Corporate Taxes and Retail Prices*

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Abstract

We study the impact of corporate taxes on barcode-level product prices, using linked survey and administrative data. Our empirical strategy exploits the dichotomy between the location of production and sales, providing estimate free from the endogeneity of state tax changes as well as confounding demand shocks. We find significant effects of corporate taxes on prices with an elasticity of 0.18. The effects are largest for low-income household and lower-price items. Approximately one quarter of corporate tax incidence falls on consumers, suggesting that models used by policymakers significantly underestimate the incidence of corporate taxes on consumers.

JEL Classification: G38, H22, H25

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1 Introduction

As an accounting fundamental, corporate taxes must result in lower payments to shareholders, lower wages, more tax avoidance, or higher product prices. This incidence of corporate taxes on workers, consumers and capital is key to debates on tax policy. While a large body work has focused on the incidence of corporate taxes on shareholders (starting with (Harberger, 1962)),[1] and more recent work has focused on the impacts on wages (Fuest, Peichl and Siegloch, 2018; Ljungqvist and Smolyansky, 2016) and avoidance through firm location choices (Giroud and Rauh, 2019; Suárez Serrato and Zidar, 2016) or tax planning (Dyreng, Jacob, Jiang and Müller, 2018), no empirical work has yet measured the price effects of corporate taxes on consumers. While the passage of the 2017 Tax Cuts and Jobs Act instituted the biggest federal corporate tax cut in recent history in the U.S., models used by policy makers assume that corporate taxes are full incident on capital and labor, rather than consumers (CBO, 2018; Cronin, Lin and Powell, 2013).

This study uses linked administrative and survey data to study the impact of corporate taxes on barcode-level product prices, which is key in evaluating the incidence of corporate taxes on consumers. We present the first estimates of corporates taxes on retail prices, finding that taxes levied on producers impact the final retail sales prices of their products. This finding stands in contrast to much early theoretical work which argued that, in a closed economy, corporate taxes should be fully incident on capital (Harberger, 1962).

There are two significant challenges to identifying the effects of corporate taxation of retail prices. The first is that corporate tax changes may be correlated with other factors that determine retail prices. For example, states may be more likely to raise taxes during recessions, when price growth is lower. The second challenge is simply that it has been difficult to assemble a corpus of data with information both on retail prices and the tax nexus of firms which produce those items. The locations where the transaction occurs cannot be relied upon as firms that produce goods are often located in states other than the states where goods are sold.

We deal with the first empirical challenge by utilizing the fact that if a firm has tax nexus (employees and property) in one state, but sells products in multiple states, then the firm's profits

[1] (Harberger, 1962) argued that corporate taxes will be incident on capital in a closed economy. Later work argued that when corporate and non-corporate firms produced the same good, the incidence can fall on labor and consumers (Feldstein and Slemrod, 1980; Gravelle and Kotlikoff, 1989). See Auerbach (2006) for a review of classic work on the incidence of corporate taxation.

will be primarily subject to the tax laws of state where the firm has nexus. We use tax changes in the states where firms' headquarters are located, and study the impact on retail prices in other states in which their products are sold. We avoid the potential endogeneity in the the corporate tax change by exploiting the dichotomy between the location of production and the location of sales, in the same spirit as (Bertrand and Mullainathan, 2003). This approach also allows us to include retailer by sold-state by year fixed effects, and therefore we can compare items sold *within* the the same retailer in the same state and year, but whose producer firms face different levels of corporate taxation due to their tax nexus location in other states. Our fixed effects capture time varying state specific shocks to product prices, such as local economic conditions where an item was sold, as well as time varying retailer shocks which may affect pricing, such as a national retail chain facing financial distress.

To overcome the second empirical challenge and implement our empirical approach, we link several datasets which enable us to observe barcode-level product prices, the location of each items' producers, and tax rates. First, and most importantly we link the Nielsen Consumer Panel, a representative panel of households in 52 metropolitan areas to barcode data from GS1, which contains the identity of the firm that produced an item sold. This provides us with a link between the firm which produced an item, and the item's final retail sale price. We further identify firm characteristics from ORBIS database, which contains administrative and ownership data. Finally, we assemble corporate tax rate by using data from Giroud and Rauh (2019), which we extend to 2017 using the same sources.

We begin by presenting a simple model, which motivates our subsequent empirical analysis. We find an elasticity of retail prices to corporate tax rates of approximately 0.18, meaning that a one percent increase in corporate tax rates leads to a 0.18 percentage increase in retail product prices. The results remain very stable when we include retailer by year, sold state by year, and retailer by sold state by year fixed effects. While our data does not contain information to identify the wage effects of corporate taxes, our model and empirical estimate allows for a back-of-envelope calculation of the wage elasticity to be 0.37, which is in line with those found in Germany by Fuest, Peichl and Siegloch (2018) and serves as a plausibility check for our price elasticity.

We complement our main analysis with a graphical event study, using 22 large tax increases and cuts, defined as tax changes greater than one percentage point (see Figure 1 for a map of tax

changes). Our analysis indicates that, for both tax increases and cuts, the timing of prices changes following tax events reflects the events studied. We see little price movement in the periods immediately before tax events, and we see prices rise or fall following tax increases and cuts respectively. For tax increases, we see strong and persistent effects on product prices. In comparison, after a tax cut, product prices were initially reduced but soon rebounded, both noisily estimated. This asymmetric response to corporate tax changes is consistent with Heider and Ljungqvist (2015), who study the effects on leverage.

Additionally, we rerun our analysis on a sample of firms which are unlikely to pay corporate taxes, S-Corporations. S-Corporations belong to another legal form of organization and they pay personal income taxes rather than corporate income taxes. If our empirical strategy is truly identifying the effects of corporate tax changes, rather than concurrent change in the state of corporation that coincide with the firms' pricing strategy, we should find that the price effects of corporate taxes to be only present for C-Corporations, but not for S-Corporations. This placebo analysis is implemented with a specification similar to Giroud and Rauh (2019). We find positive and significant price effects for C-Corporations seeing corporate income tax rates change, and positive but insignificant effects for S-Corporations seeing personal income tax rates change. We see no price effects for tax rate changes that do not affect the legal entity, in other words for C-Corporations seeing personal income tax rates change, and S-Corporations when corporate income tax rates change.

Our paper links closely to a literature studying corporate tax incidence. To our knowledge, this is the first study to empirically estimate how corporate taxes affect prices. Early work starting with Harberger (1962) argued that, in a closed economy, corporate tax incidence was borne almost entirely by capital. However, subsequent work has noted that in open economies business taxes can impact investment and consumer prices (Kotlikoff and Summers, 1987). Gravelle (2013) provides a review of much of the classic the literature on corporate tax incidence.

Newer empirical work has focused on the incidence of corporate taxes on firm location choice and workers. Giroud and Rauh (2019) study how corporate taxes impact firm location choices and employment reallocation, comparing S and C-Corporations, while Ljungqvist and Smolyansky (2016) study the impact of corporate taxes on employment and income. Suárez Serrato and Zidar (2016) estimate the incidence of corporate taxes on workers and owners and find that roughly

one third of corporate taxes are incident on workers. Fajgelbaum, Morales, Suárez Serrato and Zidar (2018) study spatial misallocation, and worker and firm preferences. There is less empirical work on the direct incidence of corporate taxes on wages, though in an important study Fuest, Peichl and Siegloch (2018) use German federal state corporate taxes and find that corporate taxes do indeed affect wages. Recent studies have also focused on how corporate taxes impact firm leverage (Heider and Ljungqvist, 2015) and risk-taking (Ljungqvist, Zhang and Zuo, 2017). We add to this literature by providing, to our knowledge, the first direct estimates of the effects of corporate taxes on product prices. We find that corporate taxes have significant effects on product prices, affecting who ultimately bears the burden of taxation.

Our paper has important implications for the progressivity of corporate taxes, and that due to effects on prices, corporate taxes are more similar to sales taxes in their effects. Many studies of corporate tax incidence ignore effects on consumers, as do models used by policy makers. For example, the CBO (2018) assumes that corporate taxes are not incident on households through consumer prices, but rather allocates incidence purely to owners of capital and through labor income, with three-quarters being incident on shareholders. The US Treasury model assumes an even higher incidence on shareholders, with more than four-fifths of corporate tax incidence borne by capital income (Cronin, Lin and Powell, 2013). Our analysis demonstrates that approximately one quarter of the total incidence of corporate taxation falls on consumers, through higher product prices.

The remainder of this paper is organized as follows. Section 2 discusses our setting, presents a theoretical model and our main empirical strategy. Section 3 discusses the data used for our analysis. Section 4 presents the main empirical results, and the incidence of corporate taxes on consumers. Section 5 concludes and discusses avenues for future research.

2 The Price Effects of Corporate Taxes

2.1 Corporate Taxes

State corporate tax rules vary from state to state,and typically states tax activities that occur within their own borders.[2] Firms thus have tax nexus in states where they have a physical presence, such as establishments, sales or employees. Multi-state firms must pay taxes in each state where the firm has nexus, and taxes are apportioned as a fraction of federal taxable income.

