Corporate tax avoidance and sales: micro evidence and aggregate implications

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Abstract

This paper examines the effect of corporate tax avoidance (CTA) on U.S. firm-level sales and its aggregate implications. In theory, CTA gives a competitive edge to avoiding firms, which affects the distribution of sales in the economy. In practice, we find a causal impact of CTA on firm-level sales using a broad set of measures of tax avoidance and different identification strategies. Combining micro-estimates and the model, we assess how changes in CTA over the past two decades have shaped the distribution of sales across U.S. industries. While the effects vary by sector, rising CTA among large firms has reinforced their dominant positions, contributing to increased concentration, in several key industries.

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1 Introduction

Corporate tax avoidance (CTA) can be broadly defined as the set of actions adopted by firms to reduce their tax burden (Hanlon and Heitzman, 2010). A common view is that CTA encompasses a wide range of actions that can be legal or not, and that *tax avoidance does not necessarily indicate that firms have done anything improper* (Chen et al., 2010, pp. 41-42). A large body of accounting literature has developed firm-level indicators of corporate tax avoidance by exploiting the annual financial statement of public firms.[1] The analysis of these indicators reveals the idiosyncrasy of tax avoidance: firms' level of CTA is highly heterogeneous, even within industries, and it varies over time (Dyreng et al., 2017; 2008; Hanlon and Heitzman, 2010).[2]

In the economic literature, corporate tax avoidance has foremost raised attention for its implications on government revenue losses.[3] This paper examines its broader consequences on the distribution of sales in the economy. We proceed in three steps. The first step clarifies the theoretical impact of CTA on sales. Tax-avoiding firms expand their sales as CTA provides them with a competitive advantage over rivals. In industries where larger firms engage in more aggressive tax avoidance, this advantage reinforces their dominance, increasing concentration. The second step empirically establishes the causal impact of CTA on firm sales, which is the key mechanism linking firm-level CTA and industry concentration. The final step evaluates the quantitative relevance of changes in CTA across large and small firms in explaining trends in U.S. industry concentration.[4] We now examine each step in

[1]See for example, Desai (2003), Desai and Dharmapala (2006a), De Simone et al. (2020), Henry and Sansing (2018), Lisowsky et al. (2013), and Wilson (2009) for firm-level measures of corporate tax avoidance based on financial statement data.

[2]Firms might differ in tax avoidance practices even under identical regulations, due to their managerial ability, executive preferences, and governance structures (see Dyreng et al., 2010; Koester et al., 2017, among others).

[3]See, among many others, Clausing (2016), Clausing (2020), Tørsløv et al. (2022), Zucman (2014),

[4]Trends in U.S. industry concentration and their potential drivers are examined in Furman and Orszag (2015), Grullon et al. (2019), Philippon (2019b), and Shambaugh et al. (2018). Grullon et al. (2019) shows that over 75% of U.S. industries have experienced an increase in concentration levels since the late 1990s. For evidence of increased concentration in European markets, see Affeldt et al. (2021) or Bighelli et al. (2022).

detail.

In a first step, we develop a model of imperfect competition where firms differ in productivity and tax avoidance levels to analyze the macroeconomic implications of CTA. Ancitipating a lower tax burden, tax-avoiding firms find it profitable to expand their sales, as the expected reduction in effective marginal costs increases their competitive edge relative to their competitors. A uniform increase in tax avoidance across all firms leaves industry concentration unchanged. However, if more productive, larger firms engage in more aggressive avoidance, their relative advantage over smaller firms increases, amplifying industry concentration. More broadly, the model predicts that the impact of CTA on industry concentration depends on the correlation between firm productivity and tax avoidance.

We also discuss the normative implications of CTA within our model by highlighting the trade-offs between allocative efficiency and market power. It appears that the implications are ambiguous and depend on the nature of existing distortions and the channels through which CTA boosts sales.

Measuring CTA and identifying its causal impact on individual sales is challenging. In a second step, we leverage firm-level data from Compustat covering the period from 1994 to 2017 to overcome these challenges.

We measure tax avoidance using a broad set of accounting-based indicators drawn from the literature and tax haven exposures.[5] Building on the finance and accounting literature (De Simone et al., 2020; Desai and Dharmapala, 2006a; Henry and Sansing, 2018; Lisowsky et al., 2013; Wilson, 2009), we construct several avoidance measures to ensure robustness across specifications. These measures combine both binary and continuous indicators, relying on annual financial statements and reports of firm activities. All these measures yield consistent results regarding the impact of CTA on firm sales.

To establish causality, we exploit exogenous variation in IRS audit probabilities, regula-

[5] Recent research show that variation in tax avoidance measures can be caused by factors not typically associated with active tax planning (Edwards et al., 2021; Christensen et al., 2022), and underscore the need for multiple measures of CTA.

tory changes, and tax planning shocks through multiple identification strategies. The first identification strategy is an instrumental variable approach based on IRS audit probability inspired by prior research that shows a negative correlation between audit probability and corporate tax avoidance (Hoopes et al., 2012; Nessa et al., 2020). Since raw audit probabilities may correlate with firm attributes – larger firms being more likely to be audited – we construct an instrument using the residuals from a regression of audit probabilities on asset brackets and year fixed effects. This isolates exogenous variation in audit risk that affects tax strategies but is unlikely to be driven by firm-specific characteristics. To strengthen the causal interpretation, we incorporate a range of controls, including sector-year and firm fixed effects, as well as firm-specific variables such as intangible assets, acquisition likelihood, multinational status, R&D intensity, or lobbying efforts related to taxation. The results remain robust across specifications, reinforcing the interpretation of CTA as a driver of firm sales. To explore the mechanisms, we further control for core inputs in an augmented specification. The effect of CTA on sales remains positive in this specification, suggesting that CTA influences sales through both a scale effect and an increase in revenue-based productivity.

We develop two alternative strategies that confirm the causal impact of CTA on sales. The first strategy uses an event-study design inspired by the literature exploiting changes in regulations that affect CTA.[6] We exploit a key regulatory change that significantly altered firms' tax planning behavior: the 1997 introduction of the check-the-box (CTB) rule, which facilitated hybrid tax planning strategies (Altshuler et al., 2024). The second strategy relies on a staggered difference-in-differences design, using firms' entry into tax havens to isolate the effects of tax avoidance on firm sales.

In a third step, we evaluate the macro-implications of CTA on sales. Using our model and the empirical estimates, we quantify the contribution of CTA to the observed changes in concentration across U.S. industries. We find that CTA contributes to the concentration dynamics in several industries. In key sectors – nonstore retail, telecommunication, computer

[6] See, for instance, Blouin and Krull (2014), Congress (2010), Herrmann and Thomas (2000), Hope et al. (2013) or Sullivan (2004).

and electronic product manufacturing, or health and personal care stores – CTA accounts for a 3- to 10-percentage point rise in the concentration ratio of the four largest firms. In some industries, predicted and observed concentration trends diverge, indicating that factors beyond CTA also play a role.

Last, we use cross-industry variation in the evolution of concentration to validate our core mechanism of within-industry competitive effects arising from different tax avoidance strategies.[7] Specifically, we compare our model's predicted changes in concentration with actual changes across industries. We find that changes in tax avoidance by large relative to small firms within industries can account for about 10% of the variation in the change in concentration across industries.

Our findings contribute to several strands of literature. First, we identify tax avoidance as a previously overlooked driver of industry concentration, complementing studies on technology (Autor et al., 2020), intangible capital (Crouzet and Eberly, 2019; Bajgar et al., 2021), barriers to entry, and weak antitrust enforcement (Gutiérrez and Philippon, 2018; Philippon, 2019b). Second, we build on research showing that tax avoidance distorts competition. For instance, Baugh et al. (2018) document how sales tax avoidance has strengthened online retailers, and Gauß et al. (2024) show that transfer pricing regulations in the EU increase the effective taxation of multinationals and enhance the profits and sales of domestic firms. We provide broader evidence that CTA has influenced industry-wide concentration trends. Gallemore et al. (2023) show that CTA possibly facilitates concentration in certain industries by looking at the correlation between CTA and concentration at the industry level. While we also show that the CTA of large firms relative to small firms has reinforced concentration in several industries, we differ from this paper in several dimensions. First, we develop a theoretical framework that clarifies the link between CTA, sales, and concentration. Second, we provide micro-level evidence of the causal impact of CTA on sales. Third, we adopt a

[7] Between 1994 and 2017, there was substantial heterogeneity in the evolution of concentration across U.S. industries. For instance, the CR4 ratio declined by 25 percentage points in other information services, while it increased by 52 percentage points in food and beverage stores.

complementary approach to assess the role of CTA in industry concentration by combining micro-estimates with theoretical insights. While prior work examines the impact of exogenous tax cuts on firm performance (Donohoe et al., 2022), we focus on CTA as a firm-driven strategy that reinvests tax savings to boost sales, and we derive aggregate implications.[8] Third, we add to studies on tax-induced investment misallocation (Arayavechkit et al., 2018; Kaymak and Schott, 2019; Kopczuk et al., 2016), showing that CTA influences the distribution of sales. Finally, we complement research on profit shifting (Alstadsæter et al., 2022; Guvenen et al., 2022; Egger and Wamser, 2015; Mooij and Liu, 2020; de Mooij and Liu, 2021; Serrato, 2018; Souillard, 2020), demonstrating that tax strategies shape the distribution of firm sales and industry concentration.

2 Theoretical framework

In this section, we develop a theoretical model examining how firms' heterogeneous tax avoidance capabilities interact with productivity differences to affect sales distribution and market concentration. We first establish the microeconomic foundations of how tax avoidance creates a competitive edge, then analyze the macroeconomic implications for industry concentration when tax avoidance correlates with firm productivity. We then discuss how the predictions extend to various theoretical frameworks, and their normative implications.

2.1 Model setup

We consider a simple economy with a distribution of heterogeneous firms that produce horizontally differentiated goods. Firm $i \in [[1; N]]$ produces $q_i = \varphi_i x_i$ units under constant returns using an input bundle x_i that aggregates capital, labor, and intermediate products. This bundle is available to all firms at price m. Firms differ in their productivity, captured by a Hicks-neutral productivity shifter φ_i. Firms also differ in their ability $\theta_i \geq 1$ to reduce

[8] Cai and Liu (2009) explore the link between competition and tax avoidance using Chinese data. They show that an increase in competition increases tax avoidance.

pre-tax profits reported to tax authorities.[9] Denoting the statutory tax rate by t^s, firm i anticipates and maximizes its after-tax profits:

$$\pi_i = (1 - t^s) \left(p_i - \frac{1}{\tilde{\theta}_i \varphi_i} \right) q_i \tag{1}$$

where $\tilde{\theta}_i \equiv \tilde{\theta}(t^s, \theta_i)$ maps tax avoidance ability θ_i at the statutory rate t^s into a marginal cost advantage.[10] This function is increasing in θ_i and such that $\tilde{\theta}(t^s, 1) = 1$. When $\tilde{\theta}_i > 1$, tax avoidance provides firm i with a competitive edge through reduced effective marginal costs, potentially arising from enhanced deductions for operating expenses or fixed investment costs. We examine the implications of these different micro-foundations more thoroughly in Section 2.4.

2.2 Tax avoidance and sales

We now consider the firm's problem in a monopolistically competitive environment where consumers have CES preferences with an elasticity of substitution $\sigma > 1$. We discuss the implications of relaxing these assumptions in Section 2.4.

Per-capita expenditure is denoted ξ, and the mass of consumers is normalized to 1. The demand for the variety supplied by firm i at price p_i is given by $d(p_i; \mathcal{P}) = \frac{\xi p_i^{-\sigma}}{\mathcal{P}^{1-\sigma}}$, where $\mathcal{P}$ is the price index: $\mathcal{P} = \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$. Under monopolistically-competitive pricing, there is a constant and equal markup for all firms over their effective marginal cost, denoted by $\mathcal{M} = \frac{\sigma}{\sigma-1}$. In this context, a firm sales s_i depend on tax-avoidance ability as follows:

$$s_i(\boldsymbol{\varphi}, \boldsymbol{\theta}) = \left(\frac{m}{\varphi_i \tilde{\theta}_i} \right)^{1-\sigma} \mathcal{M}^{1-\sigma} \mathcal{P}^{\sigma-1} \xi \tag{2}$$

From equation (2), the relative sales of any two firms i and j are given by $\frac{s_i(\boldsymbol{\varphi},\boldsymbol{\theta})}{s_j(\boldsymbol{\varphi},\boldsymbol{\theta})} = \left(\frac{\varphi_i \tilde{\theta}_i}{\varphi_j \tilde{\theta}_j} \right)^{\sigma-1}$. Differences in tax avoidance distort relative sales. A firm that engages in more

[9] Firms might differ in tax avoidance practices even under identical regulations, due to their managerial ability, executive preferences, and governance structures (see Dyreng et al., 2010; Koester et al., 2017).

