

Market Efficiency under Tax Kinks: Evidence from Taiwan

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Abstract

How do firms respond to the kinks in the tax schedule and how do firm responses shape the production efficiency and misallocation in the economy? We answer these questions using the Corporate Income Tax Reform in Taiwan, combining a comprehensive set of administrative tax data with the quasi-experiment variations. We find that the distribution of corporate taxable incomes responds sharply to the tax schedule as firms bunch below the tax threshold. Firms use a combined strategy of inflating their labor costs paid to the family members and shrinking production to keep their taxable incomes below the threshold to avoid high tax rates. Moreover, we find firms slow down their revenue growth when they approach the tax threshold.

Keywords: corporate income tax, Taiwan, tax avoidance

JEL Codes: H21, H25, H26

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1 Introduction

How do firms respond to the kinks in the tax schedule? Despite the prevalence of kinks in the tax system, little is known about its consequences on production and market efficiency in the economy. This paper uses the Corporate Income Tax Reform in Taiwan as a unique laboratory to answer the question, combining a comprehensive set of administrative tax data with the quasi-experiment variations.

The corporate income tax in Taiwan featured both tax kinks and notches before 2009. The cabinet approved the Income Tax Act Amendment proposed by the Ministry of Finance on March 5th, 2009, which was enacted in 2010. The amendment overall raised the threshold of corporate income tax and lowered the tax rates in each tax bracket, in order to reduce the cost of doing business, boost economic growth, and achieve fair tax obligation.

We start with a stylized theory model of firm decision under tax kinks. Our model highlights the heterogeneous incentives of firms to bunch below the tax threshold to avoid high tax rate. Firms achieve bunching by either real production change or misreport, depending on their productivity and idiosyncratic misreporting cost. The theoretical model yields testable predictions regarding the input expenditure shares with respect to total revenues, depending on different strategies firms take to lower taxable incomes.

We empirically examine how firms respond to tax kinks based on an employee-employer-linked data set, combining administrative corporate tax income records, value-added tax records, personal income statements for employees, and household registration records. We find that the distribution of corporate taxable incomes responds sharply to the tax schedule as well as the tax reform. We observe a sharp drop in the number of firms just right to the CIT threshold of 50K NTD before the reform. After the 2010 corporate income tax reform, the distribution of taxable incomes takes a discontinuity point at the new threshold of 120K NTD. To quantify firms' response to the tax kink, we adopt the bunching estimator following [Saez \(2010\)](#) and [Chetty et al. \(2011\)](#). We find that firms averagely lowered their corporate taxable income by 13K NTD (approximately 26% of the corporate income tax threshold) to avoid exceeding the 50K NTD threshold before the reform. After the reform, firms on average lower 27K NTD (approximately 22% of the corporate income tax threshold) to avoid exceeding the 120K NTD threshold.

Motivated by these data facts, we next investigate the channels through which firms to manage their taxable income below the threshold and respond quickly to the change of the threshold. We first rule out the possibility that firms adjust their taxable incomes by splitting into multiple smaller firms, and misreporting total revenues might not be an important force to manage taxable incomes. However, exploiting the discontinuity of incentives across taxable incomes, we find that firms

inflate their labor costs to manage to keep their taxable incomes right below the threshold. When we use the employee-employer-linked data as well as the household registration records to divide the total labor costs into the salary paid to employees who are family members of the firm owner and to employees who are not family members of the firm owner, we find that firms inflate their labor costs paid to the employees who are family members of the firm owner to manage to keep their taxable incomes right below the threshold. Moreover, we also find that firms below the threshold might have suppressed firm size in order to maintain their taxable incomes at a low level, as their intermediate input share with respect to total value is disproportionately lower. Therefore, firms use a combined strategy of inflating their labor costs paid to the family members and decreasing their intermediate goods input to keep their taxable incomes below the threshold to avoid high tax rates.

Moreover, we also document dynamic responses to tax kinks, as firm revenue growth slows down when it approaches the tax threshold. In the next step, we plan to build a structural model to evaluate the cost of misreporting and size adjustment for firms to avoid taxes. Moreover, we aim to evaluate how tax kinks change the production efficiency loss on the market, and how much tax revenue would increase and misallocation would reduce if we adopt other designs of tax policies.

Our paper contributes to the following four strands of literature. First, it contributes to a large body of work on analyzing firms' behavioral response to the corporate income tax change and estimating the elasticity of real production elasticity. The literature on using elasticity to infer the marginal welfare change dates back to [Feldstein \(1995\)](#). Starting with an elasticity of taxable income, [Chetty \(2009\)](#); [Saez et al. \(2012\)](#) further highlights the importance of distinguishing the aggregated taxable income response into real production behavior (earned income response) and reporting behavior, such as evasion or avoidance behavior. Especially corporations can adjust their corporate taxable income in various ways. Several studies have directly estimated the elasticity of corporate taxable income ([Auerbach et al., 2007](#); [Dwenger and Steiner, 2012](#)), but few studies empirically decompose firms' various ways in response to the corporate taxable income. Two recent articles focus on differentiating specific behavior from corporate taxable income. [Devereux et al. \(2014\)](#) explore the option that an owner/manager can declare income to over-report the deduction cost. [Bachas and Soto \(2021\)](#) decompose the elasticity of corporate taxable income into the elasticity of revenue and elasticity of deduction cost term using a special corporate income tax schedule targeting gross revenue in Costa Rica. To the best of our knowledge, this study is among the first to comprehensively examine firms' responses, ranging from gross revenue and production reduction (scale of production) to over-reporting deduction terms. In addition, we distinguish firms' real production response and the tax compliance behavior and structurally estimate the elasticity of real production to the corporate income tax. document a clear channel of inflating the deduction cost by increasing the salaries to only family member-employee.

Second, this paper also speaks to the literature on how threshold-dependent regulations targeting firm size affect on economic performance. Previous studies have predominantly focused on labor regulations (Gourio and Roys, 2014; Garicano et al., 2016; Amirapu and Gechter, 2020). Other literature examines policies such as VAT threshold (Liu et al., 2022), information disclosure thresholds on firms' IPO decisions (Ewens et al., 2021), and entry barrier threshold on economic growth (Barwick et al., 2022). The most closely related study to our work is Chen et al. (2021). They show that the R&D notch incentivized firm's increased R&D investment and firms' productivity. Our study shed light on a distinct source of misallocation arising from the threshold targeting on firms' profit. While existing research has primarily focused on policies directly targeting production factor inputs like the number of employees or capital, the channels through which misallocation occurs when the policy targets firm output (sales, turnover, revenue) are less straightforward. By identifying this source of misallocation, we provide valuable insights into the relative adjustment costs associated with different production factor inputs.

Third, we connect to work studying the distributional effects of corporate tax changes. Traditionally, the literature focuses on whether the lower corporate income tax can be pass-through to the employee and the distributional effect of employees within firms. (Kennedy et al., 2022; Duan and Moon, 2022; Ohn, 2022; Cloyne et al., 2023; Suárez Serrato and Zidar, 2016; Fuest et al., 2018). Different from those studies, our paper explores another dimension of the distribution effect, that the employee could also be the shareholder or a close family member of a firm-owner. Especially for the small-medium size firms, the increased salaries concentrate on those shareholder-employee or family-member-employee.

Lastly, we speak to the literature on the traceability of transactions imposed by the value-added tax (VAT) on firms' tax compliance behavior, such as individual income reporting (Kleven et al., 2011; Pomeranz, 2015), firm's gross revenue (Almunia and Lopez-Rodriguez, 2018; Carrillo et al., 2017), and wealth (Garbinti et al., 2023). Our results provide new evidence on the impact of a third-party reporting system on firms' material and capital production inputs as one of the deduction terms in calculating the corporate income tax.

