Two Faces of Product Market Competition and Tax Avoidance

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ABSTRACT

This paper investigates the effect of product market competition on a firm's tax avoidance behavior. We develop a theoretical model showing that a greater product market competition could increase the managerial incentive of tax avoidance due to a "threat-of-punishment" effect but decrease shareholders' incentive of tax avoidance due to a "value-of-tax-saving" effect, resulting in an inverted U-shape relationship between product market competition and tax avoidance. Moreover, the turning point of the inverted U-shape relationship is a function of a firm's productivity and corporate governance. Empirically, we find consistent evidence that the effect of product market competition on a firm's tax avoidance has an inverted U-Shape and such an effect varies across firms with different productivity and corporate governance. Our analysis highlights the complex effect of product market competition on a firm's tax avoidance activities.

Keywords: tax avoidance, product market competition, nonlinear, moral hazard
JEL: H26; H21; G30

1. Introduction

Tax planning strategies, when executed properly, could yield significant benefits to corporations: effective corporate tax planning allows companies to reduce tax payments, boost business operating income, and reserve cash to cope with changes in the operating environment (Scholes et al., 2009; Armstrong et al., 2011). The past decades have witnessed a growing trend of firms using tax planning and taking advantage of the favorable provisions in the tax code to significantly lower their effective tax rates (Slemrod, 2004; Dyreng et al., 2017). The increasing tax avoidance behavior has attracted great attention from regulators and academic researchers.

Extensive literature has investigated how tax avoidance is related to internal corporate governance mechanisms such as managerial incentive compensation (Rego and Wilson, 2012; Dyreng, Hanlon and Maydew, 2010; Crocker, Slemrod, 2005; Desai, 2006; Desai and Dharmapala, 2006), institutional monitoring and family firms (Desai, Dyck, and Zingales, 2007; Armstrong et al., 2015; Chen, Huang, Li and Shevlin, 2019).[1] This literature centers their analysis on managerial incentives to engage in tax avoidance and whether the internal corporate governance influences managerial tax-saving efforts, but little is known about whether and how an external governance mechanism, in particular, the product market competition, interacts with internal governance mechanisms and affects corporate tax planning. The purpose of this study is to fill this gap by conducting a comprehensive investigation both theoretically and empirically of the interaction between product market competition and internal governance mechanism and its impact on tax avoidance.

[1] Besides the studies on tax planning strategy of U.S. firms, prior literature also finds that multinational firms use transfer pricing, intracompany debt, cost-sharing agreements, and other tactics to shift income from high-tax jurisdictions to low-tax jurisdictions (e.g., Hines and Rice, 1994, Huizinga and Laeven, 2008, Dharmapala and Riedel, 2013).

It is challenging, however, to identify the causal impact of product market competition on corporation tax avoidance. In theory, the relationship between product market competition and corporate tax planning can be convoluted as the product market competition interacts with managerial incentives, costs of tax savings, and ultimately firm performance. For example, Giroud and Mueller (2010, 2011) show that competition mitigates managerial slack, improves operating performance, and substitutes for internal corporate governance. Kubick et al. (2014) show that firms with greater market power (e.g., firms in non-competitive industries) tend to engage more in tax avoidance because they have comparative advantages through persistent profits and insulation from competition threats. Given the direct impacts of product market competition on managerial incentives and firm profitability, it is crucial to integrate these two key effects of product market competition to gain a full picture of the impact of product market competition on corporate tax avoidance. Empirically, to identify the causal effect of product market competition on tax avoidance, it is necessary to address the potential nonlinearity and endogeneity in the relationship between product market competition and tax planning as they both could be determined by some unobserved firm characteristics or inversely joint determined.

To identify the complex relationship between product market competition and tax avoidance behavior, we start by developing a theoretical model of tax avoidance that considers both the impact of product market competition on firm profitability and firm-manager contractual relationship. Specifically, the firm offers its manager an incentive contract to induce managerial efforts to reduce taxable income and maximize tax deductions. The manager needs to exert costly efforts to increase tax savings, while in the meantime, she can extract private benefits under the cover of tax-avoiding activities. Tax avoidance efforts, however, might not be always successful. Some portion of tax reductions could be deemed impermissible by the tax authority, and if it

happens, the firm will receive a penalty from the tax authority and be required to audit its accounting reports, so that the manager might be punished (e.g., pay cut, demoted or dismissed) by the firm if her "tunneling" behaviors are detected through the auditing. We show that product market competition could have two opposite effects on the manager's incentives to engage in tax avoidance. On the one hand, there is a "threat-of-punishment" effect that product market competition increases the likelihood that the firm punishes the manager for diverting resources for private benefits. The manager thus has incentives to exert more efforts to increase the success of tax savings so that it lowers the likelihood that the tax authority audits the firm and detects the manager's private benefits. The "threat-of-punishment" effect results in a positive relationship between product market competition and tax avoidance. On the other hand, there is a "value-of-tax-saving" effect that product market competition lowers the firm's profit and erodes the marginal value of tax savings, so the firm is less willing to provide incentives to induce managerial efforts to engage in tax-saving activities. The "value-of-tax-saving" effect results in a negative relationship between product market competition and tax avoidance.

When the competition level is low that a firm is enjoying high profit, an increase in the competition will lead to a greater "threat-of-punishment" effect than the "value-of-tax-saving" effect. In contrast, when the competition level is high that the firm's profit is low, an increase in the competition will lead to a greater "value-of-tax-saving" effect than the "threat-of-punishment" effect. Thus, our model predicts that these two competing effects produce an inverted-U-shape relationship between product market competition and corporate tax avoidance. When the competition level is relatively low, there is a positive relationship between product market competition and tax avoidance as the "threat-of-punishment" effect dominates the "value-of-tax-saving" effect; when the competition level is relatively high, there is a negative relationship

between product market competition and tax avoidance as "value-of-tax-saving" effect dominates "threat-of-punishment" effect.

Furthermore, we derive the turning point of the inverted U-shape relationship between product market competition and tax avoidance, which is a function of a firm's productivity and quality of internal corporate governance. Specifically, for firms with higher productivity and better internal corporate governance, the positive "threat-of-punishment" effect always dominates the negative "value-of-tax-saving" effect and as such, these firms exhibit a monotonically positive relationship between product market competition and tax avoidance activities.

Equipped with theoretical predictions, we empirically investigate the relationship between product market competition and tax avoidance. To do so, we need to address a few empirical challenges. First, we need a measure of product market competition that is less susceptible to endogeneity concerns. The commonly used measures of industry concentration such as the Herfindahl-Hirschman Index (based on market share) and the price-cost margin in U.S. industries are endogenous and cannot serve such a purpose. For example, cash savings generated through tax planning helps reduce financial constraints and cost of equity (Edwards, Schwab, and Shevlin, 2016; Goh, Lee, and Lim, and Shelvin, 2016), providing firms with a competitive advantage in the product market and resulting in greater market share. We follow the recent international trade literature (Acemoglu et al., 2016; Autor et al., 2013; Autor et al., 2014) and use a U.S. firm's exposure to import competition from China as our main measure of product market threat. Such a measure can alleviate the endogeneity concern because China's export growth is largely attributed to China's transition into a market-oriented economy through Chinese government–initiated reforms, which is unlikely to be related to U.S. domestic market demand shocks (Hsieh and Ossa, 2016). To further address the potential concern that Chinese imports could co-move with some

unobservable domestic demand shocks in the U.S. such as technological innovation, productivity, or demographic changes, we follow an identification strategy in Autor et al. (2014) and Acemoglu et al. (2016) and use non-U.S. high-income countries' imports from China as an instrumental variable for import competition from China.

Second, to capture a firm's exposure to import competition from China, we use the sales-weighted sum of the market share of U.S. imports from China across all industries in which a firm operates. This measure not only considers the distribution of a firm's sales activities across industries but also has a significant time-series variation since the pattern of U.S. imports from China has evolved considerably over the past decades. Compared with industry concentration measures constructed based on a firm's primary industry, our firm-level measure considers all product markets in which a firm operates and provides a more complete picture of a firm's exposure to import competition.

Following the prior literature, we use two book-tax difference-based measures and two effective tax rate-based measures to proxy for a firm's tax avoidance activities. To explore the relationship between product market competition and a firm's tax avoidance activities, we regress each of the four tax avoidance measures on a firm's exposure to import competition from China, the square of the exposure measure to capture the non-linear effect, a set of firm-level determinants that are related to a firm's tax avoidance activities (e.g., firm size, market-to-book ratio, ROA, leverage, free cash flows, net operating losses, R&D, property, plant, and equipment (PPE), intangibles, equity in net loss/earnings, diversification, foreign sales, and business cycle), as well as firm and time- fixed effects. We find that the coefficient on product market competition is positive, while the coefficient on the square of product market competition is negative, showing that higher product market threat first increases and then reduces the level of tax avoidance of U.S.

firms. We further use non-U.S. high-income countries' imports from China as an instrumental variable for import competition from China and implement a two-stage least square regression (2SLS). The results show that the inverted U-shape relationship between product market competition and tax avoidance is robust to the IV approach. The findings thus provide strong support to the model's prediction of an inverted U-shape relationship between product market competition and tax avoidance in that the "threat-of-punishment" ("value of tax-saving") effect dominates when the competition is low (high).

Lastly, we explore the cross-sectional implication of firm heterogeneity from the theoretical model when the positive "threat-of-punishment" effect dominates the negative "value-of-tax-saving" effect. First, we examine whether the positive effect of competition on tax avoidance is dominant among firms whose profits are less adversely affected by import competition, such as less labor-intense firms, firms that have higher productivity, greater Tobin's Q, a greater value of innovation, and larger price-cost margin. Indeed, we find consistent empirical results with our theoretical prediction: The negative effect of competition on the value of tax saving is negligible as compared to the positive disciplinary effect of competition for firms whose profits are less adversely affected by competition.

Second, we examine whether the positive effect of competition on tax avoidance is dominant for firms with a higher likelihood to detect managers' private benefits and punish them, such as well-governed and transparent firms. We find supportive empirical evidence that firms engage more in tax avoidance activities if they have higher institutional ownership, higher ownership of block holders, lower bid-ask spread, more analyst following, and less dispersion of analyst forecast. These findings suggest that the positive "threat-of-punishment" effect dominates

the negative "value of tax-saving" effect for firms whose managers are more likely to be punished by the firm when its tax reduction is deemed impermissible by the tax authority.

The effect of product market competition on corporate behavior has been an important topic in economics, finance, and accounting research. The literature has shown that product market competition could significantly influence various aspects of corporate decisions and outcomes including capital structure (e.g., Chevalier 1995; Phillips 1995; Campello 2003; Fresard and Valta, 2016), firm innovation (Aghion et al., 2005), productivity growth and risk (Schmidt, 1997; Raith, 2003), cost of borrowing (Valta, 2012), financing decisions like IPOs (Hsu, Reed, and Rocholl 2010), foreign listings (Sarkissian and Wang, 2020), and market crash (Li and Zhan, 2019). Our study contributes to this literature by providing the first theoretical prediction and empirical evidence on the interaction between product market competition and internal governance and its impact on tax avoidance.

Our analysis is related to several prior theoretical models showing a non-monotonic relation between product market competition and firm outcomes. For example, Schmidt (1997) and Raith (2003) show that product market competition has an ambiguous effect on a firm's productivity growth and risk. Aghion et al (2005) find an inverted U-relationship between product market competition and corporate innovations. Our theoretical analysis and empirical evidence show that the relation between product market effect and corporate tax avoidance is also nonlinear. The documented nonlinear impact of product market competition on tax avoidance is important as it suggests that, when evaluating the tax avoidance effect of changing product market competition, one should take into account two competing effects of product market competition.

The paper proceeds as follows. Section 2 develops a model analyzing the effect of product market competition on tax avoidance. Section 3 describes the empirical research design. Section 4

describes the data, sample selection, and empirical analysis. Section 5 describes the further cross-sectional analysis of the predictions of the theoretical model. Section 6 concludes.

2. A model of tax avoidance

In this section, we develop a model based on the classical model of moral hazard problem in Hölmstrom (1979) that considers an optimal incentive scheme in inducing the manager of a firm to exert efforts to reduce tax payment in the presence of product market competition. Specifically, the firm delegates to a manager the decisions of how to report taxable income and declare tax deductions and credits to the tax authority. The firm offers the manager a compensation contract that provides the manager incentives to reduce taxable income and increase tax deductions. Because not all tax-saving activities are permissible by the tax authority, the manager must exert costly efforts to increase the acceptance rate of tax reporting by the tax authority. In the meantime, the manager could divert resources under tax savings for private benefit. If certain activities are deemed impermissible, the tax authorities will penalize the firm and request the firm to conduct an audit to correct the report on taxable income and tax deductions. Such an audit could also catch the private benefit extracted by the manager. Therefore, given the compensation contract offered by the firm, the manager has an incentive to low tax payments by reducing the likelihood that some tax-saving activities are deemed impermissible by the tax authority.

