The Elasticity of Taxable Income Across Countries

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Abstract

We use administrative tax data from 5 different countries to calculate the within-country corporate elasticity of taxable income and investigate differences between these estimates. Our estimates exploit the differential tax treatment of business income for firms earning positive and negative taxable income in a bunching framework. We develop two new estimators to overcome several challenges that are unique to the business context. We find meaningful differences in the elasticity, with Greece having the largest (1.2) and China having the smallest (0.30). The differences we find, however, are much smaller than the range found in the literature (0 to 5). This suggests that some of the difference in the estimates in the literature may be due to differences in method rather than fundamental firm-specific characteristics, e.g., industry or tax system-specific characteristics, e.g., level of credits and enforcement.

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1 Introduction

The world is currently debating and adapting policies around how to tax corporations. For example, the Organization for Economic Co-operation and Development (OECD) is working to harmonize tax policy (e.g., a 15% global minimum tax), as it estimates that mismatches in tax policy cost countries \$100 to \$240 billion in lost revenue every year.[1] To determine the correct tax policy, it is critical to understand how firms respond to corporate taxes, and how these responses differ across countries. In response to the policy discussion, academics have started to provide estimates of the corporate elasticity of taxable income from around the world (e.g., Devereux, Liu, and Loretz, 2014; Bachas and Soto, 2018; Coles, Patel, Seegert, and Smith, 2022). However, the variation in estimates across countries is large, predicting anything between a 0% and 50% change in taxable income in response to a 10% change in the net-of-tax rate (Lediga, Riedel, and Strohmaier, 2019; Krapf and Staubli, 2020). One reason why it is difficult to interpret and compare these estimates is because they rely on different econometric methods. In this paper, we separate the differences in estimates due to econometric assumptions and fundamental differences, such as composition of firms and differences in tax codes.

We develop a new bunching method to provide comparable estimates across a number of countries such that the cross country variation is solely due to fundamental differences. Our new method combines traits unique to firm behavior, rather than individual behavior, and the pioneering work by Saez (2010a), Kleven and Waseem (2013), Bertanha, McCallum, and Seegert (2019), and Coles et al. (2022). We develop a statistical package to implement these methods consistently across countries.[2] Our method, like all bunching methods, is best suited to administrative data because it is data intensive.

We implement our method using administrative data from the following countries: Canada, Chile, China, Greece, New Zealand, Norway, Slovakia, and South Africa.[3] These countries represent a wide variety of regions, economies, and tax systems. Our estimates of the corporate elasticity of taxable income are the first for many of these countries, notable exceptions are Slovakia and South Africa (Bukovina, Lichard, Palguta, and Zudel, 2020; Lediga et al., 2019). In the interest of comparability across countries, we focus on the change in marginal tax rates that firms face when reporting \$0 in taxable income. At this kink point, firms transition from generating net operating losses, which can typically be

[1] https://www.oecd.org/tax/beps/about/

[2] The package and code to simulate data can be found at www.nathanseegert.com/code.

[3] Currently, we are able to report estimates from China, Greece, Norway, and Slovakia. In addition, we are working with Canada, Chile, and New Zealand, and we anticipate these results with be forthcoming soon.

held and used to offset future positive tax liability, to paying positive tax. For example, the marginal corporate tax rate on the first dollar earned is 25% in China, 35% in Greece, 28% in Norway, and 23% in Slovakia during our sample. Previous work has shown that focusing on the $0 kink provides a representative sample of firms because all firms have some probability of reporting income on either side of this kink (Coles et al., 2022).

The methods we develop are built up from a neoclassical model of firms that are heterogeneous in productivity and fixed costs. For expositional ease, production depends on a single input, capital. With this capital, firms generate profits that are taxed. Firms are subject to a piece-wise linear tax system with a marginal tax rate of t_0 below a kink point and $t_1 (> t_0)$ above the kink point. The solution to the firm's maximization problem consists of three regions. In region 1 firms (those with low productivity or high fixed costs) set their capital according to a traditional Hall-Jorgenson condition where their marginal product of capital is equal to the external rate of return r divided by the net-of-tax rate $1 - t_0$. Similarly, in region 3, firms (those with high productivity or low fixed costs) set their marginal product of capital equal to the external rate of return r divided by the net-of-tax rate $1 - t_1$. The marginal product of capital in region 3 is greater than in region 1 because the higher tax rate distorts capital downward. In region 2, firms face a marginal product of capital at the kink point that is greater than those in region 1 and smaller than those in region 3. These firms set their capital such that taxable income is equal to the kink point. Because there is a mass of firms in region 2, there is bunching in the distribution of firms with respect to taxable income right at the kink point, where the marginal tax rate increases from t_0 to t_1.

Within this context, we develop a two-step econometric estimator that exploits variation in firm productivity and fixed costs. Identification in this model is based on variation that shifts productivity without shifting fixed costs, such as, intangible assets, input prices, and R&D spending. In addition, we rely on inputs that shift fixed costs, such as, depreciation, land expenses, and interest payments. We estimate parameters for firms to the left and to the right of the kink. With these parameter estimates, we recover the elasticity of corporate taxable income.

In addition to the two-step method, we develop a second econometric estimation strategy that combines the insights from Coles et al. (2022) and Bertanha et al. (2019). These methods must be adjusted to account for fixed costs, which explain why firms optimally locate to the left of the $0 kink in taxable income. As such, our method first estimates fixed costs based on variation in revenue and variable costs. From this estimation, we project a new measure of taxable income that combines pure taxable income and fixed costs. Transformed taxable income is a function of only one heterogeneous parameter and faces a non-zero kink in the marginal tax schedule. This transformation allows us to apply the methods developed by Bertanha et al. (2019) on the new transformed variable using the Stata package `bunching` (Bertanha, McCallum, Payne, and Seegert, 2022).

Both of these new methods require additional data and assumptions about the distributions of productivity and fixed costs to identify the elasticity. As with earlier bunching strategies, the identification of the elasticity is impossible when the distributions of productivity and fixed costs belong to the non-parametric class of all continuous distributions (Blomquist, Kumar, Liang, and Newey, 2015; Bertanha et al., 2019). With the additional structure in our two methods, however, we provide non-parametric bounds and semi-parametric estimates.

We find that the variation in the corporate elasticity of taxable income is much smaller than previous estimates would suggest. Based on our estimates, we find that firms in Greece are the most sensitive to changes in marginal tax rates — these firms respond to a ten percent increase in net-of-tax rate by increasing taxable income by 12.5 percent — whereas Chinese firms are the least sensitive to marginal tax rates — these firms respond to a ten percent increase in the net-of-tax rate by increasing taxable income by 2.95 percent. Firms in Norway and Slovakia have intermediate elasticities of 0.52 and 0.89, respectively. These estimates suggest there are larger efficiency costs to higher tax rates in Greece than China.

The differences in elasticities across countries that we find suggest that harmonizing tax rates across the world will have different costs and benefits for different countries. For example, small countries may have smaller corporate tax rates because firms in their countries could easily move to other countries. Consequently, harmonizing initiatives, such as, a global minimum tax, may affect the migration of firms across countries. The estimates and methods produced in this paper provide a foundation for future work to explore how firms will respond to different policy proposals, especially in a global tax environment.

The remaining sections of this paper provide additional details about the background of the corporate elasticity in Section 2, our data in Section 3 and our model in Section 4. We develop our two estimation strategies in Section 5. In Section 6, we report our estimates and provide a discussion and we conclude in Section 7.

2 Background

Beginning with Feldstein (1995), the elasticity of taxable income has been a focal parameter in tax policy. This parameter characterizes how sensitive individuals and firms are to tax rates. This parameter is used to estimate tax revenue implications of changes in tax policy and as a measure of potential deadweight loss.[4] Importantly, this single parameter captures a wide array of responses. For example, it captures intertemporal shifting, tax evasion, and real economic changes, such as reductions in capital expenditures, labor supply, and economic output.

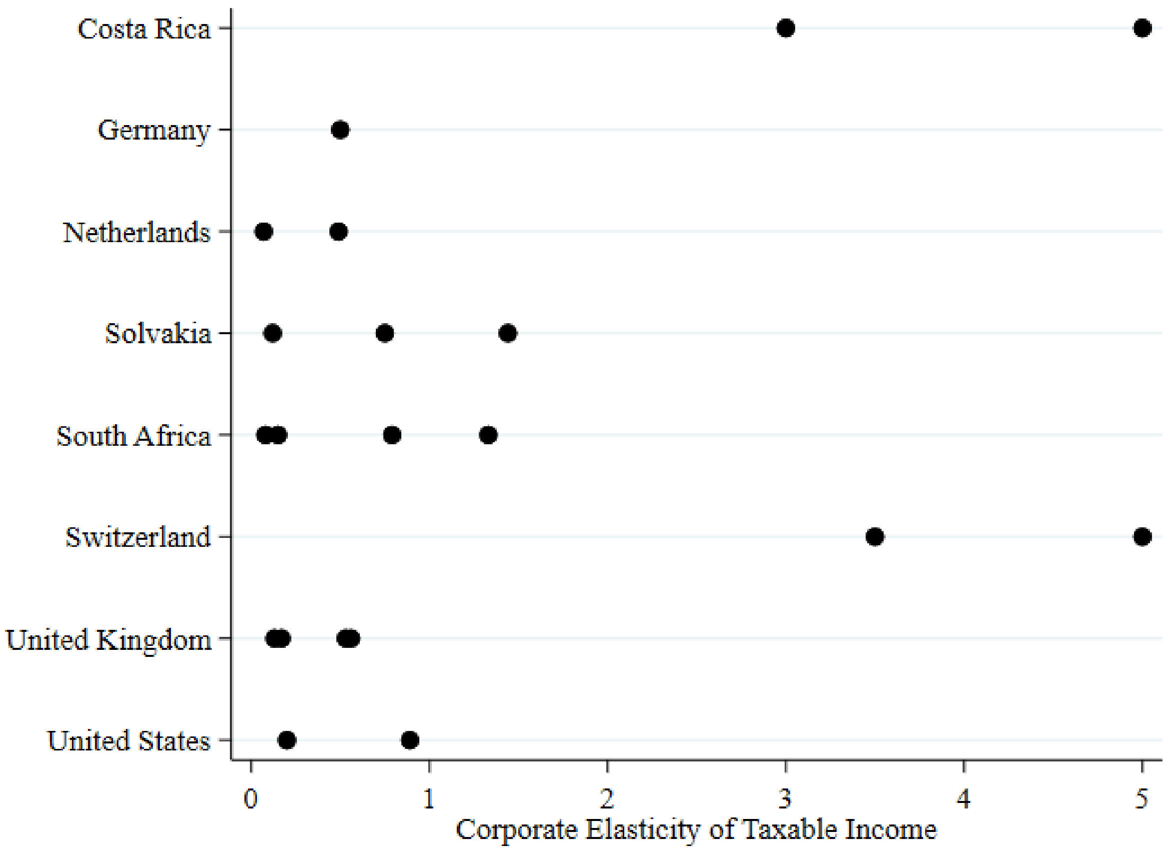
Early studies of the elasticity of taxable income for individuals used a wide range of methods and data, likely contributing to the wide range of early estimates between -0.83 and 3 (Feldstein, 1995; Goolsbee, 1999). For example, there was wide dispersion in the implementation of instrumental variable approaches outlined by Auten and Carroll (1999) and Gruber and Saez (2002) and extended by Gelber (2014), Kopczuk (2005), Giertz (2005), and Weber (2014). In addition, many papers leverage taxpayer bunching at kinks and notches in the tax schedule to estimate the elasticity of taxable income following pioneering work by Saez (2010a) and Kleven and Waseem (2013). These methods bring several new advantages over previous work including the ability to estimate an elasticity using cross-sectional data. Kleven (2016) provides a review of the many ways and contexts in which these methods have been employed. See Blomquist and Newey (2017) and Bertanha et al. (2019) for further discussion of these methods. The bunching estimator, however, is very data intensive and as such is used mostly with administrative data. The range of estimates based on bunching remains large, typically between 0 and 1 (Saez, Slemrod, and Giertz, 2012).

A more recent and quickly growing literature focuses on the corporate elasticity of taxable income. Gruber and Saez (2002) and Devereux et al. (2014) provide some of the first estimates of 0.2 and 0.5 for the US and UK, respectively. Again, these papers used different methods, the first an instrumental variable approach similar to the individual income literature and the second a bunching estimator. Coles et al. (2022) develops a new control group method that avoids the criticisms of the past methods and estimates the corporate elasticity of taxable income to be 0.89 in the U.S. (Kopczuk, 2005; Weber, 2014; Blomquist et al., 2015; Bertanha, Mccallum, and Seegert, 2016).

Subsequent literature has focused on producing estimates of the corporate elasticity of taxable income based on taxpayer behavior in different countries (Dwenger and Steiner, 2012; Bachas and Soto, 2018; Lediga et al., 2019; Krapf and Staubli, 2020; Bukovina et al., 2020; Bosch and Massenz, Bosch and Massenz). This recent work on the corporate elasticity of taxable income has led to a range of estimates from 0 to 5. We depict these estimates in Figure 1. There are several reasons why these estimates may vary so

[4]There have been several influential papers that note the elasticity of taxable income is an important parameter but have called into question whether it is sufficient Doerrenberg, Peichl, and Siegloch (2015); Feldstein (1995).

