the market power of monopolistic firms and preventing them from extracting excess profits through their dominant positions. Consequently, the reduction in such profits leads to increased tax avoidance behavior.

Moreover, in contrast to Lam et al. (2020) and Kanagaretnam et al. (2018), who examine the impact of social trust on corporate tax avoidance from the perspective of market competition and the improved legal institutions, this paper focuses more on the relative changes in firms' competitive positions after the implementation of Anti-Trust Law. Due to loss of profits and dissatisfaction with regulatory authorities, monopolistic firms engage in more tax avoidance. Therefore, this paper differs significantly from the aforementioned literature in both its research perspective and conclusions. Although this paper uses the same empirical strategy as Niu and Zhang (2023) to examine the impact of the Anti-Trust Law on corporate tax avoidance. Compared to Niu and Zhang (2023), this paper argues that, following the implementation of Anti-Trust Law, monopolistic firms' tax avoidance activities are influenced not only by the direct effects of profit reduction and increased risk but also by the indirect impact of policy decisions that lead to losses rather than profits for these firms, as well as their subjective dissatisfaction with policymakers. This aspect is not considered in Niu and Zhang (2023). Additionally, in terms of research methodology, this paper not only conducts empirical tests but also provides a theoretical analytical framework, which represents an innovation in research methodology compared to Niu and Zhang (2023).

Secondly, this paper contributes to the research on firms' bounded rationality (Armstrong & Huck, 2010; Ellison, 2006; Spiegler, 2011; Tremblay & Tremblay, 2012), especially on the role for behavioral economics in antitrust policy (Bailey, 2010, 2015). Bailey

(2015) emphasizes that whether consumers and firms make decisions in a rational manner is crucial for antitrust analysis. Kőszegi and Rabin (2006) develop a model of reference-dependent preferences and loss aversion to apply to consumer behavior and argue that gain-loss utility influences behavior when there is uncertainty. Zhou (2011) studies the implications of consumer reference dependence for market competition. These papers focus mainly on the reference-dependent preferences on the consumer side. Differently, our paper provides a model and evidence for firms' reference-dependent behaviors and the impact of psychological factors towards regulatory authorities on decision making. The empirical evidence using the Anti-Trust Law as a quasi-natural experiment provides further evidence for the role of firms' bounded rationality in antitrust analysis.

Thirdly, this study widens the study on the effects of competition policy. Previous studies mainly focus on the effect of competition policy on corporate governance (Lel & Miller, 2015), firm innovation (Baker, 2007; Segal & Whinston, 2007), firm investment (Biggar & Heimler, 2021; Immordino & Polo, 2014; Li, 2009) and economic development (Blake, 1978; Philippon, 2021). As an important competition policy, the Anti-Trust Law effectively promotes market competition and limits the barriers to entry (Dutz & Vagliasindi, 2000; Jarsulic, 2019). While the above literature focuses mainly on the impact of competition policy on the non-tax behaviour of firms, this paper examines the economic consequences of the Anti-Trust Law from the perspective of corporate tax decision making, which can provide an important basis for decision making to improve market governance and combat tax avoidance while countering monopoly.

The remainder of this paper is organized as follows. Section 2 describes the background of the implementation of the Anti-Trust Law. Section 3 provides a theoretical analysis framework. Section 4 introduces the research design and data. Section 5 presents the empirical results including the results of baseline results and a series of robustness checks. Section 6 reports the results of further analysis, including the impact channel analysis and heterogeneity analysis. Section 7 draws the conclusions and policy recommendations.

2. Institutional background

After the reform and opening up, China has carried out a series of economic system reforms, gradually shifting from a planned economy to a market economy system, with the marketisation of economic development and opening up to the outside world continuously increasing. However, in the process, some abuses of market dominance, concentration of operators, monopoly agreements and abuse of administrative power to exclude and restrict competition have also emerged, hindering the development of China's market economy.

To promote the healthy development of the socialist market economy, encourage and protect fair competition, and curb unfair competition by enterprises, China enacted the Law of the People's Republic of China Against Unfair Competition in 1993, which has played a positive role in regulating the unfair competition behavior of firms. After more than 20 years of economic system reform, the internationalisation and marketisation of China's economic development has been increasing, and the price monopoly system during the planned economy has been gradually broken. Combined with the successful experience of foreign laws on Anti-Trust and against restriction of competition, there has been a growing call from all sectors of society for China to enact an Anti-Trust Law. Therefore, to promote competition and create a fair environment for market competition, China formally promulgated the Anti-Trust Law on August 2007, which officially took effect on August 1, 2008. As an important competition law in China, the Anti-Trust Law has played an important role in curbing monopolistic behavior and maintaining fair competition in the market. According to statistics from the State Administration for Market Regulation in China, since the implementation of the Anti-Trust Law, there are 339 cases of various types of monopoly have been probed and dealt with, with fines amounting to RMB 37.9 billion, and 5409 cases of operator concentration have been completed.¹

International tax avoidance by transnational monopolies is also one of the challenges that is growing in importance in the context of deepening globalisation. Multinational monopolies use complex tax structures and transfer pricing to reduce their global tax liabilities. In 2016, the European Commission concluded that Apple Inc had committed large-scale tax evasion by taking advantage of a tax agreement with the Irish government and issued a directive requiring it to pay €13 billion in back taxes. In March 2024, the EU launched an investigation into Apple under the new Digital Markets Act regulation, arguing that Apple Inc had abused its dominant position in the market for the distribution of music streaming apps, and imposed a €1.8 billion antitrust fine on Apple. How to coordinate antitrust regulation with international tax avoidance has become an important issue to be resolved globally, and tackling illegal tax avoidance alongside antitrust will be the new normal in building the rule of law in the marketplace. Against this background, China has continued to strengthen its anti-monopoly institutional design, establishing the National Anti-Trust Bureau in November 2021, which has further strengthened enforcement of anti-monopoly regulation. In June 2022, the Anti-Trust Law of the People's Republic of China (as amended) was considered and passed, setting out new standards and requirements for the identification of monopoly agreements and the monopolisation of the platform economy, among other aspects.

3. Theoretical model

After Kahneman and Tversky (1979) introduced psychology into economic analysis, psychological factors have been considered in the analysis of tax compliance (Kirchler et al., 2008; Kornhauser, 2007). Following their approach and the classic theory on tax

¹ Data from: https://www.samr.gov.cn/xw/zj/art/2023/art_101af9a1c3d945b09284acdb5b46ddef.html.

evasion, we construct our theoretical framework under prospect theory taking into account internal motivations and subjective feelings towards regulatory authorities.

Consider the following scenario: after the implementation of the Anti-Trust Law, a Stackelberg leader loses its leadership and plays Cournot in the oligopoly game. We study the firms' behavior to underreport income to avoid tax after the implementation of the Anti-Trust Law.

Consider n firms in the market, $i = 1$ to n , $n \geq 2$. We assume that firms are identical in the cost of producing a product, but firm 1 is initially the Stackelberg leader who has a larger market share than the followers.² The leader initially earns income π^l and $n-1$ followers ($i = 2$ to n) earns income π^f , with $\pi^l > \pi^f > 0$. After the Anti-Trust Law, the leader is forced to lose its market share and leadership. The n firms become identical oligopolies who play Cournot and each earns an income π^o , with $\pi^f < \pi^o < \pi^l$.³

We study the firms' tax evading behavior after the implementation of the Anti-Trust Law. Each firm's income level is unknown to the tax authority and each firm declares an income $x_i \leq \pi^o$ to the authority. The income declared by the firm is taxed at a rate of t . The amount of unreported income is $\pi_i - x_i$ and the unpaid tax is $t(\pi_i - x_i)$. Underreporting income to avoid tax has the risk of being detected and bearing punishment. When the firm is caught evading, the unpaid tax is paid and a fine at a rate of $F > 0$ is levied on the tax that has been evaded. The probability of being caught is denoted by p . Denote the after-tax income of firm i by $y(x_i)$. Before the Anti-Trust Law, the after-tax income is denoted by y^l for firm 1 and y^f for firm $i = 2$ to n . After the Anti-Trust Law, if the firm does not underreport income, the after-tax income is $y(\pi^o)$. We assume that the leader's income is high enough and the follower's income is low enough so that the leader earns a higher after-tax income than the oligopoly's after-tax income without underreporting and the later is higher than the follower's after-tax income; that is, $y^l > y(\pi^o) > y^f$. After the Anti-Trust Law, if x_i is declared by firm i , the expected after tax income for firm i is $E_p y(x_i) = (1-p)y^{nd}(x_i) + py^d(x_i)$ where $y^{nd}(x_i) = \pi^o - tx_i$ is the after tax income if the tax evading is not detected, and $y^d(x_i) = \pi^o - tx_i - (1+F)t(\pi^o - x_i)$ is the after tax income if the tax evading is detected.