Setup

The firm's earnings $Y(\theta, A) > 0$ depends on the intensity of the product market competition $\theta \in [0,1]$, a production efficiency factor $A \in (0, \infty)$. We assume $Y(\theta, A)$ decreases with the degree of competition, $\frac{\partial Y(\theta,A)}{\partial \theta} < 0$, and the adverse impact on income is decreasing with the

intensity of competition, that is, $Y(\theta, A)$ is concave in θ, $\frac{\partial Y^2(\theta,A)}{\partial \theta^2} < 0$. Production efficiency increases the taxable income, $\frac{\partial Y(\theta,A)}{\partial A} > 0$, and weakens the adverse impact of competition on the firm's revenue, $\frac{\partial Y^2(\theta,A)}{\partial \theta \partial A} > 0$.

One of the manager's duties is to increase the tax-deductible portion of the firm's earnings $\pi Y(\theta, A)$, where π is the portion of earnings that the manager claims as deductibles for tax purposes. With probability $p \in [0,1]$, the tax authority accepts the firm's claims on tax deductions of its earnings and allows the firm to reduce taxable earnings by $\pi Y(\theta, A)$. However, with probability $1 - p$, only a fraction $d \in (0,1)$ of tax deductions claimed by the firm is permitted by the tax authority. Moreover, when the authority detects the impermissible tax savings, the firm must pay a lump-sum fine of $L_f > 0$ for misreporting tax deductibles. Hence, in this case, the net benefit of tax avoidance is $td\pi Y(\theta, A) - L_f$ with $t > 0$ being the corporate tax rate. The manager exerts costly efforts to increase the probability of p that the tax authority accepts the firm's full claims on tax deductions. Specifically, the cost function of managerial efforts is $C(p)$, with $C'(p) > 0$ and $C''(p) > 0$. In the meantime, as Desai and Dharmapala (2006) pointed out that because tax avoidance activities are executed clandestinely, managers tend to divert resources for private benefit under tax-saving activities. We thus assume that the manager enjoys a private benefit of B when engaging in tax avoidance activities.

To provide managerial incentives to save tax payment, the firm will reward the manager with a bonus $b > 0$ if and only if the tax authority accepts the firm's claims on tax deductions. If some claims are deemed impermissible by the authority, the firm is required to conduct an audit and may punish the manager if it detects the manager's private benefit. The probability of this punishment is $Gq(\theta) \in [0,1]$, where $G > 0$ is a parameter indicating the firm's internal

governance level. A stricter internal corporate governance implies that there is a greater chance of capturing the manager's private benefit through the audit. Function $q(\theta)$ is positive and increasing in the effectiveness of external governance (i.e., the intensity of product market competition θ), i.e., $q'(\theta) > 0$. Namely, when the market competition intensifies, the firm has stronger incentives to reduce slack and maximize profits, or else the firm will go out of business. Therefore, the firm facing greater competition is more likely to punish the manager when it detects the manager's private benefit. If the firm punish the manager (e.g., through compensation reduction, demotion, or dismissal), the manager will incur a utility loss of $U_m > 0$.

The purpose of the compensation contract is to incentivize the manager to maximize the expected net increase in income due to tax savings, so the firm's optimization problem is given by:

$$\underset{b}{\text{Max}}\ p[t\pi Y(\theta, A) - b] + (1-p)\left[dt\pi Y(\theta, A) - L_f\right] \tag{2.1}$$

subject to

$$\text{(IC)} \qquad p \in \arg\max_{p' \in [0,1]} p'[\text{B} + b - C(p')] + (1-p')[\text{B} - C(p') - Gq(\theta)U_m] \tag{2.2}$$

$$\text{(PC)} \qquad p[\text{B} + b - C(p)] + (1-p)[\text{B} - C(p) - Gq(\theta)U_m] \geq 0 \tag{2.3}$$

$$\text{(BC)} \qquad b > 0 \tag{2.4}$$

The incentive compatibility constraint (IC) ensures that it is optimal for the manager to choose the level of tax-saving efforts such that the tax-deductible income is as expected as the firm ($p' = p$). The participation constraint (PC) requires that the expected payoff to the manager taking the compensation contract is no less than the payoff to the manager not taking the contract. The bonus constraint (BC) requires the manager's bonus to be nonnegative.

Propositions

Solving the firm's payoff-maximizing problem in section 2.1 leads to the following three propositions, which outline the optimal compensation contract offered to the manager and the effect of competition on the managerial efforts to ensure the success of tax avoidance.[2]

PROPOSITION 1: *The unique likelihood of the tax authority accepts the firm's claims on tax deductions p^* that solves the firm's optimization problem is given by,*

$$C'(p^*) + p^*C''(p^*) = (1-d)t\pi Y(\theta, A) + L_f + Gq(\theta)U_m \tag{2.5}$$

The optimal bonus b^* offered in the compensation contract is given by,

$$b^* = C'(p^*) - Gq(\theta)U_m \tag{2.6}$$

Proof**:** see Appendix A.

If the firm could observe the tax-saving effort of the manager, differentiating the objective function in (2.1) gives the first-best optimal level of p^{FB} such that the marginal benefit of increasing the expected tax-deductible income equals zero, that is:

$$(1-d)t\pi Y(\theta, A) + L_f - b = 0 \tag{2.7}$$

When the effort is not observable, the firm must pay rent to induce the managerial efforts to successfully avoid tax, and the optimal reward policy implies that the marginal increase of the rent will be equal to the marginal benefit of increasing the expected tax-deductible income. Substituting equation (2.6) to equation (2.5) yields the optimal level of p at which marginal cost increase of the rent is equal to the marginal benefit of increasing the expected tax-deductible income:

$$p^*C''(p^*) = (1-d)t\pi Y(\theta, A) + L_f - b^* \tag{2.8}$$

Compared with the first-best level of p^{FB} in equation (2.7), the success rate of tax avoidance p^* in (2.8) is smaller. This is because the agency problem increases the firm's cost to induce

[2] The assumptions and derivations of propositions are detailed in Appendix A.

managerial efforts so that the success rate of tax avoidance reduces to a level that is below the first-best outcome.

PROPOSITION 2: *The marginal effect of competition intensity on the optimal level of the likelihood of claimed tax reductions being accepted (the manager's tax-saving effort)* p^* *is given by*

$$\frac{dp^*}{d\theta} = \frac{U_m G q'(\theta) + (1-d)t\pi \partial Y(\theta, A)/\partial\theta}{2C''(p^*) + p^* C'''(p^*)} \tag{2.9}$$

Proof**:** see Appendix A.

The sign of equation (2.9) depends on the numerator as the denominator is always positive. The two terms in the numerator capture two competing effects of product market competition on managerial efforts to increase the acceptance of claims on tax deductibles by the tax authority (p^*). On the one hand, there is a "threat-of-punishment" effect which is reflected in the first term $U_m G q'(\theta)$. The degree of competition increases the likelihood that the firm punishes the manager when it detects managerial private benefits after the tax authority rejects the firm's claims on tax deductions and requests the firm to conduct an audit of financial reports. This gives a direct incentive to the manager to make efforts to reduce the likelihood that some tax reduction claims are deemed impermissible by the tax authority. Therefore, the "threat-of-punishment" effect increases managerial tax-saving effort and results in a higher expected tax reduction. On the other hand, there is a "value-of-tax-saving" effect which is reflected in the second term $(1-d)t\pi \frac{\partial Y(\theta,A)}{\partial\theta}$. An increase in product market competition erodes the earnings of the firm $Y(\theta, A)$ (due to $\frac{\partial Y(\theta,A)}{\partial\theta} < 0$) and thus the tax savings to the firm $t\pi Y(\theta, A)$. Therefore, the "value-of-tax-saving" effect reduces the value of inducing managerial efforts to the firm and results in a lower expected

tax reduction. Since the expected reduction of tax payments (scaled by taxable income), $t\pi[d + p^*(1-d)]$, is an increasing function of p^*, the sign of the marginal effect of competition on tax avoidance depends on which of the two competing effects dominates.

PROPOSITION 3: *The second-order effect of the intensity of competition on the optimal level of the likelihood of claimed tax reductions being accepted (the manager's tax-saving effort) is negative,* $\frac{d^2p^*}{d\theta^2} < 0$.

Proof**:** see the Appendix.

Propositions 2 and 3 imply the main analytical result that the relationship between product market competition and tax avoidance is an inverted U-shape. Namely, $\frac{dp^*}{d\theta}$ is positive under low competition intensity and negative when competition is intensified. Intuitively, when competition level θ is low, an increase in competition will have a larger marginal impact on managerial entrenchment, increasing the likelihood of being punished once claims on tax deductibles are not approved by the authority. In other words, the lower competition would lower the difficulty of incentive provision, and hence encourage the firm to provide incentives to induce a higher level of p^*. By contrast, when θ is high, a marginal increase of competition intensity substantially reduces the revenue of the firm, or the value of saving tax payments, which discourages the firm to incentivize the manager. Therefore, the firm chooses a lower level of p^*.

An Analytical Example

Here, we present an analytical example to provide better intuition. Specifically, we assume that the cost function of managerial efforts is $C(p) = -ln(1-p^2)$. The degree of competition is captured by $\theta \in [0,1]$, which can be viewed as the market share of new entry; $\theta = 0$ implies that

there is no new entry so the firm (incumbent) is the monopoly in the market, and $\theta = 1$ implies numerous new entries occupy the market yielding perfect competition. The firm's earnings take the form $Y(\theta, A) = (A - \theta)^{\frac{1}{2}}$, where $1 < A$. The probability that the manager will be punished by the firm if claimed tax deductions are not accepted by the tax authority is $Gq(\theta) = G\theta^{\frac{1}{2}}$, where $0 < G \leq 1$.

According to Propositions 2 and 3, the expected maximum tax savings in the analytical example will be reached when

$$\theta = \theta^* \equiv \frac{A}{1 + \left[\frac{t\pi(1-d)}{GU_m}\right]^2} \tag{2.10}$$

In other words, the marginal effect of competition on tax avoidance is positive when $\theta < \theta^*$ and negative when $\theta > \theta^*$. The model's propositions and the analytical example together yield the main hypothesis for the empirical tests.

HYPOTHESIS 1: *There is an inverted U-shape relationship between corporate tax avoidance and competition intensity.*

Equation (2.10) also shows that the turning point of the U-shape relationship depends on the firm's productivity A and the quality of internal corporate governance G. Given that the degree of competition θ ranges between 0 (monopoly) and 1 (perfect competition), the effect of competition on tax avoidance for certain types of firms could remain monotonically positive, and the turning point of the inverted U-shape would never be achieved within such a range. From Equation (2.10), we can see that when $\theta^* > 1$, the marginal effect of competition on tax savings is positive for all levels of $\theta \in [0,1]$. Therefore, the effect of competition on tax avoidance will always be positive for firms whose characteristics satisfy the following condition.

$$A > 1 + \left[\frac{t\pi(1-d)}{GU_m}\right]^2 \tag{2.11}$$

This inequality is more likely to hold for firms with higher efficiency of production (A on the left-hand side). Intuitively, firms with higher productivity can sustain their profitability, resulting in a less negative marginal effect of product market competition on corporate earnings.[3] Therefore, the negative "value-of-tax-saving" effect is small when the firm's productivity is high and could be dominated by the positive "threat-of-punishment" effect. This leads to the following hypothesis for the cross-sectional tests in the empirical analysis.

HYPOTHESIS 2: *The positive "threat-of-punishment" effect of product market competition on tax avoidance is likely to dominate the negative "value-of-tax-saving" effect for more productive/efficient firms, resulting in a monotonically increasing relationship between product market competition and tax avoidance among these firms.*

This inequality of (2.11) is also more likely to hold for firms with a better quality of internal corporate governance (G in the denominator of the second term on the right-hand side). Intuitively, firms with better internal corporate governance could strengthen the disciplinary role of external governance, resulting in a stronger positive marginal effect of competition on the likelihood of the manager being punished.[4] Therefore, the positive "threat-of-punishment" effect is greater when the quality of the firm's internal governance is higher and could dominate the negative "value-of-

[3] From the earnings function, we can get $Y_{\theta A}(\theta, A)$=1/4 $\theta(A - \theta) > 0$. Therefore, the negative "value of tax saving effect", $(1-d)t\pi\frac{\partial Y(\theta,A)}{\partial\theta}$, become smaller (less negative) with the increase of productivity because $\frac{\partial\left[(1-d)t\pi\frac{\partial Y(\theta,A)}{\partial\theta}\right]}{\partial A} = (1-d)t\pi Y_{\theta A}(\theta, A) = 1/4(1-d)t\pi\,\theta(A - \theta) > 0$.