Figure 1: **Dispersion in estimates**



Notes: This figure graphs past estimates in the literature from different countries. This figure includes estimates from Costa Rica (Bachas and Soto, 2018), Germany (Dwenger and Steiner, 2012), the Netherlands (Bosch and Massenz, Bosch and Massenz), South Africa (Lediga et al., 2019), Switzerland (Krapf and Staubli, 2020), Slovakia (Bukovina et al., 2020), and the US (Gruber and Saez, 2002; Coles et al., 2022), the UK (Devereux et al., 2014).

dramatically. First, the type of firms (e.g., industry and size) may differ substantially across countries. Second, tax bases may differ across countries, causing firms to be more or less sensitive to tax rates. Finally, as in the individual literature, the method employed to estimate the corporate elasticity of taxable income varies across estimates.

In this paper, we provide the most comprehensive set of estimates of the corporate elasticity of taxable income. These estimates are based on administrative tax data collected by tax authorities in Canada, Chile, China, Greece, New Zealand, Norway, Slovakia, and South Africa. We develop two new bunching estimation methods that build on the work of Saez (2010a), Kleven and Waseem (2013), Coles et al. (2022), and Bertanha et al. (2019), are developed specifically for the corporate concept, and are flexible enough to accommodate the varied data and contextual needs across countries. In addition, these new methods are robust to the identification criticisms of past bunching methods (Blomquist and Newey, 2017; Bertanha et al., 2019). By holding the empirical methods fixed across countries — in fact, co-authors access administrative tax data within the parameters of their individual data-sharing arrangements and estimate the elasticity in-house using identical estimation code — the estimates that we produce reflect real differences across countries, including firm differences and tax base differences.

3 Data

We present estimates of the corporate elasticity of taxable income across several countries: China, Greece, Norway, and Slovakia. Each estimate is based on administrative tax data and reflects average firm sensitivity to tax rates within the context of the tax system in which they operate. From each country we have taxable income, a set of covariates including indicator variables for multinational status, publicly traded, and continuous variables for asset size. In what follows, we provide a short description of our estimation sample and the associated tax system.

3.1 China

Tax Data Our estimates are based on businesses in the manufacturing industry in China in 2009. Data is drawn from the 2009 China Tax Survey, conducted by the State Taxation Administration (STA) in China — the counterpart to the IRS in the United States. These data provide firm-level information of the components of tax payment in addition to limited financial information for 269,225 firms. Specifically, we observe accounting profit, net profit after tax adjustment, taxable profit, tax adjustments, operating revenue, operating costs, depreciation expenses, total wage and bonus expenses, interest payments, intangible assets purchased, fixed assets held at year end, R&D expenditures, and loss carryforwards from prior tax years.

Corporate Tax Context In 2009 corporations were subject to 17 different taxes within the Chinese business tax system. Most important among these are the Value-Added Tax (VAT), the Corporate Income Tax, the Business Tax, the VAT and Excise Tax on imports, and the domestic Excise tax. In total, these five taxes account for 80% of total corporate tax revenue. VAT and excise taxes are consumption taxes that are levied on goods.

Specifically, the VAT taxes the value-added at each stage of goods production and sales, and the baseline VAT rate is 17%. 2009 saw a VAT reform in which firms were allowed to deduct the VAT paid on investment in fixed assets. Excise taxes are levied on a selective list of goods, and business taxes apply to the provision of services, intangible assets, and real estate.

Here, we study how firms respond to the corporate income tax. Prior to 2008, domestic enterprises paid a higher corporate income tax rate than foreign-invested enterprises (33% compared with either 15% or 24%). In 2008, China consolidated corporate income tax rates to a flat 25%, regardless of foreign vs domestic distinctions. Those businesses that faced a preferential rate prior to 2008 were granted a phased-in increase in the corporate income tax rate from 18% – 25% over 5 years. After 2012, all businesses faced the flat 25% rate. Generally, firms are permitted to carry losses from prior tax years forward up to five years to offset current-year positive taxable income.

3.2 Greece

Tax Data The Greek sample consists of the population of firms established as corporations (mainly Societe Anonyme, Limited Liabilities Companies, Private Capital Companies) for the period 1999-2018. The dataset has been compiled by using two different sources: tax returns available through the Tax Administration of the Ministry of Finance and financial variables from ICAP, the leading provider in Greece. There are more than 50 variables available from the tax form and more than 100 from ICAP records. Financial information from ICAP is limited to larger corporations based on revenue, asset, and employee size thresholds.

Tax Context The corporate tax system in Greece is extremely complicated, characterized by overregulation and low tax collectability. Resident corporations are taxed on their worldwide income. Until 2003, LLCs were taxed differently compared to SAs: half of their profits were taxed in the name of the company and the rest in the name of the partners (natural persons-owners). Beginning in 2003 all corporations, no matter their specific legal type, are taxed in the same way, i.e., all their profits are taxed in the name of the firm. The statutory corporate tax rate demonstrates noticeable volatility over time: the rate has been changed 9 times in the last 20 years. Advanced tax must be also prepaid up to a certain percentage (which is unstable ranging from 55% to 100% during our study period) of the tax obligation in the current year. Businesses are permitted to carry tax losses forward up to five years to reduce taxable profit.

3.3 Norway

Tax Data We construct our estimation sample from the the universe of Norwegian private and public limited liability firms (AS, *Aksjeselskap* and ASA, *Allmennaksjeselskap*). We draw data from the Norwegian Tax Authority covering the tax years 2006-2015. Information is reported on two mandatory tax forms that must be submitted simultaneously: the actual tax return (form RF-1028) and the income statement (RF-1167). Taxable profit is reported on the tax return and defined as the pre-tax earnings less special deductions. Special deductions include losses from previous years, losses from resource extraction on the Norwegian continental shelf, and group contributions paid to other firms in the corporate group.

Revenue and ordinary deductions are taken from the income statement and computed as the sum of financial and operating income or costs, respectively. For the two-step procedure, we use additional information from the Accounting Register of Norway which collects mandatory balance sheet and profit statement information from all private and public limited liability firms. In addition, we collect information on total intangible fixed assets, depreciation and write-down of fixed assets and long-term liabilities to financial institutions.

Corporate Tax Context Norwegian companies are subject to a flat tax rate of 22% on their corporate profit. This tax base includes the operating and financial profits generated either in Norway or on the Norwegian continental shelf. Income and deductions are assigned to tax years following the realization principle. The tax year is identical to the accounting year and coincides with the calendar year for most firms.

Businesses are permitted to carry tax losses forward to future periods indefinitely to reduce taxable profit. Dividends received by corporate shareholders are exempt from taxation. This also applies to income received from foreign subsidiaries. There is no municipal or local corporate income tax. Finally, businesses face a special tax of 56% on income from offshore production and pipeline transportation of petroleum.

3.4 Slovakia

Tax Data We construct our estimation sample based on administrative tax data capturing the population of corporate tax returns in 2013. These data are confidential and owned by the Financial Directorate of the Slovak Republic (FDSR).[5] The data includes tax

[5]FDSR provides the data to other state organs of the Slovak Republic following article 11 of the Slovak Tax Code Act no. 563/2009 on tax secrecy. For details, see: https://www.zakonypreludi.sk/zz/2009-563

variables which correspond to individual items recorded on tax return forms. We utilize especially the information about corporate taxable income (or loss) before companies carry forward losses from previous fiscal years (row 400).

We merge the tax return data with additional information from corporate balance sheets and profit and loss statements. The information is publicly available from the Slovak Register of Financial Statements, into which companies are required to submit financial data when they file tax returns to the tax office.

Using these data we limit our analysis to companies with positive (non-zero) sales. In addition, we collect information about the depreciation expense for long-term tangible and intangible assets and information about the net value of non-current intangible assets.

Corporate Tax Context In 2013, governmental tax revenue in Slovakia amounted to 31% of GDP, 11% of which was derived from the corporate income tax. Prior to 2013, incorporated companies were subject to a flat corporate tax rate of 19% on all profits.[6] In 2013, the corporate tax rate increased to 23%. Businesses are permitted to carry tax losses forward to future periods for up to seven years to reduce taxable profit. Loss carrybacks are not permitted.

In addition, companies must register for the VAT once their revenue in the previous 12 months exceeds a fixed threshold specified by the tax law. Furthermore, companies are required to pay quarterly (or monthly) tax advances to the tax office if their tax liability exceeds specific thresholds, also given by the tax law. In 2013, the revenue threshold for mandatory VAT registration was 49,790 euro. The tax liability threshold for quarterly tax advances was 1659.7 euro, while the tax liability threshold for monthly tax advances was 16,597 euro.

3.5 Comparisons across countries

Firms may be more or less responsive across countries for many reasons. First, there are a series of firm-specific reasons that may explain variation in the elasticity. For example, if the average firm size is smaller in Greece than Norway and smaller firms respond more to higher tax rates than large firms, we should expect a higher elasticity in Greece. Similarly, differences in industry and size of country could affect the elasticity.

Second, there are a series of tax-system-specific reasons that may explain variation in the elasticity. For example, the tax rules around losses (e.g., whether and how long firms

[6] In contrast, the profits of unincorporated legal entities, such as sole proprietorships and partnerships, were taxed according to the personal income tax schedule, once profits were attributed to individual partners. Unincorporated companies yet generate only around 4% of tax revenue collected from legal entities.

can carry forward losses) and the amount of credits offered provide firms with different abilities to adjust.

In Table 1, we provide some characteristics of the tax systems in China, Greece, Norway, and Slovakia. All of these countries have a flat tax rate, without tax brackets. This institutional detail requires us to focus on the kink at $0 because no other kinks exist in these countries. The difference between the tax rate (reported in the first column) and the effective tax rate (reported in the third column) provides a measure of flexibility in the tax system (e.g., credits) that can lower a firm's taxes. Norway seems to be the least flexible with a 28% statutory and effective tax rate. In contrast, Slovakia has a 23% statutory rate and 4.4% effective tax rate. All of these countries allow loss carry forwards and none of them allow loss carry backs. Carry forwards are allowed for 5 years in China and Greece, 7 years in Slovakia, and indefinitely in Norway. Countries also differ in their corporate and noncorporate sectors (reported in 6).

Table 1: Tax System Characteristics

	Tax rate	Brackets	Effective tax rate	Loss carry forwards	Loss carry backs	Noncorp. sector
	(1)	(2)	(3)	(4)	(5)	(6)
China	25	0	19-25	5 yrs	No	Yes (5%)
Greece	35	0	18	5 yrs	No	No
Norway	28	0	28	indefinitely	No	Yes
Slovakia	23	0	4.4	7 yrs	No	Yes (4%)

All countries have VAT registration (over some threshold), payment advances (monthly or quarterly), and no country has a minimum tax.

There are also important interactions between firm- and tax-system-specific characteristics. For example, a tax credit for energy exploration will have a larger affect in countries with a larger energy sector. The first step in understanding differences in firm- and tax-system-specific characteristics is to provide a comparable set of estimates of the corporate elasticity across countries. The rest of the paper outlines our model, methods, and estimates.

4 Model

4.1 Neoclassical Two-Period Model

In this section, we develop a two-period neoclassical model of corporate behavior. With this model, we derive a parametric relationship between bunching at a kink point in the marginal tax schedule and the elasticity of taxable income with respect to the net-of-tax rate. This model is robust to many additional features, though for dispositional ease, we present a parsimonious model that abstracts from numerous factors.[7]

4.1.1 Model Fundamentals

Consider a firm, denoted Firm i, that is owned by a single shareholder and begins period 1 with K_1 retained earnings. Firms are heterogeneous in their productivity, captured by A_i, and their fixed costs, captured by F_i. In period 1, Firm i chooses the amount of retained earnings to distribute as a dividend payment ($D \geq 0$), and the amount of equity to issue ($E \geq 0$). In addition to equity, shareholders may hold government bonds with a tax-exempt rate of return, $r > 0$. Firm $i's$ dividend and equity choices implicitly define its level of capital in period 2, $K_2 = K_1 + E - D$.

In period 2, capital generates profits net-of-depreciation costs according to a strictly concave production function

$$Y_i(K_2) = \frac{1+e}{e} A_i^{1/(1+e)} K_2^{\frac{e}{1+e}} - F_i,$$

Here, e denotes the elasticity of taxable income with respect to the net-of-tax rate; as we will show, the elasticity captures the extent to which firms are sensitive to changes in the marginal tax rate. At the end of period 2, all firms liquidate, returning their principal and profits to their shareholders.

Firm i chooses its level of capital in period 2 to maximize its value to its shareholder:

$$max_{K_2} \quad V = K_1 - K_2 + \frac{(1-t_c)Y_i(K_2) + K_2}{1+r}, \tag{1}$$

where $K_1 - K_2 = D - E$ are net distributions in period 1 valued by its shareholder.

The benefit of higher capital in period 2 is higher profits. Profits are taxed at the rate t_c and discounted at the rate r.[8] The cost of higher capital in period 2 is lower distributions

[7]The neoclassical model presented in this section is consistent with the more in depth model presented in Patel, Seegert, and Smith (2014) that includes debt and dividend taxation.