In our main empirical analysis, we exclude products sold in the same state where they are produced, and our empirical strategy relies on comparing how the price of items sold in one state is affected by tax changes in other states where an item is produced. We follow Heider and Ljungqvist (2015) and Ljungqvist and Smolyansky (2016) and measure corporate taxes at the level of a firm's headquarter state. The fact that a firm's headquarter state may not be the only state where it has nexus may introduce some measurement error in our estimates. This would have the effect of attenuating our results, leading us to underestimate the incidence of corporate taxes on consumers. This point is discussed further in section 4.2.

2.2 Model

Our analysis begins with a simple model demonstrating how corporate taxes impact prices, and motivates our subsequent empirical analysis.[3] We assume firms operate in a standard environment similar to De Loecker (2011) and Suárez Serrato and Zidar (2016), and that firms are monopolistically competitive. Firms are endowed with some productivity level B, and combine labor, L and capital K to produce output y with the following production function, $y = B \cdot L^{\gamma} \cdot K^{1-\gamma}$.

Firms take input prices as given and the output price p is given by an inverse demand curve from CES demand with $y = I \cdot (\frac{p}{\bar{p}})^{\varepsilon}$, where $\bar{p}$ is the price level and is normalized to 1 and $\varepsilon < 0$, is the demand elasticity. The firm maximizes profits, which are taxed at a rate τ. The firm thus solves

$$\max_{L,K}(1-\tau) \cdot (p \cdot y - w \cdot L) - \rho \cdot K \tag{1}$$

[2] See Giroud and Rauh (2019) and Heider and Ljungqvist (2015) for a detailed discussion of corporate tax nexus. The precise tax nexus depends on whether a state has a throwback or throwout rule, under which sales of untaxed activities in other states are included in the home states' tax base.

[3] Appendix A provides further model details.

where w is the wage rate for labor and ρ is the rate of return for capital. For any given level of taxes τ, if we solve the above static problem, the firm's optimal price level in logs, $ln(p)$ will be given by

$$ln(p) = -(1-\gamma)ln(1-\tau) + (1-\gamma)ln(\rho) + \gamma ln(w) + Z \tag{2}$$

where Z is a constant. Equation (2) shows that product prices, p, will depend on corporate taxes τ and motivates $ln(1-\tau)$ as the particular functional form for our empirical analysis.[4] In the following section, we describe the approach we utilize to estimate this relationship.

2.3 Empirical Approach

Our empirical approach relies on the fact that, if a firm has employees and property in a state h, but sales in many states, then a firm's profits will be subject to the tax laws of state h. We compare tax rate changes in a firm's headquarter state h, and observe price changes in other states s where the produced items are sold by retailers. The approach allows use to include state by retailer by year fixed effects, and our approach allows us to compare retail prices of items *within the same state and year, sold by the the same retailer*. We thus are able to control for confounding factors, such as changes in local demand due to business cycles or other factors. The remainder of this section outlines the approach in detail.

A product i is produced by a firm headquartered in state h, and is sold at time t in state s by a retailer r, which may operate in multiple states. We estimate the following equation, which comes directly from the theoretical model presented in section 2.2, restricting to firms that we can identify as C-Corporations.

$$\ln(p_{i,s,t+1}) = \alpha_{r,s,t} + \alpha_i + \beta \ln(1-\tau_{c,h,t}) + \gamma_1 X_{i,t} + \gamma_2 X_{h,t} + \varepsilon_{i,t} \tag{3}$$

where $p_{i,s,t+1}$ is the retail price of product i sold in state s at time $t+1$ and $\tau_{c,h,t}$ is the corporate tax rate in the state in which the firm that produces an item is headquartered, h at time t. We include product specific controls $X_{i,t}$, as well as firm headquarter state controls $X_{h,t}$. These include sales, property and payroll apportionment rules, throwback and throwout rule indicators, state sales and property tax revenues, total and general state revenue, state GDP, UI base wage and insurance

[4] Our results are similar if we use $ln(1+\tau)$ or τ as independent variable.

rates, as well as state unemployment rates. $\varepsilon_{i,t}$ is an error term, which we assume is conditionally orthogonal to $(1 - \tau_{c,h,t})$. We cluster standard errors at the seller state level.

We include product fixed effects α_i for each item identified by a UPC code. These absorb time invariant product-specific factors, such as the fact that some items are generally more expensive than others, or that some items are producer in certain states. Note that since each item is produced by one firm, the product fixed effects α_i absorb the time invariant effects of headquarter states h. For example, the UPC fixed effects capture the fact that some producers may be headquartered in states with better transportation networks, which could lower final sale prices.

An important feature of our strategy is the fact that we include sold state by retailer by time fixed effects $\alpha_{r,s,t}$. The sold state by retailer by time fixed effects $\alpha_{r,s,t}$ absorb and time specific factors in the seller state, for example the effects of local business cycles. The fixed effects even capture time varying state specific demand shocks, such as changing tastes in different regions or the differential severity of recessions in particular states. The fact that these include retailer by time fixed effects also captures time specific retailer shocks, such as a major national chain declining in popularity. We thus compare items sold in the same state at the time time, but whose producer companies face different levels of corporate taxation due to their headquarters being located in different states.

3 Data

We utilize the NCP data to construct a database of prices at the retailer-state-UPC-month level. For each good at this level, we construct the price from the weighted average (based on the number of units sold at each price) of all goods purchased. To minimize issues of rapid entry and exit of products, we restrict the sample to the UPCs that have been consumed in one retailer chain at one state for at least 24 consecutive months. In total, this selection accounts for about 4% of UPCs and 23% of aggregate sales in the NCP database. We then match this sample with the GS1 producer information via UPC matching.

Finally, to assemble data on state-level corporate tax records, we utilize and extend data shared by Giroud and Rauh (2019). In their paper, they construct a database of corporate taxes primarily from the University of Michigan Tax Database (1977-2002), the Tax Foundation (2000-2011),

and the 'state finance' chapter of the 'Book of States'. We extend this data from 2013 to 2017 utilizing the same sources; primarily relying on the Tax Foundation. To complement our analysis of C-corporations and corporate tax rates, we obtain personal income tax rate data from the NBER database for use alongside data on S-corporations and prices. In addition to the tax rates, we extract apportionment rate and throw-back/throw-out rules from the Commerce Clearing House's State Tax Handbooks up through 2017.

We link the NCP price and purchase data to retailers utilizing a database of UPCs from the GS1 Company. This firm offers a method to map UPCs to products and to individual producers in order to help firms manage their inventory. Each UPC acts as a unique identifier for a product (eg. a 20-ounce plastic bottle of Coca-Cola Classic) and allows us to link a purchase and price in the NCP data to information about the firm that produced each item. This data includes the location of the firm's headquarters which we utilize to identify the applicable state-level corporate tax rate for each product and firm.[5] We additionally link firms to the ORBIS database, which contains administrative and ownership data for firms.

Table 1 shows summary statistics for the main analysis variables.[6] Table A.3 shows statistics on the various steps taken to match across different datasets and construct the final sample.

3.1 Nielsen Consumer Panel Data

The Nielsen Consumer Panel (NCP; formerly 'Homescan' data) contains 40-60,000 American households across 52 metropolitan areas, spanning the years of 2004-2017 and covering almost 2 million unique items purchased.. The panel is constructed as a representative sample of the American population and is tracked through the inclusion of numerous demographic indicators, including the location of the household. Nielsen attempts to ensure high levels of participation among households in the panel through regular reminders that go out to households, encouraging them to report purchases and trips fully. Prizes, both monetary and in-kind, are utilized to incentivize high levels of continued engagement among participant households, and households that seem to be reducing levels of reporting are removed from the sample periodically. Including these non-compliers, about 20% of households attrit from the sample each year, with the average tenure

[5] We follow Heider and Ljungqvist (2015) and measure tax changes at the state headquarter level.
[6] Table A.2 describes the main analysis variables.

in-sample being about 4 years.[7]

The NCP mostly covers trips to pharmacies, grocery stores, and big-box/mass-merchandise stores. Consequently, the data generally span groceries, drugs and sundries, small electronics and household appliances, home furnishings (though generally not large furniture), garden and kitchen equipment, and some soft goods. While somewhat limited in scope, the NCP covers a substantial fraction of household spending on non-services: approximately $375 of spending per household per month. This constitutes about 30% of all household expenditures on goods in the CPI basket.

3.2 GS1 Barcode Data

The GS1 Company data allow us to derive UPC level linkages between items and their producers, giving a relatively comprehensive match for retail-good-producing firms. UPCS (barcodes) are nearly ubiquitous for products carried by the retailers that we study and will be available for essentially all goods that a given producer manufacturers, if they are in a relevant industry. Moreover, the linkages should be unique for a product and will be unchanged over time.