2 Policy Background and Data

2.1 Corporate Income Tax Reform

Corporations in Taiwan are subject to annual corporate income tax (CIT), which is levied on the business profit. The tax basis is calculated following the standard accounting rule as firm revenues minus production costs, including material inputs, labor salaries, capital costs, as well as various

expenditures. Corporate income tax is one of the most important sources of national taxes, amounting to a total of 334,163 million NTD (10,807 million USD) in 2009 and 21.8% of the gross tax revenues.¹

The corporate income tax is progressive, and the tax schedule before the 2010 reform can be dated back to 1986. As shown in Figure 1, there were three tax brackets. The threshold of CIT is at 50K NTD (around 1,622 USD) for annual taxable income. Firms with annual corporate taxable income below such threshold were faced with zero statutory tax rate. However, the statutory tax rate jumped to 15% if the annual taxable income exceeded 50K NTD, and further increased to 25% if the annual net income exceeds 100K NTD (around 3,244 USD). To smooth the tax rate change for small enterprises, the government set a buffer range immediately right to the threshold, such that the corporate income tax was capped below fifty percent of the amount that exceeded the threshold until the average tax rate reached 15%. Consequently, the tax schedule generated two tax kinks and one tax notch. The exact tax amount T^0 can be summarized in the following formula, with x denoting the taxable income.

$$T^0(x) = \begin{cases} 0, & \text{if } x < 50K \\ \min\{15\% \times x, 50\% \times (x - 50K)\}, & \text{if } 50K \leq x < 100K \\ 25\% \times x, & \text{if } x \geq 100K. \end{cases}$$

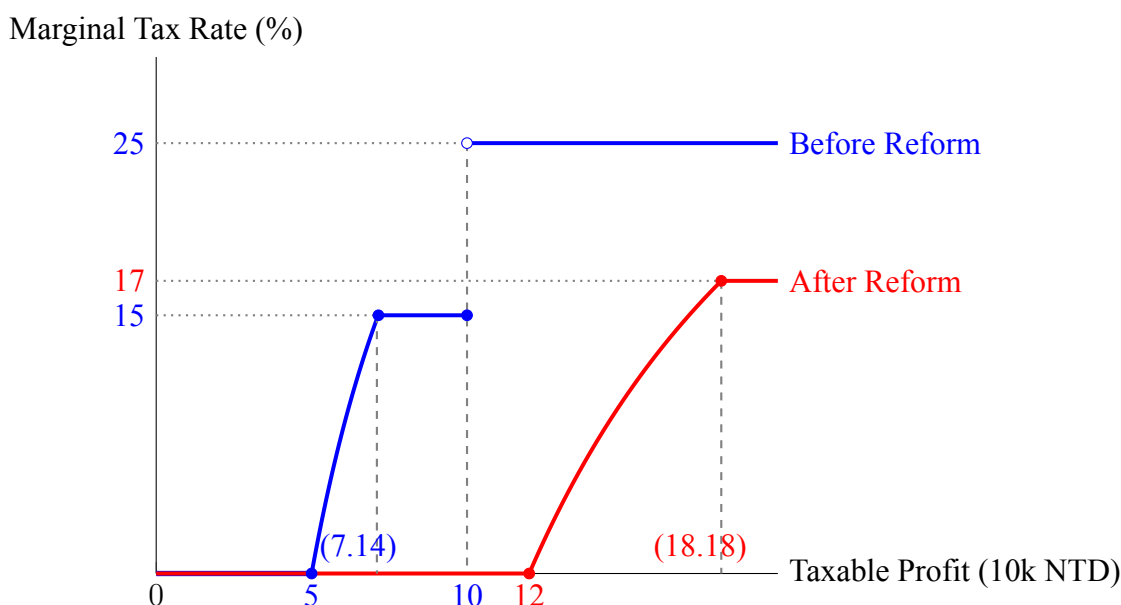
The cabinet approved the Income Tax Act Amendment proposed by the Ministry of Finance on March 5th, 2009, which was enacted in 2010. The amendment overall raised the threshold of corporate income tax and lowered the tax rates in each tax bracket. As shown in Figure 1, the original three tax brackets were combined into two, and the threshold was raised to 120K NTD (around 3,892 USD) for annual taxable income. The statutory tax rate was also lowered from 25% to 15% if the annual taxable income exceeded 120K NTD. Similar to the tax schedule before 2010, the government still set a buffer range immediately after the threshold, such that the corporate income tax was capped below fifty percent of the amount that exceeded the threshold until the average tax rate reached 17%. Accordingly, the tax schedule generated two tax kinks and no tax notch. The exact tax amount T^1 can be summarized in the following formula, with x denoting the taxable income.

$$T^1(x) = \begin{cases} 0, & \text{if } x < 120K \\ \min\{17\% \times x, 50\% \times (x - 120K)\}, & \text{if } x \geq 120K. \end{cases}$$

¹Source: Chapter 1: A General Description of Taxation, Guide to ROC Taxes 2011 from ttc.gov.tw. and Public Finance and Tax Statistics.

According to the Ministry of Finance, the corporate income tax reform was implemented to achieve two policy goals. First, lowering the CIT rate could reduce the cost of doing business, attract more foreign investment, and boost economic growth. Second, the reform could alleviate the tax burden, especially for small and medium enterprises, and thus achieve fair tax obligation.² After the reform, the corporate income tax rate in Taiwan was lower than that in mainland China (25%) and South Korea (22%), and equivalent to that in Singapore (17%) and Hong Kong (16.5%).³

Figure 1: Corporate Income Tax Rate



Notes: This figure shows the corporate income tax schedule in Taiwan. The blue curve denotes the tax schedule before 2010, and the red curve denotes the tax schedule in 2010 and after.

Another important source of tax revenues is the business tax, including the value-added tax (VAT). VAT is paid bi-monthly and relies on a third-party reporting system for monitoring both business-to-business transactions and the amount of material and capital inputs. The third-party reporting system restrains firms from filing false tax information for VAT.

2.2 Data

Our empirical analysis is mainly based on an employee-employer-linked data set, combining administrative corporate tax income records, value-added tax records, personal income statements for employees, and household registration records. These data sets are maintained by the Ministry of

²Source: News from Executive Yuan.

³Source: <https://www.lawtw.com/archives/388050>.

Finance in Taiwan, and we constructed a comprehensive sample covering the years from 2004 to 2017.

The employer-side information contains detailed information on the corporate income tax and value-added tax at the annual level. The corporate income tax files provide comprehensive, balanced sheet information, including gross revenues, total costs, and total expenditures, as well as a complete list of the breakdown items. The value-added tax files provide information on business-to-business transactions and material and capital purchases. Moreover, the data set also covers the basic information of firms including firm ownership, industry, establishment date, and location.

The employee-side information is extracted from the W2 files contained in the individual personal income statements. We access the annual salary of employees and link it with the employer data. We also obtain the kinship relationship of employees with the firm owners from the household registration records, which enables us to identify whether an employee is a family member of the firm owner.

3 Theoretical Model

3.1 Flat CIT Rate

There is a continuum of firms operating on the market. Firm i produces with the capital k_{it} , labor l_{it} , and material m_{it} according to the following production function.

$$y_{it} = z_{it}(\alpha_k k_{it}^{\frac{\sigma-1}{\sigma}} + \alpha_l l_{it}^{\frac{\sigma-1}{\sigma}} + \alpha_m m_{it}^{\frac{\sigma-1}{\sigma}})^{\frac{\mu\sigma}{\sigma-1}}.$$

We denote Hicks-neutral firm productivity as z_{it} . We use α_k , α_l , and α_m as share parameters for capital, labor, and material, respectively, where $\alpha_k + \alpha_l + \alpha_m = 1$. The elasticity of substitution is given by σ , which is greater than 1. We further assume $0 \leq \mu < 1$ such that the production function has decreasing returns to scale. Firms are faced with the interest rate r_t , wage rate w_t , and material cost p_t , and the output price is normalized as 1. Firms solve the following cost minimization problem, and I suppress the subscript i and t for ease of expression.

$$\begin{aligned} & \min_{k,l,m} rk + wl + pm \\ \text{s.t. } & z(\alpha_k k^{\frac{\sigma-1}{\sigma}} + \alpha_l l^{\frac{\sigma-1}{\sigma}} + \alpha_m m^{\frac{\sigma-1}{\sigma}})^{\frac{\mu\sigma}{\sigma-1}} \geq y \end{aligned}$$