[8]The equilibrium rate of return r is assumed to be exogenous, abstracting from all general equilibrium effects.

in period 1 (fewer dividends or more equity issuances). For expositional ease, attention is restricted to equilibria where the firm does not payout a dividend and issue equity concurrently.[9]

Consider the case where there is a kink in the marginal tax rate schedule such that $t_c = t_0$ for $Y_i \leq \kappa$ and $t_c = t_1$ for $Y_i > \kappa$, where $t_0 < t_1$. Under this marginal rate schedule, the objective function faced by the firm is

$$\begin{aligned} max_{K_{2,i}} \quad V =& K_{1,i} - \frac{r}{1+r} K_{2,i} \\ &+ \mathbb{1}(Y_i(K_{2,i}) \leq \kappa) \frac{(1-t_0)Y_i(K_{2,i})}{1+r} \\ &+ \mathbb{1}(Y_i(K_{2,i}) > \kappa) \frac{(1-t_0)\kappa + (1-t_1)(Y_i(K_{2,i}) - \kappa)}{1+r}, \end{aligned} \tag{2}$$

where $\mathbb{1}(Y_i(K_{2,i}))$ and $\mathbb{1}(Y_i(K_{2,i}))$ are indicator functions for taxable income being below or above the kink.

4.2 Model Solution

The first-order conditions for capital in period 2 is,

$$\frac{\partial V}{\partial K_{2,i}} = -1 + \mathbb{1}(Y_i(K_{2,i}) \leq \kappa)(1-t_0)Y_i'(K_{2,i}) + \mathbb{1}(Y_i(K_{2,i}) > \kappa)(1-t_1)Y_i'(K_{2,i}) + \frac{1}{1+r} = 0.$$

This condition can be rewritten as a piece-wise linear function,

$$Y_i'(K_{2,i}) = \begin{cases} \frac{r}{1-t_0}, & Y_i < \kappa \\ \in [\frac{r}{1-t_0}, \frac{r}{1-t_1}], & Y_i = \kappa \\ \frac{r}{1-t_1}, & Y_i > \kappa. \end{cases} \tag{3}$$

Writing this as a piecewise linear function reveals several intuitive results. First, when taxable income is either above or below the kink, the first order condition requires that the marginal product of capital equals the alternative rate of return given by the risk- and tax-free rate r divided by one minus the corporate tax rate. This is the familiar Hall-Jorgenson formula (Hall and Jorgenson, 1967). Here, the marginal product of capital

[9] In the general model in Patel et al. (2014) the restriction that a firm does not pay out a dividend and issue equity concurrently is derived as equilibrium behavior with a dividend tax. The restriction does not change the following analysis.

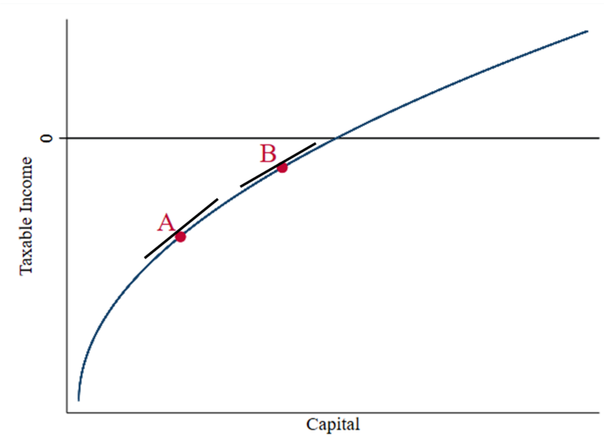
decreases with capital because the production function is increasing and concave in capital. Therefore, as the alternative rate of return increases (either because r or t_c increases), the optimal amount of capital in the firm decreases. As a result, the marginal product of capital is greater for firms that report taxable income above the kink than below.

In Figure 2, we depict the taxable income firms would report with a tax equal to t_0 (point B) and t_1 (point A) where the tax rate changes at the kink point $0 in taxable income. In Figure 2a, we depict a firm that reports taxable income to the left of the kink at point B. By reporting taxable income to the left of the kink they are subject to the marginal tax rate t_0. If this firm was subject to the higher tax rate t_1, it would reduce their reported taxable income to point A. Similarly, in Figure 2b, we depict a firm that reports taxable income to the right of the kink. This firm is subject to the higher tax rate t_1 and reports income at point A. If this firm had been subject to the lower tax rate t_0 it would have reported taxable income at point B.

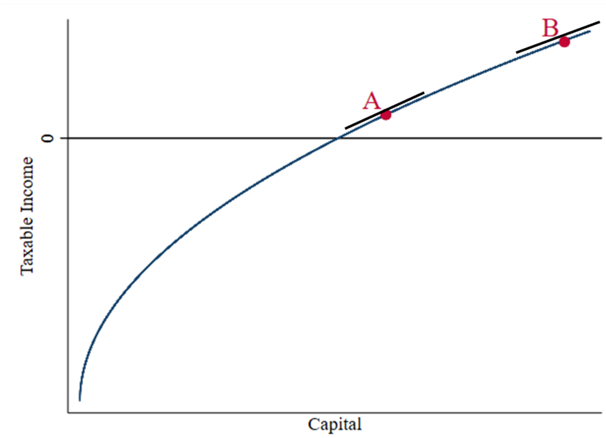
In Figure 2c, we depict the mechanism by which firm that bunches and reports taxable income equal to the kink at zero. In this example, a firm would report taxable income at point A if it were subject to the higher tax rate t_1, but at point A the firm is subject to the lower tax rate t_0. This same firm would report taxable income at point B if it were subject to the lower tax rate t_0, but at point B the firm is subject to the higher tax rate t_1. This firm, therefore, reports taxable income at the kink at zero. At the kink point, this firm has a marginal product of capital that is greater than firms right of the kink and lower than firms left of the kink.

In figure 3, we decompose this mechanism among three firms that differ in their fixed costs (in panel a) and in their productivity (in panel b). As before, these firms are again subject to a piecewise marginal tax schedule with a tax rate of t_0 below the kink at $0 and $t_1 > t_0$ above the kink. Points A, C, and E depict the taxable income these firms would report if they were subject to the higher tax rate t_1. Points B, D, and F depict the taxable income these firms would report if they were subject to the lower tax rate t_0. In both panels, the firm depicted by the dotted line reports taxable income to the right of the kink (at point A). Similarly, the firm depicted by the dashed line in both panels reports taxable income to the left of the kink (at point F). Finally, the firm depicted by the solid line bunches and reports $0 taxable income (the kink). Both of these panels demonstrate that there is a set of firms that have fixed costs and productivity such that they optimally report taxable income at the kink, $0 in this case.

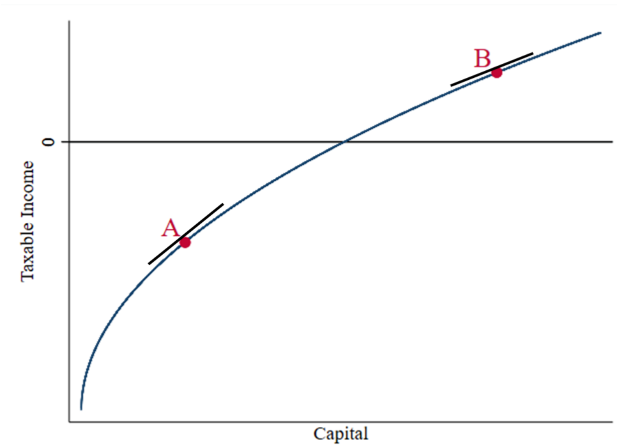
Figure 2: **Firm optimization**



(a) Firms left of the kink



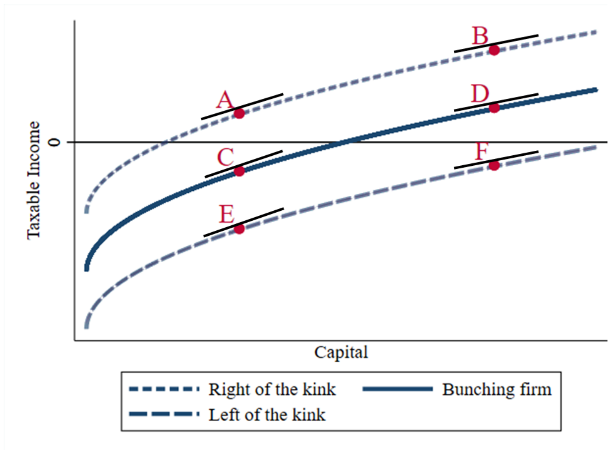
(b) Firms right of the kink



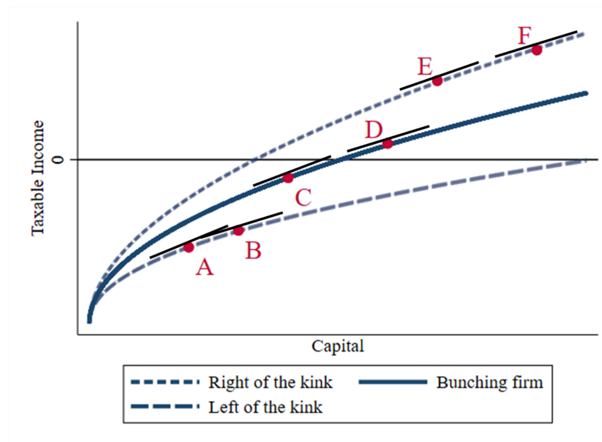
(c) Firms bunching at the kink

Notes: This figure depicts three firms in panels a, b, and c that are subject to a piecewise tax schedule with a tax rate t_0 below the kink at $0 in taxable income and subject to the tax rate $t_1 > t_0$ above the kink. Panel a depicts a firm that reports taxable income below the kink. Panel b depicts a firm that reports taxable income above the kink. Panel c reports taxable income at the kink.

Figure 3: **Heterogeneous firm optimization**



(a) Fixed cost differences



(b) Productivity differences

Notes: This figure depicts firms that are heterogeneous in their fixed costs (in panel a) and productivity (in panel b). These firms are subject to a piecewise tax schedule with tax rate t_0 below the kink at \$0 and $t_1 > t_0$ above the kink. Points A, C, and E depict the taxable income these firms would report if they were subject to the higher tax rate t_1. Points B, D, and F depict the taxable income these firms would report if they were subject to the lower tax rate t_0.

In equilibrium, a firm's taxable income in the second period can then be derived as,

$$Y_i^* = \underbrace{\frac{1+e}{e} r^{-e} (1-t_c)^e}_{\equiv \theta_c} A_i - F_i, \tag{4}$$

which depends on the firm's heterogeneous production factor A_i and fixed cost F_i, the elasticity e, the net-of-tax rate $\theta_c = 1 - t_c$, and the value of production amenities θ_c.

The solution for taxable income Y has a similar form to solutions derived in different contexts in this literature (Saez, 2010b; Coles et al., 2022; Bertanha et al., 2019):

$$Y_i = \begin{cases} \frac{1+e}{e} r^{-e} (1-t_0)^e A_i - F_i, & A_i \leq \underline{A} \\ \kappa, & \underline{A} < A_i < \overline{A} \\ \frac{1+e}{e} r^{-e} (1-t_1)^e A_i - F_i, & A_i \geq \overline{A}. \end{cases} \tag{5}$$

The thresholds are found by setting the optimal taxable income equal to the kink κ with both tax rates;

$$\underline{A} = (\kappa + F_i)/\theta_0, \qquad \text{and} \qquad \overline{A} = (\kappa + F_i)/\theta_1. \tag{6}$$

Equation (5) maps the unobserved variables A and F to the observed variable Y. This mapping depends on the kink point κ, the value of production amenities to the left of the kink $\theta_0 = \frac{1+e}{e} r^{-e}(1-t_0)^e$ and on the right $\theta_1 = \frac{1+e}{e} r^{-e}(1-t_1)^e$, and the elasticity e. We can use this mapping to write the mixed continuous-discrete distribution of Y, F_Y, which is observed by the researcher, as a function of the continuous distributions of A and F, i.e. F_A and F_F, that are unobserved. We use variation in productivity and fixed costs to derive two empirical methods to recover the elasticity e.

5 Empirical Methods

We implement new methods using variation in the tax rate in the corporate tax schedule. Firms report different amounts of taxable income as a result of the changing tax rate. These methods exploit observed changes in the distribution of firms to estimate how responsive firms are to tax rates. This type of variation has been used by Burtless and Hausman (1978), Blomquist and Newey (2002), Saez (2010a), and Bertanha, McCallum, and Seegert (2022).

The identification of the elasticity is impossible when the distributions of productivity and fixed costs belong to the nonparametric class of all continuous distributions, as is known in the bunching literature (Blomquist et al., 2015; Bertanha et al., 2016). With the parametric assumptions on A and F in equation (10), we show there are at least two methods for identifying the elasticity. Throughout this section, we suppress the subscript i on variables such as Y, A, and F for notational ease.

First, we develop a two-step identification strategy that relies on variation in covariates that separately affect productivity and fixed costs. This additional variation allows us to estimate parameters to the left and to the right of the kink in the tax schedule. We can then structurally recover the elasticity of interest by leveraging our model of corporate behavior, described in Section 4.1.

Second, we combine the insights of Coles et al. (2022) and Bertanha et al. (2022) to identify policy-relevant elasticities. We transform taxable income using estimates of fixed costs following methods by Coles et al. (2022). With this transformed variable, we apply the methods developed by Bertanha et al. (2022) using the Stata package `bunching` (Bertanha et al., 2022).