The link between UPC code and producer is driven by the first 6 to 9 digits of the UPC, known as the 'company prefix'. However, the number of digits contained in this company prefix is not fixed across UPCs and firms. Thus, for each UPC, we extract its first 6 to 9 digits as four company prefix candidates. Then, we match these candidates to the pool of company prefixes in order to create possible UPC-producer links. According to the GS1, "As the GS1 Company Prefix varies in length, the issuance of a GS1 Company Prefix excludes all longer strings that start with the same digits from being issued as GS1 Company Prefixes." Essentially, for one particular UPC code with its associated four company prefix candidates, there will be only one candidate fully matched to the company prefix pool. Our matching algorithm confirms this singular relationship. In the end, we use the GS1 Data Hub to exactly match 83% of the UPCs in the data to a GS1 company prefix.

3.3 Orbis Data

We construct our database on firm characteristics primarily through the use of the ORBIS database, developed by Bureau van Dijk (BvD). This database contains administrative and ownership data

[7] Broda and Weinstein (2010) and Einav et al. (2010) provide more detail and analysis of the NCP. In general, they find accurate coverage of household spending and non-imputed prices.

on 130 million firms across the globe. It covers both public and private firms, offering us an opportunity to identify the incorporation type of the producers of products in our pricing database.

Orbis collects both public and private data from administrative and other sources and organizes them in a consistent format. This includes information on the legal form/incorporation type that a given firm has undertaken, as noted by the "Standardized Legal Form" and "National Legal Form" variables. Unfortunately, these variables do not definitively determine whether a firm is a C-corporation or an S-corporation and we are forced to also supplement these variables with information on the number and type of shareholders in order to infer the incorporation type.

We first utilize the 'Standardized' and 'National' legal form and treat public companies as C-corporations. We treat partnerships as S-corporations and non-profit organizations and public authorities as firms that are exempt from corporate taxes altogether. For the rest of unidentified producers, we resort to information about their shareholders. We download the legal form information and the shareholder information of firms at the most recent available date. There is a reporting lag in Orbis data of roughly two years. Since we download the data in 2019, the latest available year should be 2017 or occasionally 2016.

According to the definition of an S-corporation (seen at 26 U.S. Code 1361.(b)), they should not have more than 100 shareholders and their shareholders should be individuals, not other firms or holding companies. Consequently, we treat producers who have more than 100 shareholders or who have non-individuals as shareholders as C-corporations.

To match our categorized Orbis data to our database of prices, we make use of a matching software on the web platform of Orbis. This system automatically matches firms according to names, locations, industry and other information. Since firms could operate at multiple locations, we restrict the matching criteria to company names and industries. We also manually match the name to supplement the matching for the largest firms in our sample. In the end, we match approximately 80% GS1 producers and match over 90% of all the UPCs in our pricing data.

4 Main Results

4.1 Main Estimates of Tax Elasticity

Table 2 presents estimates of equation (4). All specifications include UPC by retailer by sold state fixed effects, and controls noted in section 2.3. Column (1) includes only controls and UPC by retailer by sold state fixed effects. The estimates suggest large declines in retail prices stemming from corporate tax changes, with an elasticity of prices to corporate tax rates of approximately 0.381. The estimates are statistically significant at the 0.05 level. The estimates in column (1) may suffer from bias stemming from corporate tax changes being correlated with macroeconomic conditions. To address this concern, column (2) adds in year fixed effects. The estimates remain statistically significant, and the estimates of the elasticity of prices to corporate tax rates drops to approximately 0.215.[8]

To further control for state specific economic conditions, columns (3) includes sold state by year fixed effects. These capture state specific temporal factors, for example the housing boom and bust being more severe in certain states. Stroebel and Vavra (2019) show that local real estate prices impact retail prices. The estimates remain statistically significant at the 0.01 level. Column (4) adds in retailer by year fixed effects. The retailer by year fixed effects address firm specific temporal shocks. For example, firm financing shocks may impact retail prices (Kim, 2018). The estimates drop slightly, and the estimated elasticity falls to 0.186 and remains statistically significant at the 0.01 level.

The estimates in column (4) are also statistically indistinguishable from the estimates in column (3). Column (5) includes both sold state by year and retailer state by year fixed effects. The estimates remain very similar to those in column (4). Finally, column (6) adds in sold state by retailer by year fixed effects. The results again remain very similar to those in column (4), and statistically significantly different than zero at the 0.01 level.

Figure 2 shows the timing of price effects following large tax increases and decreases. This exercise serves as a test of our identification strategy, and the timing of observed results should coincide with the timing of tax changes. We define a large tax event as an increase or decrease of

[8] Appendix table A.4 shows that the main results are robust to weighting regressions by the total sales of each product category.

more than one percentage point, following Giroud and Rauh (2019). There are 24 large tax changes in our sample, including 10 tax increases and 14 tax cuts. We re-estimate our main specification, replacing the main treatment with an indicator of a time period before and after the large tax event, scaled by the magnitude of the tax change. Thus the figure plots coefficients β_i from the following specification:

$$\ln(p_{i,s,t+1}) = \alpha_{r,s,t} + \alpha_i + \sum_{i=1}^{T} \beta_i \mathbb{1}[i = t] \times \ln(1 - \tau_{c,h,t}) + \gamma_1 X_{i,t} + \gamma_2 X_{h,t} + \varepsilon_{i,t} \tag{4}$$

The shaded area denotes a 95% confidence interval. The panel on the left shows coefficient estimates for tax increases, while the panel on the right shoes coefficient estimates for tax cuts. We indeed find that the timing of observed effects lines up with large tax changes. For both tax increases and decreases, we see insignificant effects in the years prior to the tax event. Following the tax event, we see price effects. The effects are statistically significant for tax increases. The effects are weaker and statistically insignificant for tax cuts, which may be consistent with downwardly rigid prices on consumer goods. For instance, Heider and Ljungqvist (2015) also finds asymmetric effects of tax increases and cuts, in the context of firm employment decisions.

4.2 Interpretation of Magnitudes

In the previous section, we utilize a reduced form estimation to measure the elasticity of prices to corporate taxes. However, one should not interpret our estimates as $1 - \gamma$, the capital share of gross output. Tax increases have a direct effect on wages, which we do not not observe, so we can not separately identify the effect of taxes on wages. In fact, our empirically identified price elasticity I_p will be equal to $1 - \gamma + \gamma I_w$, where I_w is the wage elasticity.[9] We take the value of γ (the labor elasticity) to be 0.6 (Karabarbounis and Neiman, 2013), and informed by our empirical estimate of I_p, we can back out $I_w = 0.37$. This estimate is close to Fuest, Peichl and Siegloch (2018), who find the corporate income tax estimate of wage to be around 0.4. We take this back-of-envelope calculation as evidence that our estimate for the price elasticity to corporate taxes to

[9]Note that if we assume capital is mobile across states, then in our empirical setting with cross-state variation in corporate income tax, the rate of return for capital ρ should not change across states.

be of reasonable magnitude.

We can extend the model in section 2.2 to include intermediate goods and use the model and previous estimates to separately identify the intermediate input good price elasticity. Ex ante, this should be weakly lower than the product price elasticity, as intermediate goods may be sourced in the same state a firm is located, or another state. Our data can not separately identify wage or intermediate input price change, therefore our identified price incidence embody the wage incidence, which we denote I_w, and intermediate good price incidence is denoted by I_M. Our empirically identified price incidence I_p will be equal to $-\delta + \gamma I_w + (1 - \delta - \gamma) I_M$. We follow Suárez Serrato and Zidar (2016) and can set the values of γ (the labor elasticity) and $1 - \gamma - \delta$ (where δ is the capital elasticity) accordingly using BEA's 2012 data on shares of gross output by industry. These indicate that for private industries, compensation and intermediate inputs account for 28.5% and 45.6% respectively of the shares of gross output. Fuest, Peichl and Siegloch (2018) estimate that $I_w = 0.4$, and given our estimate of $I_p = -0.18$, this implies that the intermediate good price incidence $I_M = -0.077$. As a firm' intermediate inputs could be sourced locally or nationally, this -0.077 is a reasonable value of intermediate price incidence compared with the output price incidence of -0.181.

4.3 Heterogeneity

Table 3 exploits some dimensions along which the effect of corporate taxes on retail prices differs across goods. We break the UPCs in our sample into terciles according to two different metrics. In columns 1-4, we look for differential responses across UPCs depending on how expensive the UPCs are, on average. That is, for each UPC we measure the average price paid by households across all time periods in our sample. We then split the UPCs into three groups, interacting the corporate tax changes with indicators for each group (the highest-price group is the excluded category). We find that the lowest price goods tend to respond most to corporate tax changes, with average magnitudes almost twice as high for this lowest tercile relative to the highest tercile (ie. -0.230 vs. -0.230-0.291).

Columns 5-8 divide the sample of UPCs according to the average income of the households who purchase that item. Nielsen tracks household income according to income bins that vary at an annual level. We use the midpoints of these bins and construct the weighted average of

household income for the 'average' customer for each UPC. We then sort the UPCs into terciles according to this metric. Similar to the previous columns, we find generally larger effects for UPCs commonly purchased by households with lower incomes relative to those purchased by high-income households. Here the results are not as quantitatively large and are not as consistently statistically significant, but the point estimates are still substantial, associated with pass-through of corporate tax changes approximately 25-50% greater than those of "high-income UPCs". These coefficients are also displayed in Appendix Figure A.2.