[4] This can be seen by taking derivative of $U_m G q'(\theta)$ (positive "threat-of-punishment effect") with respect to $\frac{\partial(U_m G q'(\theta))}{\partial G} = U_m q'(\theta) = \frac{1}{2}U_m\theta^{-\frac{1}{2}} > 0$..

tax-saving" effect. This leads to the following hypothesis for the cross-sectional tests in the empirical analysis.

HYPOTHESIS 3: *The positive "threat-of-punishment" effect of product market competition on tax avoidance is likely to dominate the negative "value-of-tax-saving" effect for firms with better internal corporate governance, resulting in a monotonically increasing relationship between product market competition and tax avoidance among these firms.*

3. Empirical research design

In this section, we describe the construction of our variables and the empirical framework to examine the relationship between product market competition and corporate tax avoidance.

Measurement of Product Market Competition

To identify the causal impact of product market competition on a firm's tax avoidance behavior, we need a measure of product market competition that is not susceptible to endogeneity concerns. For example, higher tax avoidance could provide a firm the comparative advantage to engage in a price war that affects the product market competition. Also, any unobservable industry trends can link to both tax avoidance activities that firms engaged in and changes in the industry competition. Therefore, we need an exogenous change in product market competition to pin down the effect of product market competition on tax avoidance. As such, the commonly used measures of industry concentration such as the Herfindahl-Hirschman Index and the price-cost margin in

U.S. industries cannot serve such a purpose because U.S. firm's tax avoidance behavior and domestic industry competition are more likely to be endogenously determined.

Therefore, we follow the recent international trade literature (e.g., Autor et al., 2013; Autor et al., 2014; Bloom et al., 2016) and use a U.S. firm's exposure to import competition from China as our main measure of product market competition. Such a measure can alleviate the endogeneity concern because China's export growth is largely attributed to China's transition into a more market-oriented economy through Chinese government-initiated reforms, which is unlikely to affect the U.S. firms' tax planning activities unless via the changes in market competition in U.S. industries.

Specifically, we construct a firm's exposure to import competition from China using a sales-weighted sum of the shares of imported Chinese goods across U.S. industries in which the firm operates. We define a U.S. firm i's exposure to import competition from China ($Comp$) as follows:

$$Comp_{i,t} = \sum_{j} \left[s_{i,j,t} \times \frac{Imports\ from\ China_{j,t}}{Shipment_{j,t} - Export_{j,t} + Imports_{j,t}} \right], \tag{3.1}$$

where j and t are industry and year subscripts, respectively. $s_{i,j,t}$ is the fraction of the firm i's sales in industry j in year t, so $S_{i,t} = (s_{i,1,t}, s_{i,2,t}, \dots, s_{i,j,t}, \dots)'$ describes the distribution of firm i's sales across the product market space in year t.[5] $Comp$ lies in the interval [0,1] and a larger value indicates the U.S. firm is more exposed to import competition from China.

[5] Note that it is important to consider a firm's distribution of sales across different industries since a firm's exposure to product market competition in its primary industry may differ from its total exposure to product market competition across all the industries it operates. For example, Amphenol Corporation designs, manufactures, and markets electrical, electronic and fiber optic connectors, coaxial and flat-ribbon cable, and interconnect system. The firm has two business segments over 1998-2016: Electronic Connectors (SIC 3678) and Drawing and Insulating of Nonferrous Wire (SIC 3357). The share of imported Chinese goods in the Electronic Connectors sector in 2016 is almost 13 times of the share in 1998, while the share of imported Chinese goods in Drawing and Insulating of Nonferrous Wire sector only quadrupled over the same period. Although the fraction of Amphenol's sales in Drawing and Insulating of Nonferrous Wire sector has declined from 22% to 7%, it slightly protects Amphenol from its Chinese rivals. The primary 3-digit

Measures of Tax Avoidance

Given our theoretical framework, we are interested in the competition effect on a broad spectrum of corporate tax planning aggressiveness. There are two sets of measures commonly used in the tax-avoidance literature: Book-tax difference and effective tax rate (ETR). We use two proxies of book-tax difference and two measures of the effective tax rate in our study.

The book-tax difference is defined as the difference between income reported to the capital market and that reported to the tax authorities. Prior studies use a variety of book-tax differences measures. For example, Wilson (2009) finds that the total book-tax differences (BTD), pre-tax book income less estimated taxable income, are larger for firms accused of engaging in tax shelters than for a matched sample of non-accused firms. To capture the permanent component of the book-tax difference, Hanlon and Heitzman (2010) subtract the temporary book-tax difference from the total book-tax difference ($PERMDIFF$). To eliminate the effect of accruals and earnings management on book-tax difference measures, Desai and Dharmapala (2006) use the residual book-tax difference ($DDBT$), which is the residual estimated from a firm-fixed effect regression of the total book-tax difference on total accruals measured using the cash flow statement method. Frank, Lynch, and Rego (2009) estimate discretionary permanent differences ($DTAX$) from within-industry cross-sectional regressions of the permanent book-tax difference on factors that are unrelated to tax reporting aggressiveness, e.g., intangible assets and other statutory adjustments. Instead of examining each book-tax difference proxies, we follow the literature (Chen, Chen, Cheng, and Shevlin, 2010; Lennox, Lisowsky, and Pittman, 2013; Kim, Li, and Zhang, 2011) and use factor analysis to extract one common factor ($PCABT$) from the four proxies: BTD,

SIC industry of Amphenol is Electronic Components and Accessories (SIC 367), which is more immune to competition from China relative to its subsector-Electronic Connectors.

$PERMDIFF$, $DDBT$, and $DTAX$. We use the book-tax difference measure from Manzon and Plesko (2002) ($MPBT$) as the second measure of tax avoidance and do not include it in the factor analysis because it is based on U.S. numbers only (Kim, Li, and Zhang, 2011).

We use two proxies of the effective tax rate to measure tax avoidance. The first proxy is the cash effective tax rate ($CETR$), defined as cash tax paid over pre-tax income as in Chen, Chen, Cheng, and Shevlin (2010). The second measure is the General Accepted Accounting Principles (GAAP) current effective tax rate ($GETR$), defined as income taxes currently payable divided by pre-tax income in Rego (2003).[6] Both $CETR$ and $GETR$ gauge a firm's tax burden based on its financial income (before taxes) and control for the effect of tax-deferred strategies. We provide a detailed description of all variables in Appendix C.

Baseline Regression

In this section, we detail our empirical framework to test the relationship between product market competition and tax avoidance as suggested by the model of tax avoidance in Section 2. To test Hypothesis 1, we estimate the following reduced-form estimation by regressing tax avoidance on the firm's exposure to product market competition ($Comp$), the square of the competition measure ($Comp^2$), and to a set of control variables.

$$Tax\ Avoidance_{i,t} = \beta Comp_{i,t} + \gamma Comp_{i,t}^2 + \theta Control_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t}, \quad (3.2)$$

where $Tax\ Avoidance_{i,t}$ denotes one of the four proxies of tax avoidance measures for firm i in year t as described in Section 3.2, including $MPBT$, $DDBT$, $CERT$, and $GERT$. $Control_{i,t}$

[6] Excluding deferred taxes from the numerator of ETRs more closely reflects the time value of money, because ceteris paribus, firms defer payment of income taxes whenever possible. However, this definition may generate bias for firms which manage accounting earnings upward. Rego (2003) finds that the bias does not drive the conclusions in his paper. We also include deferred taxes in the numerator of $GETR$ for robustness check, and our main results remain intact.

denotes a set of control variables that determine a firm's tax policy. Following the prior tax avoidance literature (Chyz et al., 2013; Hope et al., 2013; McGuire et al., 2012), we control for firm size (*Size*), market-to-book ratio (MB), free cash flows (FCF), income from foreign operations (FI), leverage (LEV), the gross property, plants and equipment divided by the total assets (PPE), research and development expense over total assets (RND), and intangible assets ($INTANG$). We further include firm profitability (ROA) and net operating losses carried forward (NOL and ΔNOL) to controls for income tax variations across firms (Cheng et al., 2012; Rego, 2003). We use income related to the equity method of accounting ($EQINC$) to capture differences in financial and tax accounting treatments that influence the measures of tax avoidance (Cheng et al., 2012; Frank et al., 2009). Since a higher U.S. domestic demand may lead to higher demand for imported Chinese goods, we also include the natural logarithm of U.S. industry GDP [$\ln(GDP_{i,j})$] by firm i's primary industry j.[7] Conglomerates enjoy the tax benefits of business diversification because of the tax code's asymmetric treatment of gains and losses and their lessened exposure to tax convexity (Berger and Ofek, 1995), so we include a measure of business diversification ($Diversification$), which is defined as the sum of the square of a firm's business segment sales share. We provide a detailed description of our control variables in Appendix C.

We further include firm fixed effects (η_i) to capture any time-invariant firm heterogeneity and year dummies (τ_t) to capture any time-varying macroeconomic condition and business cycles in our main specification. We draw our reference based on standard errors clustered at the firm

[7] A firm's primary industry is defined as the business segment of which sales account for at least 50% of the firm's total sales. It can be at 2-digit, 3-digit, or 4-digit SIC level.

level.

Instrumental Variable Regression

In this section, we detail our instrumental variable regression framework. Though China's export growth is primarily due to China's economic reform, we cannot completely rule out the possibility that U.S. imports from China co-move with certain unobservable domestic demand factors in the U.S., such as technology innovation, productivity, or demographic changes, all of which can bias the baseline regression outlined in equation (3.2). To address this concern, we follow the identification strategy in Autor et al. (2014) and Acemoglu et al. (2016) and use non-U.S. high-income countries' imports from China as an instrument for U.S. imports from China. Likewise, we define the instrumental variable ($CompIV$) for $Comp_{it}$ of U.S. firm i in year t as below:

$$CompIV_{i,t} = \sum_{j} \left[s_{i,j,89-90} \times \frac{Non\ US \text{ high income country imports from China}_{j,t}}{\text{Shipments}_{j,88} - \text{Exports}_{j,88} + \text{Imports}_{j,88}} \right], \quad (3.3)$$

where j is the industry subscript and t is the time subscript. The right-hand fraction term is Chinese goods imported by non-U.S. high-income countries in industry j and year t, scaled by U.S. demand in the same industry in the year 1988.[8] We use firm i's segment sales in 1989 and 1990 rather than its annual segment sales to construct the weights, $s_{i,j,89-90}$, because contemporaneous sales distribution could reflect the changes in a U.S. firm's organizational structure due to the anticipation of future import competition from China.[9]

[8] The high-income countries for which we can obtain disaggregated bilateral trade data back to 1991 are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. As in Acemoglu et al. (2016) and Autor et al. (2014), we use 1988 U.S. demand (3 year before the year when high-income trade data was available) to normalize non-U.S. high-income countries' imports from China to account for the possibility that U.S. firms could change their operational and financial decisions in anticipation of future trade with China.

[9] We also use firm i's segment sales in year 1988-1990 and find consistent results.

Then we estimate the effect of product market competition on tax avoidance behavior using the two-stage least square (2SLS) regression analysis, where a firm's exposure to import competition from China is instrumented using Chinese goods imported by high-income countries other than the U.S. Specifically, we first regress $Comp$ and $Comp^2$ on $CompIV$, $CompIV^2$, and a set of control variables ($Control$) as in regressions (3.4a) and (3.4b) below; second, we regress one of the four measures of tax avoidance on the predicted value of the competition measure ($\widehat{Comp}$) from estimating regression (3.4a) and the predicted value of its square ($\widehat{Comp^2}$) from (3.4b).[10] The specification of 2SLS is as follows,

$$Comp_{i,t} = \mu_1 CompIV_{i,t} + \varphi_1 CompIV_{i,t}^2 + \rho_1 Control_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t}, \quad (3.4a)$$

$$Comp_{i,t}^2 = \mu_2 CompIV_{i,t} + \varphi_2 CompIV_{i,t}^2 + \rho_2 Control_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t}, \quad (3.4b)$$

$$Tax\ Avoidance_{i,t} = \beta \widehat{Comp}_{i,t} + \gamma \widehat{Comp^2}_{i,t} + \theta Control_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t}, \quad (3.4c)$$

where $CompIV$ is defined as in equation (3.3) and the definition of control variables is as in section 3.2. Like the baseline equation, we include both firm fixed effects and time fixed effects in both regressions of the 2SLS estimation to control for time-invariant firm characteristics and time-varying economic conditions.