5.1 Two-Step Identification Strategy

The two-step identification strategy we develop builds on the key insights that bunching is can be modeled based on censoring and selection models introduced by Bertanha et al. (2022) (see their Section 4.2.1). We summarize this intuition within the context of our model. First, consider observations left of the kink, where $Y < \kappa$. In this case, we write optimal taxable income as

$$Y = \underbrace{\frac{1+e}{e} r^{-e}(1-t_0)^e}_{\equiv \theta_0} A - F, \tag{7}$$

as given by equation (5). As before, the parameter θ_0 captures the value of production amenities under tax rate t_0.

We assume that firm-specific productivity is determined by observable ($X_{i,A}$) and unobservable ($\nu_{i,A}$) factors according to the relation:

$$A_i = X_{i,A}\beta_A + \nu_{i,A}. \tag{8}$$

Similarly, we assume that firm-specific fixed costs are determined by observable ($X_{i,F}$) and unobservable ($\nu_{i,F}$) factors,

$$F_i = X_{i,F}\beta_F + \nu_{i,F}. \tag{9}$$

Finally, we assume exogeneity of these error terms with respect to observables such that:

$$\begin{pmatrix} \nu_{i,a} \\ \nu_{i,b} \end{pmatrix} \Bigg| \begin{pmatrix} X_{i,A} \\ X_{i,B} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_A^2 & \rho\sigma_A\sigma_F \\ \rho\sigma_A\sigma_F & \sigma_F^2 \end{pmatrix} \right). \tag{10}$$

As such, both A_i and F_i are log-normally distributed.

We can then use the parametric assumptions in equations (8) and (9) to write the expectation of Y conditional on covariates (X_A, X_F) and selecting the sample to the left of the kink,

$$\begin{aligned} Y &= \theta_0(X_A\beta_A + \nu_A) - (X_F\beta_F + \nu_F) \\ &= X_A\beta_A\theta_0 + X_F(-\beta_F) + (\theta_0\nu_A - \nu_F) \\ \mathbb{E}[Y|X_A, X_F, Y < k] &= X_A(\beta_A\theta_0) + X_F(-\beta_F) + \mathbb{E}[(\theta_0\nu_A - \nu_F)|X_A, X_F, Y < \kappa]. \end{aligned}$$

Next, we derive an expression for the conditional expectation of $\theta_0\nu_A - \nu_F$ based on these assumptions and by setting the kink point in the marginal tax schedule, κ, to be zero, as is true in most global settings.

First, note that the distribution of $\theta_0\nu_A - \nu_F$, conditional on (X_A, X_F), is $N(0; \theta_0^2\sigma_A^2 + \sigma_F^2 - 2\theta_0\rho\sigma_A\sigma_F)$.

Second,

$$\begin{aligned} Y &< 0 \\ \Leftrightarrow \theta_0 A &< F \\ \Leftrightarrow \theta_0(X_A\beta_A) + \theta_0\nu_A &< X_F\beta_B + \nu_F \\ \Leftrightarrow \theta_0\nu_A - \nu_F &< X_F\beta_F - X_A\beta_A\theta_0. \end{aligned}$$

Third, define

$$\begin{aligned} \sigma_0^2 &\equiv \theta_0^2\sigma_A^2 + \sigma_F^2 - 2\theta_0\rho\sigma_A\sigma_F, \\ W_0 &\equiv \frac{\theta_0\nu_A - \nu_F}{\sigma_0}, \end{aligned}$$

where W_0 is distributed as standard normal, conditional on (X_A, X_B).

Finally,

$$\begin{aligned} \mathbb{E}[(\theta_0\nu_A - \nu_F)|X_A, X_F, Y < \kappa] &= \sigma_0\mathbb{E}[W_0|X_A, X_F, \theta_0\nu_A - \nu_B < X_F\beta_F - X_A\beta_A\theta_0] \\ &= \sigma_0\mathbb{E}[W_0|X_A, X_F, W_0 < (X_F\beta_F - X_A\beta_A\theta_0)/\sigma_0] \\ &= -\sigma_0\frac{\phi((X_F\beta_F - X_A\beta_A\theta_0)/\sigma_0)}{\Phi((X_F\beta_F - X_A\beta_A\theta_0)/\sigma_0)}, \\ &= -\sigma_0\lambda\left(\frac{X_F\beta_F - X_A\beta_A\theta_0}{\sigma_0}\right), \end{aligned}$$

where $\lambda(x) \equiv \phi(x)/\Phi(x)$, ϕ and Φ denote the standard normal PDF and CDF, respectively, and we use the fact that $\mathbb{E}[Z|Z < c] = -\phi(c)/\Phi(c)$ for any constant c and Z standard normal.

Therefore,

$$\mathbb{E}[Y|X_A, X_F, Y < 0] = X_A(\beta_A\theta_0) + X_F(-\beta_F) - \sigma_0\lambda\left(\frac{X_F\beta_F - X_A\beta_A\theta_0}{\sigma_0}\right).$$

Following similar steps for the data on the right-hand side of the threshold and $\kappa = 0$, we arrive at

$$\mathbb{E}[Y|X_A, X_F, Y > 0] = X_A(\beta_A\theta_1) + X_F(-\beta_F) + \sigma_1\lambda\left(\frac{X_A(\beta_A\theta_1) - X_F\beta_F}{\sigma_1}\right),$$

where $\theta_1 \equiv \frac{1+e}{e}r^{-e}(1-t_1)^e$, $\sigma_1^2 \equiv \theta_1^2\sigma_A^2 + \sigma_B^2 - 2\theta_1\rho\sigma_A\sigma_B$, and we use the fact that $\mathbb{E}[Z|Z > c] = \phi(c)/(1-\Phi(c)) = \phi(-c)/\Phi(-c) = \lambda(-c)$.

The parameters of this model can be consistently estimated by a two-step procedure, similar to Heckman's two-step estimator. The first step consists of two PROBIT regressions, and the second step consists of two OLS regressions.

Define $D_0 = \mathbb{I}\{Y < 0\}$ and $D_1 = \mathbb{I}\{Y > 0\}$. We have,

$$\begin{aligned}\mathbb{E}[D_0|X_A, X_F] &= \Phi\left(\frac{X_F\beta_F - X_A(\beta_A\theta_0)}{\sigma_0}\right), \\ \mathbb{E}[D_1|X_A, X_F] &= \Phi\left(\frac{X_A(\beta_A\theta_1) - X_F\beta_F}{\sigma_1}\right).\end{aligned}$$

Thus, a PROBIT regression of D_0 on X_A and X_B produces consistent estimates for $-(\beta_A\theta_0)/\sigma_0$ and β_F/σ_0. Likewise, a PROBIT regression of D_1 on X_A and X_B produces consistent estimates for $(\beta_A\theta_1)/\sigma_1$ and $-\beta_F/\sigma_1$. This allows the researcher to consistently estimate the lambda terms that enter in the regressions above,

$$\begin{aligned}\lambda_0(X_A, X_B) \equiv \lambda\left(X_A\left(\frac{-\beta_A\theta_0}{\sigma_0}\right) + X_B\left(\frac{\beta_F}{\sigma_0}\right)\right), \\ \lambda_1(X_A, X_B) \equiv \lambda\left(X_A\left(\frac{\beta_A\theta_1}{\sigma_1}\right) + X_B\left(-\frac{\beta_F}{\sigma_1}\right)\right).\end{aligned}$$

With those lambda functions in hand, the researcher runs two OLS regressions in the second step. First, using the sample of Y such that $Y < 0$, regress Y on X_A, X_B, and $\lambda_0(X_A, X_B)$ to obtain consistent estimates for $\beta_A\theta_0$, $-\beta_F$, and $-\sigma_0$, respectively. Second, using the sample of Y such that $Y > 0$, regress Y on X_A, X_B, and $\lambda_1(X_A, X_B)$ to obtain consistent estimates for $\beta_A\theta_1$, $-\beta_F$, and σ_1, respectively. This argument holds as long as X_A and X_F are two distinct vectors of covariates.

Consider the case where the vectors X_A and X_F share a subvector of covariates Z, but also have their unique subvectors of covariates W_A and W_F, i.e., $X_A = [W_A, Z]$ and $X_F = [W_F, Z]$. Partition the vector of parameters accordingly: $\beta_A = [\beta_A^w, \beta_A^z]$ and $\beta_F = [\beta_F^w, \beta_F^z]$. Revisiting the four regressions above gives:

Step 1: PROBIT regressions:

(a) Regress of D_0 on W_A, W_B, and Z to obtain consistent estimates for $-(\beta_A^w\theta_0)/\sigma_0$, β_F^w/σ_0, and $-(\beta_A^z\theta_0)/\sigma_0 + \beta_F^z/\sigma_0$, respectively. Construct $\lambda_0(W_A, W_B, Z) \equiv \lambda\left(W_A\left(\frac{-\beta_A^w\theta_0}{\sigma_0}\right) + W_B\left(\frac{\beta_F^w}{\sigma_0}\right) + Z\left(\frac{-\beta_A^z\theta_0}{\sigma_0} + \frac{\beta_F^z}{\sigma_0}\right)\right)$.

(b) Regress D_1 on W_A, W_B, and Z to obtain consistent estimates for $(\beta_A^w\theta_1)/\sigma_1$, $-\beta_F^w/\sigma_1$, and $(\beta_A^z\theta_1)/\sigma_1 - \beta_F^z/\sigma_1$, respectively. Construct $\lambda_1(W_A, W_B, Z) \equiv \lambda\left(W_A\left(\frac{\beta_A^w\theta_1}{\sigma_1}\right) + W_B\left(\frac{-\beta_F^w}{\sigma_1}\right) + Z\left(\frac{\beta_A^w\theta_1}{\sigma_1} + \frac{-\beta_F^w}{\sigma_1}\right)\right)$.

Step 2: OLS regressions:

(a) Use the sample of Y such that $Y < 0$ and regress Y on W_A, W_B, Z, and $\lambda_0(W_A, W_B, Z)$ to obtain consistent estimates for $\beta^w_A\theta_0$, $-\beta^w_F$, $\beta^z_A\theta_0 - \beta^z_F$, and $-\sigma_0$, respectively.

(b) use the sample of Y such that $Y > 0$ and regress Y on W_A, W_B, Z, and $\lambda_1(W_A, W_B, Z)$ to obtain consistent estimates for $\beta^w_A\theta_1$, $-\beta^w_F$, $\beta^z_A\theta_1 - \beta^z_F$, and σ_1, respectively.

It becomes straightforward to identify the elasticity e using the coefficients from the 2nd-step regression above. Specifically, the ratio of any of the coefficients on W_A between the two OLS regressions equals

$$\frac{\beta^w_{j,A}\theta_0}{\beta^w_{j,A}\theta_1} = \frac{\frac{1+e}{e}r^{-e}(1-t_0)^e}{\frac{1+e}{e}r^{-e}(1-t_1)^e} = \frac{(1-t_0)^e}{(1-t_1)^e}, \quad j = 1, \dots k^{wa}, \tag{11}$$

where k^{wa} is the number of covariates in the vector W_A. We recover the elasticity by taking the log of this ratio and dividing by the difference in logs of the net-of-tax rates,

$$e = ln\left(\frac{\beta^w_{j,A}\theta_0}{\beta^w_{j,A}\theta_1}\right)\frac{1}{ln(1-t_0) - ln(1-t_1)}. \tag{12}$$

The advantage of this method is that it relies on variation in productivity and fixed costs that are fundamental to corporations. The disadvantage of this method is that it requires observable characteristics that shift productivity but not fixed costs, an exclusion restriction. These covariates may not exist in all contexts. To complement the two-step method, we present alternative methods in the following section that do not require such covariates.

5.2 Fixed Cost Estimation

We demonstrate an alternative method for identifying the elasticity that leverages and combines the estimation strategies in Coles et al. (2022) and Bertanha et al. (2022). Our model differs from canonical bunching models in two important ways. First, instead of one, we have two unobserved variables; productivity A and fixed costs F. To return to a model with only one unknown, we separately estimate F for each firm using methods in the literature (Coles et al., 2022). Specifically, we use the relationship between variable costs, revenues, and total costs. For example, fixed costs can be recovered using a simple regression of variable costs on a polynomial of revenues; variable costs = f(revenues), where fixed costs equal the residual plus the constant of this regression.

The second way our model differs from canonical bunching models is that taxable income can be negative, and we are interested in a kink at zero and, therefore, cannot simply take log of taxable income.[10] We transform the dependent variable Y such that the kink is no longer at zero. Specifically, using the estimates of the fixed costs, we define the variable

$$W = \frac{Y + F}{F}. \tag{13}$$

Applying this transformation to Equation (5), we obtain a three-regime expression for W where the kink value equals one.

$$W_i = \begin{cases} \theta_0 A_i / F_i, & \text{if } F_i/A_i > \theta_0, \\ 1, & \theta_1 \leq F_i/A_i \leq \theta_0, \\ \theta_1 A_i / F_i, & \text{if } F_i/A_i < \theta_1. \end{cases} \tag{14}$$

The model for W with kink at 1 fits the framework of Bertanha, McCallum, and Seegert (2022).

We apply the bunching methods of Bertanha, McCallum, and Seegert (2022) to the transformed variable W to get an estimate of the elasticity of W with respect to the net-of-tax rate, that is, e_W. We focus on the nonparametric bounds and the Tobit estimator provided in the Stata package `bunching` (Bertanha et al., 2022). The nonparametric bounds method produces lower and upper bounds on e_W under the assumption that the PDF of F_i/A_i has bounded slope. If there are covariates X that explain the ratio F_i/A_i, the Tobit method retrieves e_W under the assumption that the distribution of F_i/A_i is a mixture of normal random variables averaged over the distribution of X (Lemma 1 by Bertanha et al. (2022)).