The firms' overall valuation function consists of two parts. The first part is the evaluation of income which incorporates the argument of loss aversion and reference points from prospect theory to analyze tax avoidance of firms with different initial states. We assume that firms have different evaluations of income regarding the gains or losses in income. Firms are risk averse with respect to gains and risk seeking with respect to losses, and value losses more than equally sized gains. More precisely, the evaluation function of income for the firms are as follows:

$$\begin{aligned} V_1(y) &= \begin{cases} u(y), & \text{if } y \geq y^l; \\ v(y), & \text{if } y < y^l; \end{cases} \\ V_i(y) &= \begin{cases} u(y), & \text{if } y \geq y^l; \\ v(y), & \text{if } y < y^l, \text{ for } i = 2 \text{ to } n; \end{cases} \end{aligned} \quad (1)$$

where $u'(y) > 0$, $u''(y) < 0$ and $v'(y) > 0$, $v''(y) > 0$ which are identical for all firms. Fig. 1 illustrates the different evaluations of income due to different reference points. The second part of the firms' overall valuation function reflects subjective feelings of tax compliance towards regulatory authorities after the Anti-Trust Law, which could be positive or negative. A positive feeling comes from the satisfaction after the reform, while a negative feeling comes from the dissatisfaction after the reform. Initial followers see their market position improved, thus becomes happier to pay taxes, while the initial leader sees its market position abased, thus becomes unhappier to pay taxes.

Hence, the overall expected valuation functions for the initial leader and initial followers after the Anti-Trust Law are respectively as follows:

$$\begin{aligned} W_1(x_1) &= EV_1(x_1) - \varphi(x_1; M), \\ &= (1-p)v(\pi^o - tx_1) + pv(\pi^o - tx_1 - (1+F)t(\pi^o - x_1)) - \varphi(x_1; M), \\ W_i(x_i) &= EV_i(x_i) + \phi(x_i; m), \\ &= (1-p)u(\pi^o - tx_i) + pu(\pi^o - tx_i - (1+F)t(\pi^o - x_i)) + \phi(x_i; m), \text{ for } i = 2 \text{ to } n, \end{aligned} \quad (2)$$

where $\varphi(x_1; M)$ is the firm 1's subjective cost of negative feeling to pay taxes after the Anti-Trust Law with $\frac{\partial \varphi(x_1; M)}{\partial x_1} > 0$, $\frac{\partial^2 \varphi(x_1; M)}{\partial x_1^2} > 0$ and $M > 0$ measures the degree of dissatisfaction with M large enough to ensure interior solution for firm 1; $\phi(x_i; m)$ is firm i 's subjective surplus of positive feeling to pay taxes after the Anti-Trust Law with $\frac{\partial \phi(x_i; m)}{\partial x_i} > 0$, $\frac{\partial^2 \phi(x_i; m)}{\partial x_i^2} < 0$, for $i = 2$ to n and $m \geq 0$ measures the degree of satisfaction. We assume that higher degree of dissatisfaction (satisfaction) increases the subjective cost (surplus) and also the marginal subjective cost (surplus) to pay taxes; that is, $\frac{\partial \varphi(x_1; M)}{\partial M} > 0$, $\frac{\partial^2 \varphi(x_1; M)}{\partial x_1 \partial M} > 0$, $\frac{\partial \phi(x_i; m)}{\partial m} > 0$ and $\frac{\partial^2 \phi(x_i; m)}{\partial x_i \partial m} > 0$. Examples of $\varphi(x_1; M)$ and $\phi(x_i; m)$ could be $\varphi(x_1; M) = \frac{1}{2} M x_1^2$ and $\phi(x_i; m) = \frac{1}{2} m x_i^2$.

Given the fine rate F , for a certain level of reported income $x \in [0, \pi^o]$, firms underreport if the overall expected valuation from

² In our empirical analysis, in section 4.3.2, the distinction between treatment group and control group is based on their market shares in industries.

³ Fig. 2 in section 4.2 of descriptive statistics shows that after the implementation of the Anti-Trust Law, there is a significant downward trend in the rate of return on total assets of monopolistic firms as compared with that of competitive firms.

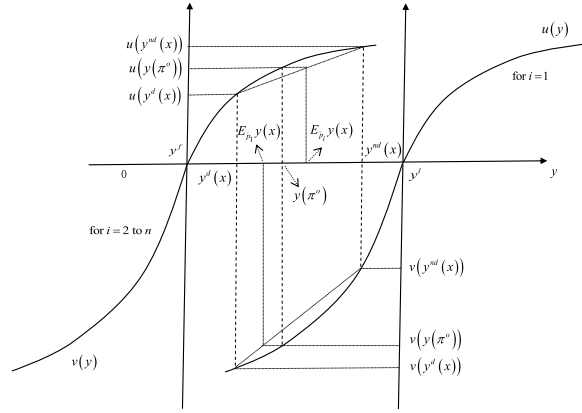


Fig. 1. Different evaluations of income due to different reference points.

underreporting is higher than the overall valuation from reporting π^0 . For firm $i = 2$ to n , it is

$$(1-p)u(y^{nd}(x)) + pu(y^d(x)) + \phi(x; m) > u(y(\pi^0)) + \phi(\pi^0; m), \quad (3)$$

which implies the critical probability of being detected

$$p < \frac{u(y^{nd}(x)) - u(y(\pi^0)) + \phi(x; m) - \phi(\pi^0; m)}{u(y^{nd}(x)) - u(y^d(x))} \equiv \hat{p}_i(x), \text{ for } i = 2 \text{ to } n; \quad (4)$$

that it, if $p < \hat{p}_i(x)$, firm $i = 2$ to n underreport. For firm 1, the condition of underreporting is

$$(1-p)v(y^{nd}(x)) + pv(y^d(x)) - \varphi(x; M) > v(y(\pi^0)) - \varphi(\pi^0; M) \quad (5)$$

which implies the critical probability of being detected

$$p < \frac{v(y^{nd}(x)) - v(y(\pi^0)) + \varphi(\pi^0; M) - \varphi(x; M)}{v(y^{nd}(x)) - v(y^d(x))} \equiv \hat{p}_1(x); \quad (6)$$

that it, if $p < \hat{p}_1(x)$, firm 1 underreports. We can obtain the following lemma.

Lemma 1. Given the fine rate F , for $x_1 = x_i = x < \pi^0$,

- (1) The firms underreport income if the probability of being detected is sufficiently low;
- (2) $\hat{p}_1(x) > \hat{p}_i(x)$ for firm $i=2$ to n ; that is, for a certain level of underreported income, the critical probability of being detected under which firm 1 chooses to underreport income is higher than that for firm $i=2$ to n ;
- (3) For $p < \hat{p}_i(x)$, for $i=2$ to n , all firms underreport income; for $\hat{p}_i(x) \leq p < \hat{p}_1(x)$, firm 1 underreports income but firm $i=2$ to n do not; for $p \geq \hat{p}_1(x)$, no firm underreports income.

Proof: The proof of result (1) follows from the previous discussion. Define $\tilde{p}_i(x) \equiv \frac{u(y^{nd}(x)) - u(y(\pi^0))}{u(y^{nd}(x)) - u(y^d(x))}$, for $i = 2$ to n and $\tilde{p}_1(x) \equiv \frac{v(y^{nd}(x)) - v(y(\pi^0))}{v(y^{nd}(x)) - v(y^d(x))}$. For result (2), from Fig. 1, since the evaluation of income for firm $i=2$ to n lies on the concave part $u(y)$ of the evaluation function, while firm 1's evaluation of income lies on the convex part $v(y)$ of the evaluation function, we must have $E_{\tilde{p}_1} y(x) < E_{\tilde{p}_i} y(x)$, which implies $\tilde{p}_1(x) > \tilde{p}_i(x)$. Moreover, $\phi(x; m) - \phi(\pi^0; m) < 0$ and $\varphi(\pi^0; M) - \varphi(x; M) > 0$. Therefore, we must have $\hat{p}_1(x) > \hat{p}_i(x)$. Result (3) follows from (2).

Lemma 1 shows that for a certain level of underreported income, firm 1 is more likely to underreport than firm $i=2$ to n .

Furthermore, we can obtain the following proposition.

Proposition 1. Given the fine rate F ,

(1) If firm $i=2$ to n underreport income $x_i^* \in (0, \pi^0)$, firm 1 must report a lower level of income than firm $i=2$ to n ; that is $x_1^* < x_i^*$, for $i=2$ to n ;

(2) Higher m implies higher x_i^* and higher M implies lower x_1^* .

Proof: For $i=2$ to n , firm i 's objective is

$$\max_{x_i} W_i(x_i). \quad (7)$$

An interior solution x_i^* satisfies the first order condition

$$\begin{aligned} \frac{\partial W_i(x_i)}{\partial x_i} \Big|_{x_i=x_i^*} &= \frac{\partial EV_i(x_i)}{\partial x_i} \Big|_{x_i=x_i^*} + \frac{\partial \phi(x_i; m)}{\partial x_i} \Big|_{x_i=x_i^*}, \\ &= t[-(1-p)u'(y^{nd}(x_i^*)) + pFu'(y^d(x_i^*))] + \frac{\partial \phi(x_i; m)}{\partial x_i} \Big|_{x_i=x_i^*} = 0. \end{aligned} \quad (8)$$

$u'(y) > 0$, $u''(y) < 0$ and $\frac{\partial^2 \phi(x_i; m)}{\partial x_i^2} < 0$ imply that the second order condition of the maximization is satisfied. The first order condition implies:

$$\frac{u'(y^d(x_i^*))}{u'(y^{nd}(x_i^*))} < \frac{1-p}{pF}. \quad (9)$$

For interior solution x_i^* , $y^d(x_i^*) < y^{nd}(x_i^*)$, $u'(y^d(x_i^*)) > u'(y^{nd}(x_i^*))$. Then, it must be that $\frac{1-p}{pF} > 1$. Furthermore, we obtain that higher degree of satisfaction m implies higher reported income x_i^* .