4. Empirical analysis

In this section, we first describe our sample construction and data sources and then present empirical results.

[10] We follow the method in Section 5 in Chapter 9 of Wooldridge, J.M., 2002. Econometric analysis of cross section and panel data. Cambridge, MA: Massachusetts Institute of Technology. to address the nonlinear endogenous problem in regression (3.2).

Data and Sample

The data on U.S. imports and exports by 4-digit SIC manufacturing industries and countries over the period 1972-2017 comes from Schott (2008) and Pierce and Schott (2012).[11] The values of industrial shipments are from the National Bureau of Economic Research (NBER) and the U.S. Census Bureau's Center for Economic Studies (CES) Manufacturing Industry Database for the period 1958 – 2011, and from the U.S. Census Bureau Annual Survey of Manufactures Dataset for the period 2012 – 2016. We use the above three datasets to calculate the exposure of U.S. imports from China at the 2-digit, 3-digit, and 4-digit SIC industry levels. Then, we use the U.S. firm's segment sales data from Compustat annual segment file to compute the weights in equation (3.1) and construct the firm-level exposure to import competition from China accordingly. We further use annual data files from Compustat to construct tax avoidance measures and relevant control variables specified in the baseline regression (3.2). To construct the instrumental variable in equation (3.3), we obtain the bilateral trade flows of goods between non-U.S. high-income countries and China at the 6-digit Harmonized System (HS) product level for the period 1991 – 2017 from the United Nation Comtrade database. Following Autor et al. (2014) and Acemoglu et al. (2016), we convert trade flows by 6-digit HS to flows by 4-digit SIC codes.

Since the data on industrial shipments from Economic Census is only available until 2016, our sample of analysis ends in 2016. We restrict the beginning year of the sample to 1991 because China's export had started to grow in the 1990s after a series of market-oriented economic reforms. We require the sample to have a non-missing value for at least one of the four tax avoidance proxies and non-missing values of all independent variables described in the baseline regression (3.2). All continuous variables are winsorized at the 1st and 99th percentiles. Our final sample consists of

[11] The dataset is available from Peter Schott's website at Yale: http://faculty.som.yale.edu/peterschott/sub_international.htm

30,226 firm-year observations and 4,368 manufacturing firms over the period 1991 – 2016.

Descriptive Statistics

Figure 1 Panel A plots the annual mean and median value of our main product market competition measure, namely, the U.S. firms' exposure to import competition from China. We observe a substantial increase in this competition measure, for example, the average value increased from 0.4% to 11% from 1991 to 2016. Though the median value increased slower than the mean, its value in 2016 is more than 64 times greater than the value in 1991. These findings suggest that U.S. firms have been facing rising import competition from China over our sample period. Figure 1 Panel B further plots the histogram of the firm-sales-weighted U.S. imports from China and we observe that this measure centralizes in the interval between 0 and 10% and disperses to as large as 70%.

Next, we present descriptive statistics of the dependent and independent variables in Table 1. Table 1 shows that tax avoidance proxies and control variables are consistent with those in prior studies (Chyz et al., 2013; McGuire et al., 2012; Chen, Chen, Cheng, and Shevlin, 2010).

Baseline Regression

Table 2 presents the regression results of the baseline specification as in equation (3.2). Columns (1) – (2) present the results using book-tax difference-based measures and columns (3) – (4) present the results using ETR-based measures. Specifically, the coefficient of $Comp$ is positive while the coefficient of $Comp^2$ is negative in column (1) and (2), and the coefficient of $Comp$ is negative while the coefficient of $Comp^2$ is positive in columns (3) and (4). All coefficients of $Comp$ and $Comp^2$ are statistically significant across different measures of tax

avoidance. The positive coefficients associated with book-tax difference-based proxies or negative coefficients on the competition measure associated with ETR-based proxies imply that firms engage in more tax avoidance activities when they are exposed to higher import competition from China. More importantly, we find that higher product market competition leads U.S. firms to avoid tax at a decreasing rate, which is consistent with Hypothesis 1 of the inverted-U-shaped relationship between product market competition and tax avoidance.

To illustrate the economic effect of Chinese import competition on tax avoidance, we plot the predictive margins of tax avoidance measures with 95% confidence intervals in Figure 2. The predictive margins are the predicted values of book-tax difference from the factor analysis (Panel A), book-tax difference as in Manzon and Plesko (2002) (Panel B), cash ETR (Panel C), and GAAP current ETR (Panel D), all of which are estimated from the baseline regression in column (1), (2), (3), and (4) in Table 2. We allow the product market competition proxy $Comp$ to increase from 0 to 0.7 while keeping other control variables at their mean. Consistent with the numerical example in Figure 1 using hypothetical parameters from the model of tax avoidance in Section 2, Panel A and B of Figure 1 first present an inverted-U-shaped graph for the book-tax difference-based measures. Then, we present a U-shape graph for the ETR-based measures in Panel C and D. Taking the *CETR* in Panel C as an illustrative example, an average firm would reduce *CETR* by 0.034 $[= 0.232^2/(4 \times 0.392)]$ if its exposure to the import competition from China increases from 0 to 0.30 $[= 0.232/(2 \times 0.3920.232)]$ (nadir) and then increase *CETR* by 0.030 $[= 0.391 \times 0.7^2 - 0.232 \times 0.7 + 0.232^2/(4 \times 0.392)]$ if the competition measure continues increasing to 0.7. This intuitive evidence in Figure 1 reaffirms that there is an inverted-U-shaped relationship between product market competition and tax avoidance.

Taken together, our main findings strongly support Hypothesis 1 and the theoretical

prediction that the product market competition has a non-linear effect on firms' tax avoidance behavior.

Instrumental Variable Regression

We then move on to the analysis of instrumental variable regressions. To address the potential concern that U.S. imports from China may co-move with certain unobservable domestic demand shocks in the U.S., we follow the 2SLS specification in equations (3.4a, 3.4b, and 3.4c) to re-estimate the non-linear effect of product market competition on tax avoidance. We report the second stage coefficient estimates in columns (1) to (4) of Table 3 and the first stage coefficient estimates in column (5) of Table 3. Again, the dependent variables are *PCABT*, *MPBT*, *CETR*, and *GETR* in columns (1), (2), (3), and (4), respectively. As expected, we find that the sign, magnitude, and significance of the coefficient estimates for both $Comp$ and $Comp^2$ are consistent with those in Table 2 based on the baseline specification (3.2).

In the first-stage estimation results, Column (5) shows a positive and significant coefficient associated with $CompIV$. This implies that the key proxy of product market competition, i.e., U.S. imports from China, is positively and significantly related to non-U.S. high-income countries' imports from China, which validates our assumption that U.S. and non-U.S. high-income countries are exposed similarly to Chinese export growth. To test whether the instruments are correlated with the endogenous regressors, we perform the under-identification test (Kleibergen and Paap, 2006), and the *p* values are less than 0.1%, suggesting the instruments are relevant. To ensure the inferences are robust to weak instruments, we test the significance of the endogenous regressors in the structural equation being estimated. In other words, we perform the weak-instrument-robust test based on the Anderson-Rubin χ^2 statistics and the *p*-value is less than 5% suggesting the

inferences are robust to weak instruments.

5. When the "threat-of-punishment" effect dominates?

The model of tax avoidance predicts that the positive "threat-of-punishment" effect of product market competition on tax avoidance dominates the "value of tax-saving" effect among more productive/efficient firms (Hypothesis 2) and firms with better internal corporate governance (Hypothesis 3). In this section, we provide a cross-sectional analysis to test Hypotheses 2 and 3.

Test of Hypothesis 2

We show in the analytical example in Section 2 that the positive "threat-of-punishment" effect can dominate the "value of tax-saving" effect for more productive/efficient firms, or broadly say, firms whose profit is less adversely affected by competition threat, yielding a monotonically increasing relationship between product market competition and tax avoidance for such firms. In this subsection, we test Hypothesis 2 by exploring whether the marginal effect of competition on tax avoidance is positive and greater for firms that are more immune to competition threats from China, e.g., less labor-intensive firms and more efficient and productive firms. We measure efficiency and productivity using a set of firm characteristics: Total factor productivity (TFP) (Levinsohn and Petrin, 2003), Tobin's Q (Peters and Taylor, 2017), the value of innovation (Kogan et al., 2017), and profit margin (1 – Expenses over Sales).

We first separate the sample into two groups each year based on the sample annual median of labor intensity and measures of firm efficiency and productivity. Because we expect a positive competition effect on tax avoidance for less labor-intensive and more efficient/productive firms,

we then estimate the marginal effect of import competition from China ($Comp$) for the two groups using the following linear regression model.

$$Tax\ Avoidance_{i,t} = \beta Comp_{i,t} + \theta Control_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t}, \quad (5.1)$$

The dependent and independent variables in equation (5.1) are defined as in the baseline regression (3.2). Last, we compare the difference of the marginal effect of $Comp$ between the two groups using the seemingly unrelated regression method. We draw our reference based on standard errors clustered at the firm level.

Table 4 reports the coefficient estimates of $Comp$ in equation (5.1) in the high- vs. low-labor-intensity groups in Panel A, the low- vs. high- industry-adjusted TFP groups in Panel B, the low- vs. high- Tobin's Q groups in Panel C, the low- vs. high- patent-value groups in Panel D, and the low- vs. high- profit-margin firms in Panel E. The last two rows of each panel report the difference in the coefficient estimates of $Comp$ between the two groups and corresponding *t*-statistics from the seemingly unrelated regression method.

Consistent with Hypothesis 2, we observe a significant and positive effect of import competition from China on tax avoidance for firms in a strong position to compete with Chinese rivals, e.g., those in the low labor-intensity, high industry-adjusted TFP, high Tobin's Q, high patent value, and high profit-margin group. Moreover, the marginal effect of competition for such firms is significantly greater than the effect for those in a weak position. In terms of magnitude, for example, the coefficient of $Comp$ in the high industry-adjusted TFP group is 1.98 times of the coefficient in the low industry-adjusted TFP group (column 1 Panel B, (0.346+0.354)/0.354 = 3.4). This result implies that a given increase of import competition from China leads to almost a two-time increase in the book-tax difference of high-productivity firms relative to low-productivity firms, which lends further support to Hypothesis 2.

Test of Hypothesis 3

We show in the analytical example in Section 2 that the positive "threat-of-punishment" effect of competition on tax avoidance dominates the negative "value of tax-saving" effect for firms with better internal governance, or broadly say, firms whose managers are more likely to be detected for fraud and heavily punished by the firm, and therefore, product market competition has an unambiguously positive impact on tax avoidance for such firms. In this subsection, we test Hypothesis 3 by examining whether the marginal effect of competition on tax avoidance is positive and stronger for well-governed and transparent firms.

We measure the corporate governance using the total institutional ownership (e.g., Chen, Harford, and Li, 2007; Chung and Zhang, 2011) and the institutional ownership of blockholders (e.g., Shleifer and Vishny, 1986; Edmans, 2014). The information asymmetry is measured by the bid-ask spread developed as in Corwin and Schultz (2012), the number of analysts following (e.g., Easley and O'Hara, 2004; Bowen, Chen, and Cheng, 2008), and analyst forecasts dispersion (e.g., Kim and Verrecchia, 1991; Barron et al., 1998). Then, we divide the sample into two groups based on their governance characteristics or degree of information asymmetry and then estimate the marginal effect of import competition from China ($Comp$) on tax avoidance in the two groups using the regression (5.1). Last, we compare the difference in the marginal effect of $Comp$ between the two groups using the seemingly unrelated regression method.

Table 5 reports the coefficient estimates of $Comp$ in the regression (5.1) in the high- vs. low- total institutional ownership groups in Panel A, the high- vs. low- ownership of blockholders groups in Panel B, the high- vs. low- bid-ask spread groups in Panel C, the high- vs. low- analysts coverage group in Panel D, and the high- vs. low- analyst forecast dispersion group in Panel E.

The last two rows of each panel report the difference in the coefficient estimates of $Comp$ between the two groups and corresponding *t*-statistics from the seemingly unrelated regression method.