We translate the estimates on e_W back to the elasticity of Y with respect to the

[10] In principle, we could follow or build on the methods in Coles et al. (2022) by using additional data to estimate the counterfactual distribution using control groups. In practice, we failed to find suitable control groups that existed across all countries. For example, control groups in Coles et al. (2022) use differences in net operating losses but only a few of the countries we look at provide data on net operating losses.

net-of-tax rate, that is, e_Y, using transformation (13):

$$\begin{aligned} e_W &= \frac{\partial W}{\partial(1-t)}\frac{(1-t)}{W} \\ &= \frac{1}{F}\frac{\partial Y}{\partial(1-t)}\frac{F(1-t)}{Y+F} \\ &= \frac{\partial Y}{\partial(1-t)}\frac{(1-t)}{Y+F} \qquad (15) \\ &= e_Y\frac{Y}{Y+F} \\ e_Y &= \left(1+\frac{F}{Y}\right)e_W. \qquad (16) \end{aligned}$$

The advantage of this method is that once the variable is transformed using the fixed cost estimation, it relies on established methods from Bertanha et al. (2022). Bertanha et al. (2022) create a suite of different estimation strategies, including nonparametric bounds, semi-parametric point estimates, and estimates that use truncation—each with different identifying assumptions. Those methods, therefore, complement the two-step method laid out in the previous section by providing a way of the robustness of elasticity estimates across different identifying assumptions.

6 Results

In this section we present corporate elasticity estimates for each of five different countries: China, Greece, Norway, Slovakia, and South Africa. As previously described, all estimates rely on administrative tax data to implement the same bunching estimation strategy, allowing us to make cross-country comparisons that reflect fundamental differences in firm behavior and tax systems, rather than differences in methods.

In all graphs and figures we report the elasticity of taxable income evaluated for a firm with zero fixed costs, which is the elasticity of W with respect to the net-of-tax rate. All in-line references to the elasticity of taxable income reflect e_W. As shown in equation (13), the elasticity of Y with respect to the net-of-tax rate is related to the elasticity of W with respect to the net-of-tax rate using a scale factor, $(1+\frac{F}{Y})$. We provide additional information about the magnitude of this scale factor within each context to allow the reader to convert e_W to e_Y.

6.1 Implementation and required identification assumptions

To implement the fixed cost method, we have to model variable costs slightly differently across countries, depending on data availability. In China, we model variable costs as a cubic function of revenue, where variable costs are proxied by a firm's interest deduction and revenue is captured by operating revenue. In Greece, we model variable costs as a log-log function of revenue, where variable costs are proxied by a firms income tax deductions and and revenue is captured by turnover scaled by sales. In Norway, we use panel data to estimate a cubic regression of variable costs and revenue with firm-specific fixed effects. We measure variable costs using a firm's sum of operational costs (including current expenses such as material cost, labor costs, and rent paid) and financial costs (e.g., losses from investments in or lending to subsidiaries, interest payments, and reduction in the value of stocks) and revenue is captured by the sum of operational revenue and financial revenue (e.g., net income from investing in or lending to subsidiaries, interest income, currency gains, gains from selling stock, income from other investments). In Slovakia, we model variable costs as an log-log function of revenue, where variable costs are proxied by a the logarithm of the depreciation of long-term tangible and intangible assets and revenue is captured by the logarithm of corporate sales revenues.

In the two-step method, identification requires a variable that shifts productivity but does not shift fixed costs – the exclusion restriction. Again, due to differences in the type of data we have available across countries, these vary slightly across countries in our sample. In China, we use the log of R&D expenses. Further, we proxy for fixed costs with the log depreciation expense and we allow the log of the wage bill to affect both variable and fixed costs. In Greece, we use the log of the intangible asset expense. We proxy for fixed costs with the deduction for depreciation expenses and the amount of fixed assets in land. In Norway, we use the log of intangible assets. We use the log of long-term debt and the log of depreciation as shifters of fixed costs. In Slovakia, we use non-current intangible assets. We proxy for fixed costs with the depreciation of long-term assets.

6.2 Summary of our elasticity estimates

We summarize our estimates of the elasticity of taxable income, Y, in Table 2. In Panel A, we show estimates using the fixed cost method and the scale factor reported above. In this table we focus on our preferred specifications based on either 40 or 60% of the data, depending on the country. In Appendix A, we additionally provide elasticity estimates using 10%, 50%, and 100% of the data used and we visualize the variation in the elasticity of W using different subsets of the data around the kink in Figure 4. In Panel B, we show estimates using the two-step method.

In column (1), we report elasticity estimates based on 60% of data for Chinese firms. We estimate that the elasticity of taxable income for manufacturing firms in China in 2009 was 0.295. This implies that Chinese manufacturing firms in 2009 would respond to a 10% increase in the net-of-tax rate with an increase in taxable income of 2.95%. The two-step method results in a higher elasticity of taxable income estimate than the fixed cost method: 0.778. In Figure 4 we show that the elasticity of taxable income ranges from 0.143 to 0.634. This estimate is considerably lower than the prevailing estimate of the responsiveness of U.S. corporations, which are predicted to respond to a 10% increase in the net-of-tax rate with an increase in taxable income of 8.9%.

In column (2), we report elasticity estimates for Greek firms, using 40% of the data. We estimate that the elasticity of taxable income for firms with zero fixed costs is 1.194, while the two-step method that uses 100% of the data, generates estimates of the elasticity of taxable income to be 0.902. As such, Greek firms respond to a 10% increase in the net-of-tax rate by increasing taxable income by 9.02%.

In column (3), we report elasticity estimates for Norwegian firms, using 60% of the data. Using fixed-cost method, we estimate the elasticity of taxable income to be 0.535. This implies that Norwegian firms respond to a 10% increase in the net-of-tax rate by increasing taxable income by 5.35%. In case of two-step method the estimated elasticity is 0.872. This estimate is similar to estimates of the elasticity of taxable income in both China and Greece using the two-step method.

Finally, in column (4), we report elasticity estimates for Slovakian firms, using 60% of the data. Using fixed-cost method, we estimate that the elasticity of taxable income is 0.791. By comparison, our estimate using the two-step method suggest that firms are more responsive: a 10% increase in the net-of-tax rate result sin a 12.94% increase in taxable income. However, the standard errors on this estimate are quite large, such that we cannot reject statistical equality between our preferred estimate using the fixed cost method and the estimate coming from the two-step method.

6.3 Importance of truncation

The reason why our preferred estimates use only a fraction of data is that the normality assumption is often too strong using 100% of the raw data. This can be seen in panel (d) across Figures A1, A2, A3, A4 in Appendix A: the normality assumption produces a poor fit. In this case, estimates based on a normality assumption are inappropriate. However, truncating the data typically improves the appropriateness of the normality assumption.

We demonstrate this in panel (e) across Figures A1, A2, A3, A4 in Appendix A, which use our preferred fraction of data. Here, we see that the fit of the normal density is much better using either 40% (Greece) or 60% of the data – this is our preferred specification as it balances the trade-off between the appropriateness of the identifying assumption with power of the estimator.[11]

Greece is a context in which the ability to estimate the counterfactual density using truncated data is an especially meaningful innovation because it avoids the complication of the bimodal distribution of firms. Similar situation applies to Norway. Norway is a country that has a small share of very large and very small firms – outliers in the distribution. Estimates using 100% of the data are quite sensitive to these outliers, as demonstrated in panel c of Figure 4, which depicts a spike in the elasticity of taxable income by a factor of five relative to the elasticity of taxable income using 90% of the data. For this reason, estimates using large shares of the data, 70% and more, as shown in panel (b) for Greece and panel c for Norway in Figure 4 are unlikely to identify the underlying elasticity of taxable income.

In turn, in case of Slovakia, the raw data shown in panel (a) in Figure A4 is very bell-shaped, which is consistent with normally distributed data. Indeed, the fit of the normal distribution looks good even using 100% of the data, shown in panel (d). In this case, the normal distribution misses the peak of the distribution near the mean, but otherwise fits the data well. Consistent with this, Figure 4 shows little variation in the estimated elasticity across a wide range of truncation; estimates vary just 40% for estimates using between 10 and 100% of the data, as shown in columns (1) – (3) of Table A4.

6.4 Nonparametric bounds

Traditional bunching methods, as in Saez (2010a), make assumptions about the slope of the counterfactual distribution in the bunching region. Figure 5 presents diagnostic information on the appropriateness of those assumptions based on variation in the slope of the counterfactual distribution between the theoretical lower and upper bound, including a trapezoidal assumption that is the canonical assumption of Saez (2010a). This graph allows the user to evaluate the appropriateness of these slope assumptions in the context of this estimator in addition to providing bounds on the range of elasticity estimates that are possible under this model. Based on the maximum slope of the unobserved density, the

[11] In Appendix A, we complement these results by showing the raw data used for each country in panel (a) of Figures A1, A2, A3, A4. Across all countries, we see clear evidence of bunching at $0 in profits. This a point where the marginal corporate tax rate increases sharply from 0% to 25% in China, from 0% to 28% in Norway, and from 0% to 31% in Slovakia.

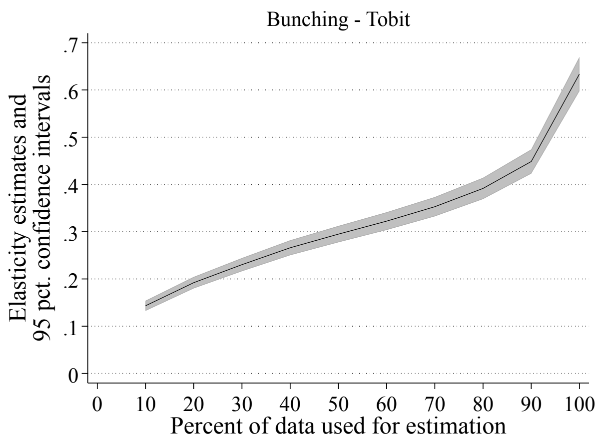
Table 2: Corporate Elasticity of Taxable Income: cross-country comparison.

	(1) China	(2) Greece	(3) Norway	(4) Slovakia
	Panel A: Fixed Cost			
Elasticity of Taxable Income	0.295	1.194	0.535	0.791
evaluated at F=0	(0.009)	(0.0627)	(0.0016)	(0.074)
% Data Used	60	40	60	60
Observations	139,589	37,247	856,968	39,000
	Panel B: Two-step			
Elasticity of Taxable Income	0.778	0.902	0.872	1.294
evaluated at F=0	(0.158)	(0.046)	(0.085)	(0.289)
% Data Used	100	100	100	100
Observations	232,648	93,117	1,428,280	65,000

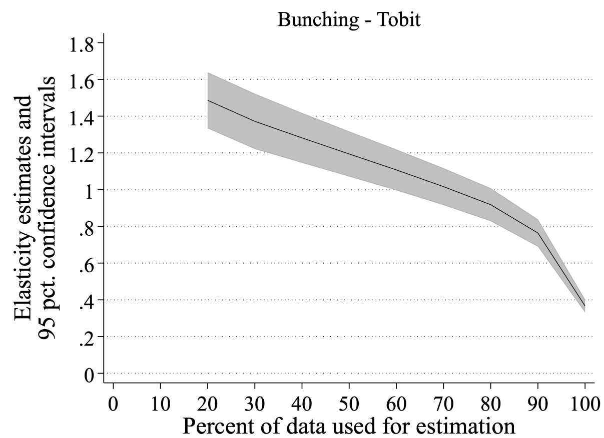
Notes: This table presents estimates of the corporate elasticity of taxable income across countries. In Panel A, we show our preferred estimates using fixed cost method, outlining the fraction of the data used. In Panel B, we show our estimates using two-step method. The Elasticity of Taxable Income is evaluated for a firm with zero fixed costs. During this time period, Chinese firms faced a flat 25% corporate income tax rate on positive taxable income.

Figure 4: Corporate Elasticity of Taxable Income: cross-country comparison of elasticity estimates across fraction of data used.