4.4 Incidence of Corporate Taxes on Consumers

Our empirical analysis estimates the elasticity of output price with respect to the net-of-business tax rate, $\delta_p = \frac{dp}{d(1-\tau)}\frac{(1-\tau)}{p}$. Armed with this estimate, we quantify the incidence of corporate taxes on product prices as the share of the total corporate income tax burden born by consumers. We enrich the setting in Fuest, Peichl and Siegloch (2018) by allowing for the welfare change of consumers induced by a marginal change in the net-of-tax rate, along side workers and firm owners.

More specifically, we consider three types of agents: (1) the consumer in state s and (2) the worker and (3) firm owner, both in a different state h. We assume that $(h \neq s)$, which is consistent with our empirical setting. Consumers maximize the utility function $U(C_s, L_s)$ given the budget constraint: $p \cdot C_s = (1 - \tau_{p,s})w_s L_s$, where p is the price for the consumption good, C_s is consumption quantity, $\tau_{p,s}$ is personal income tax rate, w_s is the wage received by consumer and L_s is the quantity of labor. Since the consumer we are concerned with is not from the state where there is a tax shock, we assume the wage and labor supply, w_s and L_s, will not change. We can write the indirect utility function as $V_{con_s}(p)$ and a change in consumer utility as a result of a change in the product price is given by $dV_{con_s} = -C_s \cdot dp$, by the envelope theorem.

The worker in state h will maximize the utility function $U(C_h, L_h)$ given the budget constraint: $p \cdot C_h = (1 - \tau_{p,h})w_h L_h$, where for simplicity we assume only wages are affected. Then the indirect utility is given by $V((1-\tau)w)$ and the change in worker utility induced by tax change is $dV_{wkr_h} = (1 - \tau_{p,h})L_i \cdot dw_h$. A representative firm in state i faces a corporate tax rate $\tau_{c,h}$ and maximizes profits, $\Pi = (1 - \tau_{c,h})(pF(K, L_h) - w_h L_h) - rK$, over capital K and labor L. We similarly apply the envelope theorem and solve that the marginal effect in welfare for firm owners is $dV_f = (1 - \tau_{c,h})F(K, L_h)dp - (pF(K, L_h) - w_h L_h)d\tau$.

The share of consumers, workers and firm owners in the overall burden of a marginal change in the corporate tax rate is given by the respective share of their own marginal effect in welfare out of the total sum $dV_{con_s} + dV_f + dV_{wrk_h}$. For example, the share of tax burden born by consumers is $I_{con_s} = \frac{dV_{con_s}}{dV_{con_s}+dV_f+dV_{wrk_h}}$. The share of consumers in the tax burden can be expressed as:

$$I_{con_s} = \frac{s_{con}\delta_p}{s_{con}\delta_p - (1-\tau_{p,h})s_{labor}\delta_w - (1-\tau_{c,h})\delta_p - (1-\tau_{c,h})(1-s_{labor})} \tag{5}$$

Here, $s_{con} = \frac{pC_s}{pF(K,L_s)}$ is the consumption share over total output and $s_{labor} = \frac{w_h L_h}{pF(K,L_h)}$ is the labor share over total output. δ_p is the tax elasticity of price and δ_w is the tax elasticity of wage. As is clear, the price elasticity and wage elasticity to the net of tax rate are two sufficient statistics to calculate marginal welfare changes of consumers, workers and firms.[10]

Our data only allows for identification of the output price elasticity, which we find to be $\delta_p = -0.18$ and we take the estimate of wage elasticity from Fuest, Peichl and Siegloch (2018), δ_w=0.4, so we calculate that the incidence on consumers, workers and firms is 27%, 34% and 39%, respectively.[11] The results suggest that approximately one quarter of corporate taxes incidence falls on consumers, potentially making corporate taxes more similar to sales taxes and hence much less progressive.

4.5 Placebo Analysis

So far, we have focused on C-Corporations, which pay corporate tax rates. A natural placebo test is to repeat our analysis on other firms which produce goods for retail sales but do not pay corporate taxes. In the United Status, such a group exists and belong to S-Corporations, which are subject to personal income tax rates on their earnings. Figure 3 shows annual price changes and tax changes across 100 quantiles for both C-corporations and S-corporations. The left panel shows the relationship for C-Corporations. Here we find a strong relationship between corporate taxes and prices, consistent with the evidence presented in section 4.1. The right panel shows the

[10] We also use $s_{con} = 0.675$ from BEA's consumption share of GDP, $s_{labor} = 0.6$ from BLS's estimate of labor share, $\tau_{p,h} = 0.35$ as personal income tax rate including federal and state taxes, and $\tau_{c,h} = 0.2$ as the sum of federal and state level corporate income tax rate.

[11] If we do not take into the account the effect of corporate income tax on product prices, the resultant incidence on workers and capital is 32% and 68%. This is consistent with Suárez Serrato and Zidar (2016), who find that the incidence of the corporate tax falls 30-35% on workers, we well as CBO and Treasury estimates.

same relationship, for S-Corporations.[12] We see a flat relationship between changes in prices and changes in corporate tax rates for S-corporations. The fact that we see no impact of tax changes on firms that do not pay corporate taxes suggests that any possible source of bias must impact only C-Corporations, but not S-Corporations, which we find to be unlikely.

We formalize the graphical evidence in Figure 3, and complement our main approach with analysis following Giroud and Rauh (2019). We estimate the following specification:

$$\ln(p_{i,s,t+1}) = \alpha_{r,s,t} + \alpha_i + \beta_1 \ln(1-\tau_{c,h,t}) \times \mathbb{1}[\text{C-Corp}] + \beta_2 \ln(1-\tau_{p,h,t}) \times \mathbb{1}[\text{C-Corp}]$$

$$+ \beta_3 \ln(1-\tau_{c,h,t}) \times \mathbb{1}[\text{S-Corp}] + \beta_4 \ln(1-\tau_{p,h,t}) \times \mathbb{1}[\text{S-Corp}] + \zeta_1 X_{i,t} + \zeta_2 X_{h,t} + \nu_{i,t} \quad (6)$$

The indicator functions $\mathbb{1}[\text{C-Corp}]$ and $\mathbb{1}[\text{S-Corp}]$ denote whether a firm is a C- or S-Corporation, respectively. $\tau_{p,h,t}$ indicates the personal tax rate in the state (h) in which the firm producing an item is headquartered at time t. Otherwise the notation is identical to that presented in equation (4).

Table 5 presents the results of this estimation. The first row presents estimates of β_1, which captures the effects of corporate tax rate changes on C-Corporations. The results are unsurprisingly quite similar to those presented in Table 2, confirming that there is a strong relationship between corporate taxes and prices. The final row of Table 5 presents estimates of β_4, which captures the effect of personal tax rate changes on S-Corporations, which pay those taxes. Once retailer and year fixed effects are included, the magnitudes are quite similar to those in the first row, however the standard errors are quite large and the results are statistically insignificant. This is consistent with their being some mis-classification error for S-Corporations.

The middle rows show the impact of personal tax rate changes in C-Corporations and the impact of corporate tax rate changes on S-Corporations. Since C-Corporations are only subject to corporate income tax rates, while S-Corporations are only subject to personal income tax rates, each type of firm is unaffected by the rates in these rows. Consistent with the placebo exercise, we see no significant effects in these rows, and estimates are very close to zero.

[12] While all firms that we classify as C-Corporations will be properly classified, there is some classification error for S-Corporations. This is discussed in appendix 3.3, and will result in classifying some C-Corporations as S-Corporations. This would bias us towards finding a zero result for our firms classified as S-corporations.

5 Concluding Remarks

This paper provides evidence that corporate taxes impact retail product prices, and that a significant portion of corporate tax incidence falls on consumers. We used linked price and firm data, and use tax changes in a firm's headquarter state to examine their effects in other states. A one percent increase in the corporate tax rate leads to an increase in retail product prices of approximately 0.18 percent. Our analysis exploits state level tax changes, and the fact that goods produced in a firm headquartered in one state are sold in another state. This allows us to include sold state by year fixed effects, thus avoiding a large number of potential biases and empirical concerns.

The fact that corporate taxes affect product prices, as well as payouts to shareholders and wages, has important implications for tax policy. If corporate taxes are incident on consumer prices, rather than primarily being borne by shareholders, these taxes may be less progressive than is commonly asserted. In particular models use by policymakers, such as the CBO and US Treasury may underestimate the incidence of corporate taxes on consumers (CBO, 2018; Cronin et al., 2013).

While the fact that we exploit state level tax changes, and goods sold in other states allows us to avoid many empirical challenges, there remain several fruitful avenues for further exploration. First, our analysis effectively focuses on US states, which are essentially small open economies. Much of the early theoretical debate on corporate tax incidence focused on differences between open and closed economies. Effects may be different at the aggregate or national level, where there are fewer opportunities for tax avoidance. Second, market structure should play an important role in price pass-through of taxes. This may make higher or lower corporate taxes in more or less competitive industries optimal.