[10] This reduced-form approach to tax planning captures both legal loopholes and broader tax-optimization strategies (e.g., Hanlon and Heitzman, 2010; Wilde and Wilson, 2018). It also aligns with profit-shifting techniques discussed in Appendix A.1.

aggressive tax avoidance increases its relative sales, generating a sales premium associated with tax avoidance. The dispersion in sales between firms reflects both productivity and the ability to avoid taxes through the distribution of $\varphi\tilde{\theta}$. We next examine how these attributes interact and their implications.

2.3 From micro to macro: CTA and industry concentration

We now examine how CTA impacts the distribution of sales in the economy. Using equation (2), firm-level sales increase proportionally to $(\varphi\tilde{\theta})^{\sigma-1}$. In the absence of tax avoidance, this property implies that the sales distribution inherits the properties of the underlying productivity distribution when assumed to be Pareto or Lognormal, as is typically done in the international trade and macroeconomics literatures (see, e.g., Melitz and Redding, 2014; Gabaix, 2011). To study how CTA influences the distribution of sales, we enhance the canonical setup by introducing a bivariate distribution of productivity and tax avoidance ability. We specify this distribution such that a single parameter, ρ, governs the correlation between the two attributes while allowing for a straightforward characterization of its moments.[11]

More specifically, these abilities $(\varphi, \tilde{\theta})$ are such that $(\ln(\varphi), \ln(\tilde{\theta} - 1))$ follow a bivariate Gaussian with means $(\mu_\varphi, \mu_\theta)$, standard deviations $(\sigma_\varphi, \sigma_\theta)$, and correlation parameter ρ.[12]

One approach to evaluating the impact of tax avoidance on market concentration is to examine how the moments of the market share distribution vary with the correlation parameter ρ. When $\rho = 0$, tax avoidance and productivity are independent, leaving the overall effect of tax avoidance on concentration ambiguous. In contrast, a positive correlation strengthens the sales advantage of high-productivity firms, increasing concentration, whereas a negative correlation weakens this advantage, reducing concentration.

To anticipate the empirical analysis, we examine how a standard concentration measure,

[11] In what follows, ρ does not directly represent the correlation between the two variables but governs it. The case of independent draws is still obtained for $\rho = 0$. See more details in Appendix A.2.

[12] Although the resulting distribution is not a bivariate lognormal, the marginal density of productivity φ remains lognormal. We could also have considered multivariate Pareto distributions. Unlike multivariate Pareto distributions, however, our distribution allows for flexible parameterization of both positive and negative correlations. For example, the classical multivariate Pareto distribution of the first kind only allows positive correlations for finite marginal variances (see Mardia, 1962; Arnold, 2008).

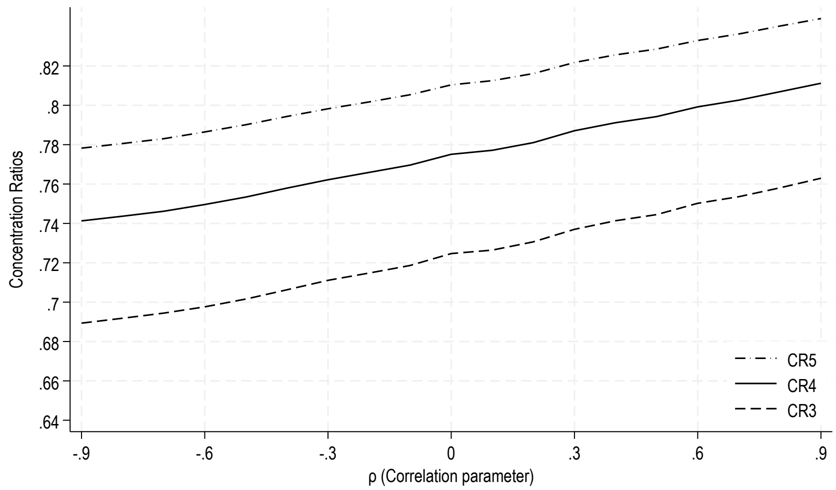


Figure 1: Concentration ratios for different values of ρ.

Notes: The graph displays the mean sum of the three, four, and five largest market shares as a function of the correlation parameter (ρ) for $\sigma = 4$. Each data point represents the average of 50,000 simulations, with 500 firms. Market shares are derived from the distribution $(e^u \cdot (1 + e^v))^{\sigma-1}$, where u and v are normally distributed variables with a correlation ρ ranging from -0.9 to 0.9 in increments of 0.025. The means and standard deviations of u and v are $\mu_u = 2$, $\sigma_u = 1.4$, $\mu_v = 0.3$, and $\sigma_v = 0.2$. The overall median firm size across all simulations is 300 million.

such as CR4 (the combined market share of the four largest firms), responds to changes in ρ. Figure 1 illustrates this relationship. Similar patterns hold for CR3 and CR5. As tax avoidance becomes more positively correlated with productivity, CR4 increases, indicating that greater tax avoidance by high-productivity firms amplifies market concentration.

In Appendix A.2, we demonstrate that this result generalizes to a parametrized entropy index with weight α, which determines the relative importance of larger firms in the concentration measure. For $\alpha >> \frac{1}{\sigma-1}$, the first-order approximation of the generalized entropy index is given by:

$$GE(\alpha) \approx \frac{e^{\frac{(\alpha^2-\alpha)(\sigma-1)^2}{2}(\sigma_\varphi^2+\sigma_\theta^2+2\rho\sigma_\varphi\sigma_\theta)} - 1}{\alpha(\alpha-1)} \quad . \tag{3}$$

This index encompasses standard inequality measures, including the Herfindahl index ($\alpha = 2$). It follows from (3) that for any $\alpha > 1$, $GE(\alpha)$ increases with ρ, implying that a stronger correlation between productivity and tax avoidance leads to greater industry concentration. Last, when the correlation between productivity and tax-avoidance ability is stronger, a rise in the dispersion of tax-avoidance ability σ_θ (which raises both its average level and variability) leads to a larger increase in industry concentration.

2.4 Discussion

This section highlights two key points. First, the effect of tax avoidance on sales can be derived from various theoretical frameworks, each offering distinct mechanisms while generally predicting a positive impact on firm sales. Second, the normative implications of CTA are ambiguous, depending on the interaction between these micro-foundations, market structure, and other economic distortions.

Oligopoly. The closed-form results derived above rest on CES demand and monopolistically competitive pricing assumptions. Accounting instead for oligopoly pricing implies that markups are no longer constant across firms. For instance, consider an oligopoly in a partial equilibrium setting.[13] In this setup, the markup $\mathcal{M}_i$ becomes an increasing function of a firm's market share, $\mathcal{M}_i = \mathcal{M}(\mathcal{S}_i)$. Under both Cournot and Bertand competition, relative market shares can be related to productivity and CTA through the following equation: $\frac{\mathcal{S}_i}{\mathcal{S}_j}\left(\frac{\mathcal{M}(\mathcal{S}_i)}{\mathcal{M}(\mathcal{S}_j)}\right)^{\sigma-1} = \left(\frac{\varphi_i}{\varphi_j}\right)^{\sigma-1}\left(\frac{\tilde{\theta}_i}{\tilde{\theta}_j}\right)^{\sigma-1}$.[14] The above equation implies that a firm's sales increase with tax avoidance. An increase in tax avoidance for the largest firms would thus increase concentration. While oligopoly per se does not affect the impact of tax avoidance on concentration, it may alter its welfare implications, as discussed below.

Micro-foundations. Tax avoidance enhances individual sales through at least two channels: it can affect productive capacity by increasing the returns to investment, or it can provide a cost advantage for a given technology. If one interprets θ as firms (heterogeneous) abilities to deduct fixed investment costs, then the return to investment, through better technology, depends directly on t^s and θ. In that case, CTA enhances sales through technology upgrading, which shifts the production possibility frontier (PPF) outward.[15] Similarly,

[13] Consumer preferences may be represented by $\mathcal{U} = x_0 + \frac{\sigma\xi}{\sigma-1}\ln\left(\sum_{i=1}^{N} q_i^{\frac{\sigma-1}{\sigma}}\right)$ where x_0 is a composite good supplied under perfect competition representing the rest of the economy.

[14] Under Cournot and Bertrand competition, the markup is $\mathcal{M}(\mathcal{S}_i) = \frac{1}{\mu(1-\mathcal{S}_i)}$ and $\mathcal{M}(\mathcal{S}_i) = \frac{1-\mu\mathcal{S}_i}{\mu(1-\mathcal{S}_i)}$, respectively, where $\mu = \frac{\sigma-1}{\sigma}$.

[15] See Appendix A.1 for an example.

tax-avoidance can enhance sales by raising the profitability of marketing or advertising expenditures.

Alternatively, CTA may simply allow firms to inflate (or, equivalently, deduct a larger share of) their production costs in the calculation of taxable income by a factor θ.[16] Under standard conditions where marginal revenue declines with output, firms that anticipate the ability to inflate their costs when computing tax liability may optimize by reducing prices.[17] This occurs because the after-tax marginal benefit of increased sales volume can exceed the benefit of maintaining monopoly pricing with lower volume.[18] A firm that avoids taxes will find it optimal to sell more output at a lower price. Under this micro-foundation, tax avoidance affects pricing and sales but does not alter the firm's technology.

Considering a revenue-based production function ($s_i = TFPR_i \times m.x_i$) offers an insightful perspective. Sales s_i depend on the contribution of input factors $m.x_i$, and the firm's revenue-based total factor productivity ($TFPR$). Tax avoidance can influence sales through input usage only without changing technology. It can also change markups or productivity as captured by $TFPR$. We investigate these channels in Section 4.2. Importantly, our analysis of the CTA-sales relationship holds irrespective of the underlying microfoundations of CTA. However, the normative implications differ significantly, as we explore below.

Normative implications. The discussion shows that normative conclusions do not follow immediately. We illustrate this with several cases. First, consider a model with CES preferences and monopolistic competition in a single-sector economy. As shown by Dhingra and Morrow (2019), the equilibrium in this setting is optimal. If CTA shifts the distribution of firms' output without changing their underlying technology, it directly reduces overall welfare.

Maintaining the same assumptions on competition and preferences, consider the case

[16] Symmetrically, a tax-avoiding firm would gain by deflating its turnover

[17] For instance, a tax-avoiding firm inflating its costs by a factor $1 \leq \theta_i < 1/t^s$ will have a taxable income given by $t^s(p_i - \frac{1}{\theta_i \varphi_i})q_i$. In this case, $\tilde{\theta}_i = \frac{1-t^s}{1-t^s\theta_i} \geq 1$.

[18] This mechanism aligns with evidence in Baugh et al. (2018), which demonstrates that online retailers' sales tax avoidance provided them with a competitive price advantage over brick-and-mortar competitors.

where CTA induces technological upgrades within firms. Here, the equilibrium remains optimal, and the PPF shifts outward, increasing the economy's productive capacity. In this setting, CTA can enhance welfare by promoting technological improvements.

Now, consider an oligopolistic competition model in partial equilibrium. Unlike in the monopolistic case, the equilibrium is no longer optimal due to two distortions: underproduction in the differentiated sector relative to the rest of the economy and misallocation among firms, with larger firms producing less than optimal levels. In this setting, CTA may raise production efficiency even without directly affecting firm-level technology by mitigating distortions stemming from market power disparities. However, when tax-avoidance enables productivity gains among the largest oligopolists, welfare increases but resource misallocation may simultaneously worsen. This occurs because these dominant firms exhibit incomplete pass-through of their lower marginal costs onto consumer prices, thereby widening the discrepancy between the market allocation of resources (driven by relative prices) and the efficient allocation of resources (determined by relative marginal costs).

This reasoning extends to distortions beyond market power. If more productive firms initially overproduce due to constraints such as credit frictions faced by smaller firms, aggressive tax avoidance by larger firms could worsen labor misallocation. Conversely, if distortions disadvantage larger firms, CTA could help reallocate production more efficiently. The welfare implications of CTA thus depend on market conditions and the nature of preexisting distortions.

3 Data

We now present the data used throughout our empirical analysis. Section 2 provides predictions regarding the impact of CTA on sales and the implications for industry concentration. The required data must be at the firm level, including sales and variables to compute CTA (to test the micro predictions), and must have wide temporal and industry coverage (to assess its macro implications). We first present Compustat data, which has the advantage of fulfilling these requirements. We then describe the different measures of tax avoidance used in the analysis.