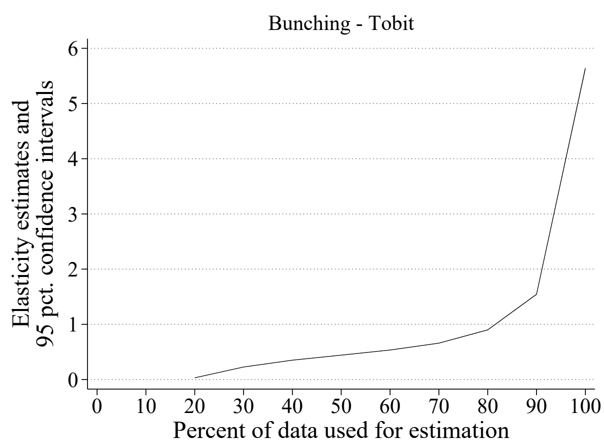
(a) China



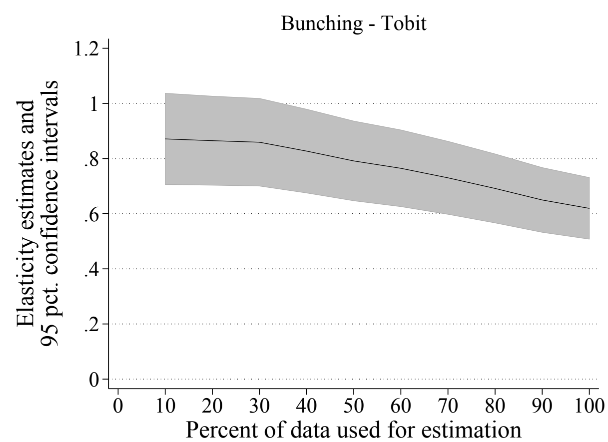
(b) Greece



(c) Norway



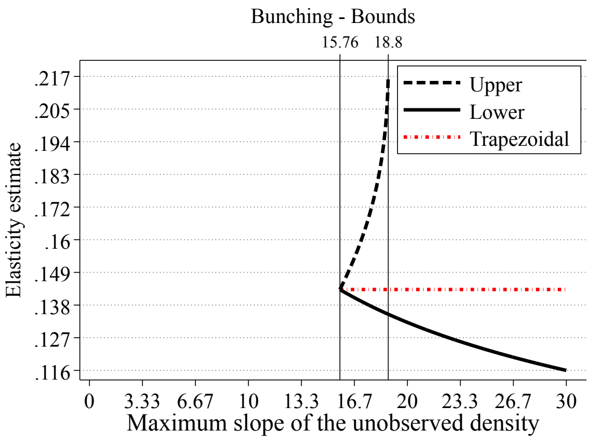
(d) Slovakia



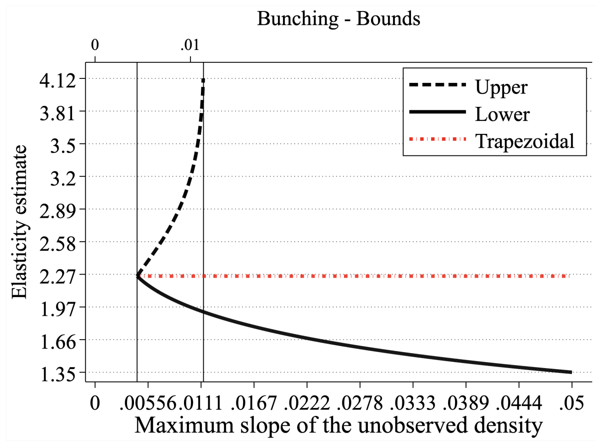
Notes: This figure plots the variation in the estimated elasticity of taxable income based on the amount of data used in the estimation. These plots are related to the estimation of the corporate elasticity of taxable income using administrative data from China (panel a), Greece (panel b), Norway (panel c), and Slovakia (panel d).

Figure 5: Corporate Elasticity of Taxable Income: cross-country comparison of bunching bounds.

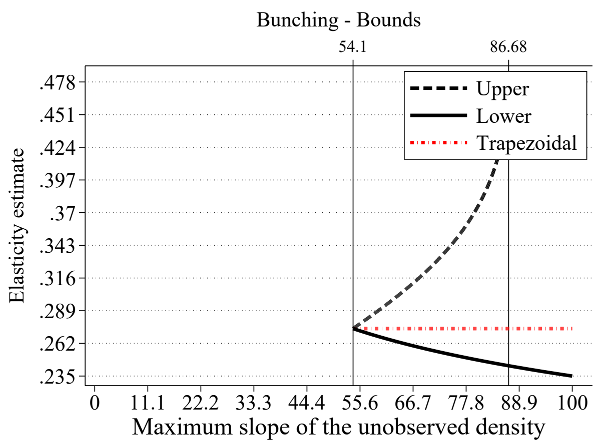
(a) China



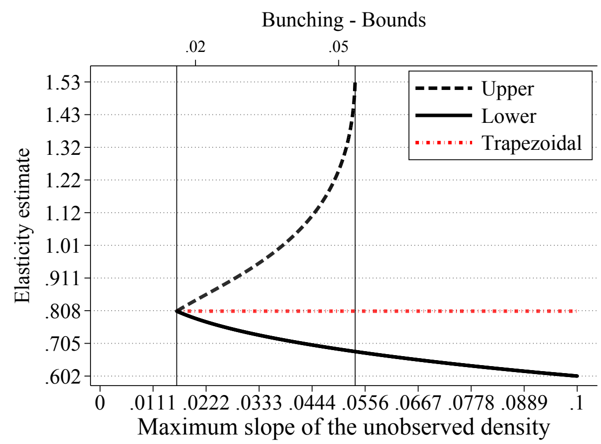
(b) Greece



(c) Norway



(d) Slovakia



Notes: This figure plots diagnostic tools for the traditional bunching estimate. These are related to the estimation of the corporate elasticity of taxable income using administrative data from China (panel a), Greece (panel b), Norway (panel c), and Slovakia (panel d). Specifically, each figure plots the resulting upper and lower bounds on e_W using the nonparametric bounds method.

elasticity of taxable income lies between 0.135 and 0.217 for Chinese firms, between 0.24 and 0.48 for Norwegian firms, and between 0.304 and 0.688 for Slovakian firms. In panel (b) we see that Greek firms are quite sensitive as the possible elasticity estimates range between 1.90 and 4.12 depending on the assumed slope of the counterfactual distribution. These estimates suggest that firms in China, Norway and Slovakia are fairly insensitive to tax rates, relative to those in China.

6.5 Discussion

By holding the estimation methodology fixed across countries, we are able to engage in cross-country comparisons wherein differences must be driven by firm and tax system fundamentals, for example, differences in the risk preferences of the firms and/or the detection and enforcement mechanisms of the tax authority, as highlighted by canonical models of optimal tax evasion (Allingham and Sandmo, 1972). Recall that past empirical estimates of the corporate elasticity of taxable income have varied from close to zero to as high as five. Here, we show that across a wide range of countries, the elasticity of taxable income is much less variable than was previously suggested.

To begin, we compare estimates using our preferred specification and the fixed cost method across countries. In this context, manufacturing firms in China appear to be the least sensitive to changes in tax rates, with a corporate elasticity of taxable income of 0.295. Chinese manufacturing firms operate in a very different economic environment than those based in Europe. For example, economic markets in China are highly regulated by the central government, which operates as a communist political organization. By comparison, large Greek firms are the most responsive to change is corporate tax rates, with an elasticity of 1.194. The economic and political environment of Greece differs sharply from that of China in many important ways. At a minimum, the Greek tax administrator has historically struggled to raise revenue to fund the provision of public goods, consistent with the hypothesis that Greek tax payers are very sensitive to tax rates and/or the Greek tax authority struggles with tax administration and enforcement. The responsiveness of Norwegian and Slovakian firms lives in between these two extremes, with elasticities of 0.535 and 0.791, respectively.

When we compare estimates based on the two-step method, variation in the elasticity collapses down even further. In addition, the rank order of the most and least responsive firms shifts, however, large standard errors on some of the two-step estimators — a common trade-off with instrumental variables models — make it difficult to statistically identify differences. Chinese firms remain the least sensitive to tax rate changes, with an estimated elasticity of 0.778. Unlike with the fixed cost method, in the two-step method Slovakian firms are the most responsive, with an elasticity of 1.294. At the same time, the standard error of this estimate is such that the lower bound of the 95% confidence interval for this estimate is 0.728, and includes the estimate from China, Greece, and Norway. The second most responsive firms are in Greece, not so dissimilar from the rank order of the two-step method results.

Regardless of method, our estimates, which hold methods fixed, suggest that the upper bound of firm responsiveness is five times smaller than was previously estimated. This reduction in variability has important consequences for policy makers considering changes in business tax policy, an area of active policy debate. Our updated estimates suggest that tax receipts will be considerably less affected by changes in business tax rates.

7 Conclusion

This paper provides new insights into the elasticity of taxable income. We provide the greatest collection of comparable estimates across counties to date. First, we find that there are meaningful differences in the elasticity across countries. These differences suggest there is scope for differences in tax regulation and enforcement to have a large affect on the elasticity. Second, we find the differences across countries are substantially smaller than that found in the literature. Across our fixed cost and two-step methods we find ranges of estimates between 0.30 and 1.19 and 0.77 and 1.29, respectively. In comparison, estimates in the literature range from 0 to 5. The substantially smaller range suggest that differences in method across studies could explain a large portion of the differences found across countries. The importance of method highlights the need to use methods with reasonable identifying assumptions that are suited for the context.

An important theoretical question is whether the elasticity is a primitive parameter such as risk aversion (Saez et al., 2012). We add to this debate by providing evidence of the corporate elasticity of taxable income across the world. We find there is substantial heterogeneity across and within countries. Some of this difference is due to firm characteristics that make it easier for them to respond to changes in tax rates (such as being a multinational or cash accounting firm (Coles et al., 2022)). Some of this difference is also due to differences in tax codes across countries that provide firms with different avenues to respond to higher taxes. Future work is needed to decompose the differences into these pieces.

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A Detailed Data Description

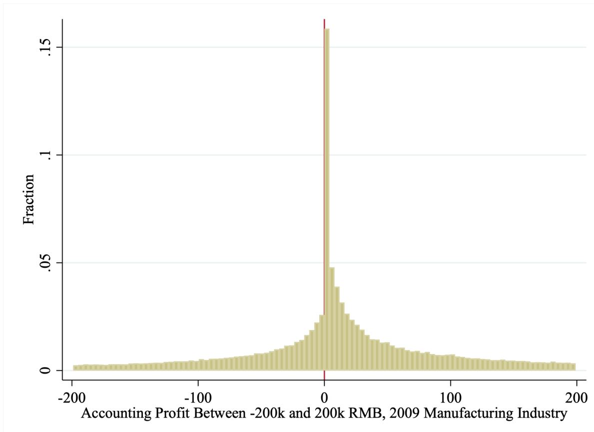
In this Appendix, we present detailed information on elasticity estimates for each country. In all graphs and figures we report the elasticity of taxable income evaluated for a firm with zero fixed costs, which is the elasticity of W with respect to the net-of-tax rate. All in-line references to the elasticity of taxable income reflect e_W. As shown in equation (13), the elasticity of Y with respect to the net-of-tax rate is related to the elasticity of W with respect to the net-of-tax rate using a scale factor, $(1 + \frac{F}{Y})$. We provide additional information about the magnitude of this scale factor within each context to allow the reader to convert e_W to e_Y.

A.1 China

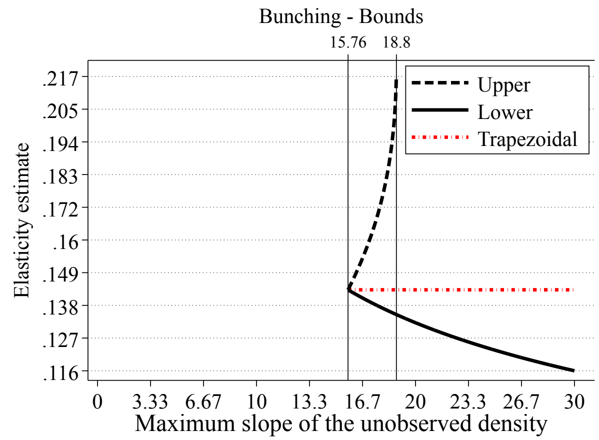
We estimate the corporate elasticity of taxable income for Chinese manufacturing firms in 2009 using both the fixed cost and the two-step method. To implement the fixed cost method, we model variable costs as a cubic function of revenue, where variable costs are proxied by a firm's Interest Deduction and revenue is captured by Operating Revenue. Identification in the two-step method requires a variable that shifts productivity but does not shift fixed costs – the exclusion restriction. In this context, we use the log of R&D expenses. In addition, we proxy for fixed costs with the log depreciation expense and we allow the log of the wage bill to affect both variable and fixed costs. In china, the scale factor that converts e_W to e_Y is 1.101 based on the ratio of the average fixed cost to average taxable income.

Figure A1: Corporate Elasticity of Taxable Income: China, 2009

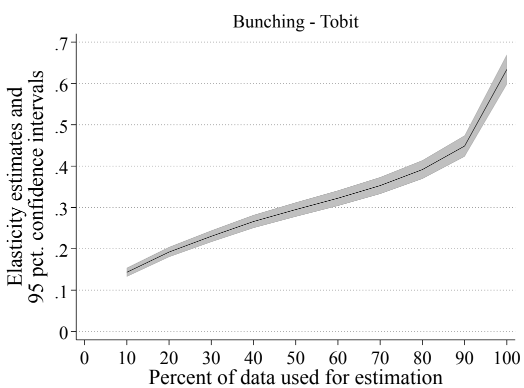
(a) Raw Data



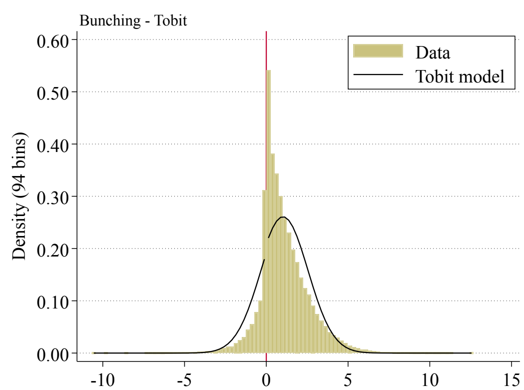
(b) Bunching Bounds



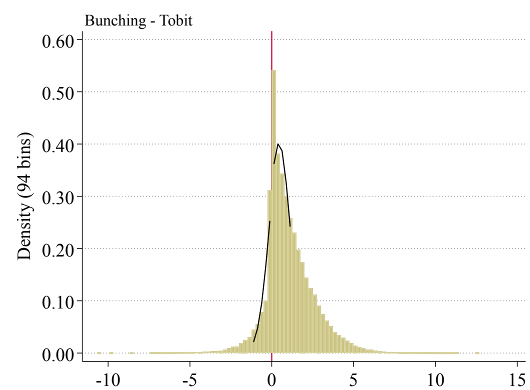
(c) Variation by Data Used



(d) Normality, 100% Data



(e) Normality, 60% Data



Notes: This figure plots diagnostic graphs related to the estimation of the corporate elasticity of taxable income using administrative data from Chinese manufacturing firms in 2009. Panel (a) plots the raw distribution of accounting profit and highlights bunching behavior. Panel (b) plots diagnostic tools for the traditional bunching estimate. Panel (c) plots variation in the estimated elasticity of taxable income based on the amount of data used in the estimation. Panel (d) plots the fit of the normal distribution in the tobit model for 100% of the data. Panel (e) plots the fit of the normal distribution in the tobit model using 60% of the data, and reflects our preferred specification.