The firm 1's objective is

$$\max_{x_1} W_1(x_1). \quad (10)$$

At $x_1 = x_i^*$, firm 1's marginal expected valuation is

$$\begin{aligned} \frac{\partial W_1(x_1)}{\partial x_1} \Big|_{x_1=x_i^*} &= \frac{\partial EV_1(x_1)}{\partial x_1} \Big|_{x_1=x_i^*} - \frac{\partial \varphi(x_1; M)}{\partial x_1} \Big|_{x_1=x_i^*}, \\ &= t[-(1-p)v'(y^{nd}(x_i^*)) + pFv'(y^d(x_i^*))] - \frac{\partial \varphi(x_1; M)}{\partial x_1} \Big|_{x_1=x_i^*}. \end{aligned} \quad (11)$$

$v'(y) > 0$ and $v''(y) > 0$ imply that $v'(y^d(x_1^*)) < v'(y^{nd}(x_1^*))$ at $x_1 = x_i^*$, or $\frac{v'(y^d(x_1))}{v'(y^{nd}(x_1))} \Big|_{x_1=x_i^*} < 1$. This implies $\frac{v'(y^d(x_1))}{v'(y^{nd}(x_1))} \Big|_{x_1=x_i^*} < 1 < \frac{1-p}{pF}$. This implies $\frac{\partial W_1(x_1)}{\partial x_1} \Big|_{x_1=x_i^*} < 0$; that is, marginally decreasing x_1 from x_i^* increases $W_1(x_1)$ to be higher than $W_1(x_i^*)$. Consequently, if firm $i=2$ to n underreport an interior x_i^* , we must have $x_1^* < x_i^*$, for $i=2$ to n . Suppose x_1^* is the interior solution for firm 1, we obtain that higher degree of dissatisfaction M implies lower reported income x_1^* for firm 1.

The economic intuition of Proposition 1 arises from loss aversion and subjective feelings towards regulatory authorities. As the initial leader, firm 1's oligopoly income after the Anti-Trust Law is coded as a loss while for the initial followers the oligopoly income is coded as a gain. Firms have different evaluations of income regarding the gains or losses in income. Firm $i=2$ to n is risk averse with respect to gains and firm 1 is risk seeking with respect to losses. By the nature of risk attitudes, risk averse firms prefer certainty while a risk seeking firm prefers uncertainty. Positive fine rate and probability of being detected imply that underreporting more income (i.e. reporting a lower income) increases uncertainty. Loss aversion implies that firm 1 prefers to take higher risk to have a chance of avoiding large drop of income after the Anti-Trust Law and obtaining an income level closer to the initial leader's income. Furthermore, on top of loss aversion, the subjective feelings towards regulatory authorities after the Anti-Trust Law increases the unwillingness or willingness to pay taxes. As a result, firm 1 prefers to underreport more income than firm $i=2$ to n . The assumption of symmetric cost even strengthens the argument that, after the Anti-Trust Law, it is not the difference in production cost that implies different tax avoidance behavior, it is the loss aversion and subjective feeling towards regulatory authorities that lead to different tax avoidance behavior.

The theoretical model suggests that the initial leader tends to avoid more tax than the initial followers after the implementation of Anti-Trust Law, and further explores the potential mechanisms through which the implementation of Anti-Trust Law influences corporate tax avoidance behavior. On the one hand, compared to competitive firms, monopolistic firms engage in increased level of tax avoidance due to the direct effects of profit reduction and heightened operational risks following the implementation of Anti-Trust Law. On the other hand, monopolistic firms' behavior is also indirectly influenced by changes in their tax compliance psychology. The implementation of Anti-Trust Law damages the profits of monopolistic firms, who perceive the policy as unfavorable to them, thereby reducing their willingness to comply with tax obligations. Based on this analysis, the paper proposes the following hypotheses for testing:

H1. Enforcement of Anti-Trust Law increases the extent of tax avoidance among monopolistic firms.

H2a. Enforcement of Anti-Trust Law reduces profitability and increases operational risks of monopolistic firms, which in turn leads to an increase in tax avoidance among monopolistic firms.

H2b. Enforcement of Anti-Trust Law decreases taxpayer satisfaction of monopolistic firms, which in turn leads to an increase in tax avoidance among monopolistic firms.

The following section will empirically test these three hypotheses using the implementation of Anti-Trust Law as a quasi-natural

experiment.

4. Research design for empirical analysis

4.1. Sample selection and data sources

This paper uses all A-share listed firms on the Shanghai and Shenzhen Stock Exchanges from 2005 to 2017 as the initial sample. The sample period is set before 2018 to avoid the effects of the consolidation of state and local tax bureaus, the major changes in antitrust enforcement agencies and the COVID-19 pandemic. The following exclusions are shifted for the initial sample: (1) all listed firms in the financial category are excluded; (2) ST, SST, *ST and S*ST listed firms are excluded; (3) samples with missing key variables are excluded; (4) samples with earnings before interest and tax less than 0 are excluded; (5) samples with effective tax rate less than 0 and greater than 1 are excluded, finally obtaining 10064 observations. To control for the influence of singular values of key variables on the results, this paper is conducted by winsorizing all continuous variables at the 1st and 99th percentiles. Nominal income tax rates are from the Wind database, all other data are from the CSMAR database.

4.2. Empirical model

This paper uses the implementation of the Anti-Trust Law as a policy shock and examines the impact of market competition on tax avoidance by constructing a DID model, as follows:

$$Taxavoidance_{it} = \alpha_0 + \beta Treat_i \times Post_t + \vartheta \sum Controls + \delta_i + \gamma_t + \varepsilon_{it} \quad (12)$$

Where $Taxavoidance_{it}$ indicates the degree of tax avoidance of firm i in year t ; $Treat$ denotes a dummy variable to distinguish the treatment and control groups; $Post$ is a year dummy variable, considering that the Anti-Trust Law came into force on August 1, 2008, so this paper takes 2009 as the policy shock point in time, $Post$ takes the value of 1 for the current year and beyond, otherwise it takes 0. $Controls$ represents a series of control variables (see Appendix Table A1); δ_i denotes individual firm fixed effects; γ_t is year fixed effects; ε_{it} denotes random disturbance terms. β is the main coefficient of interest in this paper, with a significantly positive prediction.

4.3. Variable definitions

4.3.1. Measures of firm tax avoidance

There are three approaches to measuring corporate tax avoidance in the previous literature: (1) the firm's real income tax rate ($Real_rate$) (Hanlon & Heitzman, 2010); (2) the difference between the nominal income tax rate minus the real income tax rate ($Rate_diff$) and its five-year average ($LRate_diff$) (Chen et al., 2010; Dyreng et al., 2008); (3) the corporate accounting tax differences (BTd) and accounting tax differences after the effect of accrued profits ($DDBTD$) (Cao et al., 2020). Considering that currently listed firms in different industries in China enjoy different tax incentives, which makes the nominal income tax rates of different types of firms differ to some extent. Therefore, to avoid estimation errors, this paper refers to the study of Cao et al. (2020), using BTd and $DDBTD$ to measure the degree of corporate tax avoidance, and the higher the value of BTd and $DDBTD$, the higher the degree of corporate tax avoidance, by equations (13) and (14):

$$BTd_i = \alpha \times TACC_{it} + \mu_i + \varepsilon_{it} \quad (13)$$

$$DDBTD_{it} = \mu_i + \varepsilon_{it} \quad (14)$$

Where BTd_{it} denotes the accounting tax differences, equal to (total profit before tax - taxable income)/total assets at the end of the period; $TACC_{it}$ denotes the ratio of total accrued profit to total assets at the end of the period; μ_i denotes the average of residuals of firm i over the sample period; ε_{it} denotes the individual residuals of firm i in year t ; $DDBTD_{it}$ denotes the fraction after the effect of accrued profit in the deduction.

4.3.2. Measures of competition

There are two main methods for dividing the competitive power of firms: one method is to divide the monopolistic industry according to HHI, the higher the HHI, the stronger the monopoly power of the industry, and then divide the monopolistic firms according to the market share of individual firms in the monopolistic industry, the higher the market share of the firms in the industry, the stronger the monopoly power of the firms (Scherer, 1967); other method is to measure the monopoly power of an firm based on its Lerner index, the higher the Lerner index, the stronger the monopoly power of the firm in the market (Aghion et al., 2005). Due to the Anti-Trust Law presumes whether an operator has a dominant market position based on the operator's market share in the relevant market, this paper refers to the study of Yu et al. (2021), which defines the top four firms with market shares in industries with a median annual HHI higher than that before the implementation of the Anti-Trust Law as monopolistic firms, also known as the leader in the market, the rest of the firms as competitive firms or follower.