3.1 Compustat data

We use detailed data from Compustat, a database of firm-level financial information from S&P Global Market Intelligence, to construct our variables of interest. The Compustat dataset contains data consolidated at the company level. Our analysis covers 1994-2017 when the U.S. had a worldwide taxation system.

Our empirical analysis focuses on firms headquartered in the U.S. and excludes their subsidiaries. Consistent with prior research, we remove firms in the financial and utility industries because of their unique regulatory and institutional structures. The unbalanced dataset consists of 16,396 firms in 89 NAICS 3-digit industries. Some of the observations on taxes and sales in the dataset are missing, which reduces the size of our estimation sample to 10,062 firms. However, it covers more than 82% of total yearly sales, on average, from 1994 to 2017.

The Compustat data offer two advantages. First, they provide firm-level information about sales and the financial statement information that the literature has used to infer firm-year tax avoidance, which are essential for testing the micro-mechanism at the core of our analysis. Second, they cover a broad range of manufacturing and service industries over several decades, allowing us to assess how firm-level tax avoidance has influenced industrial concentration in the U.S. This dataset has been widely used to study concentration trends across U.S. industries (Grullon et al., 2019; Philippon, 2019a).

One limitation is that Compustat covers only public firms. The microeconomic results on the impact of tax avoidance on sales are consistent with evidence from Baugh et al. (2018) on the U.S. retail industry and (Gauß et al., 2024) on European firms. We thus believe they could be generalized. However, the implications for concentration depend on the distribution of sales and tax avoidance, which may differ outside Compustat. Expanding the analysis to private firms or other countries could alter the magnitude of the estimated effects. Our results should therefore primarily be interpreted as evidence of the role of tax avoidance in shaping industry concentration among U.S. public firms. However, prior research shows that the market shares of top corporations (Kwon et al., 2024) and concentration trends (Philippon, 2019b) in Compustat closely track those observed in datasets that include both public and private firms, suggesting that the results could have broader interpretation in the U.S. context.

3.2 Measuring tax avoidance

The literature in accounting and finance defines tax avoidance broadly as *tax planning activities that are legal, or that may fall into the gray area, as well as activities that are illegal. Thus, tax avoidance does not necessarily indicate that the firm has done anything improper* (Chen et al., 2010, pp. 41-42). However, there is no consensus on its measurement. To ensure robustness, we test our results using alternative accounting-based measures of the tax position of firms. Additionally, we use proxies based on firms' presence in tax havens to capture reliance on tax avoidance strategies.

Accounting-based measures of tax avoidance. We use five accounting-based measures of tax avoidance, all yielding consistent results on the effect of tax avoidance on firm sales. Table B.1 provides the precise formulas used in their computation. Table B.2 provides the summary statistics about the main CTA variables.

First, we compute the HS gap, following Henry and Sansing (2018), which measures the difference between actual taxes paid and the expected tax liability if pre-tax income were taxed at the statutory rate.[19] This gap is scaled by the firm's book value of assets over the year.[20] A higher HS gap indicates lower tax avoidance.

To address concerns about the sensitivity of the HS gap to scaling, we introduce a binary tax avoidance indicator as a second measure (HS Indicator). This indicator equals 1 when

[19] Throughout our sample period, U.S. corporate profits were taxed at 35%, regardless of where they were earned.

[20] As a robustness check, we also scale the HS gap by the market value of assets. The main results stand.

the HS gap is negative (i.e., when cash taxes paid are lower than expected) and 0 otherwise.[21]

Third, we compute the effective tax rate (ETR) as the ratio of taxes paid to pre-tax income. Following De Simone et al. (2020), we compute ETR for the full sample to avoid restricting the analysis to firms reporting positive profits. A higher ETR indicates lower tax avoidance.[22]

Our fourth and fifth measures capture book-tax differences, which reflect discrepancies between book income and taxable income (Wilson, 2009). Desai (2003) and Desai and Dharmapala (2006a) show that large book-tax differences are indicative of tax-sheltering activity. The fourth measure, permanent book-tax differences (Perm. BTD), is computed by subtracting deferred tax expenses from total book-tax differences and adjusting for the statutory tax rate (Lisowsky et al., 2013). The fifth measure, tax sheltering residual (TS residual), isolates the component of book-tax differences driven by tax planning. It separates normal BTDs, which reflect standard accounting practices, from abnormal BTDs, which stem from tax-motivated strategies. The measure is constructed by regressing BTDs on total accruals and extracting the residual, capturing the portion unexplained by earnings management (Desai and Dharmapala, 2006b). Higher values of these indicators indicate higher tax avoidance.

Tax haven presence and hybrid planning. Beyond accounting-based measures, we use two indicators that capture firms' reliance on tax avoidance strategies rather than their reported tax positions. First, we use presence in a tax haven as a proxy for tax avoidance because firms with subsidiaries in tax havens benefit from lower tax rates and often engage in income shifting (Tørsløv et al., 2022). Second, we measure firms' engagement in hybrid tax planning, where the same entity is classified as a corporation in one jurisdiction and a pass-through in another, allowing income to escape taxation (Altshuler et al., 2024). We

[21] A positive HS gap occurs when cash taxes paid exceed expected tax liability due to unfavorable permanent or temporary book-tax differences. These differences arise when expenses are deducted for tax purposes on a cash basis but accrued for financial reporting, or when net operating loss carryforwards are restricted.

[22] Using consolidated worldwide data, we do not observe the bunching near zero found in studies with unconsolidated data (see, e.g., Koethenbuerger et al., 2019).

identify two key hybrid structures: *Double Irish with a Dutch Sandwich* and *Reverse Hybrid Mismatch*. Appendix E.1 details how firms are classified based on tax haven presence and hybrid structures. Information on the presence in tax haven and hybrid tax planning is used in Section 4.4 where we introduce event study designs as alternative approaches to our baseline specification.

4 Corporate tax avoidance and sales

The previous section introduced the dataset, outlined the key measures of tax avoidance, and justified their use in the empirical analysis. We now turn to one of the core questions: how does corporate tax avoidance affect firm sales? The goal is to establish a causal link between tax strategies and firm sales. We begin by presenting the empirical strategy used to estimate the impact of tax avoidance on sales. Next, we report the baseline results, followed by a series of robustness tests to address concerns related to omitted variables, alternative tax avoidance measures, and firm heterogeneity. Finally, we introduce event-study evidence to further validate the findings. Implications for the distribution of sales across industries are analyzed in Section 5.

4.1 Empirical strategy

Baseline specification. The empirical strategy follows directly from the theoretical framework in Section 2. We estimate a log-linearized sales equation consistent with the model's predictions:

$$\log s_{it} = \beta_0 + \beta_1 \log \tau_{it} + \mathbf{z}'_{it}\beta + FE + u_{it}\ . \tag{4}$$

The dependent variable s_{it} is the log of firm i's sales in year t. The key explanatory variable, τ_{it}, captures tax avoidance, measured using the alternative indices described in Section 3.2. By testing multiple proxies, we ensure that our results are not driven by a specific definition of tax avoidance but reflect a robust empirical relationship between firms' tax strategies and sales performance. The vector $\mathbf{z}'_{it}$ includes control variables accounting for firm characteristics that may influence sales. FE represents a set of fixed effects. The error term, u_{it}, captures idiosyncratic shocks.

All specifications include sector-year fixed effects to account for common shocks across firms within the same sector and year, such as sector-specific markups, demand fluctuations, and the sectoral price index. Some specifications also include firm fixed effects, which control for time-invariant firm characteristics that may influence sales and tax avoidance such as a firm's ability to manage tax strategies, its corporate governance practices, and its assessment of the legal tax environment.

The vector z_{it} includes controls for factors that may jointly affect tax avoidance and sales. These controls comprise the ratio of intangible assetss to total assets (Crouzet and Eberly, 2019; Autor et al., 2020), an indicator for acquisitions and payouts, and a dummy for multinational status (Antràs and Yeaple, 2014).

Augmented specification. The baseline specification captures the overall relationship between tax avoidance and sales but does not distinguish between changes in input usage and changes in (revenue-based) productivity. To address this, we estimate an augmented specification that explicitly controls for production inputs:

$$\log s_{it} = \beta_0 + \beta_1 \log \tau_{it} + \beta_\ell \cdot \ell_{it} + \beta_k \cdot k_{it} + \beta_m \cdot m_{it} + \mathbf{z}'_{it}\beta + FE + v_{it} \; . \tag{5}$$

where ℓ_{it}, k_{it}, and m_{it} denote the logs of labor, capital, and material inputs.

This specification follows the standard first-stage estimation of a production function (see Imrohoroğlu and Tüzel, 2014), but explicitly includes tax avoidance as an additional determinant of sales.[23] Unlike the baseline model, it isolates the effect of tax avoidance *conditional* on input usage. This allows for a more direct interpretation of the coefficient on τ_{it}, linked to the markup and technology mechanisms discussed in the model (Section 2.4). If all inputs were flexible, higher CTA ability would be expected to raise input usage as firms

[23] We follow Imrohoroğlu and Tüzel (2014) in constructing labor, capital, and intermediate inputs.

scale up. By controlling for labor, capital, and materials in the augmented specification, we hold input levels constant and identify the residual effect of CTA on sales. A positive coefficient on τ_{it} in this setting suggests that CTA also enhances revenue productivity. While this specification does not capture the full effect of tax avoidance on sales, it provides insight into whether the relationship primarily reflects expanded input usage or improvements in firm productivity.

Instrumentation strategy. A key challenge in estimating equations (4) and (5) is endogeneity arising from unobserved productivity shocks. If tax avoidance is systematically related to firm productivity, the tax measure will be correlated with the residuals u_{it} and v_{it}, leading to biased estimates. An ideal instrument should shift tax avoidance independently of firm-level productivity.

We construct an instrument based on audit probabilities disclosed by the Internal Revenue Service (IRS). Hoopes et al. (2012) provide evidence that stricter IRS monitoring reduces tax avoidance and report that 72% of firms explicitly consider audit probabilities in their tax decisions. We gather audit probability data from the IRS annual Data Books, which report audit statistics across eight asset brackets over time.

For each asset bracket, we compute the audit probability as the number of corporate tax audits completed in IRS fiscal year t divided by the number of corporate tax returns filed in the previous calendar year. Because audit probabilities vary systematically with firm size – the IRS audits larger firms at a higher rate, we remove asset bracket and year-specific fixed effects to isolate bracket×year specific variations. Our IV strategy follows these steps:

Step 0. Regress audit probability on year (t) and asset bracket (b) fixed effects $audit_{b,t} = FE_b + FE_t + res_{bt}$. The '*adjusted*' audit probability, $AdjAudit_{it}$, is defined as the residual res_{bt} from this regression, assigned to firm i based on its asset bracket b and year t.

Step 1. First stage: regress our measure of tax avoidance of firm i (τ_{it}) on our control variables of the second step (including sector×year fixed effects FE_{ot} and firm fixed effects FE_i) and our IV: $\tau_{it} = \alpha AdjAudit_{it} + (FE_i) + FE_{ot} + controls_{it} + \nu_{it}$.

Step 2. Second stage: sales (in log) are regressed on the predicted level of avoidance. $log\ sales_{it} = \beta\hat{\tau}_{it} + (FE_i) + FE_{ot} + controls_{it} + \epsilon_{it}$.

The residual of the audit-probability regression (Step 0) captures yearly fluctuations in audit probability specific to each asset bracket due to the inclusion of year-fixed effects in the regression. We visualize the audit probabilities by bracket of assets over the sample period in Figure C.2 of Appendix C. The residual audit probabilities are not correlated with the asset bracket, preventing a mechanical correlation between our IV and firm size. A high residual audit probability for an asset bracket in a given year means that, within this year, firms in this bracket are relatively more likely to be audited.

The instrument varies across asset brackets and years. The identification thus comes from heterogeneity in this instrument across firms within sector-year pairs, and within firm over time (in specifications with firm fixed effects), conditional on three firm-level controls: the ratio of intangible assetss to total assets, indicators for acquisitions and shareholder payouts, a dummy for multinational status.

Our identification strategy rests on the assumptions that (i) changes in tax avoidance at the level of firms are correlated to changes in the audit rates ($\mathbb{E}(\tau_{it}, AdjAudit_{it}) \neq 0$), (ii) fluctuations in audit probabilities within asset brackets over time will solely affect total sales through the readjustment of firms' tax strategies ($\mathbb{E}(u_{it}, AdjAudit_{it}) = 0$).

Assumption (i) is likely to hold if our residuals reflect contemporaneous perceptions of audit risk by managers.[24] The literature on tax enforcement finds that, all else equal, a decrease in tax enforcement is positively correlated with tax avoidance (Hoopes et al., 2012; Nessa et al., 2020). We confirm this link in the first stage of our specification.