The total cost $c(y, r, w, p)$ would be as follows.

$$c(y, r, w, p) = \frac{y^{\frac{1}{\mu}}}{z^{\frac{1}{\mu}}} (\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma})^{\frac{1}{1-\sigma}}$$

The profit maximization problem would be as follows.

$$\max_y \pi = y - c(y, r, w, p)$$

The input revenue share would be as follows.

$$\begin{aligned} \frac{rk}{Py} &= \frac{\mu \alpha_k^\sigma r^{1-\sigma}}{\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma}} \\ \frac{wl}{Py} &= \frac{\mu \alpha_l^\sigma w^{1-\sigma}}{\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma}} \\ \frac{pm}{Py} &= \frac{\mu \alpha_m^\sigma p^{1-\sigma}}{\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma}} \end{aligned}$$

Suppose the government imposes the corporate income tax on firms at a flat rate τ , as the tax basis is firm profit, corporate income tax is non-distortionary, and the optimal input revenue share would be unchanged. The optimal profit before tax would be

$$\pi = (1 - \mu)y \sim z^{\frac{1}{1-\mu}}$$

3.2 Tax Notches without Misreporting

Suppose government introduces notches to the tax schedule such that firms with profit π_{it} below $\bar{\pi}$ would enjoy a low tax rate τ_L , while firms with profit π_{it} above $\bar{\pi}$ are subject to a high tax rate τ_H . We denote the tax rate choice as D_τ which equals one if $\tau = \tau_L$.

We denote the productivity cutoff $z = z^*$ such that $\pi(z^*) = \bar{\pi}$. For firms with $z_{it} \leq z^*$, they have a dominant choice of $D_\tau = 1$. For firms with $z_{it} > z^*$, we denote $\pi^0(z)$ as profit if they don't bunch at $\bar{\pi}$. Consequently, each firm with $z_{it} > z^*$ is faced with a discrete choice as follows.

$$\max_{D_\tau \in \{0,1\}} (1 - D_\tau)(1 - \tau_H)\pi^0(z) + D_\tau(1 - \tau_L)\bar{\pi}$$

We denote the productivity cutoff $z = z^{**}$ such that $\pi(z^{**}) = \frac{1-\tau_L}{1-\tau_H}\bar{\pi}$. Therefore, firms with $z^* < z_{it} \leq z^{**}$ will choose to distort their production to bunch at $\bar{\pi}$. On the contrary, firms with

$z_{it} > z^{**}$ will maintain their production decision and pay the high tax rate τ_H . If firms choose to bunch, their output choice y^+ will be lower than the optimal level y^* such that $(1 - \mu)y^+ = \bar{\pi}$, and thus their input revenue shares will be as follows.

$$\begin{aligned} \frac{wl}{Py} &= \frac{\left(\frac{y^+}{z}\right)^{\frac{1}{\mu}}}{Py^+} \frac{\alpha_l^\sigma w^{1-\sigma}}{(\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma})^{\frac{\sigma}{\sigma-1}}} \\ &< \frac{\left(\frac{y^*}{z}\right)^{\frac{1}{\mu}}}{Py^*} \frac{\alpha_l^\sigma w^{1-\sigma}}{(\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma})^{\frac{\sigma}{\sigma-1}}} \\ &= \frac{\mu \alpha_k^\sigma r^{1-\sigma}}{\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma}} \end{aligned}$$

The same relationship also holds true for the intermediate input share and capital share.

Therefore, we have the following proposition.

Proposition 1 *If a firm achieves tax notch without misreporting, compared to the scenario where the firm does not bunch at the threshold, the input revenue share would be smaller.*

3.3 Tax Notches with Misreporting

Suppose that firms could misreport their labor expenditure at a cost. Suppose that the reported labor cost is c_l , while the real labor expenditure is wl . Firms pay the misreporting cost $g(c_l, wl) = c_l h(\frac{c_l - wl}{c_l})$. We parameterize $h(x) = \frac{\delta x^2}{2}$, such that δ captures the misreporting cost.

We assume that firm i first decides the input choice, and then decides how much labor expenditure they would like to misreport. If firm i decides to bunch below $\bar{\pi}$, after choosing input, it solves the following profit maximization problem.

$$\begin{aligned} \max_{c_l} \quad & y - c(y) - t_L \bar{\pi} - c_l h\left(\frac{c_l - wl}{c_l}\right) \\ \text{s.t.} \quad & y - c(y) + wl - c_l = \bar{\pi} \end{aligned}$$

Therefore, we could derive the optimal choice of c_l as $c_l = \sqrt{\frac{\delta \alpha^2}{\delta \alpha^2 - 2\alpha}} wl > wl$.

$$\frac{c_l}{Py} = \sqrt{\frac{\delta \alpha^2}{\delta \alpha^2 - 2\alpha}} \frac{wl}{Py} = \sqrt{\frac{\delta \alpha^2}{\delta \alpha^2 - 2\alpha}} \frac{\left(\frac{y^+}{z}\right)^{\frac{1}{\mu}}}{Py^+} \frac{\alpha_l^\sigma w^{1-\sigma}}{(\alpha_k^\sigma r^{1-\sigma} + \alpha_l^\sigma w^{1-\sigma} + \alpha_m^\sigma p^{1-\sigma})^{\frac{\sigma}{\sigma-1}}}$$

We could reach the following two propositions.

Proposition 2 *If a firm misreports its labor expenditure, compared to the scenario where the firm doesn't misreport, the labor expenditure share in total revenue would be higher, while the capital and material expenditure share would be lower.*

4 Empirical Evidence

4.1 Distribution of Corporate Taxable Incomes

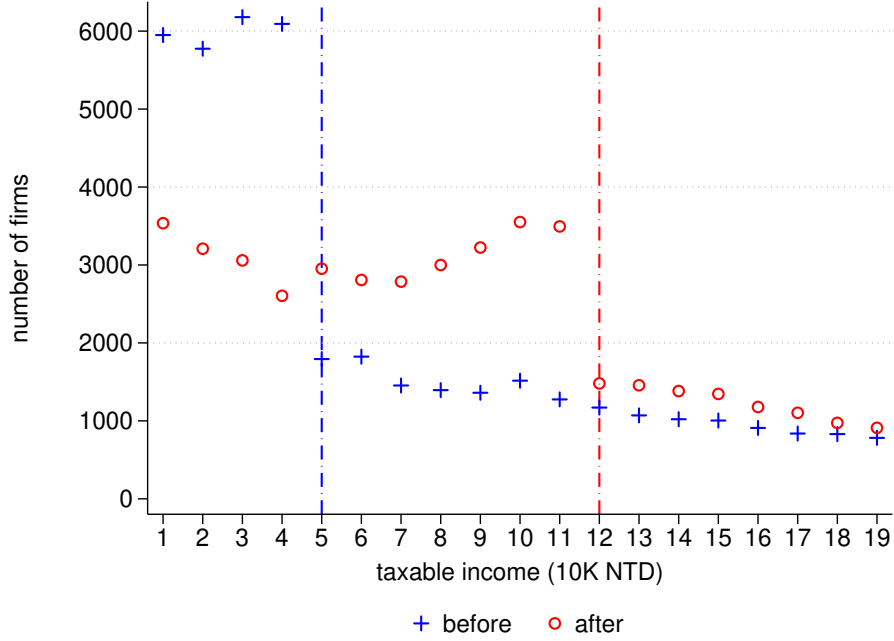
We first describe the distribution of corporate taxable incomes. As shown in Figure 2, we observe a sharp drop in the number of firms at the CIT threshold of 50K NTD before the reform. The annual number of firms was around 6,000 for each 10K NTD taxable income bin below the threshold. However, this number decreased sharply to below 2,000 right above the threshold. As the tax schedule before the reform was in place for over twenty years, the discontinuity in the distribution of corporate taxable incomes indicates strong and steady incentives for firms to manage their corporate taxable incomes below the threshold to avoid paying any corporate income tax.