References

Auerbach, Alan, "Who bears the corporate tax? A review of what we know.," *Tax Policy and the Economy*, 2006, *20*, 1–40.

Bertrand, Marianne and Sendhil Mullainathan, "Enjoying the quiet life? Corporate governance and managerial preferences," *Journal of Political Economy*, 2003, *111* (5), 1043–1075.

Broda, Christian and David E. Weinstein, "Product Creation and Destruction: Evidence and Price Implications," *American Economic Review*, 2010, *100* (3), 691–723.

CBO, "The Distribution of Household Income, 2014," *Congressional Budget Office Staff Report*, 2018.

Cronin, Julie Anne, Emily Lin, and Laura Powell, "Distributing the Corporate Income Tax: Revised U.S. Treasury Methodology," *National Tax Journal*, 2013, *66* (1), 239–262.

Dyreng, Scott, Martin Jacob, Xu Jiang, and Maximilian A Müller, "Tax incidence and tax avoidance," *Available at SSRN 3070239*, 2018.

Einav, Liran, Ephraim Leibtag, and Aviv Nevo, "Recording Discrepancies in Nielsen Homescan Data: Are they Present and Do They Matter?," *QME*, 2010, *8* (2), 207–239.

Fajgelbaum, Pablo D, Eduardo Morales, Juan Carlos Suárez Serrato, and Owen Zidar, "State taxes and spatial misallocation," *The Review of Economic Studies*, 2018, *86* (1), 333–376.

Feldstein, Martin and Joel Slemrod, "Personal taxation, portfolio choice and the effect of the corporation income tax," *Journal of Political Economy*, 1980, *88* (5), 854–866.

Fuest, Clemens, Andreas Peichl, and Sebastian Siegloch, "Do higher corporate taxes reduce wages? Micro evidence from Germany," *American Economic Review*, 2018, *108* (2), 393–418.

Giroud, Xavier and Joshua Rauh, "State taxation and the reallocation of business activity: Evidence from establishment-level data," *Journal of Political Economy*, 2019, *127* (3).

Gravelle, Jane and Laurence Kotlikoff, "The incidence and efficiency costs of corporate taxation when corporate and noncorporate firms produce the same good," *Journal of Political Economy*, 1989, *97* (4), 749–780.

Gravelle, Jennifer, "Tax Incidence," *National Tax Journal*, 2013, *66* (1), 185–214.

Harberger, Arnold, "The incidence of the corporation income tax," *Journal of Political Economy*, 1962, *70* (3), 215–240.

Heider, Florian and Alexander Ljungqvist, "As certain as debt and taxes: Estimating the tax sensitivity of leverage from state tax changes," *Journal of Financial Economics*, 2015, *118* (3), 684–712.

Karabarbounis, Loukas and Brent Neiman, "The global decline of the labor share," *The Quarterly Journal of Economics*, 2013, *129* (1), 61–103.

Kim, Ryan, "The effect of the credit crunch on output price dynamics: the corporate inventory and liquidity management channel," *Working Paper*, 2018.

Kotlikoff, Laurence and Lawrence Summers, "Tax Incidence," *Handbook of Public Economics*, 1987, *2*, 1043–92.

Ljungqvist, Alexander and Michael Smolyansky, "To cut or not to cut? On the impact of corporate taxes on employment and income.," *Working Paper*, 2016.

_ , Liandong Zhang, and Luo Zuo, "Sharing risk with the government: How taxes affect corporate risk taking," *Journal of Accounting Research*, 2017, *55* (3), 669–707.

Loecker, Jan De, "Product differentiation, multiproduct firms, and estimating the impact of trade liberalization on productivity," *Econometrica*, 2011, *79* (5), 1407–1451.

Stroebel, Johannes and Joseph Vavra, "House prices, local demand, and retail prices," *Journal of Political Economy*, 2019, *127* (3).

Suárez Serrato, Juan Carlos and Owen Zidar, "Who benefits from state corporate tax cuts? A local labor markets approach with heterogeneous firms," *American Economic Review*, 2016, *106* (9), 2582–2624.

Figure 1: Change in State Corporate Taxes

Notes: This figure shows the change in state corporate tax rates between 2004 and 2017. Source: Giroud and Rauh (2019) and Tax Foundation.

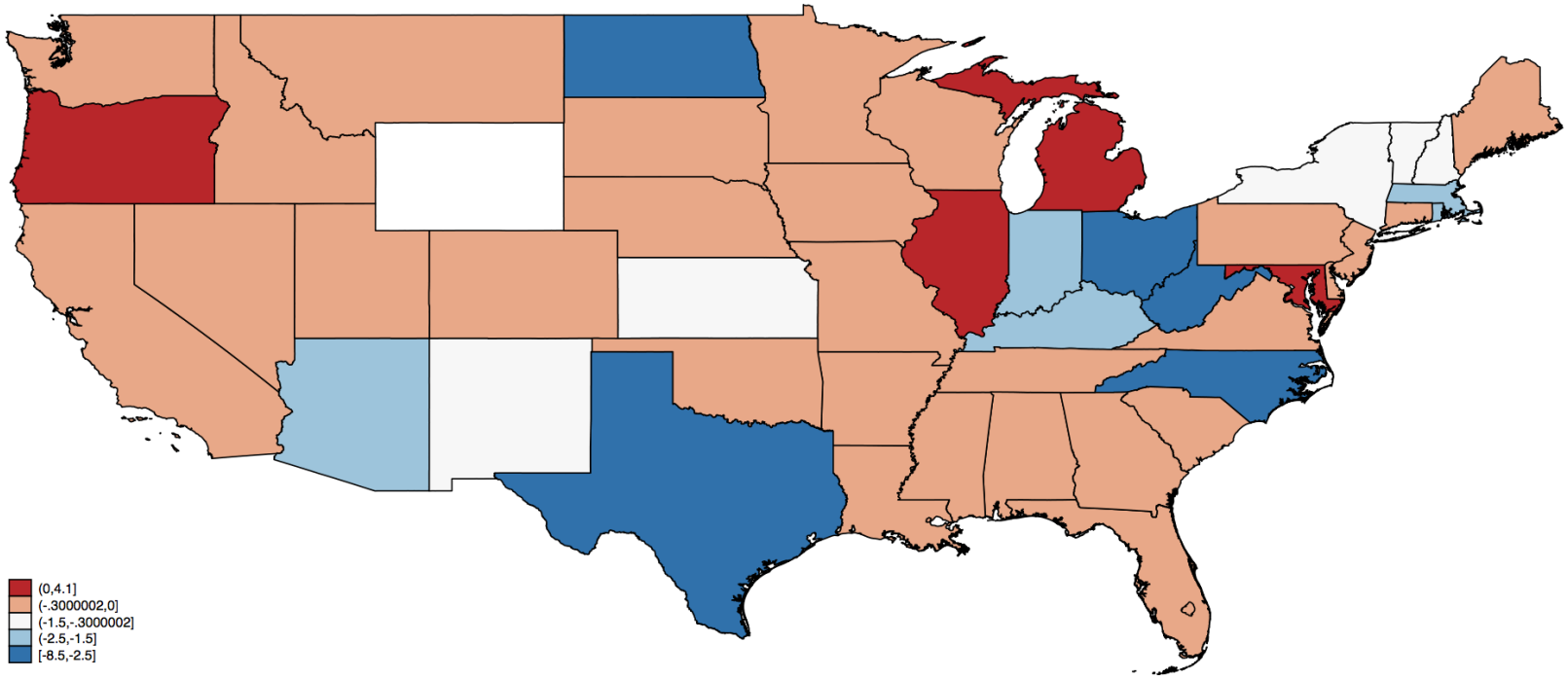


Figure 2: Prices Following Large Tax Changes

Notes: This figure shows the impact on product prices of a one percent corporate tax increase or decrease over time. The figure plots coefficients β_i from the following specification: $\ln(p_{i,s,t+1}) = \alpha_{r,s,t} + \alpha_i + \sum_{i=1}^{T} \beta_i \mathbb{1}[i = t] \times \ln(1 - \tau_{c,h,t}) + \gamma_1 X_{i,t} + \gamma_2 X_{h,t} + \varepsilon_{i,t}$. The solid line denotes point estimates. The shaded area denotes a 95% confidence interval. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1.