[24]The question is how firms anticipate audit variation. Nessa et al. (2020) show a positive correlation between IRS resources and audit probability. Since the federal budget for the upcoming year is submitted by the President in early February (Heniff Jr., 2008), it is plausible that firms (or their accountants) use this information to form expectations.

There is no proper test of assumption (*ii*). It states that, *conditionally* on our explanatory variables, audit probability shocks are not correlated with individual sales. Reassuringly, the literature suggests that audit probability shocks are associated with IRS funding and thus unrelated to the individual sales of U.S. firms. Indeed, Nessa et al. (2020) show that IRS resources positively correlate with audit probability and the net revenue collected through tax enforcement. Fluctuations in the IRS enforcement budget resulted from Congressional battles between Democrats and Republicans. As Kiel and Eisinger (2018) report, the Republican-controlled Senate in 1997 and 1998 held a series of dramatic hearings on alleged abuses by the IRS.[25] Hoopes et al. (2012) argue that this drop is tightly linked to cuts in the budget of the IRS. It is thus likely exogenous to individual companies' sales dynamics.

A related concern might be that growing firms have more resources to lobby on taxation, thus affecting audit probability. As we just discussed, there is no evidence in the literature that changes in IRS audit probability over the period have been driven by firms' lobbying. We show in Section 4.3 that a firm's participation in lobbying on taxation or internal revenue code does not influence the effects of the residual audit probability on the level of CTA.

Last, it is worth noting that the first-stage regression primarily identifies firms whose tax avoidance behavior responds to changes in audit probability. Our measures of corporate tax avoidance encompass a broad range of strategies, including those explicitly incentivized by the government (e.g., R&D tax credits). Our IV strategy isolates the changes in tax avoidance that are sensitive to tax enforcement intensity. The estimates should thus be considered as a local average treatment effect (Bellemare, 2018).

4.2 Baseline results

Table 1 reports the OLS and second-stage 2SLS estimates for five measures of tax avoidance: HS Gap, HS Indicator, ETR, Permanent BTD, and TS residual. Columns (1)–(2) present

[25] A more recent reason for cutting the IRS funding is that the agency was chosen to monitor the Affordable Care Act. Instead, there were no cuts during the George W. Bush administration, and tax collection increased over this period (and the audit probability of large firms remained flat), which political commentators explain by the fact that the IRS was not an object of a dispute during this era.

OLS estimates, while columns (3)–(4) report 2SLS second-stage estimates. Columns (5)–(6) extend the baseline specification by incorporating controls for inputs. We also report the first-stage coefficient on adjusted audit probability and the Kleibergen–Paap F-statistic, which exceeds conventional thresholds, indicating that the instrument is not weak.

All specifications include sector × year fixed effects to account for unobserved heterogeneity, exploiting within-sector-year variation to identify the effect of tax avoidance. Some regressions further control for firm fixed effects, isolating within-firm variation in tax strategies and other covariates. Robust standard errors are clustered at the firm level.

Table 1: Sales and Tax Avoidance – OLS and 2SLS Estimates

	Baseline				Augmented specif.	
	OLS		2SLS		OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
A. HS Gap	-3.249***	-0.862***	-6.726***	-4.923***	-1.363***	-3.414***
	(0.184)	(0.075)	(1.264)	(1.805)	(0.082)	(0.445)
Adj. Audit Proba			0.003***	0.001***		0.001***
			(0.000)	(0.000)		(0.000)
Obs.	78,487	77,376	78,487	77,376	68,888	68,888
Adj. R^2	0.406	0.938			0.978	0.963
KP F-stat.			80.77	20.63		74.56
B. ETR	-0.359***	-0.027***	-4.701***	-1.308***	-0.109***	-1.211***
	(0.026)	(0.008)	(1.044)	(0.495)	(0.006)	(0.197)
Adj. Audit Proba			0.004***	0.003***		0.004***
			(0.001)	(0.001)		(0.001)
Obs.	78,486	77,375	78,486	77,375	68,888	68,888
Adj. R^2	0.377	0.937			0.975	0.911
KP F-stat.			48.89	32.17		53.35
C. HS Indicator	0.562***	0.070***	2.838***	0.945***	0.127***	0.866***
	(0.020)	(0.006)	(0.545)	(0.343)	(0.004)	(0.128)
Adj. Audit Proba			-0.006***	-0.004***		-0.006***
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
PF Controls	No	No	No	No	Yes	Yes
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	No

Continued on next page

Table 1 – continued from previous page

	Baseline				Augmented specif.	
	OLS		2SLS (2^{nd} Stage)		OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
			(0.001)	(0.001)		(0.001)
Obs.	78,487	77,376	78,487	77,376	68,888	68,888
Adj. R^2	0.392	0.937			0.976	0.922
KP F-stat.			80.35	34.98		61.77
D. Perm. BTD	0.602***	0.155***	4.278***	2.772***	0.223***	0.786***
	(0.040)	(0.017)	(0.608)	(0.724)	(0.018)	(0.109)
Adj. Audit Proba			-0.012***	-0.005***		-0.008***
			(0.002)	(0.001)		(0.001)
Obs.	41,642	40,464	41,642	40,464	37,907	37,907
Adj. R^2	0.384	0.949			0.978	0.950
KP F-stat.			54.78	14.93		51.82
E. TS residual	0.964***	0.159***	3.294***	1.632***	0.155***	0.661***
	(0.053)	(0.015)	(0.366)	(0.291)	(0.012)	(0.092)
Adj. Audit Proba			-0.014***	-0.008***		-0.009***
			(0.001)	(0.001)		(0.001)
Obs.	41,138	40,568	41,138	40,568	37,502	37,502
Adj. R^2	0.437	0.949			0.978	
KP F-stat.			95.19	39.17		61.13
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
PF Controls	No	No	No	No	Yes	Yes
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	No	No

Notes: OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. Each panel uses a distinct tax avoidance measure: Henry and Sansing (2018) (HS gap, Panel A), effective tax rate computed on the full sample (ETR, Panel B), HS indicator equal to one if HS is negative (favorable tax position) (HS Indicator, Panel C), permanent book-tax difference (Perm. BTD, Panel D), and tax sheltering residual (TS residual, Panel E). CTA is higher when the HS gap is lower, the ETR is lower, the HS indicator equals one, permanent BTD is higher, and tax sheltering is higher. Baseline controls are: intangible intensity, MNE status, and a dummy for acquisition. The augmented specifications (cols. 5-6) further include 'production function' (PF) controls, which are measures of capital, employment, and intermediate inputs. Columns 3, 4 and 6 report the first stage in the second row for each CTA measure. First-stage Kleibergen-Paap Wald F-statistic reported. ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

The key takeaway of Table 1 is that, at the firm-level, more tax avoidance leads to higher sales. The result is robust to the tax avoidance measure (see panels A to E), and holds across specifications with and without firm fixed effects (columns 1 vs. 3 and 2 vs. 4). The coefficient on tax avoidance declines when controlling for inputs (columns 5 and 6), indicating that CTA enables firms to expand by increasing their input use. However, the coefficient remains positive and significant, suggesting that part of the effect operates through higher TFPR rather than input expansion alone. The estimates (panel 1, column 4) indicate that a firm moving from the 25^{th} percentile to the 75^{th} percentile of tax avoidance increases its sales by 15.7%.[26]

4.3 Robustness of the results

Establishing the causal impact of tax avoidance on sales is central to our analysis. We conduct a series of robustness tests to ensure that our findings are not driven by omitted variables or by alternative measures of tax avoidance. The results, presented in Figure 2, are discussed below. This figure presents the second-stage coefficients of the HS gap variable unless otherwise specified.[27] Additionally, we propose two alternative identification strategies using event studies to further validate our findings.

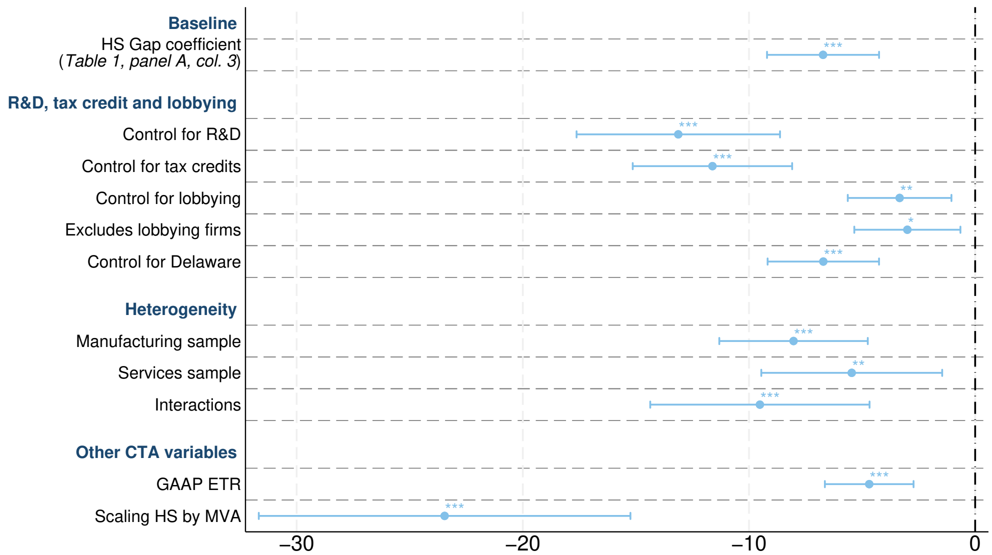
R&D and lobbying activities. We first address potential confounding effects from R&D expenditures, and lobbying (top of Figure 2). Since R&D investment can increase both sales and tax savings, we test whether our results hold when we control for lagged R&D expenditures. The results remain unchanged, confirming that tax avoidance affects sales beyond any indirect effects through R&D incentives.[28] We also construct a tax credit indicator based on the investment tax credit and introduce a dummy for firms receiving such credits. If tax credits explain heterogeneity in tax avoidance, this could alter the interpretation of our findings. The results remain robust, confirming that tax credits do not drive the relationship between tax avoidance and sales.

Arayavechkit et al. (2018) show that firm size and tax avoidance are positively correlated with lobbying activity. Using lobbying data from Kim (2018), we construct an indicator for

[26] Tables D.3 to D.7 present the full tables including covariates, which shows the following relationships: Firms with a higher share of intangibles report higher sales, consistent with Crouzet and Eberly (2019) and Autor et al. (2020). Multinational firms generate significantly higher sales than domestic firms, in line with Antràs and Yeaple (2014). Last, acquisition has a positive impact on sales.

[27] The results remain consistent when using alternative CTA definitions.

[28] Using contemporaneous R&D expenses does not alter the results: an increase in tax avoidance still positively affects sales.



Notes: Unless stated otherwise, the robustness tests use the HS gap as the CTA variable. The specification includes controls for the share of intangibles, an acquisition dummy, and multinational status, as well as sector-year fixed effects.

Figure 2: Sensitivity analysis

firms lobbying on taxation or the Internal Revenue Code. Lobbying firms tend to be larger than non-lobbying firms, but lobbying does not affect the causal relationship between CTA and sales. Moreover, lobbying has no impact on CTA levels, and including the lobbying dummy does not alter the effect of residual audit probability on aggressive tax planning. To further assess this, we restrict the sample to non-lobbying firms and find that the causal effect of tax avoidance on sales remains unchanged.

Other sensitivity analyses. We conduct additional tests to assess the robustness of the causal relationship between tax avoidance and sales and summarize our key findings below. We examine the role of Delaware incorporation, which provides legal and governance benefits but also serves as a tax strategy to lower state tax burdens (Dyreng et al., 2013). Including a Delaware incorporation indicator in our regressions confirms that state-level tax planning does not influence our results. We also examine heterogeneity in the impact of tax avoidance on sales across sectors and firms. The positive effect is robust in both manufacturing and services and is magnified for firms with high intangible assetss intensity, as shown in a specification including an interaction term.[29] To test the robustness of our results to alternative tax avoidance measures, we first replace ETR with GAAP ETR and then scale the HS gap by market value of assets instead of book value. The results remain consistent across these specifications.