Consistent with Hypothesis 3, we find that there exists a significant positive relation between China import competition and tax avoidance for well-governed and information transparent firms, e.g. those in the high total institutional ownership, high blockholder ownership, low bid-ask spread, greater analyst coverage, and small analyst forecast dispersion group. Moreover, the marginal effect of competition for such firms is significantly greater than the effect for poorly governed and opaque firms. In terms of magnitude, for example, the coefficient of $Comp$ in the high total institutional ownership group is 3.75 times the coefficient in the low total institutional ownership group (column 1 Panel A, (0.540-0.024)/0.024 = 21.5). This fact implies that an increase in import competition from China leads to a more than twenty-one-times increase in the book-tax difference of firms with better corporate governance relative to those with worse governance. All the findings in Table 5 are supportive of the cross-sectional prediction outlined in Hypothesis 3.

The findings in Table 5 also add new evidence to the literature that studies the effect of internal corporate governance and information environment on tax planning. For example, Minnick and Noga (2010) find that corporate governance plays an important role in long-run tax management and better tax management is positively related to higher returns to shareholders. Desai, Dyck, and Zingales (2007) find that the quality of the corporate governance system affects the firm's tax avoidance behavior.[12] Gallemore and Labro (2015) show that tax avoidance is associated with higher quality information environments. We show how the external governance

[12] Yet, some papers also find no relation between corporate governance mechanisms and tax avoidance, see Armstrong et al. (2015).

mechanism (product market competition) interacts with internal corporate governance and the firm's information environment to affect corporate tax avoidance.

6. Conclusion

In this paper, we explore the relationship between product market competition and tax avoidance behavior. We present a novel theoretical analysis showing that the tradeoff between the positive "threat-of-punishment" effect and the negative "value-of-tax saving" effect results in an inverted U-shape relation between product market competition and tax avoidance. Furthermore, we derive cross-sectional theoretical predictions of firm heterogeneity and find that the positive "threat-of-punishment" effect is more likely to dominate the negative "value-of-tax saving" effect for (i) firms more immune to import competition from China, e.g., less labor-intensive and more efficient and productive firms, (ii) firms with better corporate governance, and (iii) firms operated in an environment with lower information asymmetry. Our theoretical finding of the non-linear relationship between product market competition and tax avoidance adds to prior theoretical models of the non-monotonic relation between product market competition and firm decisions, including productivity growth and risk (e.g., Schmidt, 1997; Raith, 2003) and firm innovation (Aghion et al., 2005).

We provide a systematic empirical analysis identifying the causal relationship between product market competition and tax avoidance behavior using U.S. imports from China as a proxy for product market competition and non-U.S. high-income countries' imports from China as the instrumental variable. We show that the product market competition has an inverted-U-shaped effect on a firm's tax avoidance behavior and the positive effect of product market competition dominates the negative effect for productive and better-governed firms, supporting the theoretical

predictions. Our theoretical and empirical analyses highlight the complex relationship between product market competition and tax avoidance, suggesting that it is important to consider two opposite effects when assessing the impact of product market competition on corporate tax avoidance behavior.

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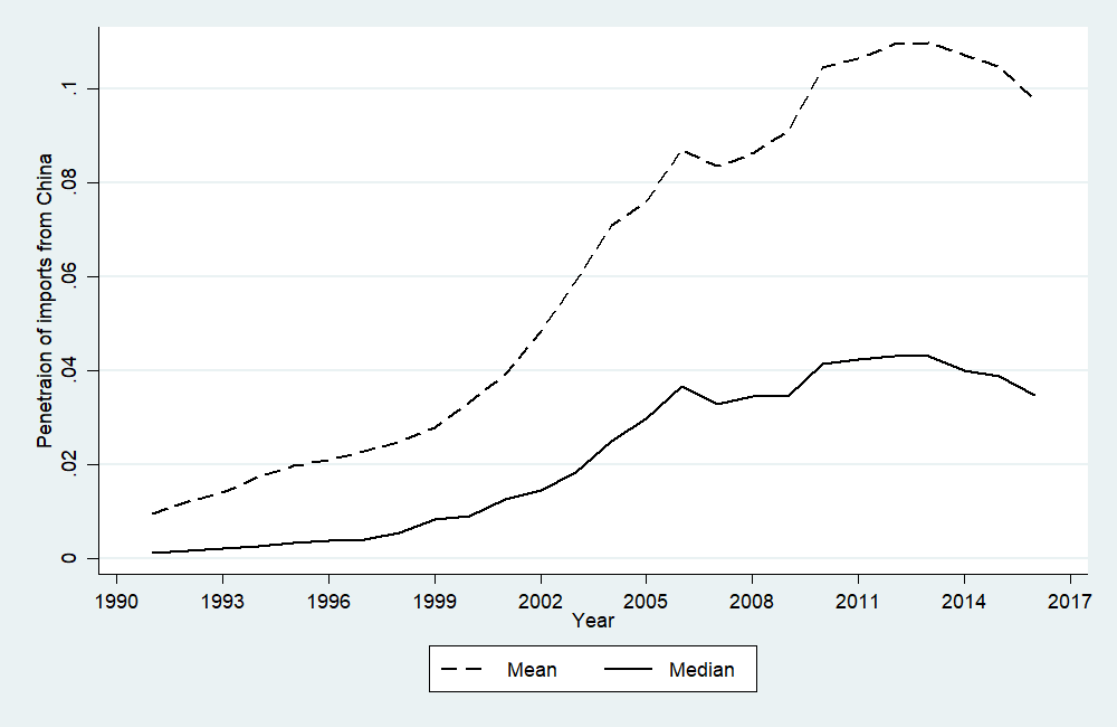
Figure 1 Firm exposure to import penetration from China

Panel A: Annual mean and median import penetration of China



Panel B: Histogram of import penetration of China

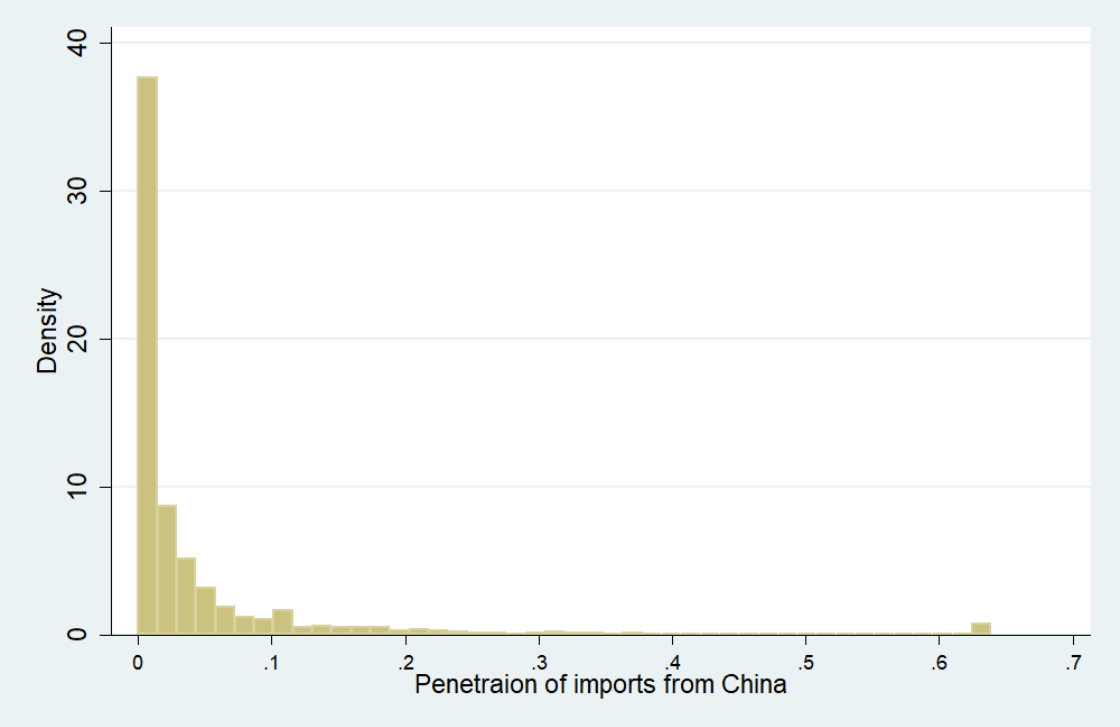
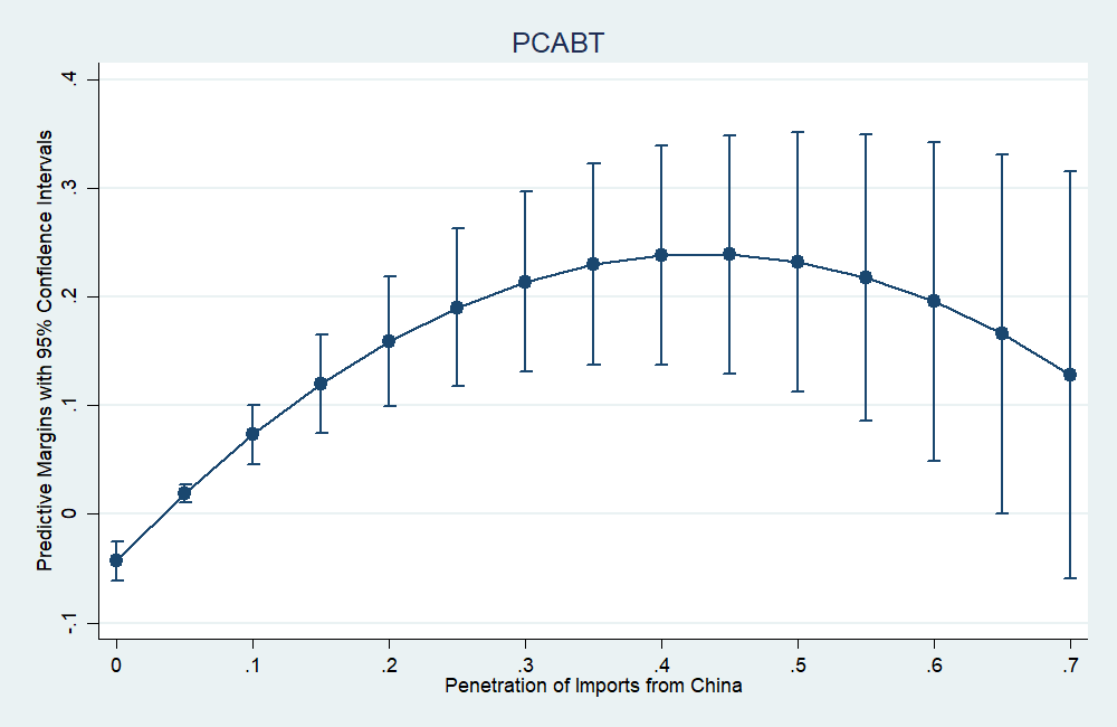
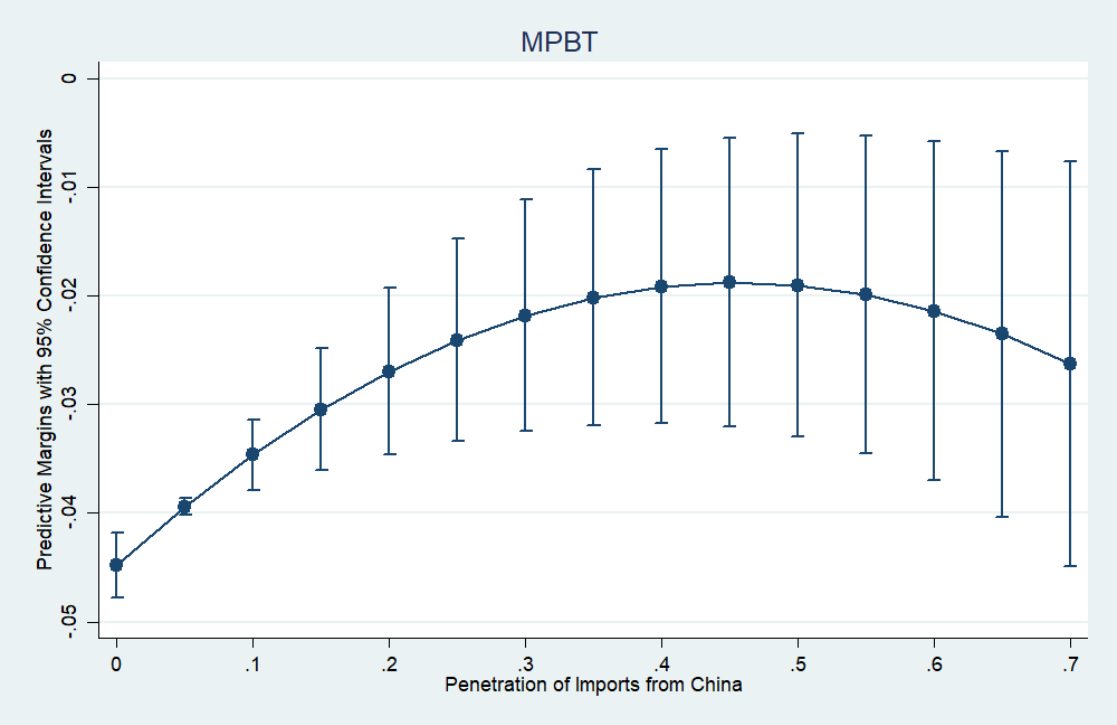