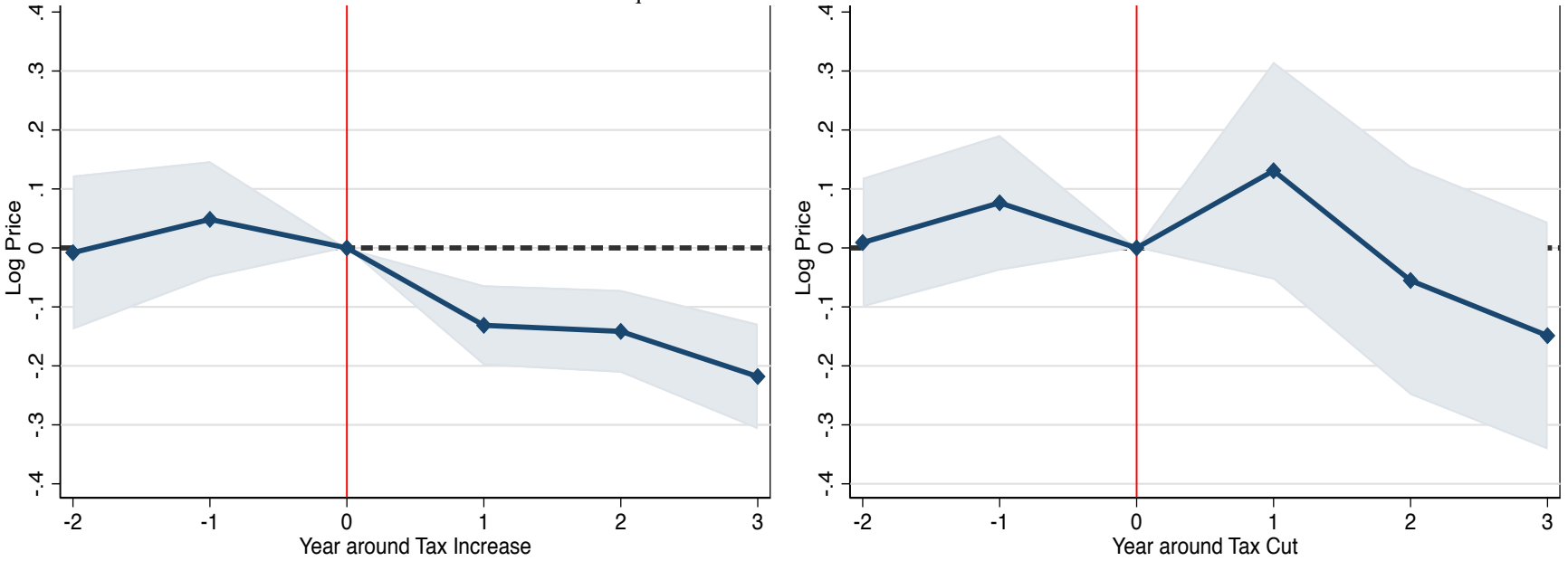


Figure 3: Corporate Taxes and Retail Prices

Notes: This figure shows percentile binned scatter plots of changes in prices $\Delta Log(Price_{t+1})$ and changes in corporate tax rates $\Delta Log(1-\tau_{c,t})$. The left panel shows estimates for C-corporations, which pay corporate tax rate, while the right panel estimates estimates for S-corporations, which pay at individual income tax rates. Source: Nielsen and GS1.

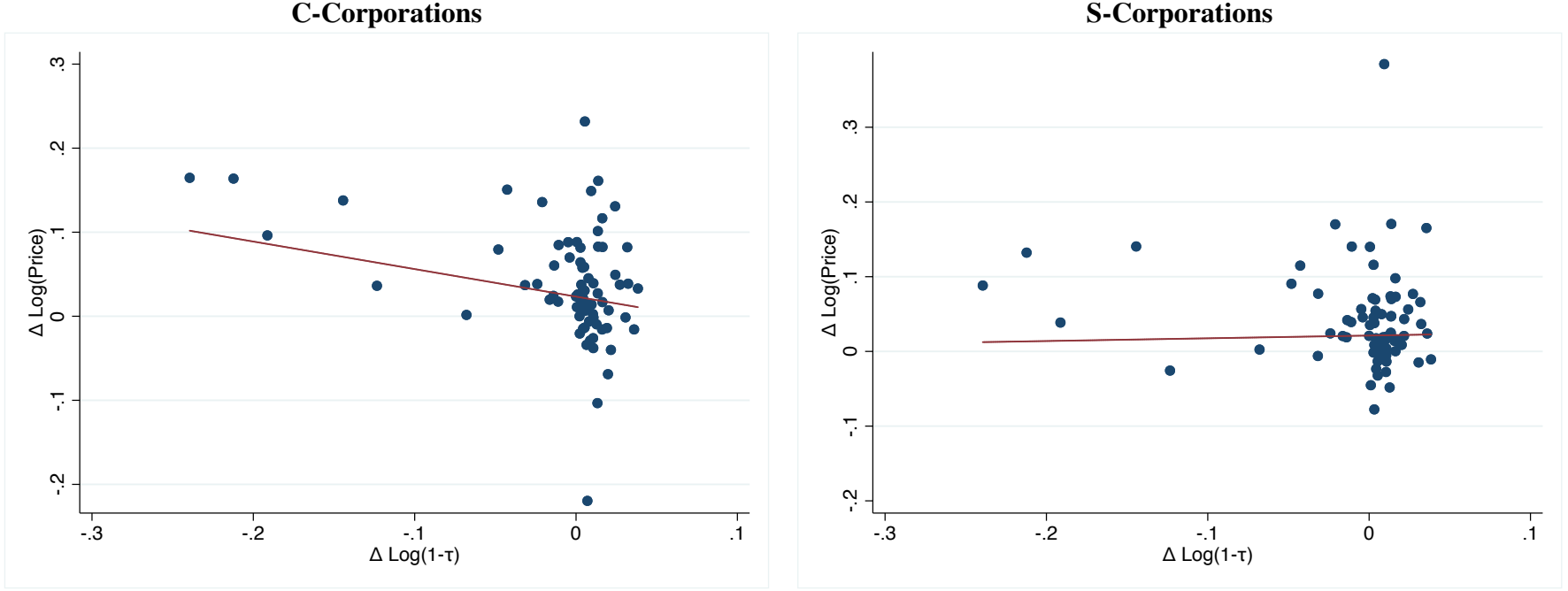


Table 1: Summary Statistics

This table shows summary statistics for the main analysis sample. The top panel shows all data, while the bottom panel shows data for firms identified as C-Corporations. Source: Nielsen and GS1.

	(1) Total Sample				
	Mean	Std. Dev.	25^{th} Pctl.	Median	75^{th} Pctl.
Sale-weighted Price	3.31	4.15	1.32	2.22	3.47
Log(Sales)	735.01	4275.06	127.91	228.69	464.86
State Corporate Tax Rate	8.53	4.10	6.50	7.75	9.50
State Personal Income Tax Rate	6.02	2.99	3.75	6.08	7.21
Observations			787,960		

	(1) C-Corporations				
	Mean	Std. Dev.	25^{th} Pctl.	Median	75^{th} Pctl.
Sale-weighted Price	2.73	2.73	1.18	2.10	3.12
Log(Sales)	342.69	618.84	116.28	199.10	363.66
State Corporate Tax Rate	7.60	3.16	6.50	7.10	8.84
State Personal Income Tax Rate	6.90	3.06	5.40	7.11	7.95
Observations			344,564		

Table 2: Corporate Taxes and Retail Prices

The tables shows the relationship between retail prices and corporate taxes. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. The inclusion of controls and fixed effects is denoted beneath each specification. The sample is restricted to firms that we can identify as C-Corporations. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1. *$p < .1$, ** $p < .05$, *** $p < .01$.

	(1) Log(Price)	(2) Log(Price)	(3) Log(Price)	(4) Log(Price)	(5) Log(Price)	(6) Log(Price)
Log(1 - τ_c)	-0.381**	-0.215***	-0.211***	-0.186***	-0.181***	-0.181***
	(0.143)	(0.0486)	(0.0516)	(0.0485)	(0.0444)	(0.0455)
Controls	**X**	**X**	**X**	**X**	**X**	**X**
UPC×Retailer×Sold State	**X**	**X**	**X**	**X**	**X**	**X**
Year		**X**				
Sold State×Year			**X**		**X**	
Retailer×Year				**X**	**X**	
Sold State× Retailer×Year						**X**
Observations	344,564	344,564	344,564	344,564	344,564	344,564

Table 3: Corporate Taxes and Retail Prices - Pass-through Heterogeneity

The tables shows the relationship between corporate taxes and retail prices across products with different average customer incomes and average retail prices. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. The inclusion of controls and fixed effects is denoted beneath each specification. The sample is restricted to firms that we can identify as C-Corporations. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1. *$p < .1$, ** $p < .05$, *** $p < .01$.