4.4 Alternative Identification Strategies

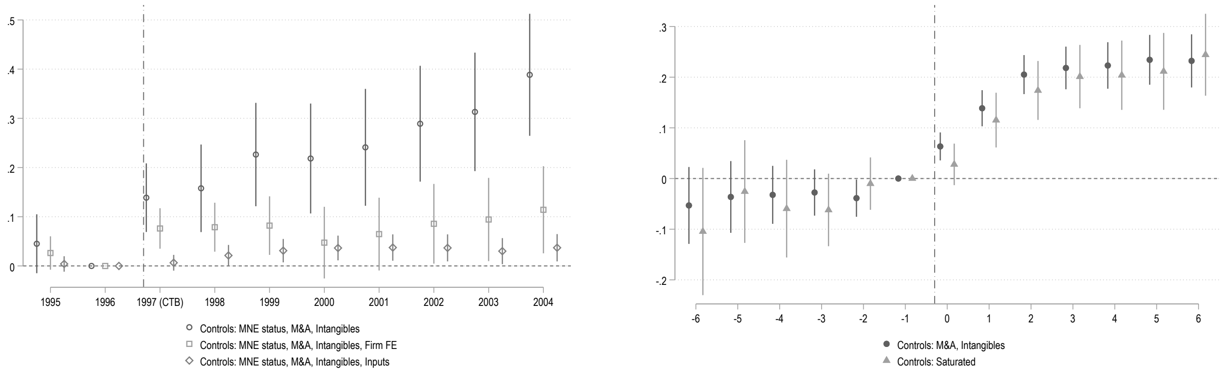
We establish the robustness of the causal impact of tax avoidance on sales using two event studies. Appendix E provides details on data construction and empirical implementation.

The first event study exploits the 1997 check-the-box (CTB) regulation, which allowed U.S. firms to classify foreign subsidiaries as either corporations or pass-through entities. This policy enabled hybrid tax planning by allowing firms to exploit mismatches in entity classification across jurisdictions, effectively avoiding taxation. We focus on firms utilizing the Double Irish with a Dutch Sandwich or Reverse Hybrid Mismatch structure, as these were directly affected by CTB (Altshuler et al., 2024). The event study framework tests for pre-trends and isolates the CTB effect from broader macroeconomic fluctuations.

The second event study introduces an alternative strategy that does not rely on policy changes but instead leverages firms' endogenous decisions to engage in tax planning. Establishing subsidiaries in conduit countries or low-tax jurisdictions is a central tax avoidance strategy, reducing firms' effective tax rates. To measure its impact on sales, we employ a staggered difference-in-differences design. Firms are grouped into cohorts based on their entry year into a tax haven, and we track sales trajectories before and after entry. Firms that never establish a presence in a tax haven serve as a control group. This approach allows us to identify the causal effect of tax haven entry on sales while ensuring that the results are not confounded by fixed policy timing.

Figure 3 summarizes the estimated effects of tax avoidance on firm sales. Panel (a) confirms that the CTB regulation led to a significant increase in sales for firms engaged in

[29] In unreported regression, we further show that the effect of CTA on sales is stronger in downstream industries, which suggests that firms may have more rooms to adjust the price and/or appeal of the products in these industries.



(a) Effect of CTB on firm-level sales (b) Effect of entry into tax havens on firm sales

Figure 3: Effects of tax avoidance strategies on firm sales

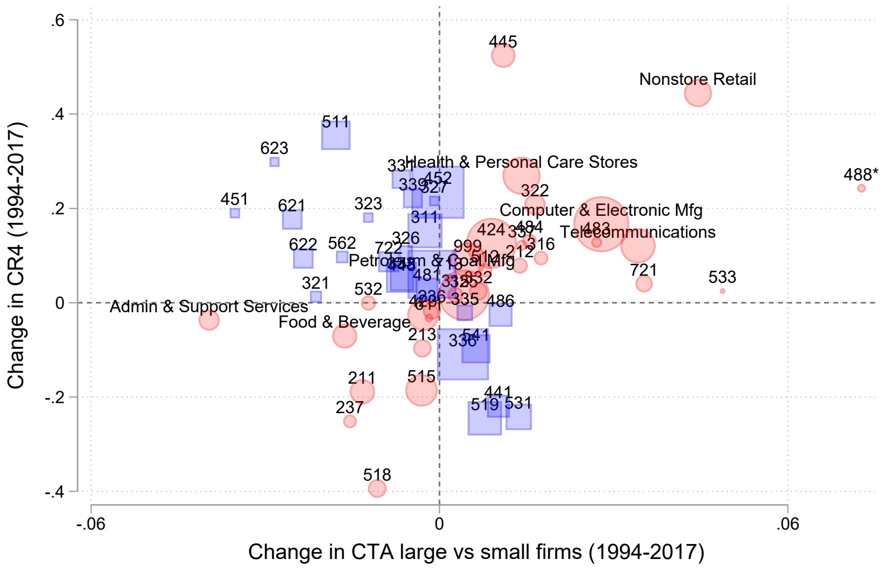
hybrid tax planning. The event-study framework detects no systematic differences between treated and control firms before 1998, validating the parallel trends assumption – only two years of pre-treatment data are available before CTB was enacted. The post-treatment effects show a clear upward trajectory, indicating that firms benefiting from CTB-driven tax planning experienced increased sales.

Panel (b) presents the dynamic effects of entry into tax havens. Pre-treatment coefficients remain close to zero, confirming that firms entering tax havens did not differ systematically from non-entrants before the event. After entry, the coefficients become positive and statistically significant, showing that firms expanding into tax havens report higher sales. The effect persists across specifications that control for firm characteristics and sector-specific trends, reinforcing the conclusion that tax avoidance strategies contribute to firm sales.

5 Impact of tax avoidance on concentration

5.1 Preliminary evidence

Having established the causal effect of tax avoidance on sales, we examine its implications for industry concentration. The theory predicts that higher CTA among the largest firms increases concentration, while a relative rise in CTA among the smallest firms reduces it. Figure 4 illustrates the correlation between changes in CTA for large versus small firms and changes in industry concentration.



Notes: Changes in CTA of large vs small firms between 1994 and 2017 (a positive value means that CTA of top4 firms increased relative to smaller ones) against changes in the CR4 ratio between 1994 and 2017. Symbols are either circles when the change in CTA aligns with the change in concentration, or squares when they don't. The size of the symbol is proportional to the size of the 3-digit NAICS industry. * For support activities for transportation (NAICS 488), the change in CTA has been scaled down by a factor of two to improve readability.

Figure 4: Tax avoidance and industry concentration (1994-2017)

For each NAICS 3-digit sector, we plot the change in CTA of the four largest vs. smallest firms against the change in industry concentration between 1994 and 2017.

Our analysis reveals that in roughly 55% of industries, accounting for 55% of total sales, changes in tax avoidance and industry concentration move in the same direction (red circles, NE and SW quadrants). In 36% of industries accounting for 42% of sales, including sectors such as non-store retail, telecommunications, and electronics manufacturing, increased tax avoidance by large firms is associated with rising concentration (NE quadrant). In 19% of industries accounting for 13% of sales, such as administrative and support services, declining tax advantages for large firms coincide with falling concentration (SW quadrant).

In the remaining 45% of industries, CTA appears to influence concentration, but other forces offset its effects (blue squares, NW and SE quadrants). For example, in petroleum and coal products, concentration has risen despite a slight decline the CTA of large relative to small firms. Conversely, in food and beverage retail, concentration has increased substantially, while CTA of small vs large firms has been stable.

This discussion is qualitative and intended to illustrate broad patterns. The next sections present quantitative results using the estimated impact of CTA on sales and the model.

5.2 Methodology

We build on the insights of our theoretical model and use the estimated semi-elasticity of CTA firms' sales (Table 1, panel A, column 4) to assess the quantitative impact of tax avoidance on the distribution of sales. To do so, we compute the counterfactual level of industry concentration in 1994 if firms resorted to their CTA strategy of 2017. This experiment is a way to single out the contribution of CTA to the 1994-2017 change in industry concentration.

Firm i's counterfactual level of sales can be written as $\hat{s}_i = z(\varphi_i) \times \tau(\hat{\theta}_i) \times \hat{\kappa}$ with τ capturing the impact of CTA on sales, $z(\varphi_i)$ the element related to firm productivity, and κ the sector-specific variables such as the sectoral demand or price index. Using the relation between $z(\varphi_i)$ and the sales s_i, firm i's counterfactual sales and its market share can be expressed as a function of observed sales and change in CTA:

$$\begin{aligned} \hat{s}_i &= \frac{\tau(\hat{\theta}_i)}{\tau(\theta_i)} \times \frac{\hat{\kappa}}{\kappa} \times s_i \\ \Leftrightarrow \frac{\hat{s}_i}{\sum_j \hat{s}_j} &= \frac{\tau(\hat{\theta}_i)/\tau(\theta_i) \times s_i}{\sum_j \tau(\hat{\theta}_j)/\tau(\theta_j) \times s_j}. \end{aligned} \tag{6}$$

Note the counterfactual market share of firm i in equation (6) - unlike the counterfactual *level* of sales - does not depend on the counterfactual price index. It only depends on (observed) individual sales s_i and the impact of a change in tax avoidance on sales $\tau(\hat{\theta}_i)/\tau(\theta_i)$, which is backed out from the observed change in tax avoidance and the sensitivity of tax avoidance to sales estimated in Table 1.

We do not observe the level of avoidance of each firm in 1994 and 2017 because of attrition. To address this challenge, we consider the sales of the four largest firms in each industry in

1994 and their level of tax avoidance in 1994 and 2017. We use expression (6) to compute the counterfactual levels of CR4 (the combined market share of the four largest firms within an industry) across U.S. industries:

$$\widehat{CR4} = E(CR4_{2017}|Avoid = Avoid^{2017}, \varphi^{1994}) \ .$$

The deviation of the counterfactual from the observed CR4 in 1994: $\Delta_c = \widehat{CR4} - CR4_{1994}$ provides information on the change in concentration measured by the CR4 in 2017 had firms only changed their CTA strategy between 1994 and 2017 while maintaining their productivity constant.

5.3 Results

Table 2 reports observed concentration ratios, their changes between 1994 and 2017 ($\Delta_o = CR4_{2017} - CR4_{1994}$), counterfactual changes in concentration ratios (Δ_c), and the contribution of these counterfactual changes to observed trends (Δ_c/Δ_o).[30]

Table 2: Evolution of observed and counterfactual industry concentration (values in %)

	NAICS code	Weight	CR4 (1994)	Δ_o	Δ_c	Δ_c/Δ_o
561	Administrative and Support Services	1,0%	40,4%	-3,7%	-4,6%	124,9%
325	Chemical Manufacturing	6,7%	31,1%	1,6%	0,5%	28,0%
517	Telecommunications	3,1%	77,6%	11,9%	2,8%	23,4%
334	Computer and Electronic Product Manufacturing	8,1%	25,5%	16,6%	2,7%	16,3%
312	Beverage and Tobacco Product Manufacturing	1,5%	86,0%	-7,0%	-1,0%	14,1%
454	Nonstore Retailers	1,9%	45,4%	44,5%	5,5%	12,3%
423	Merchant Wholesalers, Durable Goods	2,5%	34,8%	-2,6%	-0,3%	12,1%
322	Paper Manufacturing	1,0%	44,8%	20,8%	2,0%	9,6%
424	Merchant Wholesalers, Nondurable Goods	6,6%	54,4%	12,6%	1,1%	8,7%
211	Oil and Gas Extraction	1,5%	54,4%	-19,0%	-1,6%	8,4%
446	Health and Personal Care Stores	3,6%	68,5%	26,9%	1,5%	5,5%
445	Food and Beverage Stores	1,4%	42,3%	52,4%	1,3%	2,5%
999	Nonclassifiable Establishments	3,1%	90,6%	9,1%	0,2%	2,2%

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[30]Our analysis suggests that different measures yield consistent results. The correlation between the observed changes in CR4, CR5, and CR3 is approximately 98%. The predicted change in CR4 correlates with the predicted changes in CR3 and CR5 at 66% and 96%, respectively.

Table 2 – *Continued from previous page*

	NAICS code	Weight	CR4 (1994)	Δ_o	Δ_c	Δ_c/Δ_o
515	Broadcasting (except Internet)	2,6%	84,4%	-18,6%	-0,2%	1,1%
452	General Merchandise Stores	6,8%	62,9%	23,5%	0,0%	-0,1%
519	Other Information Services	2,7%	99,0%	-24,5%	0,0%	-0,2%
311	Food Manufacturing	2,8%	35,1%	15,3%	-0,3%	-1,8%
324	Petroleum and Coal Products Manufacturing	5,7%	70,1%	6,0%	-0,1%	-2,2%
336	Transportation Equipment Manufacturing	6,5%	67,0%	-10,9%	0,4%	-4,0%
441	Motor Vehicle and Parts Dealers	1,1%	73,6%	-22,0%	1,0%	-4,4%
511	Publishing Industries (except Internet)	1,9%	26,2%	35,5%	-1,7%	-4,7%
481	Air Transportation	1,1%	79,5%	2,9%	-0,2%	-5,8%
531	Real Estate	1,5%	43,4%	-24,2%	1,7%	-6,8%
541	Professional, Scientific, and Technical Services	1,9%	41,0%	-9,8%	0,8%	-7,7%
333	Machinery Manufacturing	2,1%	35,4%	5,4%	-0,7%	-13,7%
448	Clothing and Clothing Accessories Stores	1,3%	46,2%	5,0%	-0,8%	-15,8%
486	Pipeline Transportation	1,2%	75,4%	-2,6%	0,9%	-37,0%

Notes: Industry weights correspond to their share of total sales in Compustat in 2017. CR4 denotes the observed concentration ratio in 1994. Δ_c and Δ_o represent, respectively, the change in predicted concentration based on changes in CTA and the change in observed concentration, as defined in the main text. Only sectors accounting for more than 1% of total sales are shown.