Figure 2 Predictive margins of tax avoidance measures

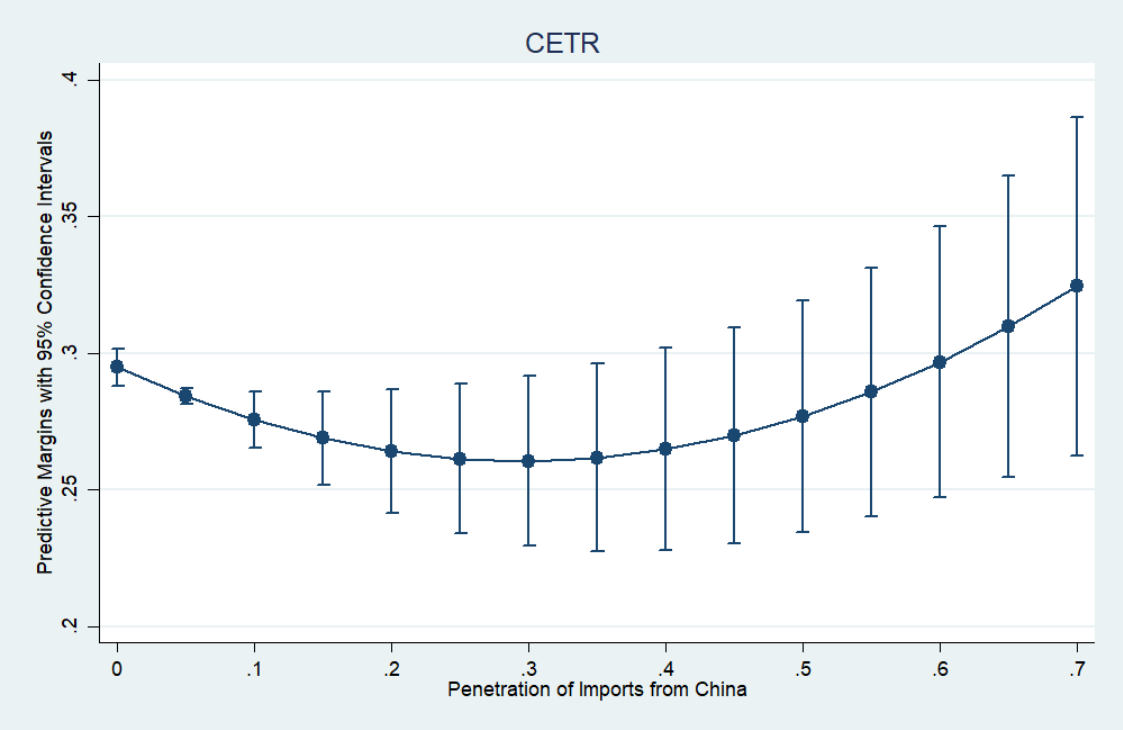
Panel A: Predictive margins of PCABT



Panel B: Predictive margins of MPBT



Panel C: Predictive margins of CETR



Panel D: Predictive margins of GETR

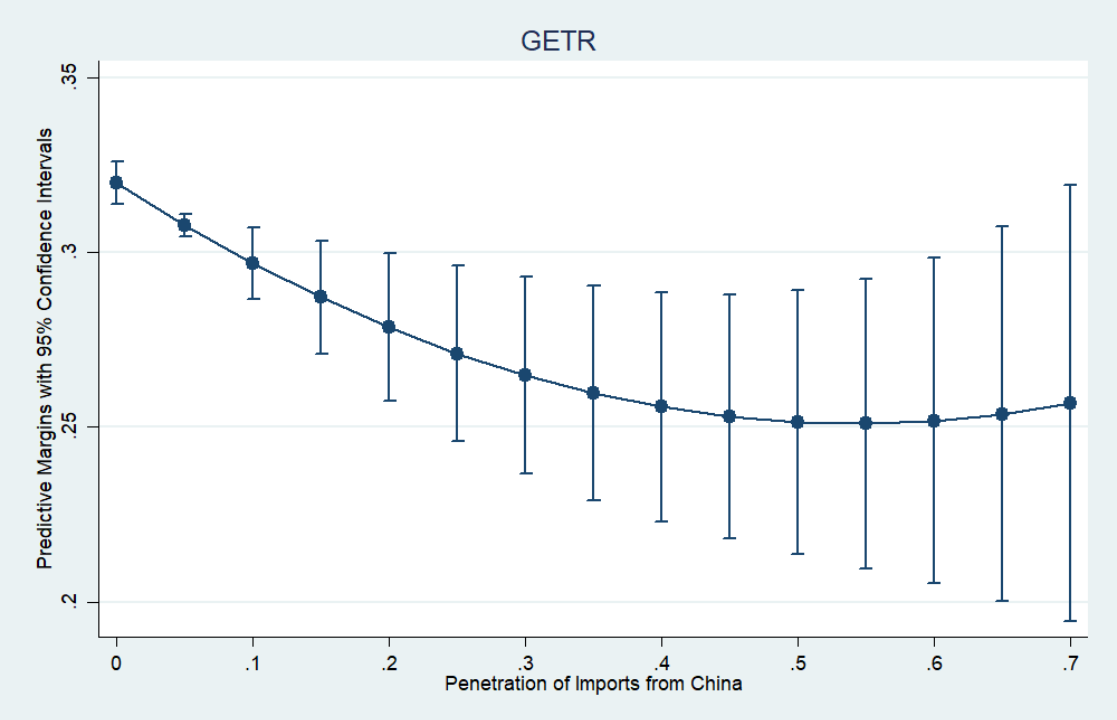


TABLE 1
Descriptive statistics

Variable	N	Mean	Median	Standard deviation	Mean in 91-99	Mean in 00-08	Mean in 09-16
Tax avoidance measures							
PCABT	30032	0.003	0.259	1.400	-0.092	0.075	0.116
MPBT	20433	-0.040	-0.002	0.148	-0.023	-0.040	-0.056
CETR	19511	0.288	0.262	0.228	0.311	0.269	0.267
GETR	20012	0.310	0.306	0.208	0.330	0.304	0.280
Import penetration and instrument							
Comp	30226	0.052	0.011	0.110	0.019	0.066	0.104
CompIV	29321	0.048	0.012	0.083	0.016	0.065	0.097
Control variables							
ROA	30226	-0.019	0.051	0.300	-0.039	0.012	-0.010
LEV	30226	0.185	0.124	0.223	0.182	0.186	0.190
NOL	30226	0.445	0.000	0.497	0.322	0.453	0.685
ΔNOL	30226	0.049	0.000	0.286	0.046	0.034	0.072
FI	30226	0.016	0.003	0.048	0.010	0.022	0.022
PPE	30226	0.240	0.200	0.180	0.277	0.218	0.190
INTAN	30226	0.140	0.052	0.194	0.078	0.182	0.219
EQINC	30226	0.000	0.000	0.003	0.000	0.001	0.001
FCF	30226	-0.030	0.027	0.228	-0.067	0.011	0.001
SIZE	30226	5.437	5.432	2.404	4.474	6.194	6.573
MB	30226	2.984	2.052	4.762	2.987	3.013	2.947
RND	30226	0.076	0.028	0.127	0.079	0.066	0.080
Ln(GDP)	30226	16.757	16.756	1.282	16.561	16.880	17.019
Diversification	30226	0.887	1.000	0.209	0.910	0.858	0.874

Notes: This table provides summary statistics of the key variables. The sample period is from 1991 to 2016. All continuous variables are winsorized at the 1% and 99% levels. Appendix C provides details on variable construction.

TABLE 2
Baseline regressions

	Book-tax difference		Effective tax rate	
	(1)	(2)	(3)	(4)
	PCABT	*MPBT*	*CETR*	*GETR*
Comp	1.315***	0.114***	-0.232**	-0.254***
	(5.06)	(3.24)	(-2.35)	(-2.68)
$Comp^2$	-1.529***	-0.126***	0.392***	0.234*
	(-3.96)	(-2.67)	(2.79)	(1.87)
ROA	4.382***	0.549***	-0.516***	-0.330***
	(46.09)	(35.19)	(-11.65)	(-9.51)
LEV	0.031	-0.003	0.023	0.015
	(0.66)	(-0.53)	(1.48)	(1.02)
NOL	0.039***	0.003*	-0.026***	-0.021***
	(2.64)	(1.89)	(-4.37)	(-4.00)
ΔNOL	3.440***	-0.023***	0.046***	0.061***
	(72.17)	(-5.15)	(2.90)	(4.30)
FI	-0.133	-0.711***	-0.695***	-0.560***
	(-0.53)	(-24.02)	(-8.14)	(-6.75)
PPE	-0.372***	-0.008	0.016	0.068***
	(-3.99)	(-0.68)	(0.58)	(2.71)
INTAN	-0.099*	0.007	0.021	0.035**
	(-1.87)	(1.05)	(1.26)	(2.05)
EQINC	-9.283***	-1.310***	-1.731**	-2.192***
	(-5.61)	(-6.74)	(-2.43)	(-3.29)
FCF	0.935***	0.023	-0.202***	0.014
	(11.34)	(1.63)	(-7.96)	(0.69)
SIZE	-0.046***	-0.002*	0.041***	0.022***
	(-4.91)	(-1.95)	(12.65)	(7.02)
MB	-0.006***	-0.001***	-0.000	0.000
	(-3.11)	(-4.50)	(-0.09)	(0.18)
RND	-0.931***	-0.152***	0.339***	0.108
	(-5.63)	(-6.14)	(2.77)	(1.02)
Ln(GDP)	-0.018**	-0.002**	0.003	0.007**
	(-2.41)	(-2.10)	(0.94)	(2.34)
Diversification	-0.119***	-0.008*	0.023	0.000
	(-3.26)	(-1.71)	(1.37)	(0.02)
Adjusted R^2	0.774	0.851	0.260	0.278
Observations	30032	20433	19511	20012

Notes: This table presents coefficient estimates from the baseline regression in equation (3.2). All variables are defined in Appendix C. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the firm level. ***, **, and * indicate significance, respectively, at the 1%, 5%, and 10% levels.