	(1) Log(Price)	(2) Log(Price)	(3) Log(Price)	(4) Log(Price)	(5) Log(Price)	(6) Log(Price)	(7) Log(Price)	(8) Log(Price)
Log(1-τ_c)	-0.265***	-0.241***	-0.244***	-0.230***	-0.265***	-0.251***	-0.273***	-0.254***
	(0.0440)	(0.0511)	(0.0524)	(0.0525)	(0.0411)	(0.0603)	(0.0590)	(0.0579)
Log(1-τ_c) $*$ $I\{$ $1st\ tercile\ of\ prices\}$	-0.267*	-0.237**	-0.214*	-0.219*				
	(0.132)	(0.114)	(0.122)	(0.122)				
Log(1-τ_c) $*$ $I\{$ $2nd\ tercile\ of\ prices\}$	-0.0509	-0.0628	-0.0424	-0.0676				
	(0.0515)	(0.0543)	(0.0633)	(0.0530)				
Log(1-τ_c) $*$ $I\{$ $1st\ tercile\ of\ cust.\ inc.\}$					-0.141***	-0.104*	-0.0716	-0.0673
					(0.0505)	(0.0611)	(0.0535)	(0.0457)
Log(1-τ_c) $*$ $I\{$ $2nd\ tercile\ of\ cust.\ inc.\}$					-0.0309	-0.0231	0.0125	-0.00779
					(0.0348)	(0.0457)	(0.0461)	(0.0432)
Controls	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
UPC×Retailer×Sold State	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Sold State×Year	**X**		**X**		**X**		**X**	
Retailer×Year		**X**	**X**			**X**	**X**	
Sold State× Retailer×Year				**X**				**X**
Observations	344564	344564	344564	344564	344564	344564	344564	344564

Table 4: Corporate Taxes and Retail Prices: Placebo Estimates

The tables shows placebo estimates. The top panel repeats the analysis for S-Corporations, which do not pay corporate taxes. The bottom panel replaces the corporate tax rate τ_c with the personal income tax rate τ_p, which is not levied on C-Corporations. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. The inclusion of controls and fixed effects is denoted beneath each specification. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1. *$p < .1$, ** $p < .05$, *** $p < .01$.

S-Corporations

	(1) Log(Price)	(2) Log(Price)	(3) Log(Price)	(4) Log(Price)	(5) Log(Price)	(6) Log(Price)
Log(1 - τ_c)	-0.0597	0.0571	0.0717	-0.0237	-0.0197	-0.00836
	(0.0903)	(0.0747)	(0.0862)	(0.118)	(0.117)	(0.118)
Controls	**X**	**X**	**X**	**X**	**X**	**X**
UPC×Retailer×Sold State	**X**	**X**	**X**	**X**	**X**	**X**
Year		**X**				
Sold State×Year			**X**		**X**	
Retailer×Year				**X**	**X**	
Sold State× Retailer×Year						**X**
Observations	404,556	404,556	404,556	404,556	404,556	404,556

Table 5: Taxes, Firm Type and Retail Prices

The tables shows the relationship between retail prices, corporate and personal taxes, by whether a firm is identified as a C or S Corporation. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. The inclusion of controls and fixed effects is denoted beneath each specification. The sample is restricted to firms that we can identify as C-Corporations. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1. *$p < .1$, ** $p < .05$, *** $p < .01$.

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Price)	Log(Price)	Log(Price)	Log(Price)	Log(Price)	Log(Price)
Log(1 - τ_c) $\times$ C-Corp.	-0.355**	-0.207***	-0.195***	-0.179***	-0.174***	-0.167***
	(0.166)	(0.0599)	(0.0553)	(0.0491)	(0.0477)	(0.0461)
Log(1 - τ_p)$\times$ C-Corp.	-0.0108	0.118*	0.114	-0.0198	-0.0137	0.00212
	(0.113)	(0.0666)	(0.0737)	(0.0845)	(0.0839)	(0.0855)
Log(1 - τ_c) $\times$ S-Corp.	0.730***	0.223	0.196	0.0690	0.0660	0.0655
	(0.200)	(0.142)	(0.148)	(0.143)	(0.142)	(0.148)
Log(1 - τ_p) $\times$ S-Corp.	0.0800	-0.0266	-0.0569	-0.169	-0.158	-0.163
	(0.866)	(0.590)	(0.596)	(0.570)	(0.571)	(0.568)
Controls	**X**	**X**	**X**	**X**	**X**	**X**
UPC$\times$Retailer$\times$Sold State	**X**	**X**	**X**	**X**	**X**	**X**
Year		**X**				
Sold State$\times$Year			**X**		**X**	
Retailer$\times$Year				**X**	**X**	
Sold State$\times$ Retailer$\times$Year						**X**
Observations	787,960	787,960	787,960	787,960	787,960	787,960

A Model

We assume firms operate in a monopolistically competitive environment similar to De Loecker (2011) and Suárez Serrato and Zidar (2016). Firms are endowed with some productivity level B, and combine labor, L and capital K to produce output y with the following production function,

$$y = B \cdot L^{\gamma} K^{1-\gamma} \tag{7}$$

Firms take input prices as given and the output price p is given by an inverse demand curve from CES demand with $y = I \cdot (\frac{p}{\bar{p}})^{\varepsilon}$, where $\bar{p}$ is the price level and is normalized to 1 and $\varepsilon < 0$, is the demand elasticity. The firm maximizes profits, which are taxed at a rate τ. The firm thus solves

$$\max_{L,K} (1-\tau) \cdot (p \cdot y - w \cdot L) - \rho \cdot K \tag{8}$$

where w is the wage rate for labor, and ρ is the rate of return for capital.

Inserting the price equation into the objective function yields the firm's problem:

$$\max_{L,K} (1-\tau)(y^{\frac{1}{\mu}} I^{-\frac{1}{\varepsilon}} - w \cdot L) - \rho \cdot K \tag{9}$$

Where the markup $\mu \equiv [\frac{1}{\varepsilon} + 1]^{-1}$ is constant due to CES demand. The solutions yields for L and K:

$$\frac{y^{\frac{1}{\mu}}}{\mu} \cdot \frac{\gamma}{l} \cdot I^{-\frac{1}{\varepsilon}} = w \tag{10}$$

$$\frac{y^{\frac{1}{\mu}}}{\mu} \cdot \frac{1-\gamma}{k} \cdot I^{-\frac{1}{\varepsilon}} = \rho(\frac{1}{1-\tau}) \tag{11}$$

Combine them with the firm's production function $y = BL^{\gamma}K^{1-\gamma}$ and after rearranging, we solve for p:

$$ln(p) = -(1-\gamma)ln(1-\tau) + (1-\gamma)ln(\rho) + \gamma ln(w) + Z \tag{12}$$

where Z is a constant and given by

$$Z = -ln(B) - ln(\frac{1}{\varepsilon} + 1) - (1-\gamma)ln(1-\gamma) - \gamma ln(\gamma) \tag{13}$$

Figure A.1: Change in State Corporate Taxes

Notes: This figure shows the state corporate tax rates in 2004, 2010 and 2017. Source: Giroud and Rauh (2019) and Tax Foundation.

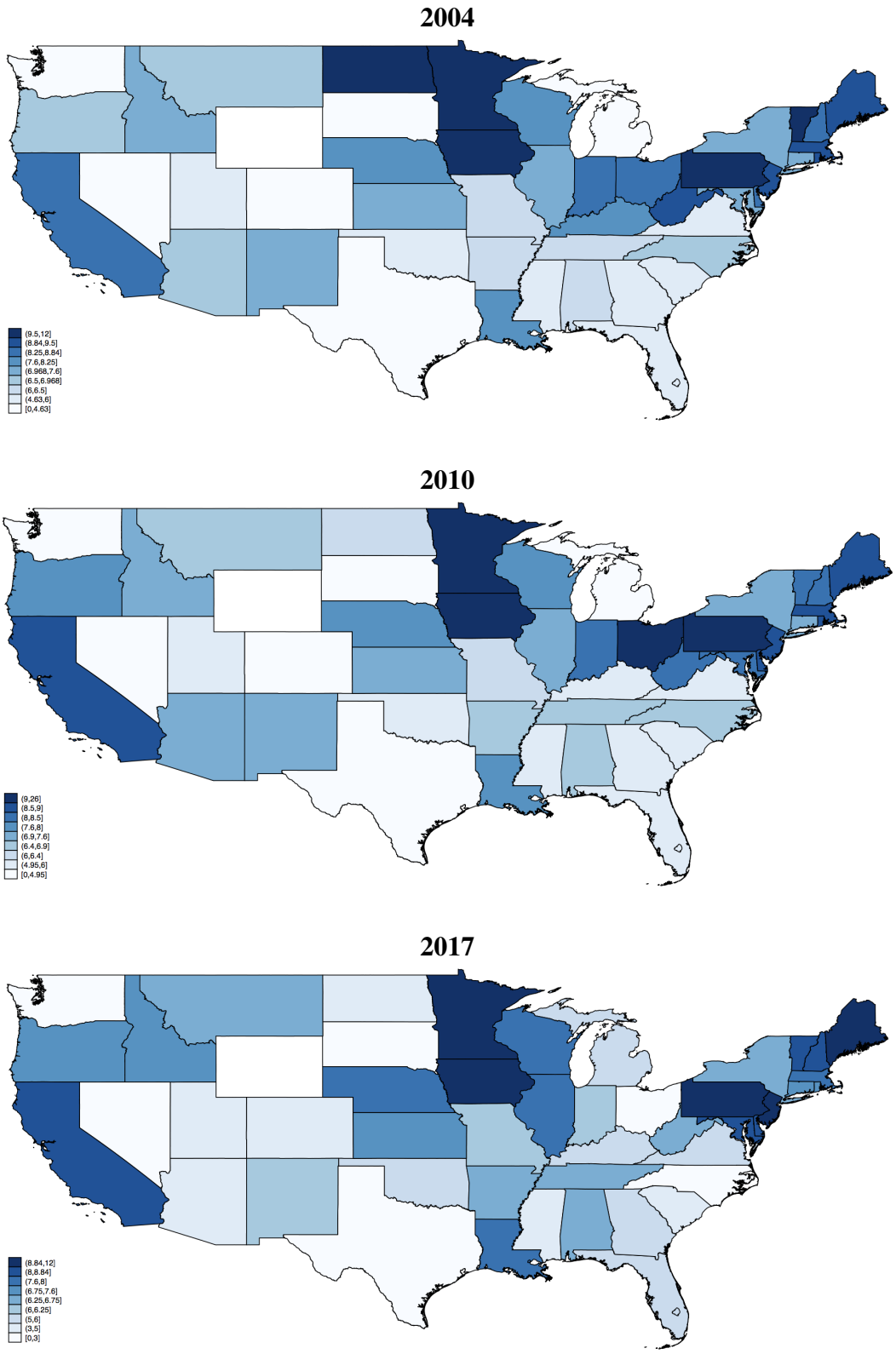


Figure A.2: Corporate Taxes and Retail Prices

Notes: This figure shows the relationship between corporate taxes and retail prices across products with different average customer incomes and average retail prices. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. Estimates include UPC and state year fixed effects. The sample is restricted to firms that we can identify as C-Corporations. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1.