We don't observe a sharp bunching right below the threshold of 50K NTD. Instead, the distribution of firms was evenly spread in the region below the threshold. According to Figure 1, there was a tax notch at 100K NTD and another tax kink at around 71.4K NTD. However, we don't observe any discontinuity at these two critical points.

After the 2010 corporate income tax reform, the threshold was raised to 120K NTD and the tax rate above 120K NTD was also significantly reduced. We observe the distribution of taxable incomes takes a discontinuity point at this new threshold. The number of firms remained stable for the taxable income bins above 120K NTD. However, a large number of firms with taxable incomes below 50K NTD were shifted to the taxable income bracket between 50K NTD and 120K NTD. Consistent with the observations before the reform, we find the distribution of firms was still evenly spread in the region below the threshold and there was no discontinuity at the other kink 181.8K NTD. The change in the distribution in response to the new tax schedule after the reform suggests that it is indeed motivated by the corporate income tax kink, and firms strategically lower their reported taxable income to take advantage of the tax kink.

To quantify firms' average taxable income response to the first kink, we adopt the bunching estimator following Saez (2010), Chetty et al. (2011), Kleven and Waseem (2013), and Almunia and Lopez-Rodriguez (2018). By assuming that only firms around the threshold would respond, we can use the distribution far away from the threshold to construct the counterfactual. We first group the data into bins of the firm's corporate taxable income, x , and estimate the counterfactual

Figure 2: Distribution of Corporate Taxable Incomes



Notes: This figure shows the average annual distribution of corporate taxable incomes before the reform (2004-2009, in blue circle) and after (2010-2017, in red plus). The vertical axis denotes the average number of firms yearly in each taxable income bin. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).

distribution using the following polynomial:

$$f_j = \sum_{i=0}^q \beta_i \cdot (x_j)^i + \sum_{k=x_{ub}}^{x_{lb}} \gamma_k \cdot \mathbf{1}(x_j = k) + \eta_j$$

where f_j is the number of firms in bin j ; q is the order of the polynomial $\mathbf{1}(x_j = k)$ to capture the interval of distribution that is impacted by firms' corporate taxable responses to the policy; x_j is the midpoint of corporate taxable bin j . To avoid the distribution generated by the firm's response, we excluded the region around the threshold $[x_{lb}, x_{ub}]$. The γ_k captures the intercept shift generated by firms' response to the policy of each bin within the exclusive interval. The counterfactual distribution, in the absence of the policy, is predicted by $\hat{f}_j = \sum_{i=0}^q \hat{\beta}_i \cdot (x_j)^i$. We denote the tax threshold as x_{th} and the bunching mass area (B) and the missing mass area (H) is given by

$$\hat{B} = \sum_{j=x_{lb}}^{j=x_{th}} (f_j - \hat{f}_j) \geq 0, \quad \hat{H} = \sum_{j=x_{th}}^{j=x_{ub}} (\hat{f}_j - f_j \geq 0).$$

Figure 3 displays the results for the pooled year before and after the reform. The dotted line in each panel represents the observed distribution, and the shadow line represents the estimated counterfactual distribution. The vertical gray line indicates the lower and upper bound of the exclusive region, generated by a data-driven procedure to ensure that the aggregated density of observed and counterfactual distribution is the same. To characterize the average firm's taxable income response, we compute the average firm's taxable income response, denoted as bunching estimator dx , as the percentage of the firms' density in the exclusive region.⁴

Before the reform as shown in Panel (a), we find firms lowered their corporate taxable income by 13K NTD (approximately 26% of the corporate income tax threshold) to avoid exceeding the 50K NTD threshold. After the reform as shown in Panel (b), firms on average lower 27K (approximately 22% of the corporate income tax threshold) NTD to avoid exceeding the 120K NTD threshold. One thing worth noting is that the bunching estimation is constrained by the fraction of firms in the range $[x_{th}, x_{ub}]$ that do not respond to the threshold, as firms with corporate taxable income above the exempt threshold and below the upper bound of the exclusive region do not respond to the threshold due to the higher cost of lowering taxable income. The fraction of firms that do not respond to exempt threshold is between 59-69%.⁵

Lastly, we further explore the heterogeneity of the distribution across different industries and the dynamics of the distribution after the reform. As shown in Appendix Figure A.1, we observe almost the same distribution pattern in four major sectors in Taiwan: wholesales, retail, manufacturing, construction, as well as all the remaining industries, despite their different volumes of firms. Moreover, as presented in Appendix Figure A.2, the transition of the distribution before and after the reform was quick. The distribution became stationary since the year when the new tax schedule was enacted.

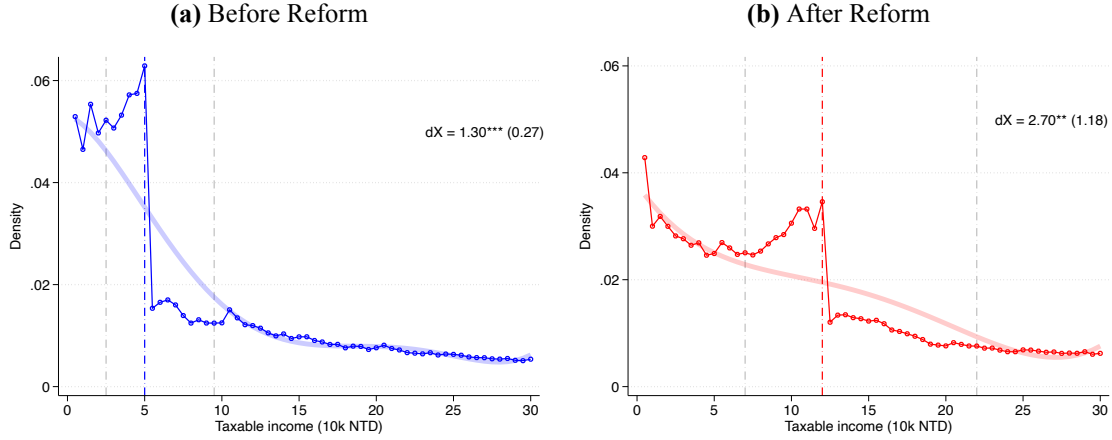
4.2 How Firms Respond to the Tax Kinks

We next investigate the channels for firms to manage their taxable income below the threshold and respond quickly to the change of the threshold. We first rule out the possibility that firms adjust their taxable incomes by splitting into multiple smaller firms. As we could access firms' shareholder information, we define splitting firms as those which have a common shareholder with any other firms and calculate the ratio of splitting firms to the total number in each tax bin. The result is shown in Appendix Figure A.4. We observe no shape discontinuity in the ratio of firm

⁴ $dx = \frac{\hat{B}}{\frac{1}{2}(\hat{f}_{x_{th}} + \hat{f}_{x_{ub}})}$ where $\hat{f}_{x_{th}}$ and $\hat{f}_{x_{ub}}$ are the number firm in each bin of the counterfactual distribution at the tax kink and at the upper bound of the bunching interval, respectively. The standard errors are estimated using bootstrapping.

⁵Following the literature, the fraction of firms that do not respond is defined as $a \equiv \int_{x_{th}}^{x_{ub}} f_0(X)dx / \int_{x_{th}}^{x_{ub}} f(x)dx$.

Figure 3: Bunching Estimates



Notes: This figure shows the density distribution of corporate taxable incomes before the reform (2004-2009) in Panel (a) and after (2010-2017) in Panel (b) with the bunching estimator reported at the right corner of each panel. The horizontal axis represents the taxable income bins. The vertical axis denotes the firms' density of corporate taxable income between 0 and 300K NTD. The vertical blue (in panel A) and red (in panel B) indicates the CIT exempt threshold before and after the reform. The vertical dashed line represents the lower bound and upper bound of the exclusive region.

splitting either with respect to the taxable income threshold or before/after the reform. The ratio remained roughly 10-15% across all taxable income bins over time. Consequently, the changing ownership is unlikely to be the main driving force in the empirical facts we find.