Figure A1 displays the raw data used for analysis in panel (a) in addition to several diagnostic tests for the fit in the two-step method in panels (b) – (e). In panel (a) we see clear evidence of bunching at $0 in accounting profit, where the tax rate increases sharply from 0% to 25%. Traditional bunching methods, as in Saez (2010a), make assumptions about the slope of the counterfactual distribution in the bunching region. Panel (b) presents diagnostic information the appropriateness of those assumptions based on variation in the slope of the counterfactual distribution between the theoretical lower and upper bound, including a trapezoidal assumption that is the canonical assumption of Saez (2010a). This graph allows the user to evaluate the appropriateness of these slope assumptions in the context of this estimator in addition to providing bounds on the range of elasticity estimates that are possible under this model. Based on the maximum slope of the unobserved density, the elasticity of taxable income lies between 0.135 and 0.217.

In panels (c) – (e), we relax the the global functional form requirements and use truncated estimates. Panel (c) plots variation in the elasticity of W using different subsets of the data around the kink. The normality assumption is often too strong using raw data; this can be seen in figure (d), which uses 100% of the data: the normality assumption produces a poor fit. In this case, estimates based on a normality assumption are inappropriate. However, truncating the data typically improves the appropriateness of the normality assumption. In panel (e) we see that the fit of the normal density is much better using 60% of the data – this is our preferred specification as it balances the trade-off between the appropriateness of the identifying assumption with power of the estimator.

Table A1 collects our estimates. Columns (1) – (4) report estimates of the elasticity of taxable income, Y, using the fixed cost method and the scale factor reported above, and column (5) reports the elasticity of taxable income using the two-step method. Specifically, columns (1) – (3) report estimates for 10%, 50%, and 100% of the data used, similar to what is seen in panel (c) of Figure A1. The elasticity of taxable income ranges from 0.143 to 0.634. Column (4) reports our preferred specification based on 60% of the data; here, we estimate that the elasticity of taxable income for manufacturing firms in China in 2009 was 0.295. In other words, Chinese manufacturing firms in 2009 would respond to a 10% increase in the net-of-tax rate with an increase in taxable income of 2.95%. This estimate is considerably lower than the prevailing estimate of the responsiveness of U.S. corporations, which are predicted to respond to a 10% increase in the net-of-tax rate with an increase in taxable income of 8.9%. The two-step method results in a higher elasticity of taxable income estimate than the fixed cost method: 0.778.

Table A1: Corporate Elasticity of Taxable Income: China, 2009

	Fixed Cost				Two-Step
	(1)	(2)	(3)	(4)	(5)
Elasticity of Taxable Income	0.634	0.322	0.143	0.295	0.778
evaluated at F=0	(0.018)	(0.010)	(0.005)	(0.009)	(0.158)
% Data Used	10	50	100	60	100
Observations	23,265	116,324	232,648	139,589	232,648

Notes: This table presents estimates of the corporate elasticity of taxable income for Chinese manufacturing firms in 2009 using both the fixed cost method in columns (1) – (4) and the two-step method in column 5. The Elasticity of Taxable Income is evaluated for a firm with zero fixed costs.

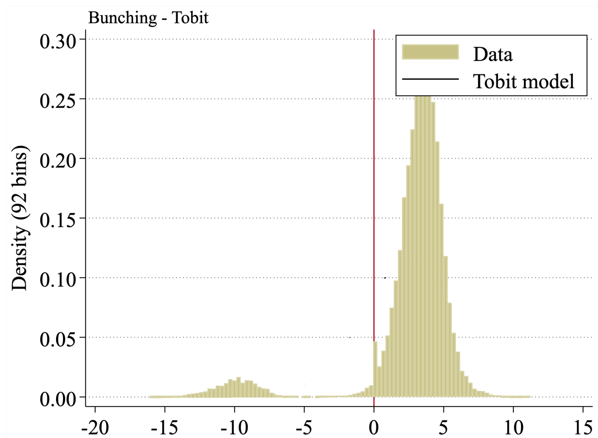
A.2 Greece

We estimate the corporate elasticity of taxable income for large Greek firms using data from 2002 – 2004 using both the fixed cost and the two-step method. To implement the fixed cost method, we model variable costs as a log-log function of revenue, where variable costs are proxied by a firms income tax deductions and and revenue is captured by turnover scaled by sales. Identification in the two-step method requires a variable that shifts productivity but does not shift fixed costs – the exclusion restriction. In this context, we use the log of the intangible asset expense. In addition, we proxy for fixed costs with the deduction for depreciation expenses and the amount of fixed assets in land.

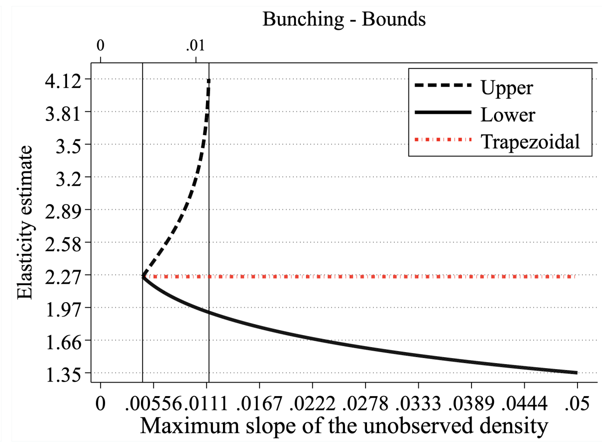
Panel (a) of Figure A2 displays the raw data used for analysis. Here we can see that the distribution of firms according to W is bi-modal. In light of this, we anticipate that the normal assumption using 100% of the data is going to be a poor fit. In panel (b) we see that Greek firms are quite sensitive as the possible elasticity estimates range between 1.90 and 4.12 depending on the assumed slope of he counterfactual distribution.

Figure A2: Corporate Elasticity of Taxable Income: Greece, 2002–2004

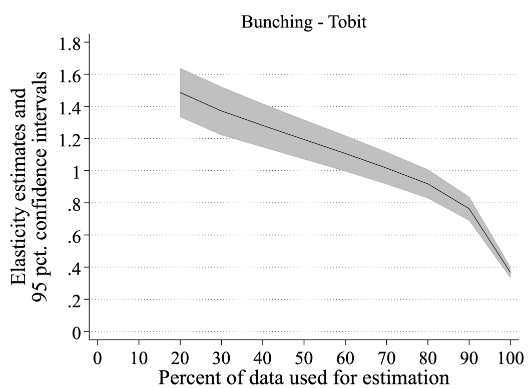
(a) Raw Data



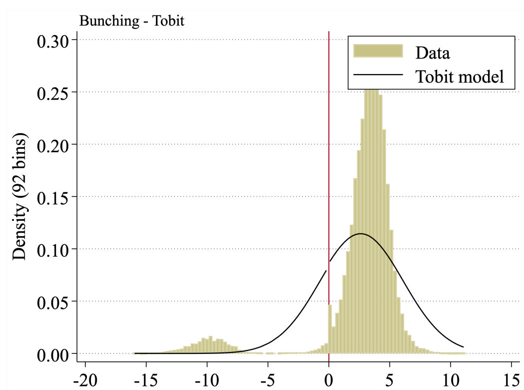
(b) Bunching Bounds



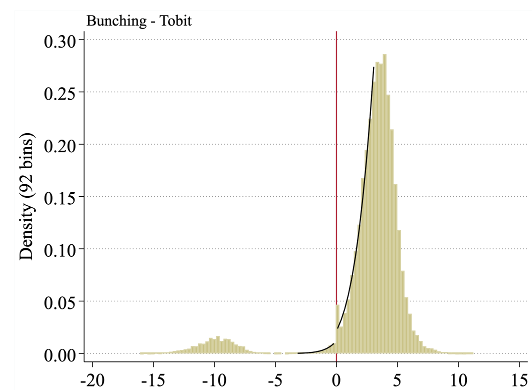
(c) Variation by Data Used



(d) Normality, 100% Data



(e) Normality, 40% Data



Notes: This figure plots diagnostic graphs related to the estimation of the corporate elasticity of taxable income using administrative data from large Greek firms using data from 2002–2004. Panel (a) plots the raw distribution of accounting profit and highlights bunching behavior. Panel (b) plots diagnostic tools for the traditional bunching estimate. Panel (c) plots variation in the estimated elasticity of taxable income based on the amount of data used in the estimation. Panel (d) plots the fit of the normal distribution in the tobit model for 100% of the data. Panel (e) plots the fit of the normal distribution in the tobit model using 60% of the data, and reflects our preferred specification.

Table A2: Corporate Elasticity of Taxable Income: Greece, 2002–2004

	Fixed Cost				Two-Step
	(1)	(2)	(3)	(4)	(5)
Elasticity of Taxable Income	1.486	1.107	0.366	1.194	0.902
evaluated at F=0	(0.0779)	(0.0568)	(0.0180)	(0.0627)	(0.046)
% Data Used	10	50	90	40	100
Observations	9,312	46,558	83,805	37,247	93,117

Notes: This table presents estimates of the corporate elasticity of taxable income for large Greek firms in 2002–2004 using both the fixed cost method in columns (1) – (4) and the two-step method in column 5. The Elasticity of Taxable Income is evaluated for a firm with zero fixed costs. During this time period, Greek firms faced a flat 35% tax rate on positive taxable income.

In panels (c) – (e), we explore variation in the estimated elasticity using the fixed cost method that assumes the counterfactual distribution is locally normal, where locally normal is a function of how much data is used to estimate the density. A subset of these estimates are also reported in columns (1) –(4) of Table A2. Greece is a context in which the ability to estimate the counterfactual density using truncated data is a meaningful innovation because it avoids the complication of the bimodal distribution of firms. To this point, panel (d) depicts the poor fit of the normality assumption using 100% of the data. For this reason, estimates using large shares of the data, 70% and more shown in panel (c), are unlikely to identify the underlying elasticity of taxable income.

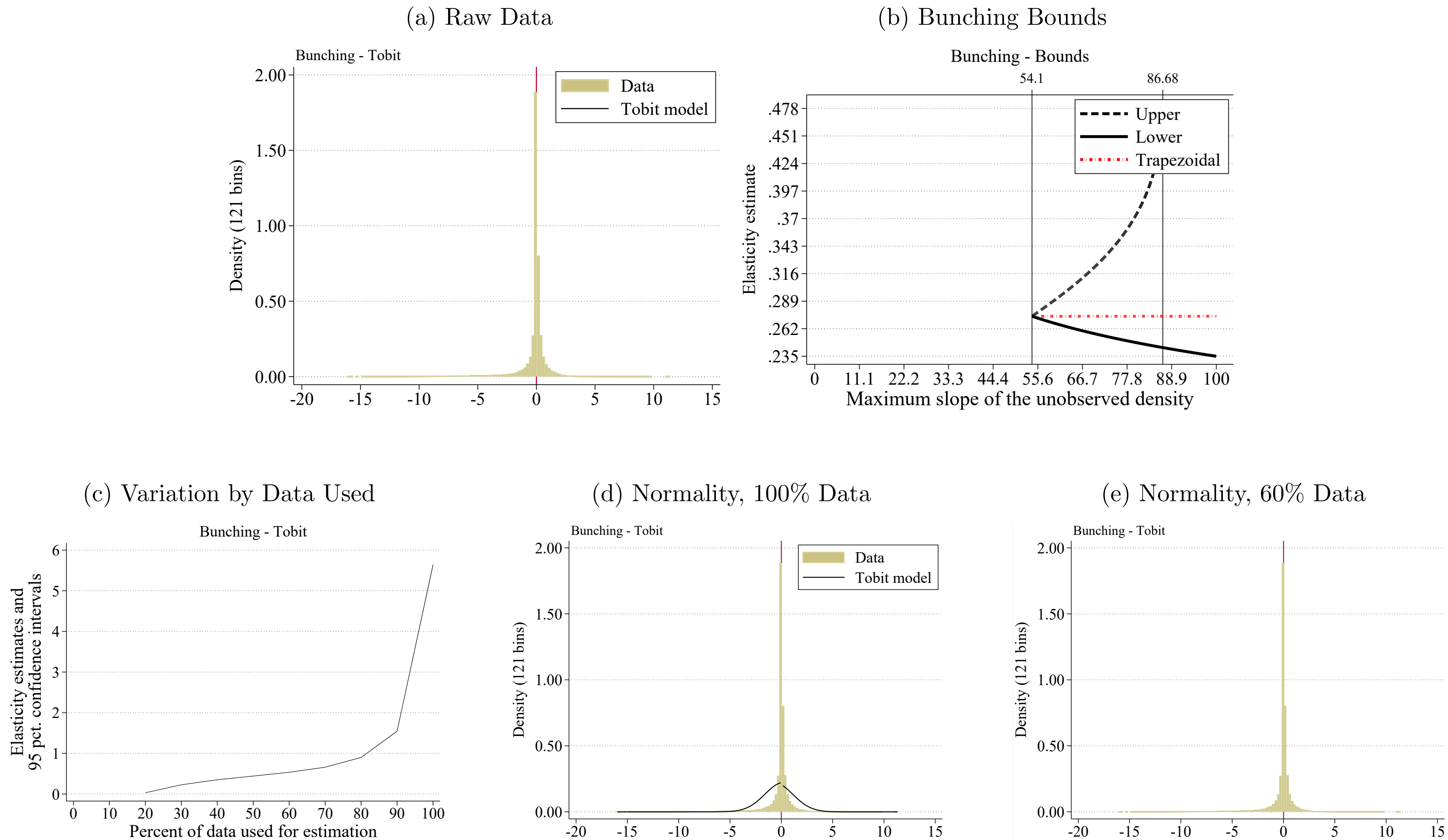
In our preferred specification, which uses 40% of the data and is depicted in Figure A2 panel (e). We estimate that the elasticity of taxable income for firms with zero fixed costs is 1.194 (col 4, Table A2). Finally, column (5) reports the estimated elasticity based on the two-step method and using 100% of the data. In this case, we estimate the elasticity of taxable income to be 0.902, or that Greek firms respond to a 10% increase in the net-of-tax rate by increasing taxable income by 9.02%.