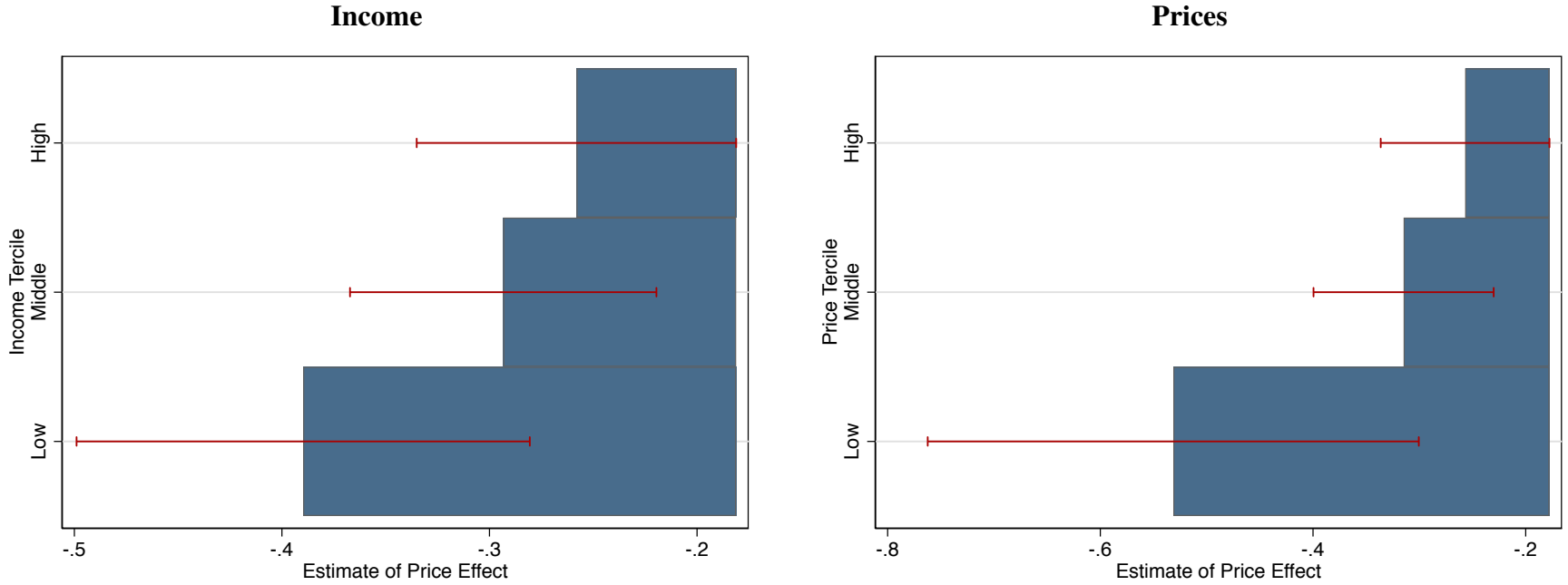


Table A.1: Variable Descriptions

This table describes the main analysis variable used.

Name	Source	Description
Price	Nielsen Homescan	Price of a UPC sold by a retailer in a state. The price data is aggregated to compute the weighted average price of that item sold at this retailer in each state. The price is weighted by the quantity sold.
Sales	Nielsen Homescan	Annual sale for each UPC- retailer-sold state pair.
Corporate Income Tax	Various	The state corporate income tax rate for each state in different years. This is obtained from the State Tax Handbook, the Tax Foundation (2004-2011), the Book of States, and the state Tax Policy Center (2013-2017)
Personal Income Tax	NBER	The state personal income tax rate for each state.
Nonstandard Tax	State Tax Handbook	Indicator of whether a state imposed a non-standard corporate tax.
Property Apportionment	State Tax Handbook	Weight assigned to the property factor in the apportionment formula. The multi-state firms must apportion its profits according to the formula when deciding how much tax it should pay.
Sales Apportionment	State Tax Handbook	Weight assigned to the sales factor in the apportionment formula. The multi-state firms must apportion its profits according to the formula when deciding how much tax it should pay.
Throwback	State Tax Handbook	Indicator of whether a state has adopted a throwback rule when calculating the taxable income. Under the throwback rule, the state requires the firms to add sales that are to buyers in a state where the company has no nexus.
Throwout	State Tax Handbook	Indicator of whether a state has adopted a throwout rule when calculating the taxable income. The sales that are to buyers in a state where the company has no nexus are called nowhere sales. Under the throwout rule, the state requires the firms to subtract the nowhere sales from total sales (the denominator), and thereby increasing the apportion weights.
Property Tax Revenue	Census	Total property tax revenue in a given year.
Total State Revenue	Census	Total state tax revenue in a given year.
General State Revenue	Census	Total state general revenue in a given year.
Total Expenditure	Census	Total state expenditure in a given year.
GDP	BLS	State GDP in millions of dollars.

Table A.2: Variable Descriptions (Continued)

This table describes the main analysis variable used.

Name	Source	Description
UI Base	State UI Laws	Maximum taxable wage base subject to state unemployment insurance program.
UI Rate	State UI Laws	Maximum unemployment insurance rate at each state in a given year.
UI	State UI Laws	Unemployment insurance base wage multiplied by the unemployment insurance rate.
Unemployment	BLS	State unemployment rate.
Budget Balance	Census	State/s budget balance, computed as (revenues - expenditures) / expenditures.
LFO	Orbis	The legal form organization is identification by the legal form information and shareholder information from the Orbis database. Non-profit organizations and public authorities are labelled firms who don/t need to pay a tax. Public limited companies, and firms with more than 100 shareholders or with non-natural persons as shareholders are identified as C corporations, leaving the rest as the S corporations.

Table A.3: Summary Statistics for Sample Construction

Sample	# Obs.	# UPCs	# Retailers	# Producers	# C-Corps	Total $ Sales			
						Mean	25th	Median	75th
Full UPC Sample	162,231,673	2,545,667	1,238	-	-	27.5	3	6	16
Persistent UPC Sample	1,336,198	91,956	670	-	-	650.3	120.9	214.4	427.1
Matched GS1 Sample	1,323,033	90,087	670	3,937	-	653	121	214.6	427.5
Matched Orbis Sample	1,160,260	82,925	666	3,551	919	694.9	120.4	214.9	435.9
Exclude own-state	969,304	59,944	649	2,713	783	736.5	120.6	216.3	443.4
Final Sample	787,960	36,443	449	1,971	609	735.01	127.91	228.69	464.86

Table A.4: Corporate Taxes and Retail Prices, Weighted Regressions

The tables shows the relationship between retail prices and corporate taxes from weighted regressions, using sales as weight. Retail prices are measured in the geographic location where a good is sold. Corporate taxes are measured in the state where a firm is headquartered. The inclusion of controls and fixed effects is denoted beneath each specification. The sample is restricted to firms that we can identify as C-Corporations. Standard errors are clustered at the headquarter state level. Source: Nielsen and GS1. *$p < .1$, ** $p < .05$, *** $p < .01$.

	(1) Log(Price)	(2) Log(Price)	(3) Log(Price)	(4) Log(Price)	(5) Log(Price)	(6) Log(Price)
Log(1 - τ_c)	-0.428***	-0.297***	-0.303***	-0.279***	-0.275***	-0.268***
	(0.136)	(0.0371)	(0.0374)	(0.0406)	(0.0365)	(0.0395)
Controls	**X**	**X**	**X**	**X**	**X**	**X**
UPC×Retailer×Sold State	**X**	**X**	**X**	**X**	**X**	**X**
Year		**X**				
Sold State×Year			**X**		**X**	
Retailer×Year				**X**	**X**	
Sold State× Retailer×Year						**X**
Observations	344,564	344,564	344,564	344,564	344,564	344,564