A Tax-Shaped Retail Landscape

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Abstract

We investigate the impact that seemingly uniform business tax policies have on shaping the retail landscape. Using data about all retail establishments in the United States, we show that while retailers are more likely to open establishments in markets that experienced decreases in business state tax, these inferred effects are more pronounced for large chains as compared with small chains. Motivated by these empirical realities, we develop an entry model where firms are subject to taxes that impact their sunk costs of entry. A key insight from this model is that taxes can potentially amplify market dominance, such that retailers with preexisting advantages are disproportionately more responsive to the tax policies.

Keywords: Business Dynamism; Entrepreneurship; Firm Size; Market Power; Place-Based Policies; Public Finance; Strategic Entry; Tax Incentives; Urban Policy and Revival

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1 Introduction

Tax policies are designed with the understanding that they may impact firm entry as they often relate to property, purchased equipment, job creation and training, investment, research, and property are all incurred by firms as a component of the sunk entry cost. Moreover, in industries with small trade areas such as retail, geographic markets can often only support a handful of firms that serve a localized set of customers. A relevant question then is whether certain types of firms will be disproportionately responsive to such tax policies. Answering this question is relevant for policy debates, as critics of such tax policies, such as the prominent NY State Empire Zone (Commission 2008) suggest that the retailer responsiveness to such policies appear to be concentrated towards the largest retailers:

> *The benefits are highly concentrated. Of the approximately 5,000 firms that claimed credits in 2006, just 500 claimed almost $391 million, or 76 percent, of the $514 million total... Within that group of 500 firms, a handful account for $100 million... Many of the large corporations are "big box" retailers. Of the 25 firms among the Fortune 1000 that received Empire Zone credits 11 were retail chains. The firms - Wal-Mart, Home Depot, Costco, Target, Walgreen's, Lowe's, Staples, Kohl's, Family Dollar, Radio Shack, and Dick's Sporting Goods - got $30 million in credits.*

If one were to take this quote at face value, it would insinuate that tax policies are exclusively benefiting the largest retail chains, as reflected by their apparent responsiveness to such policies. Under the context of declining business dynamism and rising state tax subsidies (Shambaugh et al. 2018), evaluating the credibility of the quoted statement has immediate policy value. In order to verify whether these criticisms about such tax policies can be supported by data, we analyze comprehensive information about all establishment entry in the US retail industry from 1990 to 2014 to establish the extent to which retail entry

patterns differ across states with varying tax policies. Most importantly, we investigate whether the impact of taxes exhibits asymmetry across different types of retailers (e.g., large/small chains, independents).

Our empirical analysis confirms that reductions in state business taxes will generally lead to higher retail establishment counts[1] and that this increase is noticeably *more pronounced* for larger retail chains compared to smaller retail chains. At the same time, we note that the inferred patterns also suggest noticeable effects of tax cuts on establishment entry among small independent retailers. Therefore, the underlying mechanisms that generate the documented patterns might be more nuanced than the claims made by Commission (2008), as tax cuts might impact *both* the largest and the smallest retailers. In light of these nuances, we explore a potential theoretical explanation that revolves around naturally occurring strategic competition between oligopolistic firms.

We proceed by developing a new theoretical model of entry with taxes to illustrate one potential economic mechanism. Intuitively, large retailers with extensive existing geographic coverage can benefit from demand (e.g., customer loyalty, brand equity) or cost-based (e.g., scale economies) advantages. Consequently, these advantages suggest that already large and strong retailers might have *more* to gain from entering local geographic markets, compared to smaller retailers with *less* demand and/or cost-based advantages. Therefore, a uniform "one-size-fits-all" tax policy that affects the sunk cost of entry can lead to asymmetric responses among retailers. Based on this intuition, our model explores the extent to which differences in size-based firm power across competing retailers can lead to asymmetric responses to uniform tax policies that reduce or increase fixed entry costs. Analysis of the model's equilibrium entry decisions confirm that differences in firm strength can indeed be one explanation for these asymmetric responses to tax policies. That is, firms with larger size-based advantages will be *disproportionately responsive* to such policies.

[1]This finding is consistent with past research Fajgelbaum et al. (2019), Nallareddy et al. (2022), Sedlácek and Sterk (2019), Serrato and Zidar (2018), Suárez Serrato and Zidar (2016) that have demonstrated a connection between business dynamism and tax reductions.

In a calibrated empirical case study on the retail sector of home improvement (i.e., Home Depot and Lowe's), we show that hypothetical tax policies that maintain balanced entry responses would involve Lowe's paying 22% more in taxes relative to Home Depot. This analysis helps quantify the potential economic magnitude associated with heterogeneous responses to uniform tax policies. In summary, these examples demonstrate how proposed tax designs can be assessed, taking into account potential market competition effects.