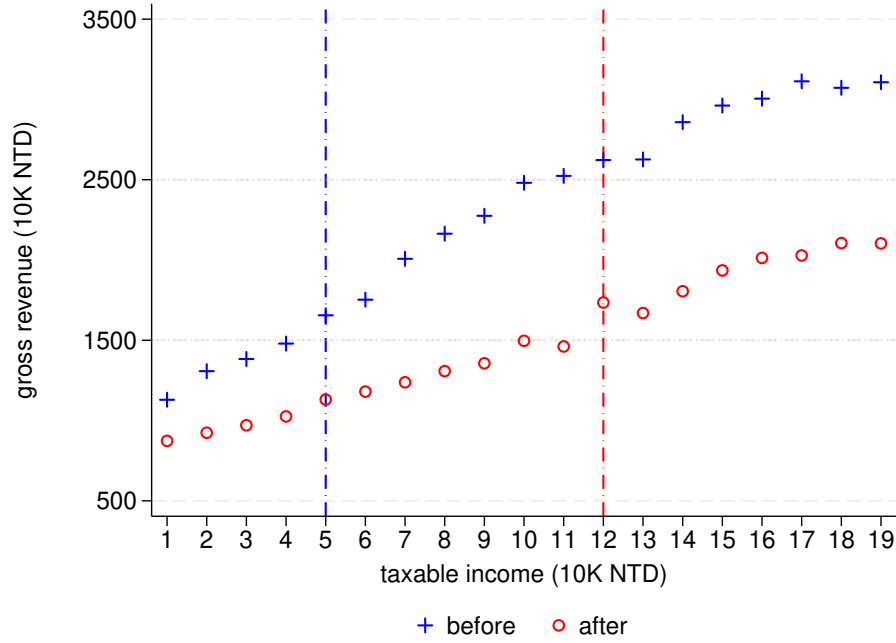
Alternatively, we explore which margin of the taxable income is mainly manipulated by firms. According to the accounting rule of calculating the taxable income, it could be roughly defined as firm revenues minus material inputs, capital costs, and labor salaries. Therefore, we explore the following three channels: under-reporting revenues, shrinking firm size, and over-reporting costs.

4.2.1 Reporting Gross Revenues

We explore the average firm revenues across taxable income bins as shown in Figure 4, and find no evidence that firms strategically lower their reported revenue by manipulating the reported gross revenue. The average firm revenues by taxable bin are increasing with respect to taxable incomes, and the relationship is smooth around the thresholds and displays no discontinuity. If firms manage their taxable incomes mainly by strategically controlling their revenues, we expect to observe a sharp drop in total revenues left to the threshold, which is inconsistent with the data pattern we observe.

To ease the concerns of revenue misreporting, we measure the revenues from business-to-

Figure 4: Average Firm Revenues across Taxable Income Bins



Notes: This figure shows the average firm revenues across corporate taxable income bins before the reform (2004-2009, in blue circle) and after (2010-2017, in red plus). The vertical axis denotes the average firm revenues in each taxable income bin. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).

business transactions in the VAT records and constructed the ratio of the business-to-business revenues to firms' total revenues.⁶ Following Kleven et al. (2011) and Carrillo et al. (2017), if firms tend to under-report revenue, they will tend to hide the business-to-consumer transaction but leave the business-to-business transactions unchanged. As shown in Appendix Figure A.3, the ratio of the business-to-business revenues is around 70% across different taxable income bins and both before and after the reform. Since the VAT relies on a third-party reporting system for monitoring business-to-business transactions, the revenues are less likely to be misreported, and this piece of evidence serves as additional support that distorting total revenues might not be an important force to manage taxable incomes. It might be relatively more costly for firms to under-report their

⁶A value-added tax (VAT) system serves as a third-party reporting system. It makes the revenue from selling intermediate goods to other firms (business-to-business transaction, B2B), easy to track. Since such transaction records are the deduction term of the buyer firms, buyer firms would always have an incentive to report such transactions to the tax authority. Assuming no collusion exists between supplier and buyer firms, it is easy to cross-check the discrepancy in B2B sales. Therefore, B2B transactions are subject to higher transaction traceability. In contrast, revenue from selling goods to the final consumer (business-to-consumer transaction, B2C) is subject to lower transaction traceability. Since the final consumer would not be incentivized to keep the receipts and report to the IRS, B2C is subject to lower transaction traceability.

revenues than to take other strategies.

4.2.2 Shrinking Firm Size

Next, we explore if firms lower their taxable income by shrinking firm size. Motivated by the theoretical model, we examine this channel by focusing on the share of intermediate input with respect to the total revenue. If firms shrink their size in response to the tax kinks, we expect to observe a lower intermediate input share. We run the following empirical model.

$$y_{ijt} = \sum_{k=1, k \neq 4}^{21} \beta_k \mathbb{1}(x_{ijt} = k) + \xi_{jt} + \epsilon_{ijt} \quad (1)$$

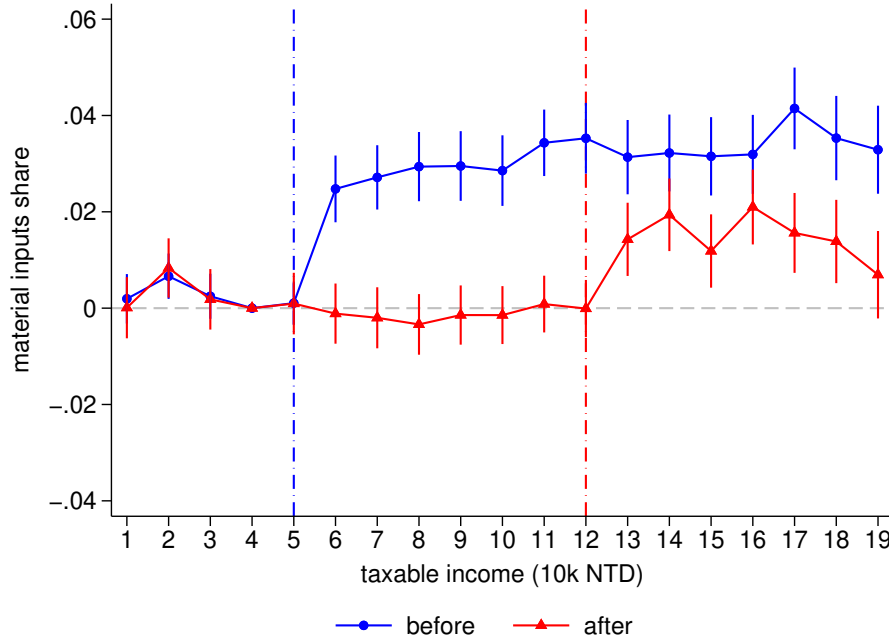
We use i , j , and t to denote firm, industry, and year, respectively. y_{ijt} represents the outcome variables, including the ratio of intermediate goods to the total revenues. x_{ijt} is the taxable income group that firm i belongs to in the year t , and each group represents a taxable income interval of 10K NTD. For example, $x_{ijt} = k$ includes firms with taxable income between $k \times 10K$ NTD (included) to $(k + 1) \times 10K$ NTD (excluded) in the year t . We keep the taxable income range between 10K NTD to 210K NTD. The group of $x_{ijt} = 4$ is omitted as the baseline group since it's just left to the CIT threshold before the reform. Therefore, β_k summarizes the mean difference in y_{ijt} for each group k with respect to the fourth group. ξ_{jt} is the industry-by-year fixed effects to control for the unobserved heterogeneity across time and industries.

The results are shown in Figure 5, the blue dot line represents the average ratio (β_k) of intermediate inputs to total revenues for the pooled year before the policy, while the red triangle line illustrates the corresponding ratio for the pooled year after the policy. We observe a relatively flat average intermediate inputs ratio below the CIT threshold at 50K NTD before the reform, compared to the baseline group as 4th taxable income bin. However, the intermediate inputs ratio experiences a noticeable jump precisely at the 50K NTD threshold. This result suggests that firms shrink their size to keep the taxable incomes below the threshold.