4.3.3. Control variables

Given the large number of factors that influence corporate tax decisions, and with reference to the existing literature (Chen et al.,

2010; Desai & Dharmapala, 2009; Shen et al., 2021), this paper controls for a number of firm characteristic variables in the model, including: firm size (Size), financial leverage (Lev), sales size (Sale), firm growth (Growth), earnings before interest and tax margin (Ebit), type of firm (State), firm age (Age), equity concentration (Top10), fixed asset intensity (Ppe), intangible asset intensity (Intang), share of independent directors (Indep), with specific variable definitions as shown in Appendix A1.

5. Empirical results

5.1. Descriptive statistics and correlation analysis

Table 1 shows the results of the descriptive statistics for the main variables. As can be seen from Table 1, the mean and median values of the explanatory variable BTD and DDBTD are greater than 0 during the sample period, which indicates that most of the listed firms may have tax avoidance behavior. The mean value of Treat is 0.121, indicating that 12.1% of the firms in the sample are competitive firms with a dominant position in the relevant product market. In terms of firm characteristics, the descriptive statistics in this paper are generally consistent with existing studies (Shen et al., 2021). To avoid the effect of multicollinearity, Pearson Correlation Test and Variance Inflation Factor (VIF) test are performed on all control variables of the model before regression analysis, and the results are shown in Appendix A2 and Appendix A3. The results show that the correlation coefficients between the variables are lower than the critical value of the multicollinearity problem (0.8), and the VIF values of all the variables are lower than 10, which further indicates that there is no multicollinearity problem between the main variables in this paper.

Fig. 2 shows the annual changes in the degree of tax avoidance by monopolies and competitive firms over the sample period. As can be seen from the figure, after the implementation of the Anti-Trust Law, the annual average of the degree of tax avoidance of monopolistic enterprises increases significantly, and the increase is significantly higher than that of competitive enterprises. This shows that the implementation of the Anti-Trust Law increases the degree of tax avoidance of monopolistic enterprises.

5.2. Baseline results

The paper conducts an empirical test using model (12), and the baseline results are shown in Table 2. The results in column (1) of Table 2 show that when using BTD as a measure of the degree of corporate tax avoidance, the coefficient of is 0.0138 and is significantly positive at the 1% level after adding no firm-level control variables but controlling for individual corporate fixed effects and year fixed effects. In the regression results in column (2), further controlling for a series of variables such as firm size, the results show that the coefficient of the interaction term is still significantly positive at the 1% level. When DDBTD is used as a measure of the degree of tax avoidance, the coefficient of Treat $\times$ Post does not change significantly, and the empirical results are shown in columns (3) and (4) of Table 2. The results show that tax avoidance is higher for firms with high monopoly power than firms with low monopoly power after the implementation of the Anti-Trust Law, supporting hypothesis H1.

5.3. Robustness checks

To verify the robustness of the baseline result, we conduct a battery of sensitivity tests in this subsection.

5.3.1. Dynamic effects

To verify the rationality of the model use, the study conducts a dynamic effect test. On the one hand, conducting dynamic tests show the dynamic effects of the implementation of the Anti-Trust Law on corporate tax avoidance. On the other hand, it can overcome the effects of potential omitted variables and reciprocal causality problems. Therefore, this paper examines the starting year of the sample data in 2005 as the base year, by constructing the point-in-time variables of the implementation of the Anti-Trust Law, as shown in equation (15).

Table 1
Descriptive statistics.

Variables	N	Mean	SD	Min	Max
BTD	10064	0.031	0.064	−0.128	0.284
DDBTD	10064	0.021	0.060	−0.103	0.249
Treat	10064	0.121	0.327	0.000	1.000
Size	10064	22.316	1.339	19.804	26.208
Lev	10064	0.494	0.187	0.081	0.868
Sale	10064	21.746	1.473	18.366	25.792
Growth	10064	0.215	0.481	−0.518	3.305
Ebit	10064	0.070	0.047	0.007	0.246
State	10064	0.555	0.497	0.000	1.000
Age	10064	16.458	5.294	0.330	37.250
Top10	10064	0.548	0.158	0.207	0.904
Ppe	10064	0.234	0.170	0.002	0.706
Intang	10064	0.047	0.057	0.000	0.364
Indep	10064	0.368	0.053	0.143	0.714

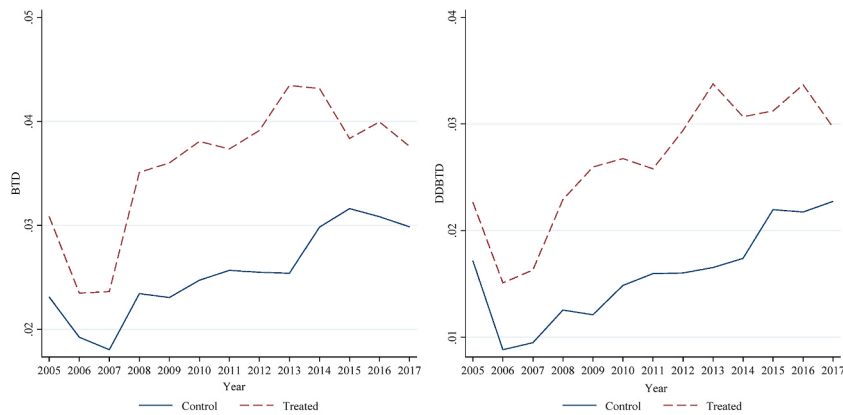


Fig. 2. Annual changes in BTD and DDBTD in the Treated and Control groups.

Table 2
Baseline results.

Variables	BTD		DDBTD	
	(1)	(2)	(3)	(4)
Treat × Post	0.0138*** (2.744)	0.0132*** (2.761)	0.0115** (2.239)	0.0104** (2.138)
Size		−0.0066** (−2.099)		−0.0051 (−1.517)
Lev		0.0003 (0.039)		0.0154* (1.730)
Sale		−0.0137*** (−4.462)		−0.0137*** (−4.188)
Growth		−0.0001 (−0.077)		−0.0011 (−0.708)
Ebit		−0.3370*** (−9.052)		−0.3511*** (−9.029)
State		−0.0007 (−0.133)		−0.0098 (−1.632)
Age		0.0015*** (3.109)		0.0016*** (3.172)
Top10		0.0647*** (6.795)		0.0740*** (7.317)
Ppe		0.0117 (1.340)		0.0016 (0.163)
Intang		0.0223 (1.071)		0.0046 (0.187)
Indep		−0.0072 (−0.434)		−0.0066 (−0.337)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	10064	10064	10064	10064
Adjusted R ²	0.0333	0.1225	0.0112	0.0947

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

$$Taxavoidance_{it} = \alpha_0 + \alpha_1 before_3 + \alpha_2 before_2 + \alpha_3 before_1 + \alpha_4 current + \alpha_5 after_1 + \alpha_6 after_2 + \alpha_7 after_3 + \alpha_8 after_{\geq 4} + \delta_i + \gamma_t + \varepsilon_{it} \quad (15)$$

Before, *current* and *after* denotes the interaction term of the year dummy variable (taking the value of 1 in that year and 0 otherwise) with *Treat*, the remaining variables are defined in the same way as equation (12). The test results are shown in Fig. 3. The findings indicate that the coefficient of the interaction term is positive but insignificant before the Anti-Trust Law was implemented, yet the coefficient is significantly positive in the year of implementation and thereafter. The results show that the conclusions of the study are not affect by reverse causation and omitted variables.

According to the existing literature on DID, the pre-processing trend test is not sufficiently necessary to satisfy the validity of the DID parallel trend assumption, and there may be a low-power problem (Freyaldenhoven et al., 2019; Roth et al., 2023). Therefore, we refer to Rambachan and Roth (2023) to conduct a sensitivity analysis on the confidence intervals of the point estimates by constructing the relative degree of deviation from the parallel trend (Mbar) and setting both the maximum degree of deviation, $Mbar = 1 \times \text{standard}$

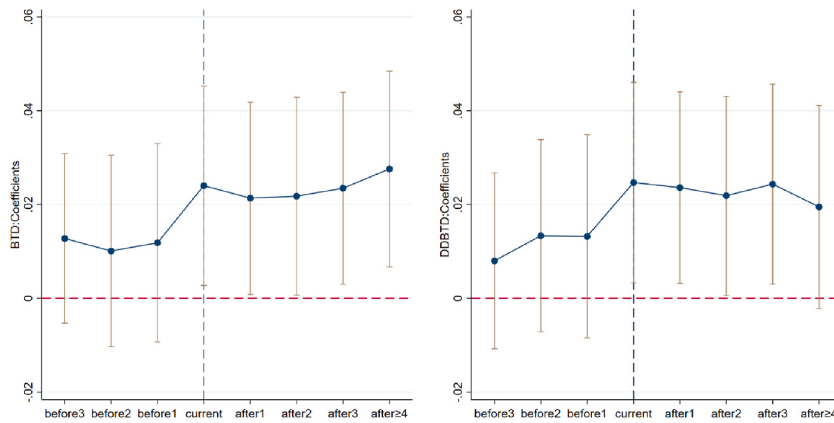


Fig. 3. Dynamic effects.

error, and smoothing restriction, to validate the robustness of the parallel trends test in this paper. The results of the test are shown in Fig. 4, which indicates that at the maximum level of deviation set in this paper, the confidence intervals of the point estimates are all above 0. Under the smoothing restriction, the breakdown value of the significant effects is 0.002 and 0.004, which suggests that the conclusions of this paper have good robustness at a certain level of deviation.