The exercise shows that rising tax avoidance by large firms accounts for 10% to 25% of the observed increase in concentration in sectors such as chemical manufacturing, telecommunications, nonstore retail, and merchant wholesale. This result is consistent with existing evidence. In the nonstore retail sector, for instance, Amazon's ability to avoid corporate and sales taxes has reinforced its competitive advantage. Baugh et al. (2018) document how sales-tax avoidance favored online retailers over brick-and-mortar firms, a pattern that parallels the corporate tax dynamics captured in our analysis.

Tax avoidance, however, is not the sole driver of concentration in these industries. While aggressive tax planning by firms like Apple and Amazon likely disadvantaged competitors, their expansion also reflects substantial innovation and scale economies. Accordingly, the predicted changes in concentration remain well below the observed ones, underscoring that CTA is a contributing but not the dominant force.

In some industries, predicted and observed changes move in opposite directions. For pipeline transportation, clothing, and machinery manufacturing, the counterfactual change accounts for –37%, –16%, and –14% of the observed trend, respectively. These cases reflect shifts in CTA among smaller firms that did not translate into greater concentration.

Finally, several industries, such as general merchandise, information services, food manufacturing, and motor vehicle retail, exhibit large changes in observed concentration but near-zero counterfactual shifts. In these sectors, tax behavior between small and large firms has remained stable, suggesting that other factors have driven the observed changes in concentration.

As shown in Figure 4, U.S. industries have experienced highly heterogeneous changes in concentration, ranging from a 52% increase in food and beverage retail to a 25% decline in information services. To further assess the role of CTA in shaping the distribution of sales within sectors, we regress the observed change in concentration (Δ_o) on the predicted change (Δ_c) implied by shifts in CTA between large and small firms. The coefficient of determination from this regression indicates the extent to which cross-industry variation in the changes in CTA between large and small firms can account for differences in concentration changes across U.S. industries.

We implement this regression across three measures of concentration: CR3, CR4, and CR5. The results, reported in Table 3, yield R^2 values between 9.45% and 13.24%, suggesting that differences in CTA behavior account for a nontrivial share of the variation in concentration trends across industries. This confirms the role of CTA in shaping the distribution of sales in U.S. industries.

Table 3: Explanatory power of CTA in changes in industry concentration

	Changes in:		
	CR3	CR4	CR5
$\Delta CR\ counterfactual$	3.44**	3.06**	3.45***
	(1.47)	(1.43)	(1.25)
# obs.	52	52	52
R^2	9.47%	9.45%	13.24%

The dependent variable is the change in the observed concentration ratio (CR4, CR3 or CR5) between 2017 and 1994. The explanatory variable is the predicted change in the concentration ratio, based on the observed change in corporate tax avoidance of large vs smaller firms over the period. R^2 are obtained from a weighted regression where industries are weighted based on their aggregate sales.

6 Conclusion

This study provides compelling evidence of the causal impact of tax avoidance and firm-level sales. We demonstrate that tax avoidance gives a competitive edge to firms that engage in it. In several industries, CTA has increased more for larger than smaller firms, reinforcing their dominant position and increasing concentration. Overall, changes in tax avoidance of large relative to small firms can account for about 10% of the variation in concentration across U.S. industries between 1994 and 2017.

Our results have important implications for tax and competition policy, highlighting the interdependence of these policies. We demonstrate that the enforcement of corporate tax policy can help curb industry concentration in industries where dominant firms have the most aggressive tax strategies, and that laxer tax enforcement has distorted sales in favor of tax-avoiding firms. The European Commission's rulings against tax breaks given to Apple, Fiat, Amazon, and Starbucks further underscore the need for coordinated tax policies to ensure fair competition within the European Union.[31]

Our study has broad implications for any reform of international taxation that changes the relative tax position of small and large firms, as such reforms could significantly impact firms' sales distribution and, thereby, real output. Our findings suggest that tax policy should be part of competition policy and that policymakers must work towards coordinated tax policies to ensure a level playing field for all firms.

[31] According to Commissioner Margrethe Vestager, "We have to continue to use all tools at our disposal to ensure companies pay their fair share of tax (· · ·) If Member States give certain multinational companies tax advantages not available to their rivals, this harms fair competition in the European Union in breach of state aid rules." (The European Commission, 2020).

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Appendix

A Theory

A.1 Micro-founding tax avoidance

Our reduced-form modeling of tax planning is consistent with perfectly-legal loopholes or even fiscal incentives designed to encourage investment. It also aligns with various profit-shifting techniques across affiliates in different jurisdictions. While the exact channel through which firms reduce their tax burden is not relevant per se, it should be noted that our instrument strategy captures practices whose legality is at least debatable, e.g., profit-shifting techniques through transfer pricing. Generally, a tax-avoiding firm may manipulate the value of intra-firm transactions (transfer pricing) to shift their tax base to low-tax jurisdictions.[32]

We detail three cases below. A profit-shifting firm may i) inflate costs by importing from an affiliate located in a low or zero tax jurisdiction a good or service beyond its "arm's length" ii) borrow from an affiliate in a tax haven, and deduct interest payments in the non-haven country while declaring them in a tax haven where they are not taxed iii) locate their intangible assetss (e.g., intellectual property) in tax havens.

Transfer pricing. A common practice that firms adopt to shift profits to a low-tax jurisdiction is to inflate the costs of inputs (p^I) sourced from their affiliates in tax havens. Without loss of generality, we can assume taxes are almost nil in tax havens; that is, $t^H \approx 0$, and inputs are produced at almost no cost. Firm profits then read:

$$\pi_i = (1-t^s)\left(p_i - p^I - \varphi_i^{-1}\right) q_i(p_i) + p^I q_i(p_i)(1-t^H) .$$

Simplifying, we get

$$\pi_i = \left(p_i - \varphi_i^{-1}\right) q_i(p_i) - t^s \left(p_i - \varphi_i^{-1}\theta_i\right) q_i(p_i) ,$$

where $\theta_i = 1 + \varphi_i p^I$.

If the profit-maximizing transfer price results from a trade-off between a lower effective tax rate and a concealment cost, θ can be endogeneized as in Davies et al. (2018). When large firms benefit from scale economies in their tax planning, $\theta(\varphi)$ increases with firm productivity, so large firms deviate more from the arm's-length price than small firms. A similar argument can be made if firms instead manipulate their export prices to foreign affiliates in tax havens downward.

Debt shifting In the spirit of Mintz and Smart (2004), capital is the sole factor of production. Technology is linear, and capital productivity is equal to φ. One affiliate in a tax haven may lend for free to the parent firm in a non-haven. We assume no outside debt can be issued so that the deduction in the non-haven corresponds exactly to the interest payments declared in the tax haven. We denote $b_i > 0$, the per-unit interest payment of capital in

[32] Note that low and high tax jurisdictions may coexist in one country: the discussion below does not imply that the bulk of tax avoidance is international rather than domestic.

the non-haven country. Overall, the firm uses q_i/φ_i units of capital so that total interest payments amount to $b_i\varphi_i^{-1}\varphi_i^{-1}q_i$. Firms' profits are then given by:

$$\pi_i = (1-t^s)\left(p_i - \varphi_i^{-1}\right)q_i + t^s b_i\varphi_i^{-1}q_i - t^H b_i\varphi_i^{-1}q_i \ ,$$

where t^H is the corporate tax rate in the tax haven. This leads back to our baseline equation with $\theta_i = \frac{t^s - t^H}{t^s}b_i$. In the absence of taxation in the tax haven, that is, $t^H = 0$, θ_i comes down to the per-unit interest payment b_i. As in Mintz and Smart (2004), b_i may be endogeneized, assuming borrowing is costly. In that case, firm size and profit shifting would be co-determined by φ_i.

Investment in intangibles. Firms can invest in some intangible f to decrease their marginal cost of production, now written $\varphi^{-1}c(f)$, where $c_f < 0$, in the non-haven country. The tax-deducted share of this investment f is denoted γ. Absent profit-shifting motives, the investment is denoted f_0. The firm's profits are thus given by

$$\pi_i = \left(p_i - \varphi^{-1}c(f_0)\right)q_i(p_i) - f_0 - t^s\left(p_i - \varphi^{-1}c(f_0)\right)q_i(p_i) + t\gamma f_0 \ .$$

.

Now, assume the cost f is borne in a tax haven in the form of the production of an intangible that is not taxed. Assume, moreover, that this intangible may be imported at an inflated cost $\delta f > f$. The above equation becomes:

$$\pi_i = \left(p_i - \varphi^{-1}c(f)\right)q_i(p_i) - f - t^s\left(p_i - \varphi^{-1}c(f)\right)q_i(p_i) + t^s\delta\gamma f \ .$$

Firms decide on their prices and investment to maximize their profits. Taking the first-order conditions with respect to f_0 and f, respectively, the optimal investments f and f^* with and without tax avoidance are related by

$$\frac{c_f(f^*)}{c_f(f_0^*)} = \frac{1-t^s\gamma\delta}{1-t^s\gamma} < 1 \ .$$

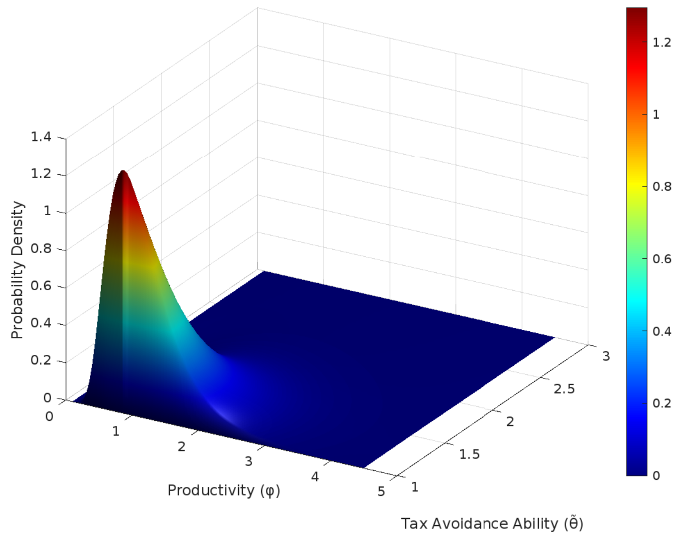
It follows that firms engaged in profit shifting invest more $f^* > f_0^*$ with f^* so that their equilibrium productivity is higher, consistent with the competitive edge put forward in our baseline model.

A.2 Tax avoidance and concentration

As explained in the text, we enhance the canonical setup by considering a bivariate distribution of productivity and tax avoidance abilities. These abilities $(\varphi, \tilde{\theta})$ are such that $(\ln(\varphi), \ln(\tilde{\theta}-1))$ follow a bivariate Gaussian with means $(\mu_\varphi, \mu_\theta)$ and standard deviations $(\sigma_\varphi, \sigma_\theta)$ and correlation ρ (See Figure A.1: More productive firms tend to have greater tax avoidance ability, though such firms remain relatively infrequent in the distribution.). Without loss of generality, we assume that $\mu_\varphi = 0$ to alleviate expressions.

Importantly, the resulting sales distribution retains a single parameter - ρ - to govern the correlation between attributes, and its moments can be easily characterized. While ρ is not the correlation between the two variables, it still governs it. The case of independent draws

Figure A.1: Joint distribution of productivity and avoidance ability



is still obtained for $\rho = 0$. Denoting $Z = (\varphi\tilde{\theta})^{\sigma-1}$, the k^{th} moment is given by

$$E[Z^k] = \sum_{i=0}^{k(\sigma-1)} \binom{k(\sigma-1)}{j} \exp\left(j\mu_\theta + \frac{k^2(\sigma-1)^2\sigma_\varphi^2 + j^2\sigma_\theta^2 + 2k(\sigma-1)j\rho\sigma_\varphi\sigma_\theta}{2} \right) \qquad (7)$$

where σ is assumed to be an integer and $\binom{}{}$ is the binomial coefficient.