This discontinuity is still present in the data after the reform, but is shifted to the new threshold at 120K NTD. Collectively, these results suggest that firms situated just below the CIT exception taxable income threshold generally employ a lower ratio of intermediate inputs to generate production compared to their counterparts positioned just above the threshold, which indicates that these firms strategically shrink size to avoid high tax rate.

Importantly, this pattern is unlikely to be driven by the reporting behavior, as the intermediate inputs are important deduction items in the value-added tax which is strictly monitored. Moreover, the intermediate inputs are required to be reported bi-monthly in the Taiwanese VAT system, which

Figure 5: Intermediate Input Share by Taxable Incomes



Notes: This figure shows the average ratios of firms' intermediate input to total revenues across corporate taxable income bins before the reform (2004-2009, in blue) and after (2010-2017, in red). The empirical model is as shown in Equation (1). The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included). The vertical axis denotes the differences in the average ratios of firms' intermediate goods to total revenues compared to the baseline group (the 4th taxable income bin).

increases the misreporting cost compared to other items that are reported only annually, such as labor expenditures.

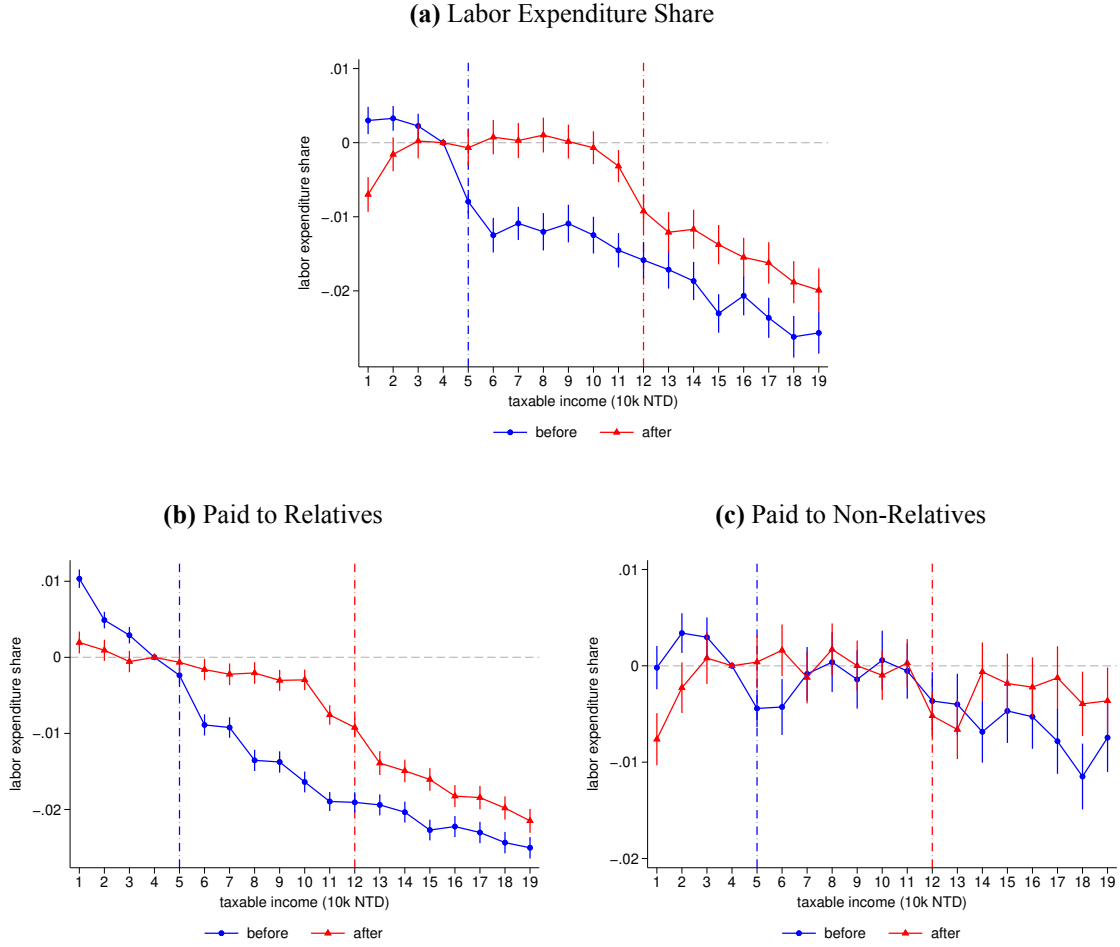
4.2.3 Over-reporting Labor Cost

We next investigate firms' labor costs. The empirical model is the same as Equation (1) and Figure 6 plots coefficients β_k for firms' labor cost shares with respect to the total revenue. Panel A shows the average ratio of labor costs to total revenues is relatively stable left to the taxable income threshold at 50K NTD before the reform, following a significant drop immediately right to the threshold. Such pattern shifts correspondingly to the increased taxable income threshold at 120K NTD after the reform. Compared to the baseline mean at 4th taxable income bin, the average ratio of labor costs to total revenues is relatively stable left to the taxable income threshold, while there is a significant drop immediately right to the threshold. The significant shift in labor cost share between 50k and

120k taxable income further indicates that firms strategically lower their taxable income by inflating labor cost as a deduction term.

We investigate whom exactly firms increase their revenue on the record by linking the firm-level data to employee information to explore the heterogeneity within the firm. If the increased salary is a *reporting strategy* to lower the taxable income, the most straightforward way is to increase the salary of those who own the firms or the manager of the firm who can make the decision. We divide all employees into two groups: those related to the shareholder of the firms (relatives), and those not related to the shareholder of the firms (non-relatives). The results shown in Panel B and Panel C of Figure 6 demonstrates that misreporting is mainly driven by the salary paid to employees who are related to the shareholder of the firms, while we observe null effects on the salary paid to other employees. As a result, we interpret the higher labor cost share as a *reporting strategy*, which serves as a way to manage their taxable incomes right below the threshold.

Figure 6: Labor Expenditure Share by Taxable Incomes



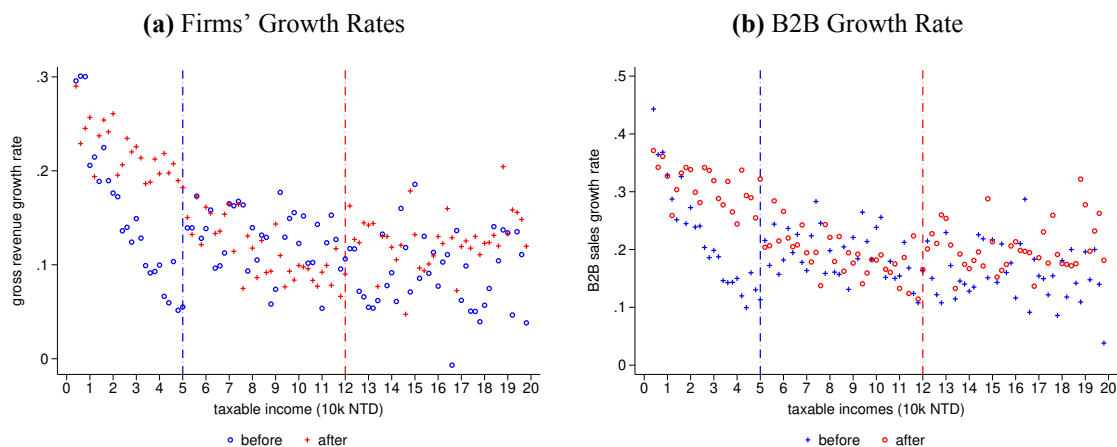
Notes: This figure shows the average ratios of firms' labor costs to total revenues across corporate taxable income bins before the reform (2004-2009, in blue) and after (2010-2017, in red). The empirical model is as shown in Equation (1). The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included). The vertical axis denotes the differences in the average ratios of firms' labor costs to total revenues compared to the baseline group (the 4th taxable income bin). Panel (a) presents the results for the firms' labor cost share, and Panels (b) and (c) show results for firms' labor cost share paid to the family members of firm owners and to the other employees.