5.3.2. Placebo test

To test whether the results are affected by sample selection error and other omitted variables, this paper refers to the study of Geng et al. (2021), conducting a placebo test by the sham treatment group. In the baseline regression, there are 1017 firms, among which 120 are monopoly enterprises. Therefore, 120 out of 1017 samples are randomly selected as experimental group, the rest are control group. And then repeating the regression test 500 times, the estimated results are shown in Fig. 5. It's apparent that the most of the coefficients estimated using the fictitious treatment effect are clustered around 0, indicating that the increase in corporate tax avoidance is due to the implementation of the Anti-Trust Law rather than random factors.

5.3.3. Sample self-selection test

Considering the sample construction method in this paper may generate the problem of sample self-selection bias, which will bias the estimation of the results in this paper. Therefore, this paper uses PSM-DID and adopts the matching methods of 1:1 nearest neighbors matching, radius matching and kernel matching to re-match the samples, and then performs regression tests. The estimation results are shown in Table 3, which indicates that the estimated coefficients obtained using different matching methods are still significantly positive, verifying the robustness of the results in this paper.

5.3.4. Replace measures of corporate tax avoidance

To avoid the bias of choosing BTDCoefficients and DDBTDCoefficients as the measurement indicators in this paper. This paper follows the literatures (Chen et al., 2010; Dyreng et al., 2008), using the difference between the nominal tax rate and the effective tax rate (Rate_diff) and its five-year average (LRate_diff) as the indicators of tax avoidance, are estimated again. The results in columns (1) and (1) of Table 4 indicate that the coefficient of $Treat \times Post$ remains significantly positive. In addition, we also analyze the impact of the implementation of the Anti-Trust Law on the real tax burden (Real_rate) of firms. The results in columns (3) of Table 4 show that the estimated coefficient of interaction terms is significantly negative at the level of 1%. This indicates that the conclusions of this paper aren't influenced by the measures of tax avoidance, suggesting that the results of this paper are robust.

5.3.5. Reclassify treatment and control groups

The paper refers to the study of Peress (2010) to re-divide the treatment and control groups using the Lerner index and then re-estimate them: The Lerner index (MP) of firms in 2008 is divided into three groups based on size, the group with the highest MP value is the treatment group with $Treat$ taking the value of 1, and the group with the lowest MP value is the control group with $Treat$ taking the value of 0, the results are shown in columns (1) and (3) of Table 5, indicating that the estimated coefficient remains significantly positive. Secondly, we only estimate the enterprises in the industries that are not affected by the implementation of the Anti-Trust Law as the control group again, the results of Table 5 columns (2) and (4) show that the estimated coefficient is still significantly positive, but compared with the baseline results, the estimated coefficient is smaller and the results can be underestimated. Therefore, the findings of this paper are not affected by the different classification criteria of the treatment and control groups.

5.3.6. Excluding the impact of concurrent policies

At the same time as the Anti-Trust law, China was facing the reform of corporate income tax and the implementation of new accounting standards. The reform of corporate income tax may increase tax avoidance by group enterprises through transfer pricing

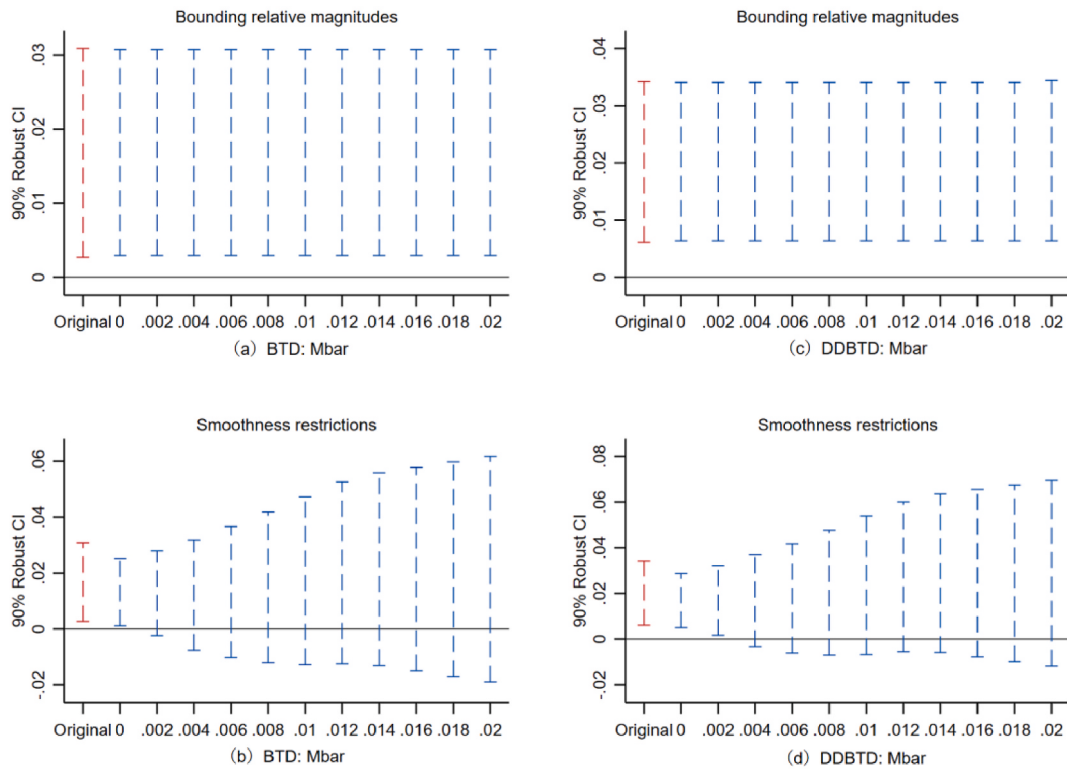


Fig. 4. Parallel trends sensitivity test.

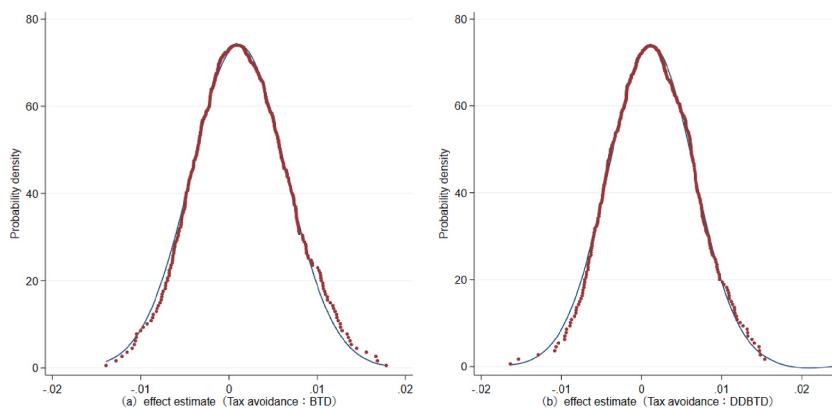


Fig. 5. Placebo test.

and other means by taking advantage of the tax rates differences between internal members (Davies et al., 2018). The results may be impacted due to the implementation of the new accounting standards in 2007. Therefore, to exclude the impact of income tax reform and new accounting standards, this paper controls the income tax reform policy variable (Income Tax_Policy),⁴ and adds an interaction term between Treat and the dummy variable (New_account) for the year of the implementation of the new accounting standards to the model. The results in Table 6 reveal that the coefficient of Treat $\times$ Post is still significantly positive after excluding the impact of the same period, which indicates that the conclusions of this paper are robust.

⁴ This is done by first generating the policy variable Treat based on the tax rate applied by the firm, with 1 for a reduction in the applicable tax rate from the original 33%–25% and 0 otherwise, then constructing the year variable, with 1 for 2008 and later and 0 otherwise, and finally forming the interaction term of the policy variable IncomeTax_Policy.

Table 3
Sample self-selection test.

Variables	Panel A: Nearest neighbour matching (1:1)		Panel B: Radius matching		Panel C: Kernel matching	
	BTD	DDBTD	BTD	DDBTD	BTD	DDBTD
	(1)	(2)	(3)	(4)	(5)	(6)
Treat × Post	0.0113*** (2.746)	0.0083** (2.000)	0.0113*** (2.735)	0.0083** (2.012)	0.0121*** (2.977)	0.0101** (2.464)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9609	9609	9598	9598	10050	10050
Adjusted R ²	0.1253	0.0932	0.1252	0.0931	0.1302	0.0970

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

Table 4
Replace measures of corporate tax avoidance.

Variables	Rate_diff	LRate_diff	Real_rate
	(1)	(2)	(3)
Treat × Post	0.0520** (2.304)	0.0321** (2.420)	−0.0076*** (−2.663)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	9859	9859	10059
Adjusted R ²	0.1665	0.4450	0.2776

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

Table 5
Reclassify treatment and control groups.