TABLE 3
Instrumental variable regressions

	Second-Stage					First-Stage	
	Book-tax difference		Effective tax rate				
	(1)	(2)	(3)	(4)		(5)	(6)
	PCABT	*MPBT*	*CETR*	*GETR*		*Comp*	*Comp²*
Comp	2.605***	0.168**	-0.536**	-0.610***	*CompIV*	0.536***	-0.065
	(4.25)	(2.42)	(-2.47)	(-2.89)		(6.75)	(-1.10)
Comp²	-2.911***	-0.111	0.900**	0.781**	*CompIV²*	0.300	1.035***
	(-2.74)	(-1.00)	(2.28)	(2.20)		(1.37)	(5.69)
ROA	4.353***	0.554***	-0.525***	-0.348***	*ROA*	-0.002	-0.000
	(44.45)	(34.25)	(-11.51)	(-9.58)		(-0.67)	(-0.18)
LEV	0.005	-0.001	0.023	0.014	*LEV*	-0.003	-0.003*
	(0.11)	(-0.20)	(1.48)	(0.92)		(-1.11)	(-1.69)
NOL	0.035**	0.004**	-0.026***	-0.021***	*NOL*	-0.003	-0.002*
	(2.39)	(2.21)	(-4.45)	(-3.78)		(-1.62)	(-1.65)
ΔNOL	3.454***	-0.024***	0.053***	0.067***	*ΔNOL*	0.001	0.001
	(70.78)	(-5.31)	(3.30)	(4.50)		(1.02)	(0.78)
FI	-0.174	-0.707***	-0.686***	-0.541***	*FI*	-0.019	-0.015
	(-0.68)	(-22.86)	(-7.91)	(-6.51)		(-1.11)	(-1.34)
PPE	-0.306***	-0.010	0.008	0.060**	*PPE*	0.010	0.008*
	(-3.31)	(-0.84)	(0.28)	(2.35)		(1.57)	(1.95)
INTAN	-0.078	0.007	0.021	0.039**	*INTAN*	0.000	0.002
	(-1.53)	(1.20)	(1.26)	(2.27)		(0.00)	(0.45)
EQINC	-9.083***	-1.346***	-1.732**	-2.088***	*EQINC*	0.038	0.120
	(-5.42)	(-7.06)	(-2.41)	(-3.11)		(0.22)	(1.05)
FCF	0.965***	0.015	-0.198***	0.023	*FCF*	-0.004	-0.001
	(11.78)	(1.23)	(-7.79)	(1.06)		(-1.03)	(-0.40)
SIZE	-0.046***	-0.003**	0.041***	0.022***	*SIZE*	-0.004***	-0.002***
	(-4.90)	(-2.41)	(12.56)	(6.96)		(-4.62)	(-3.92)
MB	-0.007***	-0.001***	0.000	0.000	*MB*	-0.000	-0.000**

	(-3.26)	(-4.16)	(0.03)	(0.29)		(-1.53)	(-2.18)
RND	-0.982***	-0.160***	0.345***	0.115	*RND*	0.002	0.002
	(-5.81)	(-6.48)	(2.81)	(1.07)		(0.21)	(0.45)
Ln(GDP)	-0.016**	-0.001*	0.002	0.006**	*Ln(GDP)*	-0.003**	-0.001
	(-2.06)	(-1.71)	(0.74)	(2.08)		(-2.35)	(-1.47)
Diversification	-0.102***	-0.008*	0.018	-0.005	*Diversification*	-0.007	0.004
	(-2.67)	(-1.72)	(1.07)	(-0.33)		(-1.14)	(1.00)
Underidentification test (*p*)	0.000	0.000	0.000	0.000			
Anderson-Rubin χ^2 (*p*)	0.000	0.000	0.048	0.007	Adjusted R^2	0.895	0.767
Observations	28646	19649	18621	19032	Observations	28646	28646

Notes: This table presents the results from the two-stage least squares (2SLS) instrumental variable regression as in equations (3.4a), (3.4b), and (3.4c). Columns (1)-(4) report that coefficient estimates from the second-stage instrumental variable regression (with fixed-effect) of equation (3.4c), where *Comp* and $Comp^2$ are instrumented with the predicted value of the dependent variable and its square from fixed-effect regression (3.4a) and (3.4b). Columns (5) and (6) report the first-stage regression estimates in equation (3.4c) based on the sample used in Column (1). All variables are as defined in Appendix C. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the firm level. ***, **, and * indicate significance, respectively, at the 1%, 5%, and 10% levels.

TABLE 4
Firm heterogeneity: test of hypothesis 2

	Book-tax difference		Effective tax rate	
	(1)	(2)	(3)	(4)
	PCABT	*MPBT*	*CETR*	*GETR*
Panel A: Labor-intensity				
High	0.202	-0.001	0.168*	0.035
	(1.02)	(-0.05)	(1.79)	(0.42)
Low	0.489***	0.068***	-0.099*	-0.240***
	(2.89)	(3.17)	(-1.75)	(-4.58)
Low – High	0.287	0.069**	-0.267**	-0.275***
	(1.10)	(2.22)	(-2.43)	(-2.77)
Panel B: TFP – Industry TFP				
Low	-0.354**	-0.019	0.206**	0.092
	(-2.17)	(-1.43)	(2.39)	(1.14)
High	0.346***	0.052***	-0.047	-0.195***
	(2.80)	(2.67)	(-0.88)	(-3.79)
High - Low	0.700***	0.071***	-0.253**	-0.287***
	(3.43)	(3.00)	(-2.50)	(-2.99)
Panel C: Tobin's Q				
Low	-0.166	-0.012	0.134	-0.031
	(-1.48)	(-0.90)	(1.57)	(-0.44)
High	0.660***	0.070***	-0.076	-0.135**
	(2.65)	(2.77)	(-1.37)	(-2.39)
High - Low	0.826***	0.081***	-0.210**	-0.104
	(3.02)	(2.88)	(-2.07)	(-1.16)

TABLE 4 (continue)

	Book-tax difference		Effective tax rate	
	(1)	(2)	(3)	(4)
	PCABT	*MPBT*	*CETR*	*GETR*
Panel D: Patent value by Kogan et al. (2017)				
Low	-0.441	-0.034	0.293*	0.005
	(-1.51)	(-1.39)	(1.88)	(0.03)
High	0.607***	0.100***	-0.090	-0.337***
	(2.88)	(2.84)	(-0.94)	(-4.00)
High - Low	1.047***	0.134***	-0.383**	-0.341**
	(2.90)	(3.12)	(-2.09)	(-2.22)
Panel E: Profit margin				
Low	-0.050	0.015	0.160*	-0.050
	(-0.30)	(0.90)	(1.78)	(-0.66)
High	0.462***	0.061***	-0.079	-0.158***
	(3.68)	(3.22)	(-1.49)	(-2.89)
High - Low	0.513**	0.046*	-0.239**	-0.108
	(2.43)	(1.82)	(-2.29)	(-1.15)

Notes: This table reports the regression results of the subsample analysis of firms in a strong and weak position to compete with Chinese rivals. The specification follows the baseline regression in equation (5.1). The coefficient estimates of *Comp* are reported in the high- and low- labor-intensive groups in Panel A, in the low- and high- industry-adjusted-TFP groups in Panel B, in the low- and high- Tobin's Q groups in Panel C, in the low- and high- patent-value groups in Panel D, and in the low- and high- profit-margin groups in Panel E. The coefficient estimates of other control variables are not reported for brevity. The difference in the coefficient estimates of *Comp* between the two groups in each panel and corresponding *t*-statistics from the seemingly unrelated regression method are reported in the last two rows. All variables are as defined in Appendix C. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the firm level. ***, **, and * indicate significance, respectively, at the 1%, 5%, and 10% levels.

TABLE 5
Firm heterogeneity: test of hypothesis 3

	Book-tax difference		Effective tax rate	
	(1)	(2)	(3)	(4)
	PCABT	*MPBT*	*CETR*	*GETR*
Panel A: Ownership of institutional shareholders				
Low	0.024	-0.024	0.209**	0.013
	(0.12)	(-1.04)	(2.46)	(0.17)
High	0.540***	0.062***	-0.090	-0.144**
	(3.88)	(3.23)	(-1.13)	(-2.34)
High - Low	0.516**	0.086***	-0.299**	-0.158
	(2.13)	(2.87)	(-2.56)	(-1.58)
Panel B: Ownership of blockholders				
Low	0.129	-0.010	0.173**	-0.044
	(0.64)	(-0.39)	(2.20)	(-0.60)
High	0.616***	0.075**	-0.122	-0.163**
	(3.29)	(2.46)	(-1.25)	(-2.56)
High - Low	0.487*	0.085**	-0.295**	-0.119
	(1.77)	(2.15)	(-2.35)	(-1.21)
Panel C: Bid-ask spread				
High	0.028	0.018	0.097	0.006
	(0.14)	(0.99)	(1.13)	(0.08)
Low	0.526***	0.059***	-0.093	-0.196***
	(3.71)	(2.74)	(-1.46)	(-3.83)
Low – High	0.499**	0.042	-0.190*	-0.202**
	(2.04)	(1.48)	(-1.78)	(-2.15)

TABLE 5 (continue)

	Book-tax difference		Effective tax rate	
	(1)	(2)	(3)	(4)
	PCABT	*MPBT*	*CETR*	*GERT*
Panel D: number of analyst following				
Low	0.077	0.017	-0.029	-0.042
	(0.35)	(0.69)	(-0.32)	(-0.60)
High	0.558***	0.092***	-0.112*	-0.286***
	(2.80)	(4.27)	(-1.68)	(-5.59)
High - Low	0.480	0.075**	-0.083	-0.244***
	(1.61)	(2.27)	(-0.74)	(-2.81)
Panel E: Dispersion of analyst forecast				
High	-0.059	0.010	0.018	-0.113
	(-0.25)	(0.55)	(0.21)	(-1.31)
Low	0.543***	0.063***	-0.097*	-0.244***
	(4.45)	(3.42)	(-1.70)	(-5.28)
Low – High	0.602**	0.053**	-0.115	-0.130
	(2.29)	(2.02)	(-1.13)	(-1.33)

Notes: This table reports the regression results of the subsample analysis of firms with high- vs. low-corporate governance and information asymmetry. The specification follows the baseline regression in equation (5.1). The coefficient estimates of *Comp* are reported in the low- and high- ownership of institutional shareholders groups in Panel A, in the low- and high- ownership of blockholders groups in Panel B, in the high- and low- bid-ask spread groups in Panel C, in the low- and high- analysts following groups in Panel D, and in the high- and low- analyst forecast dispersion groups in Panel E. The coefficient estimates of other control variables are not reported for brevity. The difference in the coefficient estimates of *Comp* between the two groups in each panel and corresponding *t*-statistics from the seemingly unrelated regression method are reported in the last two rows. All variables are as defined in Appendix C. *t*-statistics are reported in parentheses. Standard errors are corrected for heteroskedasticity and are clustered at the firm level. ***, **, and * indicate significance, respectively, at the 1%, 5%, and 10% levels.

Appendix A: The model of tax avoidance

For expositional convenience, we impose the following three assumptions so that the principal's optimization problem is globally concave and has a unique solution.

Assumption 1 $2C''(p) + pC'''(p) > 0, \forall\, p \in [0,1]$.

Assumption 2 $C(0) = C'(0) = 0$ and $\lim_{p\to 1} C(p) = \infty$

Assumption 3 $t(1-d)\pi Y(\theta, A) + L_f > \underline{p}C''\left(\underline{p}\right),\ where\ \underline{p} \equiv (C')^{-1}[Gq(\theta)U_m]$.

Assumption 3 says the maximum marginal reduction of tax payments to the firm ($tkY(\theta, A) + L_f$) is greater than the minimum marginal increase of the rent paid to induce managerial efforts. Otherwise, the firm would not need to offer the contract to the manager to induce tax-saving efforts.

Proof of Proposition 1. The incentive constraint (2.2) implies:

$$b = C'(p) - Gq(\theta)U_m \tag{A.1}$$

Substituting (A.1) to the participation constraint (2.3) yields

$$\mathrm{B} + p[C'(p) - Gq(\theta)U_m] - C(p) - (1-p)Gq(\theta)U_m \geq 0$$

$$\Leftrightarrow pC'(p) - C(p) \geq Gq(\theta)U_m - B \tag{A.2}$$

The right-hand side of (A.2) is negative. The left-hand side of (A.2) is 0 at $p = 0$ and increasing with p because:

$$C'(p) + pC''(p) - C'(p) = pC''(p) > 0 \tag{A.3}$$

Thus, the participation constraint (2.3) is automatically held for any compensation contract that satisfies the incentive constraint (2.2). Substituting equation (A.1) into the objective function (2.1), the maximization problem is reduced to

$$\max_p\, td\pi Y(\theta, A) - L_f + p\left[t(1-d)\pi Y(\theta, A) - C'(p) + Gq(\theta)U_m + L_f\right] \tag{A.4}$$

$$\text{subject to: } C'(p) - Gq(\theta)U_m > 0 \tag{A.5}$$

The first-order condition for the solution is

$$C'(p) + pC''(p) = t(1-d)\pi Y(\theta, A) + Gq(\theta)U_m + L_f \tag{A.6}$$

Assumption 4 implies $C'\left(\underline{p}\right) + \underline{p}C''\left(\underline{p}\right) < t(1-d)\pi Y(\theta, A) + Gq(\theta)U_m + L_f$. Since $\lim_{p\to 1} C(p) = \infty$, $C'(p)$ must eventually go to ∞ as p approaches 1. Thus, there exists a $p^* \in \left(\underline{p}, 1\right)$ that solves (A.6). Moreover, the optimal bonus $b^* = C'(p^*) - Gq(\theta)U_m > C'\left(\underline{p}\right) - q(\theta, G)U_m = 0$, so (A.5) holds at p^*. According to **Assumption 1**, the second-order condition is globally satisfied with strict inequality, so p^* is the unique solution to the optimization problem of the firm. ||

As a point of reference, consider the case when the manager's tax-saving effort can be observed and contractible. In this case, the principal offers a contract that maximizes tax reductions (2.1) subject to the constraint

(FB) $$b \geq C(p) + (1-p)Gq(\theta)U_m \tag{A.7}$$

The FB constraint says how much bonus award the manager must be able to cover his effort cost and expected utility loss. The first-best effort level p^{FB} is uniquely characterized by

$$C'(p^{FB}) = t(1-d)\pi Y(\theta, A) + L_f + Gq(\theta)U_m \tag{A.8}$$

The manager is paid $b^{FB} = C(p^{FB}) + (1-p^{FB})Gq(\theta)U_m$ if $p = p^{FB}$ and 0 otherwise. It is easy to see $p^* < p^{FB}$, the optimal level of managerial tax-saving effort is distorted to a level lower than the first-best outcome when the manager's effort cannot be observed and contractible by the firm.