4.3 Revenue Growth

Last, we explore whether the tax kinks impact firms' decisions *dynamically*. We focus on how firm's behavioral response to tax notch shape the growth rate

We present the average revenue growth rate with respect to taxable income bins in Figure 7. The blue circles represents the growth rate for the pooled year before the policy, while the red points triangle line depicts the corresponding rate for the pooled year after the policy. We observe a gradual decline in firms' growth rates as the taxable income approaches the exemption threshold at 50K NTD, followed by an evident jump at the threshold. Moreover, such a pattern is still observed when the exemption threshold rises to 120K NTD after the reform. a smooth decreasing growth rate below the threshold with a discontinuous recovery right at the threshold.

Figure 7: Revenue Growth Rates



5 Conclusion

How do firms respond to the kinks in the tax schedule and how do firm responses shape the production efficiency and misallocation in the economy? We answer these questions using the Corporate Income Tax Reform in Taiwan, combining a comprehensive set of administrative tax data with the quasi-experiment variations. We find that the distribution of corporate taxable incomes responds sharply to the tax schedule as firms bunch below the tax threshold. Firms use a combined strategy of inflating their labor costs paid to the family members and shrinking production to keep their taxable incomes below the threshold to avoid high tax rates. Moreover, we find firms slow down their revenue growth when they approaches the tax threshold.

References

- Almunia, M. and Lopez-Rodriguez, D. (2018). Under the radar: The effects of monitoring firms on tax compliance. *American Economic Journal: Economic Policy*, 10(1):1–38.
- Amirapu, A. and Gechter, M. (2020). Labor Regulations and the Cost of Corruption: Evidence from the Indian Firm Size Distribution. *The Review of Economics and Statistics*, 102(1):34–48.
- Auerbach, A. J., Hines Jr, J. R., and Slemrod, J. (2007). *Taxing corporate income in the 21st century*. Cambridge University Press.
- Bachas, P. and Soto, M. (2021). Corporate taxation under weak enforcement. *American Economic Journal: Economic Policy*, 13(4):36–71.
- Barwick, P. J., Chen, L., Li, S., and Zhang, X. (2022). Entry deregulation, market turnover, and efficiency: China’s business registration reform. *Market Turnover, and Efficiency: China’s Business Registration Reform (October 6, 2022)*.
- Carrillo, P., Pomeranz, D., and Singhal, M. (2017). Dodging the taxman: Firm misreporting and limits to tax enforcement. *American Economic Journal: Applied Economics*, 9(2):144–164.
- Chen, Z., Liu, Z., Suárez Serrato, J. C., and Xu, D. Y. (2021). Notching r&d investment with corporate income tax cuts in china. *American Economic Review*, 111(7):2065–2100.
- Chetty, R. (2009). Is the taxable income elasticity sufficient to calculate deadweight loss? the implications of evasion and avoidance. *American Economic Journal: Economic Policy*, 1(2):31–52.
- Chetty, R., Friedman, J. N., Olsen, T., and Pistaferri, L. (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *The quarterly journal of economics*, 126(2):749–804.
- Cloyne, J., Kurt, E., and Surico, P. (2023). Who gains from corporate tax cuts? Technical report, National Bureau of Economic Research.
- Devereux, M. P., Liu, L., and Loretz, S. (2014). The elasticity of corporate taxable income: New evidence from uk tax records. *American Economic Journal: Economic Policy*, 6(2):19–53.
- Duan, Y. and Moon, T. (2022). Tax cuts, firm growth, and worker earnings: Evidence from small businesses in canada. *Firm Growth, and Worker Earnings: Evidence from Small Businesses in Canada (December 12, 2022)*.

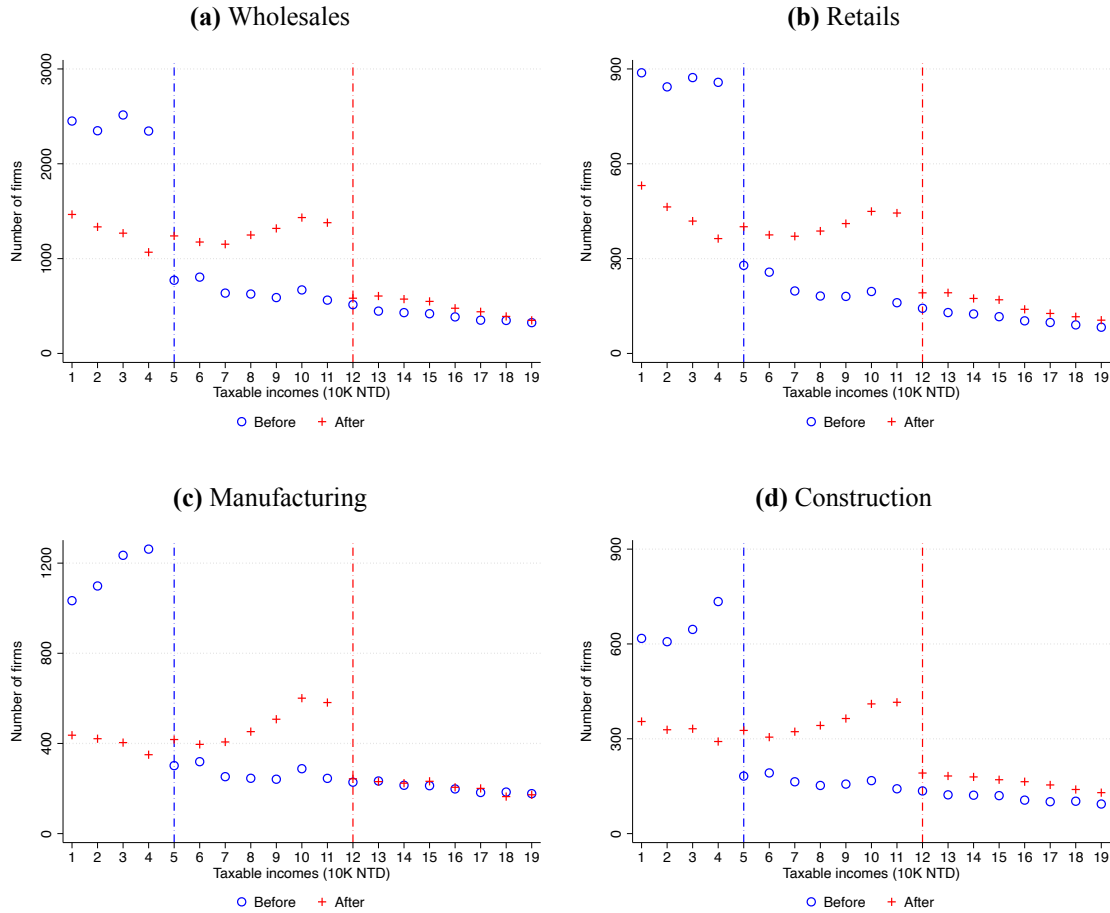
- Dwenger, N. and Steiner, V. (2012). Profit taxation and the elasticity of the corporate income tax base: Evidence from german corporate tax return data. *National Tax Journal*, 65(1):117–150.
- Ewens, M., Xiao, K., and Xu, T. (2021). Regulatory costs of being public: Evidence from bunching estimation. Technical report, National Bureau of Economic Research.
- Feldstein, M. (1995). The effect of marginal tax rates on taxable income: a panel study of the 1986 tax reform act. *Journal of Political Economy*, 103(3):551–572.
- Fuest, C., Peichl, A., and Siegloch, S. (2018). Do higher corporate taxes reduce wages? micro evidence from germany. *American Economic Review*, 108(2):393–418.
- Garbinti, B., Goupille-Lebret, J., Muñoz, M., Stantcheva, S., and Zucman, G. (2023). Tax design, information, and elasticities: Evidence from the french wealth tax. Technical report, National Bureau of Economic Research.
- Garicano, L., Lelarge, C., and Van Reenen, J. (2016). Firm size distortions and the productivity distribution: Evidence from france. *American Economic Review*, 106(11):3439–79.
- Gourio, F. and Roys, N. (2014). Size-dependent regulations, firm size distribution, and reallocation. *Quantitative Economics*, 5(2):377–416.
- Kennedy, P., Dobridge, C., Landefeld, P., and Mortenson, J. (2022). The efficiency-equity tradeoff of the corporate income tax: Evidence from the tax cuts and jobs act. *Unpublished manuscript*.
- Kleven, H. J., Knudsen, M. B., Kreiner, C. T., Pedersen, S., and Saez, E. (2011). Unwilling or unable to cheat? evidence from a tax audit experiment in denmark. *Econometrica*, 79(3):651–692.
- Kleven, H. J. and Waseem, M. (2013). Using notches to uncover optimization frictions and structural elasticities: Theory and evidence from pakistan. *The Quarterly Journal of Economics*, 128(2):669–723.
- Liu, L., Lockwood, B., and Tam, E. (2022). Small firm growth and the vat threshold: evidence for the uk.
- Ohrn, E. (2022). Corporate tax breaks and executive compensation. *American Economic Journal: Economic Policy*, Forthcoming.
- Pomeranz, D. (2015). No taxation without information: Deterrence and self-enforcement in the value added tax. *American Economic Review*, 105(8):2539–69.