Variables	BTD		DDBTD	
	(1)	(2)	(3)	(4)
Treat × Post	0.0089*** (3.317)	0.0130** (2.211)	0.0102*** (2.886)	0.0112* (1.831)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	5765	4368	5765	4368
Adjusted R ²	0.4974	0.4939	0.6489	0.4765

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

5.3.7. Excluding the financial crisis

At the same time as the implementation of the Anti-Trust law, China was also facing the global financial crisis. [Edwards et al. \(2016\)](#) find that the increased financial pressure caused by the deterioration in the macroeconomy faced by firms would increase the extent of tax avoidance by firms. Therefore, in order to exclude the financial crisis from interfering with the results of this paper, this paper conducts regression analyses by separately excluding the data from 2008 to 2009, as well as excluding the samples from both years simultaneously, the estimation results are shown in [Table 7](#). The results in [Table 7](#) reveal that the coefficient of Treat × Post is still significantly positive after excluding the financial crisis, which indicates that the conclusions of this paper are robust.

6. Further analysis

6.1. Mechanism analysis

6.1.1. Corporate performance

As a constraint mechanism, product market competition has a negative impact on the performance of firms, and the increase in market competition will reduce the current profits of firms, reduce the average profitability of the industry in which firms are located, and expose firms to higher liquidity risks ([Tinaikar & Xue, 2009](#)). After the implementation of the Anti-Trust Law, monopoly firms have significantly reduced their ability to obtain excess monopoly profits due to their loss of monopoly pricing power. Due to performance

Table 6

Excluding the impact of the same period.

Variables	Exclude the income tax reform		Exclude the new accounting standards	
	BTD	DDBTD	BTD	DDBTD
	(1)	(2)	(3)	(4)
Treat × Post	0.0159*** (3.447)	0.0131*** (2.792)	0.0129** (2.561)	0.0086* (1.709)
Income Tax_Policy	0.0353*** (9.048)	0.0356*** (8.465)		
New_account			0.0014 (0.190)	0.0067 (0.910)
Firm's variables	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	10064	10064	10064	10064
Adjusted R ²	0.1378	0.1085	0.1223	0.0945

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

Table 7

Excluding the financial crisis.

Variables	Excluding 2008		Excluding 2009		Excluding 2008; 2009	
	BTD	DDBTD	BTD	DDBTD	BTD	DDBTD
	(1)	(2)	(3)	(4)	(5)	(6)
Treat × Post	0.0119** (2.235)	0.0091* (1.703)	0.0146*** (2.865)	0.0113** (2.180)	0.0130** (2.375)	0.0097* (1.753)
Firm's variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9210	9210	9178	9178	8323	8323
Adjusted R ²	0.4151	0.4153	0.4101	0.4072	0.4129	0.4150

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

pressures, corporate managers tend to adopt more aggressive tax avoidance behaviors to increase cash flow and profits, so the degree of tax avoidance is higher. Therefore, this paper uses Roa (the corporate operating profit margin) and Cash (the natural logarithm of cash and cash equivalents) to measure the corporate performance, and discusses whether the implementation of the Anti-Trust Law has a negative impact on the corporate performance, thereby improving the degree of corporate tax avoidance, through equations (16) and (17).

$$Performance_{it} = \alpha_0 + \alpha_1 Treat_i \times Post_t + \vartheta \sum Controls + \delta_i + \gamma_t + \varepsilon_{it} \quad (16)$$

$$Taxavoidance_{it} = \beta_0 + \beta_1 Treat_i \times Post_t + \beta_2 Performance_{it} + \tau \sum Controls + \delta_i + \gamma_t + \varepsilon_{it} \quad (17)$$

The results of Table 8 show that the net profit and cash flow of firms have decreased significantly, and the coefficients of Treat × Post are significantly positive and the coefficients of corporate performance are significantly negative in columns (4–5) and (7–8) of Table 8, which indicates that the corporate performance has played a part of the role of channels in the process of the implementation of the Anti-Trust Law affecting corporate tax avoidance, supporting hypothesis H2a.

6.1.2. Business risk

According to Schumpeter's "creation of destruction" theory, one of the important features of a market economy is the turnover of firms. Under the "competition-efficiency-elimination" mechanism, inefficient firms will exit the market. As competition increases, the likelihood of exit, liquidation and merger increases (Aghion et al., 1999). To avoid exit and merger, listed companies on the verge of bankruptcy often engage in positive surplus management to hide the fact that their financial situation has deteriorated significantly (Rosner, 2003). After the implementation of the Anti-Trust Law, the possibility of bankruptcy increases, and managers may adopt more aggressive tax avoidance behaviors to avoid competition.

To test the mechanism, this paper uses the earnings volatility of the firm in the last 3 years as a measure of business risk (Risk) according to the existing literature (Acharya et al., 2011; Boubakri et al., 2013). The higher the volatility, the higher the risk of the firm. The results of the mechanism of action based on operational risk are shown in Table 9 Panel A. Column (3) of the table shows that the coefficient of the interaction term is significantly positive, which indicates that after the implementation of the Anti-Trust Law, monopolistic firms face greater operational risk than competitive firms. The results of columns (4) and (5) of Table 9 Panel A show that

Table 8
Mechanism analysis: Corporate performance.

Variables	BTD	DDBTD	Roa	BTD	DDBTD	Cash	BTD	DDBTD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat × Post	0.0102** (2.115)	0.0080* (1.831)	−0.0347** (−2.486)	0.0099** (2.061)	0.0077* (1.776)	−0.1099** (−2.070)	0.0097** (2.033)	0.0074* (1.722)
Roa				−0.0082* (−1.844)	−0.0074* (−1.955)			
Cash							−0.0046*** (−3.593)	−0.0053*** (−4.457)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10056	10056	10056	10056	10056	10056	10056	10056
Adjusted R2	0.4062	0.4086	0.2348	0.4087	0.4109	0.8700	0.4077	0.4109

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, respectively.

the coefficients of both the interaction term and operational risk (Risk) are significantly positive, which indicates that the implementation of the Anti-Trust Law increases the operational risk of monopolistic firms, which in turn increases the degree of corporate tax avoidance.

According to [Richardson et al. \(2015\)](#), the worse a firm's financial situation is, the higher its degree of tax avoidance is. Therefore, to test whether the facilitative effect of the implementation of the Anti-Trust Law on the extent of corporate tax avoidance differs significantly across firms with different financial distress and to further verify the role of operational distress as a channel, this paper uses Z-score values to measure corporate financial distress.⁵ Then, group regressions were conducted, and the regression results are shown in [Table 9](#) Panel B. The results show that the coefficient of Treat × Post is significantly positive in the group with bad financial status but insignificant in the group with good financial status, further confirming the channel through which the implementation of the Anti-Trust Law promotes corporate tax avoidance by increasing corporate business risks, supporting hypothesis [H2a](#).

6.1.3. Policy satisfaction

Public services are a key factor influencing taxpayers' tax compliance ([Alm et al., 1992](#); [Kim, 2002](#); [Spicer & Lundstedt, 1976](#)). Behavioral public finance suggests that taxpayers are boundedly rational individuals in real-world decision-making, and tax compliance is shaped by a series of economic and social behavioral choices based on tax laws, tax psychology, the fulfillment of tax obligations, and participation in social cooperation ([Nguyen, 2022](#)). Drawing on contract theory ([Rousseau, 1762](#)), the government provides public services to citizens through taxation, while taxpayers fulfill their tax obligations to meet public needs. When the tax burden aligns with the level of public services, taxpayers, driven by perceptions of fairness, tend to comply with tax laws ([Verboon & Van Dijke, 2007](#)). The Anti-Trust Law aims to combat monopolistic practices and promote fair market competition. Broad exemption clauses may encourage rent-seeking behavior by firms, while frequent antitrust investigations, fluctuating legal interpretations, and uncertainty about the intensity of enforcement may reduce monopolistic firms' satisfaction with the government. This, in turn, may reduce their willingness to pay taxes. Therefore, the Anti-Trust Law may indirectly increase tax avoidance behavior of monopolistic firms by reducing political satisfaction, as suggested by hypothesis [H2b](#).

Given that policy satisfaction reflects a firm's subjective psychological perception of the government's provision of public policy services, it is challenging to measure directly. Theoretically, if Anti-Trust Law reduces tax compliance by lowering monopolistic firms' satisfaction with the government, the effect of Anti-Trust Law on reduced compliance will be more pronounced in regions with lower levels of government satisfaction. Therefore, to test the aforementioned logic, this paper uses the ratio of fiscal livelihood expenditures to fiscal revenue and the business environment index in various regions with reference to [Chen and Yang \(2024\)](#) to indirectly capture firms' satisfaction with the government. Fiscal livelihood expenditures include spending on education, healthcare, social security, and employment. The sample is then divided into two groups based on the median values of provinces and years, and group testing is conducted. The test results are shown in [Table 10](#), the results indicate that in samples with higher levels of public service and business environment, the coefficient of Treat × Post is not significant. However, in samples with lower levels, the coefficient of Treat × Post is significantly positive at the 1% or 5% level and passes the Fisher intergroup difference coefficient test. These findings suggest that following the implementation of the Anti-Trust Law, monopolistic firms in regions with lower levels of public service and business environment exhibit higher levels of tax avoidance compared to competitive firms, supporting hypothesis [H2b](#).