Industry concentration may be captured by the generalized entropy index. For a large number of firms N and using the law of large numbers, we can write as:

$$GE(\alpha) \approx \frac{1}{\alpha(\alpha-1)} \left(N^\alpha \cdot \mathbb{E}[s^\alpha] - 1 \right) .$$

The larger α the more sensitive the index is to large firms. This index boils down to the Herfindahl index when $\alpha = 2$. It is also related to the Atkinson index (see Mayer et al. (2021) for an application to the skewness of a firm product portfolio). Using that the market share of firm i simplifies to

$$s_i(\boldsymbol{\varphi}, \boldsymbol{\theta}) \approx \frac{(\varphi_i\tilde{\theta}_i)^{\sigma-1}}{N\mathbb{E}[(\varphi\tilde{\theta})^{\sigma-1}]} ,$$

we see that a uniform facilitation in tax avoidance $\tilde{\theta}$ across firms has no impact on the GE index as it would leave market shares unchanged. When $\alpha \cdot (\sigma - 1)$ is large, the index is then entirely determined by the dispersion and correlation parameters of the productivity and tax avoidance variables. To see this, take the first-order approximation of the entropy index $GE(\alpha)$ when $\alpha(\sigma-1)$ is large. Using (7) and noting that the highest-order term in the α^{th} moment of the sales distribution impacting ρ is proportional to $\alpha^2(\sigma-1)^2$ we obtain:

$$GE(\alpha) \approx \frac{1}{\alpha(\alpha-1)} \left(e^{\frac{(\alpha^2-\alpha)(\sigma-1)^2}{2}(\sigma_\varphi^2+\sigma_\theta^2+2\rho\sigma_\varphi\sigma_\theta)} - 1 \right) .$$

This demonstrates that when the concentration index gives significant importance to large companies ($\alpha > 1$), the correlation between tax avoidance capability and productivity consistently boosts the concentration index.

B Variable definitions and calculations

Table B.1: Variable definitions and calculations

Variable	Description	Calculation
ETR	Effective Tax Rate	ETR is computed as the ratio of cash taxes paid ($TXPD$) to pre-tax book income (PI). We compute ETR for the full sample to avoid restricting the analysis to firms reporting positive profits.[33] To account for special cases, we apply three adjustments. First, when the computed ETR exceeds 1 while the firm reports positive pre-tax income, we cap the rate at 1. Second, for firms that pay taxes despite reporting losses, we set ETR to 1, as these firms are not tax avoiders. Third, when firms receive subsidies while earning positive profits, we set ETR to 0, reflecting that they benefit from tax advantages.
HS Gap	Henry and Sansing (2018) HS gap	The HS Gap measures the deviation between the actual taxes paid ($TXPD$) and the amount that would have been paid if pre-tax financial income (PI) were taxed at the statutory rate (τ). It is defined as :$HSGap = \frac{TXPD - \tau PI}{BVA}$, where τ is the statutory tax rate, set at 35%, and BVA is the book value of assets. In some specifications, we use the market value of assets (MVA) as an alternative scalar.
HS Indicator	Binary Indicator for the HS gap	This indicator equals 1 when the HS gap is negative i.e., when cash taxes paid are lower than expected, and 0 otherwise
Perm BTD	Estimated permanent book-tax differences	Difference between total book-tax differences and temporary book-tax differences. Total book-tax differences is computed as: [Pre-Tax Income (PI) - Minority Interest (MII)] - [Current Tax Expense ($TXFED$) + Current Foreign Tax Exp ($TXFO$)]/Statutory Tax Rate - DNOL ($TLCF$). If $TXFED$ is missing, Current Tax Expense = [Total Tax Expense (TXT) - Foreign Tax Expense ($TXFO$) - State Tax Expense (TXS) - Deferred Tax Expense ($TXDI$)]. Temporary book-tax differences is computed as [Deferred Tax Expense ($TXDI$)/Statutory Tax Rate].
TS Residual	Tax sheltering residual	Residuals from Equation (12) in (Desai and Dharmapala, 2006b): $BT_{it} = \beta_1 TA_{it} + \mu_i + \varepsilon_{it}$, where BT_{it} is the book-tax gap for firm i in year t, scaled by the lagged value of assets. TA_{it} is total accruals for firm i in year t, also scaled by the lagged value of assets. μ_i represents firm fixed effects, and ε_{it} is the error term. The tax sheltering residual is defined as: TS_{it} where $TS_{it} = \mu_i + \varepsilon_{it}$. Total accruals are calculated as income before extraordinary items (IBC) plus total tax expense (TXT) less the sum of cash flows from operating activities (OANCF) and cash taxes paid (TXPD) adjusted for extraordinary items and discontinued operations (XIDOC).

Table B.2: Summary statistics by sample

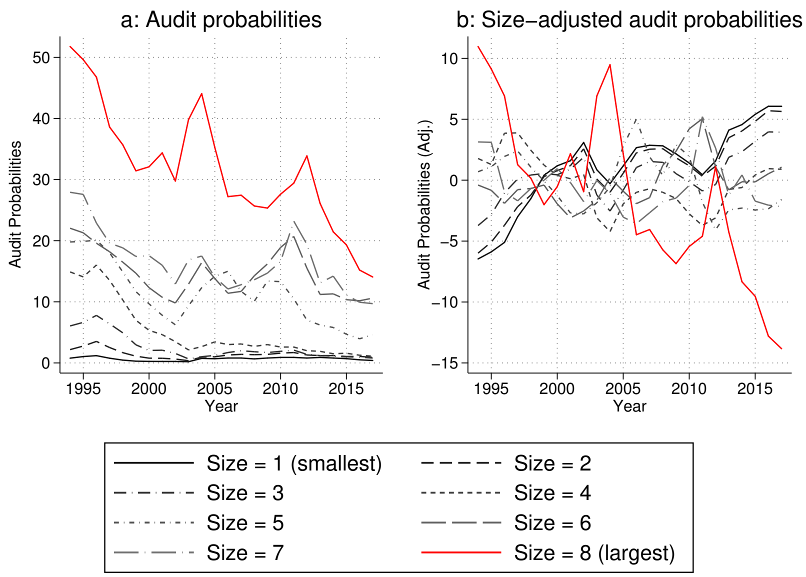
Variable	Panel A Full Sample					Panel B Estimation Sample				
	p10	p25	p50	p75	p90	p10	p25	p50	p75	p90
ETR	0.000	0.029	0.268	0.813	1.000	0.000	0.086	0.294	0.761	1.000
HS Gap	-0.028	-0.012	0.001	0.030	0.134	-0.027	-0.013	-0.001	0.018	0.065
HS indicator	0.000	0.000	0.000	1.000	1.000	0.000	0.000	1.000	1.000	1.000
Perm. BTD	-0.482	-0.065	0.003	0.028	0.088	-0.236	-0.034	0.004	0.027	0.079
TS residual	0.363	0.745	0.821	0.888	1.045	0.585	0.773	0.827	0.896	1.054
GAAP ETR	0.000	0.069	0.342	0.408	1.000	0.000	0.204	0.355	0411	1.000
HS Gap (MVA)	-0.016	-0.007	0.001	0.020	0.073	-0.016	-0.008	0.000	0.012	0.049

Notes: The table reports the 10th, 25th, 50th, 75th, and 90th percentiles for each outcome. The full sample in Panel A includes all firm-year observations for U.S.-incorporated, publicly listed, industrial firms that report consolidated financial statements in U.S. dollars under a standardized format. The sample excludes subsidiaries and retains only firms with strictly positive and non-missing values for key financial variables: total sales, profits, taxes paid, total assets, and market value of assets. We eliminate utilities and financial firms. The estimation sample in Panel B corresponds to the regression samples used in Section 4.2. The variables *HS Gap*, *Perm. BTD*, *TS residual*, *GAAP ETR* and *HS Gap (MVA)* are winsorized at the 1^{st} and 99^{th} percentiles by fiscal year.

C Audit probability

Audit probabilities. The IRS annual Data-Books disclose data to compute the average audit probability for each of the eight asset brackets across our sample period. We compute the audit probability as the number of corporate tax return audits completed in the IRS's fiscal year t for an IRS asset bracket divided by the number of corporate tax returns received in the previous calendar year for the same IRS asset bracket. The size-adjusted audit probabilities are the residuals from a regression of raw probabilities on year and asset-bracket fixed effects. The residuals provide information on the deviations from the predicted average audit probability within each year.

Figure C.2: Size-adjusted audit probabilities by asset class



The left panel of Figure C.2 shows the evolution of the audit probabilities as computed using the raw IRS disclosed data. It shows that the probability of an IRS audit has dropped for larger firms in the U.S. but remained relatively constant for the smallest firms. The drop in the audit probability for the smallest firms reporting in the first IRS asset bracket between 1994 and 2017 is 0.4%, whereas it is over 37% for the largest firms. In panel (b), we display the evolution of the adjusted audit probabilities. It shows a relative decline in the size-adjusted audit probabilities in the eighth brackets of assets from 1994 to 2017. The value of assets reported by firms in this class amount to \$250,000,000 or more and corresponds to the largest firms. However, the decline in the adjusted probabilities is not linear across years, with large variations in the early 2000 and 2010.

D Full tables

Table D.3: Sales and tax avoidance – HS gap (OLS and 2SLS estimates)

	Baseline						Augmented Baseline		
	OLS		2SLS				OLS	2SLS	
			1^{st} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage		1^{st} Stage	2^{nd} Stage
HS Gap	-3.249***	-0.862***		-6.726***		-4.923***	-1.363***		-3.414***
	(0.184)	(0.075)		(1.264)		(1.805)	(0.082)		(0.445)
Share of Intangible	0.864***	0.889***	-0.012***	0.813***	-0.029***	0.766***	0.124***	-0.001	0.119***
	(0.091)	(0.048)	(0.004)	(0.093)	(0.006)	(0.072)	(0.014)	(0.003)	(0.014)
MNE Status	1.231***	0.324***	-0.018***	1.170***	-0.000	0.323***	0.015***	-0.001	0.013**
	(0.036)	(0.020)	(0.001)	(0.042)	(0.001)	(0.020)	(0.006)	(0.001)	(0.006)
Acquisition	0.827***	0.117***	-0.013***	0.782***	-0.003***	0.107***	0.007**	-0.005***	-0.003
	(0.027)	(0.007)	(0.001)	(0.030)	(0.001)	(0.008)	(0.003)	(0.001)	(0.004)
Employment							0.286***	-0.005***	0.276***
							(0.007)	(0.001)	(0.007)
Capital							0.067***	-0.006***	0.055***
							(0.004)	(0.001)	(0.004)
Material							0.658***	0.004***	0.666***
							(0.007)	(0.001)	(0.007)
Adj. Audit Proba			0.003***		0.001***			0.001***	
			(0.000)		(0.000)			(0.000)	
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	Yes	No	No	No
Obs.	78,487	77,376	78,487	78,487	77,376	77,376	68,888	68,888	68,888
Firms	9,679	8,571	9,679	9,679	8,571	8,571	8,507	8,507	8,507
Adj. R^2	0.406	0.938	0.0491		0.471		0.978	0.0904	
KP F-stat.				80.77		20.63			74.56

Sample years: 1994-2017. The dependent variable is the firm's log sales. OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. First-stage Kleibergen-Paap Wald F statistic reported. ***, **, and * significantly different from 0 at the 1%, 5%, and 10% confidence levels, respectively.

Table D.4: Sales and tax avoidance – ETR (OLS and 2SLS estimates)

	Baseline						Augmented Baseline		
	OLS		2SLS				OLS	2SLS	
			1^{st} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage		1^{st} Stage	2^{nd} Stage
ETR	-0.359***	-0.027***		-4.701***		-1.308***	-0.109***		-1.211***
	(0.026)	(0.008)		(1.044)		(0.495)	(0.006)		(0.197)
Sh. of Intangible	0.950***	0.920***	0.112***	1.420***	0.165***	1.124***	0.138***	0.100***	0.243***
	(0.093)	(0.048)	(0.013)	(0.151)	(0.018)	(0.097)	(0.015)	(0.014)	(0.027)
MNE Status	1.304***	0.325***	0.044***	1.494***	0.042***	0.380***	0.023***	0.062***	0.092***
	(0.037)	(0.020)	(0.004)	(0.061)	(0.007)	(0.030)	(0.006)	(0.005)	(0.015)
Acquisition	0.859***	0.120***	-0.030***	0.727***	-0.001	0.119***	0.012***	-0.018***	-0.009
	(0.027)	(0.007)	(0.004)	(0.041)	(0.004)	(0.008)	(0.003)	(0.004)	(0.006)
Employment							0.291***	-0.014***	0.276***
							(0.007)	(0.004)	(0.008)
Capital							0.073***	-0.015***	0.057***
							(0.004)	(0.003)	(0.006)
Material							0.653***	0.009***	0.663***
							(0.007)	(0.003)	(0.008)
Adj. Audit Proba.			0.004***		0.003***			0.004***	
			(0.001)		(0.001)			(0.001)	
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	Yes	No	No	No
Obs.	78,486	77,375	78,486	78,486	77,375	77,375	68,888	68,888	68,888
Firms	9,679	8,571	9,679	9,679	8,571	8,571	8,507	8,507	8,507
Adj. R^2	0.377	0.937	0.0503		0.232		0.975	0.0488	
KP F-stat.				48.89		32.17			53.35

Sample years: 1994-2017. The dependent variable is the firm's log sales. OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. First-stage Kleibergen-Paap Wald F statistic reported. ***, **, and * significantly different from 0 at the 1%, 5%, and 10% confidence levels, respectively.