- Saez, E. (2010). Do taxpayers bunch at kink points? *American economic Journal: economic policy*, 2(3):180–212.
- Saez, E., Slemrod, J., and Giertz, S. H. (2012). The elasticity of taxable income with respect to marginal tax rates: A critical review. *Journal of economic literature*, 50(1):3–50.
- Suárez Serrato, J. C. and Zidar, O. (2016). Who benefits from state corporate tax cuts? a local labor markets approach with heterogeneous firms. *American Economic Review*, 106(9):2582–2624.

Online Appendix (Not for Publication)

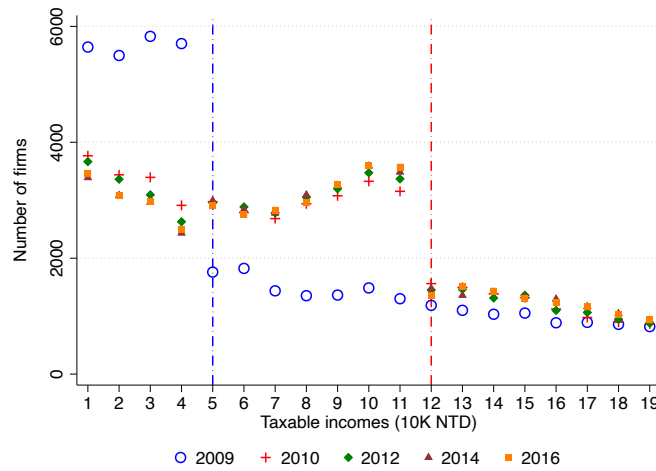
Additional Figures/Tables

Figure A.1: Distribution of Corporate Taxable Incomes by Sector



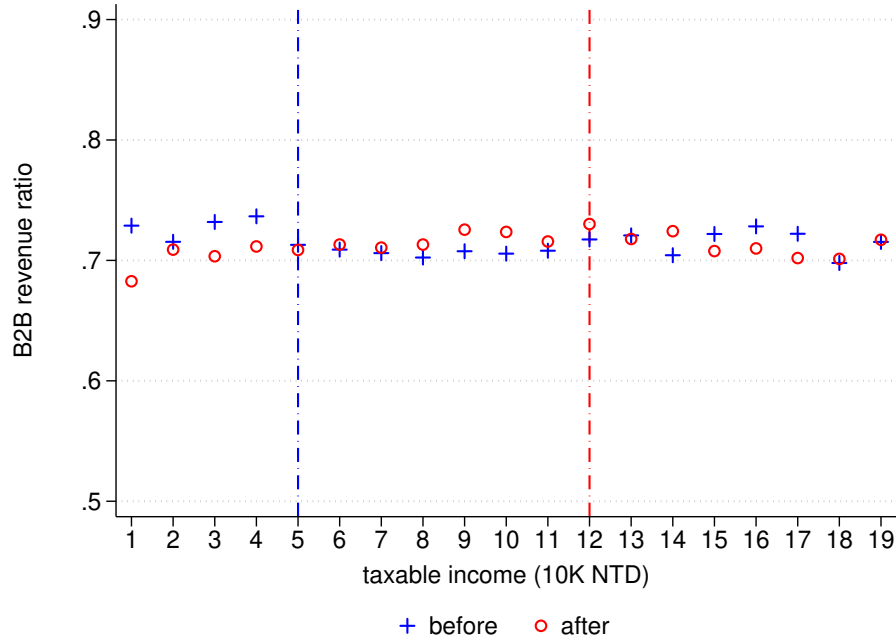
Notes: This figure shows the average annual distribution of corporate taxable incomes before the reform (2004-2009, in blue circle) and after (2010-2017, in red plus) by five different sectors: wholesales, retails, manufacturing, construction, and other sectors. The vertical axis denotes the average number of firms yearly in each taxable income bin. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).

Figure A.2: Distribution of Corporate Taxable Incomes by Years



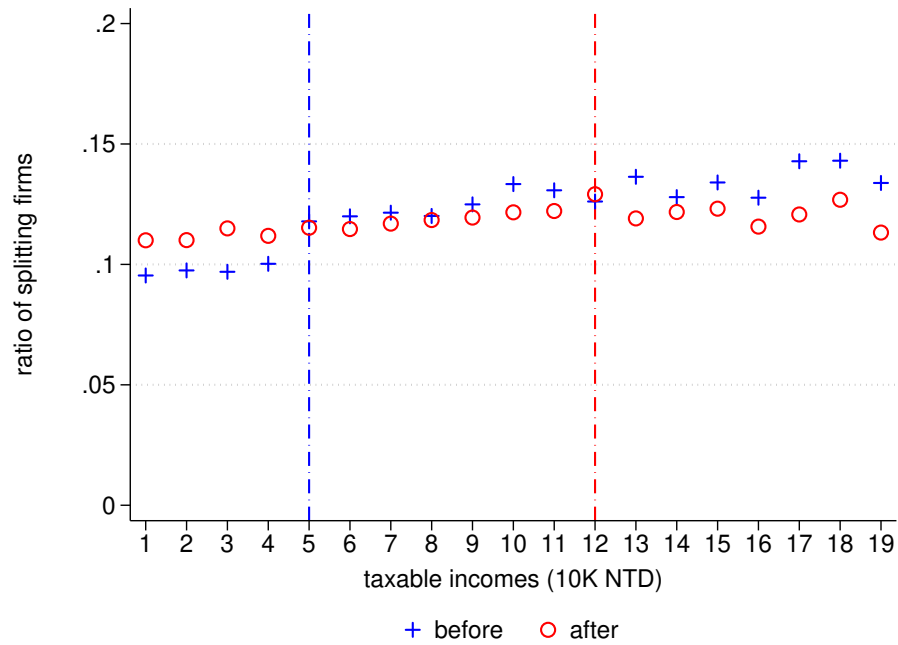
Notes: This figure shows the annual distribution of corporate taxable incomes in five different years: 2009 (in blue circle), 2010 (in red plus), 2012 (in green diamond), 2014 (in maroon triangle), and 2016 (in orange square). The vertical axis denotes the number of firms yearly in each taxable income bin. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).

Figure A.3: Ratio of B2B Revenues by Taxable Incomes



Notes: This figure shows the ratio of firms' B2B revenues in each taxable income bin before the reform (2004-2009, in blue circle) and after (2010-2017, in red plus). The vertical axis denotes the ratio of business-to-business revenues to the total revenues of firms in each taxable income bin. Business-to-business revenues are constructed from firms' VAT records. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).

Figure A.4: Ratio of Firm Splitting by Taxable Incomes



Notes: This figure shows the ratio of splitting firms in each taxable income bin before the reform (2004-2009, in blue circle) and after (2010-2017, in red plus). The vertical axis denotes the ratio of splitting firms to the total number of firms in each taxable income bin. Splitting firms are defined as those which have a common shareholder with any other firms. The horizontal axis represents the taxable income bins. For example, the 5th bin represents firms that have taxable income between 50 thousand NTD (included) and 60 thousand NTD (not included).