⁵ The calculation of Z-score can be found in Lyer et al. (2008), which is calculated as $Z\text{-score} = 1.0 \times \text{Operating Income/Total Assets} + 3.3 \times \text{Earnings Before Interest and Tax/Total Assets} + 1.2 \times \text{firm Working Capital/Total Assets} + 1.4 \times \text{Undistributed Profit/Total Assets} + 0.6 \times \text{Total Stock Market Value/Total Liabilities}$, where a larger Z-score means the higher the financial situation faced by the firm, when $Z\text{-score} > 2.67$, the firm has less crisis of bankruptcy, when $1.81 < Z\text{-score} < 2.67$ is a gray area, the firm's financial situation is very unstable, and the possibility of bankruptcy crisis is higher, when $Z\text{-score} < 1.81$ is financial distress, the firm is latent bankruptcy crisis. Therefore, we categorize the sample into better and worse financial status groups based on whether the Z-score is greater than 2.67.

Table 9
Mechanism analysis: Business risk.

Variables	Panel A: Business risk (Risk)					Panel B: Financial distress			
	BTD	DDBTD	Risk	BTD	DDBTD	BTD		DDBTD	
						Bad	Good	Bad	Good
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat × Post	0.0118*** (3.380)	0.0094** (2.511)	0.0150*** (3.512)	0.0113*** (3.237)	0.0089** (2.368)	0.0172** (2.146)	0.0100 (1.592)	0.0169** (2.208)	0.0071 (1.166)
Risk				0.0332*** (3.710)	0.0357*** (3.730)				
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P value						0.001		0.000	
Observations	9301	9301	9301	9301	9301	3868	6196	3868	6196
Adjusted R ²	0.4114	0.4075	0.7859	0.4123	0.4084	0.1153	0.1435	0.1166	0.1020

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, test for differences in coefficients between groups were performed using the Fischer test.

Table 10
Mechanism analysis: Policy satisfaction.

Variables	Panel A: Public services				Panel B: Business environment			
	BTD		DDBTD		BTD		DDBTD	
	High	Low	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat × Post	0.0060 (0.776)	0.0200*** (3.322)	−0.0010 (−0.126)	0.0202*** (3.286)	0.0075 (1.106)	0.0187*** (2.830)	0.0068 (0.988)	0.0139** (2.040)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P value		0.001		0.000		0.001		0.046
Observations	5080	4984	5080	4984	5000	5064	5000	5064
Adjusted R ²	0.4520	0.3854	0.4540	0.3747	0.4137	0.4266	0.4092	0.4207

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, tests for differences in coefficients between groups were performed using the Fischer test.

6.2. Heterogeneity analysis

6.2.1. Tax enforcement

Tax department can play an external supervisory role by tax enforcement activities, which has a suppressive effect on the self-interest behavior of firm management and has an important governance role for companies (Dyck & Zingales, 2004). In regions where the level of tax collection is relatively high, the tax department are more vigilant in monitoring firms and the cost of tax avoidance is higher for firms, so firms may not adopt more aggressive tax avoidance behaviors (Chen, 2010; Slemrod, 2007). In addition, local tax bureaus have less tax collection efforts compared to state tax bureaus (Cai et al., 2018), and limited tax collection resources may also cause local governments to increase tax collection efforts for taxes such as business taxes and decrease tax collection efforts for corporate income taxes (Han & Kung, 2015). Therefore, this paper predicts that the promotion effect of the Anti-Trust Law on corporate tax avoidance will be more significant among firms in regions with a lower level of tax administration and firms whose income tax is administered by local tax bureaus.

To verify this predict, this paper calculates the tax administration intensity of each region by referring to Mertens (2003) and divides the sample into two groups of samples with higher tax administration intensity and lower tax administration intensity according to the median of province years, and then conducts empirical analysis again. Panel A of Table 11 presents the empirical results, the results show that the coefficient of Treat × Post is positive and more significant in the sample with low tax administration level, and pass the coefficient of difference between groups, confirming the speculation of this paper.

For the division of tax collection agencies, this paper divides the overall sample into two categories of firms whose income tax is

Table 11
Heterogeneity analysis: Tax enforcement.

Variables	Panel A: Tax collection and administration level				Panel B: Tax collection agencies			
	BTB		DDBTD		BTB		DDBTD	
	High	Low	High	Low	State	Local	State	Local
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat × Post	0.0058 (1.285)	0.0056* (1.847)	0.0105 (1.402)	0.0115** (1.975)	0.0242 (1.338)	0.0125** (2.492)	0.0154 (0.930)	0.0103** (2.010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P value		0.073		0.046		0.000		0.000
Observations	3969	6095	3969	6095	1450	8614	1450	8614
Adjusted R ²	0.3025	0.2389	0.0652	0.1208	0.2028	0.1200	0.1359	0.0970

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, tests for differences in coefficients between groups were performed using the Fischer test.

administered by the state tax bureaus and local tax bureaus, based on the criteria of when the firms were established and whether they are “central listed firms”: all non-central firms and non-foreign firms established before January 1, 2002 (exclusive), the income tax of such firms are administered by the local tax bureaus before and after the reform, and otherwise is state tax bureaus.⁶ The results are shown in Table 11 Panel B. We find that the coefficient of Treat × Post is more significant in the group where the tax collection agency is the local tax bureaus compared to the state tax bureaus, and pass the coefficient of difference between groups, which indicates that firms whose corporate income tax is collected by the state tax bureaus are more affected by the implementation of the Anti-Trust Law.

6.2.2. Quality of information disclosure

Transparent information can alleviate the adverse selection problem of investors due to information uncertainty (Diamond & Verrecchia, 1991) and help investors to restrain managers from encroaching on the interests of the firm. Wagenhofer (1990) finds that the more intense the product market, the lower the quality of information disclosure, when firms face increased competition, the information disclosed by firms may allow their own competitors to make unfavorable decisions against the firm, thus damaging the value of the firm, that firms will face higher costs of competitive disadvantage. Therefore, corporate executives will conceal more internal information or disclose incorrect information externally to mislead their competitors to avoid competition. Following this logic, this paper argues that the effect of the implementation of the Anti-Trust Law on the extent of corporate tax avoidance will be more significant among firms with lower quality disclosures.

Therefore, this paper measures the information disclosure quality of firms using evaluation results from the CSMAR database. Firms are then grouped based on these evaluation outcomes. Specifically, firms with an average annual evaluation score of good or higher are categorized as having high-quality information disclosure, while those with lower scores are classified as having low-quality information disclosure. Following this classification, regression analysis is performed for both groups.⁷ The results in Table 12 show that the effect of the implementation of the Anti-Trust Law on the extent of corporate tax avoidance is significantly positive in the group with lower quality of corporate disclosure, the coefficient of Treat × Post is positive but insignificant in the group with higher quality of corporate disclosure, and pass the coefficient of difference between groups.

6.2.3. Ownership structure

For a long time, most of the state-owned enterprises are industries related to the lifeline of the national economy and national security, which are often sheltered and supported by the government due to their special characteristics and importance, and do not belong to the focus scope of the Anti-Trust Law (Song et al., 2023). Compared with private enterprises, state-owned enterprises are easier to finance and face less market risk, thus they are less affected and have relatively weaker incentives to avoid taxes after the implementation of the Anti-Trust Law. To test whether the implementation of the Anti-Trust Law had a greater impact on private enterprises, this paper first excludes the sample of Anti-Trust Law exempted industries, such as mining, petroleum processing, coking and nuclear fuel processing, ferrous metal smelting and rolling, non-ferrous metal smelting and rolling, and electricity, heat and water production and supply, based on Yu et al. (2021). Then, we perform a regression on the sample excluding the aforementioned industries, with the estimation results presented in columns (1) and (4) of Table 13. The results show that, the estimated coefficients of the core explanatory variables remain significantly positive after excluding these industries. Following this, we divide the sample into private and non-private firms to conduct a heterogeneity test. The results of Table 13 indicate that the coefficient of the interaction

⁶ «Notice of the State Council on the Issuance of the Income Tax Revenue Sharing Reform Program» (Guo Fa(2008) No. 120), «Notice of the State Administration of Taxation on the Adjustment of the Scope of Collection and Administration of New firm Income Tax» (Guo Fa (2001) No. 37), «Notice of the State Administration of Taxation on Strengthening the Mutual Delegation of Collection and Collection by the State Taxation Bureau and Local Taxation Bureau» (General Administration of Taxation Fa(2015)No. 155).

⁷ According to the information disclosure assessment standards of listed companies, the quality of information disclosure of firms is divided into 4 grades, with 1 indicating excellent, 2 indicating good, 3 indicating qualified and 4 indicating unqualified.

Table 12
Heterogeneity analysis: Quality of information disclosure.