A.3 Norway

We estimate the corporate elasticity of taxable income for Norwegian firms using data from 2006–2015 using both the fixed cost and the two-step method. To implement the fixed cost method, we use panel data to estimate a cubic regression of variable costs and revenue with firm-specific fixed effects. We measure variable costs using a firm's sum of operational costs (including current expenses such as material cost, labor costs, and rent paid) and financial costs (e.g., losses from investments in or lending to subsidiaries, interest payments, and reduction in the value of stocks) and revenue is captured by the sum of operational revenue and financial revenue (e.g., net income from investing in or lending to subsidiaries, interest income, currency gains, gains from selling stock, income from other investments). Identification in the two-step method requires a variable that shifts productivity but does not shift fixed costs – the exclusion restriction. In this context, we use the log of intangible assets. In addition, we use the log of long-term debt and the log of depreciation as shifters of fixed costs.

Panel (a) of Figure A3 displays the raw data used for analysis. This distribution shows a large mass of firms to the right of $0 in taxable income, the point at which the marginal corporate tax rate increases from 0% to 28%. In panel (b) we see find a range of estimates between 0.24 and 0.48 depending on the assumed slope of the counterfactual distribution. These estimates suggest that firms in Norway are fairly insensitive to tax rates and similar to firms in China.

Figure A3: Corporate Elasticity of Taxable Income: Norway, 2006–2015



Notes: This figure plots diagnostic graphs related to the estimation of the corporate elasticity of taxable income using administrative data from Norwegian firms using data from 2006–2015. Panel (a) plots the raw distribution of accounting profit and highlights bunching behavior. Panel (b) plots diagnostic tools for the traditional bunching estimate. Panel (c) plots variation in the estimated elasticity of taxable income based on the amount of data used in the estimation. Panel (d) plots the fit of the normal distribution in the tobit model for 100% of the data. Panel (e) plots the fit of the normal distribution in the tobit model using 60% of the data, and reflects our preferred specification.

Table A3: Corporate Elasticity of Taxable Income: Norway, 2006-2015

	Fixed Cost				Two-Step
	(1)	(2)	(3)	(4)	(5)
Elasticity of Taxable Income	0.227	0.442	1.544	0.535	0.872
evaluated at F=0	(0.0010)	(0.0014)	(0.0041)	(0.0016)	(0.085)
% Data Used	20	50	90	60	100
Observations	285,656	714,140	1,428,280	856,968	1,428,280

Notes: This table presents estimates of the corporate elasticity of taxable income for Norwegian firms in 2006–2015 using both the fixed cost method in columns (1) – (4) and the two-step method in column 5. The Elasticity of Taxable Income is evaluated for a firm with zero fixed costs. During this time period, Norwegian firms faced a flat 22% tax rate on positive taxable income.

In panels (c) – (e), we explore variation in the estimated elasticity using the fixed cost method using subsets of the data centered around the kink. A subset of these estimates are also reported in columns (1) –(4) of Table A3. Norway is a country that has a small share of very large and very small firms – outliers in the distribution. Estimates using 100% of the data will be quite sensitive to these outliers, and we can confirm this in panel (c), which depicts a spike in the elasticity of taxable income by a factor of five relative to the elasticity of taxable income using 90% of the data. To this point, panel (d) depicts the poor fit of the normality assumption using 100% of the data. For this reason, estimates using large shares of the data, 70% and more shown in panel (c), are unlikely to identify the underlying elasticity of taxable income.

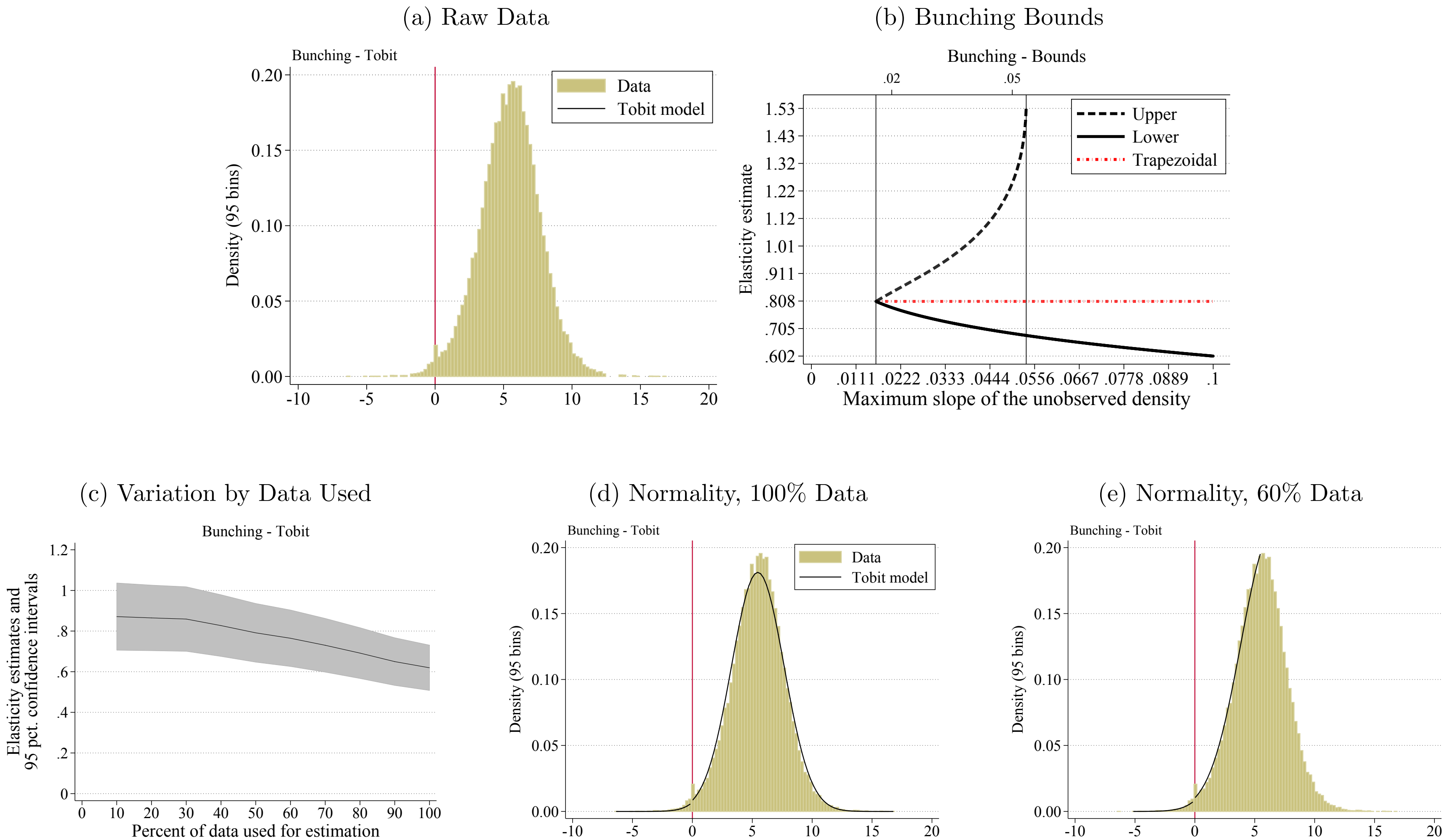
In our preferred specification, which uses 60% of the data, we estimate the elasticity of taxable income to be 0.535, reported in column (4) of Table A3. In other words, Norwegian firms respond to a 10% increase in the net-of-tax rate by increasing taxable income by 5.35%. Column (5) reports our estimate of the elasticity of taxable income using the two-step method. In this case, we estimate that firms respond to a 10% increase in the net-of-tax rate by increasing taxable income by 8.72%. This estimate is similar to estimates of the elasticity of taxable income in both China and Greece using the two-step method.

A.4 Slovakia

We estimate the corporate elasticity of taxable income for Slovakian firms using data from 2013 using both the fixed cost and the two-step method. To implement the fixed cost method, we model variable costs as an log-log function of revenue, where variable costs are proxied by a the logarithm of the depreciation of long-term tangible and intangible assets and revenue is captured by the logarithm of corporate sales revenues. Identification in the two-step method requires a variable that shifts productivity but does not shift fixed costs – the exclusion restriction. In this context, we use non-current intangible assets. In addition, we proxy for fixed costs with the depreciation of long-term assets.

Panel (a) of Figure A4 displays the raw data used for analysis. This distribution shows a mass of firms to the right of $0 in taxable income, the point at which the marginal corporate tax rate increases from 0% to 31%. In panel (b) we see that, using traditional bunching methods which assume a slope of the counterfactual distribution in the bunching region, the range of possible elasticity estimates is between 0.304 and 0.688. These estimates suggest that firms in Slovakia are moderately sensitive to tax rates.

Figure A4: Corporate Elasticity of Taxable Income: Slovakia, 2013



Notes: This figure plots diagnostic graphs related to the estimation of the corporate elasticity of taxable income using administrative data from Slovakian firms using data from 2013. Panel (a) plots the raw distribution of accounting profit and highlights bunching behavior. Panel (b) plots diagnostic tools for the traditional bunching estimate. Panel (c) plots variation in the estimated elasticity of taxable income based on the amount of data used in the estimation. Panel (d) plots the fit of the normal distribution in the tobit model for 100% of the data. Panel (e) plots the fit of the normal distribution in the tobit model using 60% of the data, and reflects our preferred specification.

Table A4: Corporate Elasticity of Taxable Income: Slovakia, 2013

	Fixed Cost				Two-Step
	(1)	(2)	(3)	(4)	(5)
Elasticity of Taxable Income	0.619	0.765	0.871	0.791	1.294
evaluated at F=0	(0.057)	(0.071)	(0.084)	(0.074)	(0.289)
% Data Used	10	50	100	60	100
Observations	6,500	32,500	65,000	39,000	65,000

Notes: This table presents estimates of the corporate elasticity of taxable income for Slovakian firms in 2013 using both the fixed cost method in columns (1) – (4) and the two-step method in column 5. The Elasticity of Taxable Income is evaluated for a firm with zero fixed costs. During this time period, Slovakian firms faced a flat 23% tax rate on positive taxable income.

In panels (c) – (e), we explore variation in the estimated elasticity using the fixed cost method and subsets of the data centered around the kink. A subset of these estimates are also reported in columns (1) –(4) of Table A4. The raw data shown in panel (a) is very bell-shaped, which is consistent with normally distributed data. Indeed, the fit of the normal distribution looks good even using 100% of the data, shown in panel (d). In this case, the normal distribution misses the peak of the distribution near the mean, but otherwise fits the data well. Consistent with this, panel (c) shows little variation in the estimated elasticity across a wide range of truncation; estimates vary just 40% for estimates using between 10 and 100% of the data, as shown in columns (1) – (3) of Table A4.

Our preferred specification uses 60% of the data, shown in panel (e) — this specification captures the height of the empirical density well in its fit. In this case, we estimate that the elasticity of taxable income is 0.791. By comparison, our estimate using the two-step method suggest that firms are more responsive: a 10% increase in the net-of-tax rate result sin a 12.94% increase in taxable income (col 5, Table A4. However, the standard errors on this estimate are quite large, such that we cannot reject statistical equality between our preferred estimate using the fixed cost method and the estimate coming from the two-step method.