Table D.5: Sales and tax avoidance – HS indicator (OLS and 2SLS estimates)

	Baseline						Augmented Baseline		
	OLS		2SLS				OLS	2SLS	
			1^{st} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage		1^{st} Stage	2^{nd} Stage
HS Indicator	0.562***	0.070***		2.838***		0.945***	0.127***		0.866***
	(0.020)	(0.006)		(0.545)		(0.343)	(0.004)		(0.128)
Share of Intangible	0.960***	0.926***	-0.093***	1.155***	-0.165***	1.064***	0.139***	-0.091***	0.201***
	(0.091)	(0.048)	(0.018)	(0.104)	(0.024)	(0.077)	(0.015)	(0.019)	(0.022)
MNE Status	1.260***	0.325***	0.050***	1.146***	-0.012	0.337***	0.017***	-0.005	0.022***
	(0.036)	(0.020)	(0.006)	(0.046)	(0.009)	(0.021)	(0.006)	(0.006)	(0.007)
Acquisition	0.830***	0.119***	0.070***	0.671***	0.010**	0.110***	0.009***	0.032***	-0.015**
	(0.027)	(0.007)	(0.005)	(0.045)	(0.005)	(0.008)	(0.003)	(0.005)	(0.006)
Employment							0.289***	0.030***	0.267***
							(0.007)	(0.005)	(0.008)
Capital							0.072***	0.025***	0.053***
							(0.004)	(0.004)	(0.005)
Material							0.654***	-0.010***	0.661***
							(0.007)	(0.004)	(0.007)
Adj. Audit Proba			-0.006***		-0.004***			-0.006***	
			(0.001)		(0.001)			(0.001)	
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	Yes	No	No	No
Obs.	78,487	77,376	78,487	78,487	77,376	77,376	68,888	68,888	68,888
Firms	9,679	8,571	9,679	9,679	8,571	8,571	8,507	8,507	8,507
Adj. R^2	0.392	0.937	0.0553		0.209		0.976	0.0701	
KP F-stat.				80.35		34.98			61.77

Sample years: 1994-2017. The dependent variable is the firm's log sales. OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. First-stage Kleibergen-Paap Wald F statistic reported. ***, **, and * significantly different from 0 at the 1%, 5%, and 10% confidence levels, respectively.

Table D.6: Sales and tax avoidance – Permanent book-tax difference (OLS and 2SLS estimates)

	Baseline						Augmented Baseline		
	OLS		2SLS				OLS	2SLS	
			1^{st} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage		1^{st} Stage	2^{nd} Stage
Permanent BTD	0.602***	0.155***		4.278***		2.772***	0.223***		0.786***
	(0.040)	(0.017)		(0.608)		(0.724)	(0.018)		(0.109)
Share of Intangible	0.942***	0.946***	-0.020	0.953***	-0.114***	1.216***	0.142***	-0.023	0.149***
	(0.116)	(0.060)	(0.024)	(0.138)	(0.042)	(0.155)	(0.018)	(0.020)	(0.020)
MNE Status	1.108***	0.265***	0.052***	0.913***	0.013	0.234***	0.001	0.008	-0.003
	(0.045)	(0.028)	(0.008)	(0.057)	(0.011)	(0.041)	(0.007)	(0.007)	(0.007)
Acquisition	0.780***	0.092***	0.033***	0.649***	0.003	0.085***	0.006	0.003	0.004
	(0.034)	(0.008)	(0.006)	(0.041)	(0.006)	(0.016)	(0.004)	(0.005)	(0.005)
Employment							0.283***	0.018***	0.274***
							(0.008)	(0.004)	(0.009)
Capital							0.069***	0.020***	0.057***
							(0.005)	(0.004)	(0.005)
Material							0.661***	-0.009**	0.666***
							(0.009)	(0.004)	(0.009)
Adj. Audit Proba			-0.012***		-0.005***			-0.008***	
			(0.002)		(0.001)			(0.001)	
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	Yes	No	No	No
Obs.	41,642	40,464	41,642	41,642	40,464	40,464	37,907	37,907	37,907
Firms	6,723	5,550	6,723	6,723	5,550	5,550	6,175	6,175	6,175
Adj. R^2	0.384	0.949	0.0241		0.305		0.978	0.0324	
KP F-stat.				54.78		14.93			51.82

Sample years: 1994-2017. The dependent variable is the firm's log sales. OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. First-stage Kleibergen-Paap Wald F statistic reported. ***, **, and * significantly different from 0 at the 1%, 5%, and 10% confidence levels, respectively.

Table D.7: Sales and tax avoidance – Tax sheltering residual (OLS and 2SLS estimates)

	Baseline						Augmented Baseline		
	OLS		2SLS				OLS	2SLS	
			1^{st} Stage	2^{nd} Stage	1^{st} Stage	2^{nd} Stage		1^{st} Stage	2^{nd} Stage
TS residual	0.964***	0.159***		3.294***		1.632***	0.155***		0.661***
	(0.053)	(0.015)		(0.366)		(0.291)	(0.012)		(0.092)
Share of Intangible	0.930***	0.939***	0.007	0.864***	-0.048	0.983***	0.141***	-0.025	0.148***
	(0.108)	(0.059)	(0.031)	(0.112)	(0.046)	(0.090)	(0.018)	(0.026)	(0.021)
MNE Status	1.022***	0.266***	0.110***	0.762***	0.018	0.243***	0.004	-0.012	0.011
	(0.043)	(0.028)	(0.010)	(0.056)	(0.012)	(0.033)	(0.007)	(0.009)	(0.008)
Acquisition	0.714***	0.091***	0.083***	0.512***	0.012*	0.074***	0.007*	-0.002	0.008
	(0.031)	(0.008)	(0.009)	(0.040)	(0.006)	(0.012)	(0.004)	(0.007)	(0.005)
Employment							0.282***	0.026***	0.269***
							(0.008)	(0.006)	(0.009)
Capital							0.064***	0.057***	0.035***
							(0.005)	(0.006)	(0.007)
Material							0.656***	0.024***	0.644***
							(0.009)	(0.005)	(0.009)
Adj. Audit Proba			-0.014***		-0.008***			-0.009***	
			(0.001)		(0.001)			(0.001)	
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	No	Yes	Yes	No	No	No
Obs.	41,138	40,568	41,138	41,138	40,568	40,568	37,502	37,502	37,502
# firms	6,129	5,562	6,129	6,129	5,562	5,562	5,689	5,689	5,689
Adj. R^2	0.437	0.949	0.0622		0.374		0.978	0.163	
KP F-stat.				95.19		39.17			61.13

Sample years: 1994-2017. The dependent variable is the firm's log sales. OLS and 2SLS estimates with robust standard errors clustered at firm-level in parentheses. First-stage Kleibergen-Paap Wald F statistic reported. ***, **, and * significantly different from 0 at the 1%, 5%, and 10% confidence levels, respectively.

E Tax haven and event studies

We further assess the causal impact of tax avoidance on sales using two event studies. These tests leverage Exhibit 21 filings, which provide detailed geographic data on subsidiaries of publicly traded U.S. multinationals Dyreng and Lindsey (2009). This dataset allows us to classify firms based on their presence in tax havens.

E.1 Tax haven and hybrid structures: definition

We define tax havens following Hines and Rice (1994), with the Netherlands included as a key conduit jurisdiction for U.S. firms (Zucman, 2014; Laffitte and Toubal, 2022).

Among tax havens, hybrid structures allow firms to exploit mismatches in entity classification across jurisdictions. In these cases, the same entity was treated as a corporation in one jurisdiction but as a pass-through in another, enabling profits to escape taxation. These structures were widely used by U.S. multinationals with affiliates in Ireland, the Netherlands, and Luxembourg (Altshuler et al., 2024). Two key structures emerged:

- *Double Irish with a Dutch Sandwich:* Firms shifted profits offshore by routing them through two Irish subsidiaries and a Dutch intermediary, using treaty provisions to minimize withholding taxes. The first Irish entity (tax resident in Bermuda) received royalty payments from a second Irish subsidiary (a standard Irish-resident company) via the Dutch entity, reducing tax liability.

- *Reverse Hybrid Mismatch:* Firms exploited classification mismatches, particularly using Dutch CV-BV or Luxembourg SCS-SARL structures, to avoid corporate taxation in both the U.S. and the host country. These entities were treated as pass-through in their European jurisdiction but as corporations under U.S. tax law, creating tax-exempt income flows.

E.2 The Check-the-Box Regulation

The 1997 CTB regulations allowed U.S. firms to classify foreign subsidiaries as separate corporations or disregarded entities, facilitating hybrid tax planning (Altshuler et al., 2024). Following CTB implementation in 1997, these firms experienced substantial declines in effective tax rates and continued expansion of their hybrid structures.

To estimate the causal effect of CTB on firm sales, we use an event study specification:

$$\log(Sales_{i,t}) = \sum_{k \neq 1997} \beta_k D_{i,t}^k + \gamma X_{i,t} + \alpha_i + \delta_{st} + \nu_{i,t}, \tag{8}$$

where $D_{i,t}^k$ is an indicator variable equal to 1 if firm i is observed in event time k relative to the CTB implementation year (1997), and 0 otherwise. The treatment group consists of firms engaged in hybrid tax planning strategies, specifically the Double Irish with a Dutch Sandwich and the Reverse Hybrid Mismatch. The term $X_{i,t}$ includes multinational status, intangible intensity, and acquisition and payout dummies. Firm and sector-year fixed effects, α_i and δ_{st}, control for time-invariant firm characteristics and industry shocks. The coefficient β_k captures the effect of CTB in period k, relative to the omitted reference year 1997. Under the parallel trends assumption, pre-treatment coefficients (β_k for $k < 0$) should be close to zero, confirming no differential trends before the event. Standard errors are clustered at the firm level.

The event-study framework tests whether differences between treated and control firms emerged exactly in 1998 or whether trends began earlier. We only have two years before CTB was enacted. The results, presented in Figure 3a, confirm that pre-trends are not a concern. Most importantly that corporate tax avoidance increase firm sales.

E.3 Entry into Tax Havens

To further validate our findings, we introduce an alternative strategy that does not rely on policy changes but exploits firms' endogenous decisions to engage in tax planning. Entry into tax havens is a key tax planning strategy, as firms establish subsidiaries in conduit countries or low-tax jurisdictions to reduce effective tax rates. We assess its impact on firm sales using a *staggered difference-in-differences* design, grouping firms into cohorts based on their year of entry.

We construct a stacked dataset where each cohort includes both multinationals that establish subsidiaries in a tax haven and those that never do so. Control firms may appear in multiple cohorts, reflecting their role as comparison units before and after the entry year c of treated firms:

$$\log(Sales_{ict}) = \sum_{l=-6, l\neq -1}^{6} \delta_l D_{c,t-l} + \mathbf{X}_{\mathbf{ict}}^{'}\beta + \gamma_i + \eta_{st} + \epsilon_{ict}, \tag{9}$$

where $\log(Sales_{ict})$ represents firm-level log sales, and $D_{c,t-l}$ is a dummy equal to 1 if firm i in cohort c is at relative event time l (i.e., $t-c=l$) and 0 otherwise. Fixed effects γ_i (firm) and η_{st} (sector-year) account for time-invariant heterogeneity and aggregate shocks. The vector $\mathbf{X}_{ict}$ includes acquisition and payout dummies, intangible intensity, and additional covariates such as NOL, R&D intensity, and debt ratio in the saturated specification. Standard errors are clustered at the firm level.

This methodology, widely applied in tax avoidance research Altshuler et al. (2024), confirms that firms entering tax havens experience a significant increase in sales relative to non-entrant firms. Figure 3b presents the dynamic treatment effects of tax haven entry on firm sales. Pre-treatment coefficients ($-6 \leq k \leq -1$) are close to zero, supporting the parallel trends assumption. In contrast, post-treatment coefficients ($k \geq 0$) are positive and significant, confirming that tax haven use enhances firm sales. These findings remain robust across specifications with additional controls.