Variables	BTD		DDBTD	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
Treat × Post	0.0114 (1.438)	0.0160*** (2.638)	0.0117 (1.402)	0.0122** (2.028)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
P value	0.032		0.049	
Observations	3868	6196	3868	6196
Adjusted R ²	0.1153	0.1435	0.1166	0.1020

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, tests for differences in coefficients between groups were performed using the Fischer test.

term is more significantly positive in private enterprises. This suggests that after the implementation of the Anti-Trust Law, private enterprises are more affected compared to non-private enterprises.

7. Conclusions and policy implications

To prevent monopolistic behavior, China enacted the Anti-Trust Law on August 30, 2007, and started to implement it on August 1, 2008. Taking this policy as a quasi-natural experiment, this paper theoretically and empirically examines the impact of the Anti-Trust Law on corporate tax avoidance behavior by using data of Chinese A-share listed companies from 2005 to 2017. The results indicate that: (1) Monopolistic firms avoid taxes to a greater extent than competitive firms after the Anti-Trust Law, and the results remain robust after a series of robustness tests; (2) The analysis of the mechanism shows that the Anti-Trust Law increases the level of corporate tax avoidance by reducing corporate performance, increasing business risk and subjective dissatisfaction with regulators; (3) The results of the heterogeneity analysis reveals that the encouraging effect of the Anti-Trust Law on corporate tax avoidance is more pronounced among enterprises located in regions with lower levels of tax administration, enterprises whose income tax is collected and administered by local tax bureaus, enterprises with lower quality of information disclosure and private enterprises.

The findings of this paper hold important policy implications for China's ongoing efforts to accelerate the construction of a unified national market and strengthen tax governance. Firstly, while the implementation of the Anti-Trust Law has promoted product market competition, it has also led to higher levels of tax avoidance among monopolistic enterprises. It may result in a loss of tax revenue, negatively affecting government's public investment, and ultimately undermine the public interest. Secondly, the implementation of the Anti-Trust Law has facilitated tax avoidance by enterprises, leading to an uneven distribution of the actual tax burden across different industries and firms, which undermines the construction of China's modern tax system. In addition, the law includes broad exemption provisions that grant antitrust enforcement agencies significant discretionary power, potentially intensifying rent-seeking activities between enterprises and the government. Finally, the law's promotion of tax avoidance has resulted in internal transactions and unreasonable tax avoidance practices, creating enforcement challenges for tax authorities. To accelerate the establishment of an efficient, regulated, and competitive unified national market, this paper proposes the following policy recommendations.

Firstly, strengthen reforms in tax collection and administration to establish a standardized and efficient tax management system. Tax administration should be modernized by leveraging big data and artificial intelligence technologies, enabling real-time monitoring and analysis of corporate financial data. In addition, it is crucial to enhance the information-sharing mechanisms between tax authorities and other departments such as market regulation and finance, fostering a coordinated regulatory approach. Deepen reforms in

Table 13
Heterogeneity analysis: Ownership structure.

Variables	BTD			DDBTD		
	Full sample	Private	Non-Private	Full sample	Private	Non-Private
	(1)	(2)	(3)	(4)	(5)	(6)
Treat × Post	0.0127** (-2.552)	0.0079** (-2.010)	0.003 (-0.889)	0.0112** (-2.234)	0.0197*** (-2.661)	0.0052 (-0.790)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
P value	0.160			0.052		
Observations	9066	4256	4810	9066	4256	4810
Adjusted R ²	0.1274	0.2672	0.2735	0.1005	0.0863	0.1259

Note: the t value in parentheses; *, ** and *** denote significance at the 10%, 5% and 1% levels, the standard errors cluster adjusted at the enterprise level, tests for differences in coefficients between groups were performed using the Fischer test.

the local tax management system to reduce excessive local government interference in taxation, ensuring the uniformity and transparency of policy implementation. By adjusting fiscal incentive mechanisms, local government revenue should be linked to the long-term compliance of businesses, minimizing the impact of short-term interest-driven tax supervision lapses. Finally, strengthen the professional development of local tax authorities, improving law enforcement capabilities and technical expertise, and enhancing transparency in tax enforcement. By publicly disclosing penalty cases and providing policy clarifications, businesses' understanding of tax laws and regulations can be strengthened, ultimately reducing the motivation for tax avoidance at its source.

Secondly, accelerating the reform of antitrust enforcement to reduce uncertainty in its implementation. Establishing and publishing consistent enforcement standards to minimize the arbitrariness of discretionary powers and ensure fairness and predictability in policy implementation. Developing detailed implementation guidelines tailored to the specific characteristics of different industries, avoiding a "one-size-fits-all" approach that could disrupt normal business operations. Finally, establish effective complaint and feedback mechanisms to facilitate communication between businesses and enforcement agencies, enabling the timely resolution of business concerns regarding policies.

Thirdly, improving the corporate information disclosure system to enhance financial transparency. Regulatory authorities should strengthen the verification of the authenticity of financial reports of listed companies, and impose stricter penalties on companies that fail to make required disclosures or make false disclosures. Random inspections and special audits should be conducted to ensure the quality of disclosures. At the same time, third-party institutions such as accounting firms and rating agencies should be encouraged to participate in supervision, thus creating a diversified regulatory mechanism to enhance market transparency. Finally, the application of blockchain technology in financial data management should be promoted to take advantage of its immutability and enhance the credibility of information disclosure.

Finally, strengthen policy support for private enterprises to mitigate the impact of policy shocks. The government should improve the financing environment by reducing financing costs and offering innovative credit products, thereby easing the financial burden on private enterprises and preventing them from developing tax avoidance motives due to lack of funds. In addition, policy advisory services should be strengthened to help private enterprises better understand and comply with the requirements of the Anti-Trust Law, thereby minimizing unnecessary costs due to policy misunderstandings. Local governments should be encouraged to provide tax incentives or subsidies to private enterprises during the implementation of the Anti-Trust Law, while ensuring strict supervision of their use to prevent policy distortions from creating new tax loopholes.

Author statement

Manuscript title: Competition and Tax Avoidance: Evidence from Quasi Natural Experiment of the Implementation of Anti-Trust Law.

I have made substantial contributions to the empirical analysis of this paper.

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I work with Yuan Gao on the empirical analysis of this paper and give advice on this part.

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I am responsible for the theoretical model in this paper and make contribution on the writing of the paper.

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Appendix A

Table A1

Description and definition of key variables.

Variables	Description	Definition
BTD	Corporate tax avoidance	(Total profit before tax - Taxable income amount)/Total assets
DDBDT		Represents the portion of BTD net of the effect of accrued profit
Treat	Treatment variable	A dummy that equals to 1 if a firm is monopolistic firms and 0 otherwise
Post	Year dummy variable	A dummy that equals to 1 after 2008 and 0 otherwise
Size	Firm's size	Natural logarithm of Total assets
Sale	Sale's size	Natural logarithm of operating income

(continued on next page)

Table A1 (continued)

Variables	Description	Definition
Lev	Financial leverage	Total liabilities/Total assets
Growth	Firm's growth	Changes in operating income for the current period/Operating income for the previous period
Ebit	Earnings before interest of tax	Earning before interest of tax/Total assets
Age	Firm's age	Number of years since the firm is IPO
Top10	Equity concentration	Shareholding ratio of top ten shareholders
Ppe	Fixed asset intensity	Net fixed assets at the end of the period/Total assets
Intang	Intangible asset intensity	Net intangible assets at the end of the period/Total assets
State	Nature of shareholding	A dummy that equals to 1 if a firm is state-owned firms and 0 otherwise
Indep	Percentage of independent directors	Number of independent directors on the board of directors/Total number of directors on the board

Table A2

Pearson correlation test

Variables	Size	Lev	Sale	Growth	Ebit	State	Age	Top10	Ppe	Intang	Indep
Size	1.000										
Lev	0.421***	1.000									
Sale	0.473***	0.424***	1.000								
Growth	0.035***	0.057***	0.053***	1.000							
Ebit	-0.063***	-0.349***	0.034***	0.137***	1.000						
State	0.262***	0.176***	0.258***	-0.058***	-0.107***	1.000					
Age	0.219***	0.101***	0.121***	-0.019*	-0.132***	0.047***	1.000				
Top10	0.234***	-0.007	0.233***	0.122***	0.201***	0.051***	-0.228***	1.000			
Ppe	0.033***	-0.022**	0.074***	-0.075***	0.021**	0.120***	-0.122***	0.062***	1.000		
Intang	-0.007	-0.058***	-0.035***	-0.019*	0.036***	0.036***	-0.025**	0.034***	0.074***	1.000	
Indep	0.095***	0.025**	0.050***	0.014	-0.068***	-0.043***	-0.012	0.022**	-0.064***	-0.034***	1.000

Note: *, ** and *** denote significance at the 10%, 5% and 1% levels.

Table A3

Variance Inflation Factor (VIF) test

	Treat × post	Size	Sale	Lev	Growth	Ebit	Top10	Age	State	Ppe	Intang	Indep	Mean VIF
VIF	1.17	4.9	4.72	1.49	1.05	1.31	1.23	1.2	1.12	1.07	1.02	1.03	1.78
1/	VIF	0.85822	0.20388	0.21203	0.67207	0.94803	0.76173	0.81265	0.83566	0.89639	0.93377	0.97825	0.97048

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