Proof of Proposition 2. Take differential of equation (A.6) with respect to p and θ, respectively, and the implicit function theory implies equation (2.7). ||

We impose the following assumption on higher derivatives of the managerial cost function $C(.)$ at the optimal solution p^*.

Assumption 4 $3C'''(p^*) + p^*C''''(p^*) \geq 0$.

Proof of Proposition 3. Take differential of equation (2.7) with respect to θ yielding:

$$\frac{d^2p^*}{d\theta^2} = \frac{1}{\Gamma(p^*)}\left[U_m G q''(\theta) + t(1-d)\pi\frac{\partial Y^2(\theta, A)}{\partial\theta^2}\right] + \frac{-[3C'''(p^*) + p^*C''''(p^*)]}{\Gamma(p^*)}\left(\frac{dp^*}{d\theta}\right)^2 \qquad \text{(A.9)}$$

Where $\Gamma(p^*) \equiv 2C''(p^*) + p^*C'''(p^*) > 0$ by **Assumption 1**. By **Assumption 3**, the second term on the right-hand side of equation (A.9) is negative. Because $q''(\theta) < 0$ and $\frac{\partial Y^2(\theta,A)}{\partial\theta^2} < 0$, the first term on the right-hand side of equation (A.9) is negative. Therefore, $\frac{d^2p^*}{d\theta^2} < 0$, that is, p^* is a concave function of θ. ‖

Appendix B: An illustrative example

We use Amphenol Corporation as an illustrative example in Table B.1 below to show the difference in firm and industry exposure to import competition from China.

Amphenol Corporation operates in two segments [SIC 3678 (primary) and 3357]. The columns labeled "Sales Share" list the fraction of Amphenol's sales in two segments. The columns labeled "Import Penetration" show the share of U.S. imports from China in the industry demand of Amphenol's segments. The column *Comp* reports the exposure of Amphenol to import competition from China, as defined in equation (3.1). The column *CHINA* reports the share of U.S. imports from China in the industry demand of Amphenol's primary 3-digit SIC industry. The last row reports the difference between the last two columns and the *t*-value in parenthesis. ***, **, and * indicate significance, respectively, at the 1%, 5%, and 10% levels.

TABLE B.1
Import penetration for Amphenol Corporation

	Segment 1 (SIC=3678)		Segment 2 (SIC=3357)			SIC = 367
year	Sales share	Import Penetration	Sales Share	Import Penetration	*Comp*	*CHINA*
1998	78.15%	2.53%	21.85%	2.42%	2.51%	1.88%
1999	76.19%	6.28%	23.81%	2.58%	5.40%	2.77%
2000	74.22%	8.08%	25.78%	2.72%	6.70%	3.32%
2001	82.15%	8.53%	17.85%	2.97%	7.54%	4.24%
2002	84.02%	11.95%	15.98%	4.27%	10.72%	5.47%
2003	86.48%	12.48%	13.52%	5.11%	11.49%	6.65%
2004	87.15%	15.58%	12.85%	6.01%	14.35%	8.39%
2005	88.07%	16.28%	11.93%	6.02%	15.06%	8.96%
2006	89.32%	19.43%	10.68%	6.46%	18.05%	11.77%
2007	90.12%	22.00%	9.88%	7.55%	20.57%	11.55%
2008	91.17%	21.17%	8.83%	8.13%	20.02%	11.51%
2009	91.01%	21.53%	8.99%	9.32%	20.43%	12.01%
2010	92.15%	24.05%	7.85%	10.46%	22.98%	14.55%
2011	93.05%	22.61%	6.95%	9.34%	21.69%	14.04%
2012	92.90%	21.11%	7.10%	11.32%	20.42%	17.89%
2013	92.51%	23.39%	7.49%	13.69%	22.66%	19.28%
2014	93.40%	28.64%	6.60%	14.49%	27.71%	21.33%
2015	94.08%	27.74%	5.92%	16.02%	27.05%	21.51%
2016	94.21%	27.48%	5.79%	16.11%	26.82%	21.00%
				Difference	5.48%*** (10.11)	

Appendix C: Variable definition

Tax avoidance measures

$PCABT$ — The principal component extracted from the factor analysis of the four proxies (defined below) of book-tax difference: BTD, $PERMDIFF$, $DTAX$, and $DDBT$.

BTD — The total book-tax difference is defined as the difference between pre-tax income (*pi*) and taxable income scaled by lagged assets (*at*). The taxable income is the total current tax expense over the statutory tax rate and then subtracting the change in net operating loss carryforwards (*tlcf*), where the total current tax expense is the sum of current federal tax expense (*txfed*) and current foreign tax expense (*txfo*). If current federal tax expense (*txfed*) is missing, we follow Frank, Lynch, and Rego (2009) and Kim, Li, and Zhang (2011) to calculate total current tax expense as total income taxes (*txt*) minus deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*).

$PERMDIFF$ — The permanent total book-tax difference is defined as the pre-tax income minus total current tax expense over statutory tax rate and then minus deferred tax expense (*txdi*) over statutory tax rate, scaled by lagged assets (*at*). The total current tax expense is the sum of current federal tax expense (*txfed*) and current foreign tax expense (*txfo*). If current federal tax expense (*txfed*) is missing, we follow Frank, Lynch, and Rego (2009) and Kim, Li, and Zhang (2011) to calculate total current tax expense as total income taxes (*txt*) minus deferred taxes (*txdi*), state income taxes (*txs*), and other income taxes (*txo*).

$DDBT$ — The Desai and Dharmapala (2006) residual book-tax difference is the residual $\epsilon_{i,t}$ estimated from the following firm fixed effects regression.

$$BTD_{i,t} = \beta TA_{i,t} + \mu_i + \epsilon_{i,t},$$

where total accruals (TA) is income before extraordinary items (*ibc*) minus the difference between net cash flow (*oancf*) and extraordinary items and discontinued operations (xidoc), and then scaled by lagged assets, according to the cash flow method in Hribar and Collins's (2002). μ_i is a firm-level fixed effect.

$DTAX$ — The discretionary permanent book-tax difference for firm i in year t is the residual $\varepsilon_{i,t}$ estimated from the following regression by two-digit SIC code and year in Frank, Lynch, and Rego (2009).

$$PERMDIFF_{i,t} = \beta_0 + \beta_1 INTAN_{i,t} + \beta_2 EQINC_{i,t} + \beta_3 MI_{i,t} + \beta_4 CSTE_{i,t} + \beta_5 \Delta NOL_{i,t} + \beta_6 PERMIDFF_{i,t-1} + \varepsilon_{i,t}$$

where $INTAN$ is intangible assets (*intan*) scaled by lagged assets (*at*), $EQINC$ is equity in net loss/earnings (*esub*) divided by lagged assets (*at*), MI is income (loss) attributable to minority interest (*mii*) over lagged assets (*at*), $CSTE$ is current state income tax expense (*txs*) scaled by lagged assets (*at*), and ΔNOL is the change in net operating loss carryforwards (*tlcf*) over lagged assets (*at*). We handle the missing values as in Frank, Lynch, and Rego (2009) and Hasan, Hoi, Wu, and Zhang (2014).

$MPBT$ — The Manzon-Plesko (2002) book-tax difference is U.S. domestic financial income (*pidom*) minus current federal tax expense (*txfed*) over statutory tax rate, state income taxes (*txs*), other income taxes (*txo*), and equity in net loss/earnings (*esub*), and then scaled by lagged assets (*at*).

$CETR$	The cash effective tax rate is defined as Cash taxes paid (*txpd*) / Pretax Income (*pi*). As in the literature (Chen et al., 2010), we set $CETR$ to missing when the denominator (pre-tax income) is zero or negative and truncate $CETR$ to the range [0,1].
$GETR$	The *GAAP* current effective tax rate is defined as [Total taxes expense (*txt*) – deferred tax expense (*txdi*)] / Pretax Income (*pi*). If deferred tax expense is missing, we set its value to 0. As in the literature (Chen et al., 2010), we set $GETR$ to missing when the denominator (pre-tax income) is zero or negative and truncate $GETR$ to the range [0,1].

Competition measure and instrument variable

Comp	Firm i's exposure to import penetration from China is calculated as follows: $Comp_{i,t} = \sum_j \left[s_{i,j,t} \times \frac{Import\ from\ China_{j,t}}{Shipment_{j,t} - Export_{j,t} + Imports_{j,t}} \right]$, where $s_{i,j,t}$ is the fraction of the firm i's sales in industry j in year t, so $S_{i,t} = \left(s_{i,1,t}, s_{i,2,t}, \dots, s_{i,j,t}, \dots\right)'$ describes the distribution of firm i's sales across the product market space in year t. This measure is the sales-weighted shares of imported Chinese goods in U.S. industry demand.
CompIV	The instrument variable for *Comp* is defined as follows: $CompIV_{i,t} = \sum_j \left[s_{i,j,89-90} \times \frac{Non\ US\ \text{High income country imports from China}_{j,t}}{\text{Shipments}_{j,88} - \text{Exports}_{j,88} + \text{Imports}_{j,88}} \right]$ where $s_{i,j,89-90}$ is the fraction of the firm i's segment sales in industry j in 1989 and 1990.

Other control variables

ROA	Return on assets measured as operating income (*pi* - *xi*) scaled by lagged assets (*at*).
LEV	Leverage is measured as long-term debt (*dltt*) divided by lagged assets (*at*).
NOL	A dummy variable that is equal to 1 if lagged net operating loss carryforwards (*tlcf*) are positive.
Δ*NOL*	Change in net operating loss carryforwards (*tlcf*) scaled by lagged assets (*at*).
FI	Foreign income (*pifo*) scaled by lagged assets (*at*).
PPE	Net property, plant, and equipment (*ppent*) divided by lagged assets (*at*).
INTAN	Intangible assets (*intan*) scaled by lagged assets (*at*).
EQINC	Equity in net loss/earnings (*esub*) divided by lagged assets (*at*).
FCF	Operating cash flows (*onacf*) minus capital expenditures (*capx*) and then scaled by lagged total assets.
SIZE	Logarithm of the market value of equity (*prcc*csho*) at the beginning of a year
MB	Market-to-book ratio at the beginning of a year, measured as the market value of equity (*prcc*csho*) scaled by the book value of equity (*ceq*).
RND	Research and development expense (*xrd*) over assets (*at*)
Ln(GDP)	Natural logarithm of U.S. domestic market demand in a firm's primary industry
Diversification	The sum of the square of the share of firm business segment sales.

Productivity and efficiency measures

Labor intensity	Number of employees (*emp*) over sales (*sale*)
Industry adj. TFP	We use the econometric method developed by Levinsohn and Petrin (2003) to estimate a firm's total factor productivity (TFP). The industry-adjusted TFP of a firm is the firm's TFP minus the average TFP of its primary industry.
Patent value	The value of patents is as defined in Kogan et al. (2017). The data is available at https://kelley.iu.edu/nstoffma/.
Total-Q	The total-Q is as defined in Peters and Taylor (2017). The data is available at Wharton Research Data Services (WRDS).
Profit margin	One minus the sum of the cost of goods (*cogs*) and selling, general, and administrative expenses (*xsga*) over sales (*sale*).

Corporate governance measures

Total institutional ownership	The percent of stocks that are owned by institutional investors
Ownership of block holders	The percent of stocks owned by block holders. A blockholder refers to institutional shareholders who hold 5% of stocks.

Information asymmetry measures

Bid-ask spread	The bid-ask spread based on daily high and low prices, as in Corwin and Schultz (2012).
Analyst following	The number of analysts following the stock for the year
Analyst forecast dispersion	The standard deviation of individual analysts' most recent forecast of earnings over the absolute value of the actual earnings.