The scope of the model is assessed in a variety of theoretical extensions. First, we consider scenarios where tax is proportional to the cost of entry. The second extension we investigate is a model where firms face different entry costs. Finally, we incorporate the presence of a competitive fringe (i.e., local independent retailers). In all of these extensions, our key theoretical insight regarding the asymmetric impact of tax continues to be relevant.

2 Related Literature

We contribute towards a few main areas of literature. First, we add to the study of local or national government policies and their impact on local businesses. Some examples include the impact of right-to-work laws on manufacturer entry (Holmes 1998), land use zoning regulation's impact on retail (Bertrand and Kramarz 2002, Suzuki 2013), information waves caused by census data releases (Chi 2024), and the effects of business improvement districts targeting retail (Shoag and Veuger 2018). Most relevant to us is the growing body of work about the impact of place-based tax policies on firm investment, primarily in manufacturing, innovation or entrepreneurship (Atkinsa et al. 2023, Badertscher et al. 2013, Brülhart et al. 2012, Corinth and Feldman 2024, Criscuolo et al. 2019, Da Rin et al. 2011, Devereux et al. 2007, Fajgelbaum et al. 2019, Giroud and Rauh 2019, Hanson and Rohlin 2011, Kennedy and Wheeler 2021, Kline and Moretti 2014, LaPoint and Sakabe 2021, Mukherjee et al. 2017, Slattery and Zidar 2020, Suárez Serrato and Zidar 2016). We provide complementary insights about the relationship between localized policies and the evolving retail landscape, by demonstrating that even if these policies help stimulate entry, the benefits from these policies

may not be spread out evenly across all firms, thereby leading to asymmetric responses among the firms.

Second, we contribute to the literature on the drivers of retail entry across geographic markets.[2] Examples include but not limited to Bresnahan and Reiss (1991), Arcidiacono et al. (2016), Blevins et al. (2018), Fang and Yang (2024), Hollenbeck (2017), and Igami and Yang (2016). Many of these studies focus on industry-specific analysis of competition between firms with respect to location selection and market expansion decisions. In particular, larger firms have been shown to drive much of overall retail growth (Haltiwanger et al. 2010), and these patterns of market dominance appear quite persistent over time (Basker et al. 2012, Blevins et al. 2018, Geurts and Van Biesebroeck 2016, Hanner et al. 2015, Jarmin et al. 2009, Paul 1994).[3]

Large retailers have been shown to have size-based advantages through resilience to macroeconomic shocks (Basker et al. 2018), product line variety (Hollenbeck and Giroldo 2022), management control systems (Sandino 2007), retail network inventory flexibility (Ergin et al. 2022), productivity and efficiency (Javorcik and Li 2013), access to information and new technologies (Basker 2012, Chi 2024, Yang 2020) and strategic entry deterrence (Fang and Yang 2024, Igami and Yang 2016, Nishida and Yang 2020). We complement this branch of research in two ways: (1) we demonstrate that government policies are an important driver of market dominance for some firms in retail; and (2) we provide insights that are broadly applicable to all retail sectors, unlike most of the existing studies that are confined to only one particular retail sector. This broadened scope of analysis uncovers universal antitrust and urban-development implications of state-level tax policies for retail sectors as a whole.

Furthermore, our work also relates to research that aims to explain increasing concentration in non-traded sectors, and in particular, retail. Smith and Ocampo (2022) document

[2]This line of work falls within the broader set of empirical and theoretical literature about industry dynamics (Dunne et al. 1989, Hopenhayn 1992, Jovanovic 1982).

[3]Beyond antitrust concerns, policies that disproportionately impact the entry of large versus small firms may also has implications on the availability of amenity variety might impact the municipality's attractiveness as a place to reside (Couture and Handbury 2020), local labor market conditions (Basker 2005a), or externalities from complementary businesses (Shoag and Veuger 2018).

increasing concentration in the retail sector using product-level revenue for all retail stores in the US, while Autor et al. (2017) demonstrate the rise of "superstar firms," particularly in the retail industry. Similarly, Hsieh and Rossi-Hansberg (2022) shows an increase in national concentration in the service industries. This past research has posited that growing fixed costs (especially in technologies) and lower marginal costs have tilted the benefits towards large firms more than small firms in these sectors. Ultimately, increasing market concentration might lead to dampened firm investment (Gutiérrez and Philippon 2017). On the other hand, market concentration may be conducive to productivity improvements that benefit the economy as a whole (Choi et al. 2024). We complement this existing literature by exploring a potential external force (i.e., government tax policies) that may further impact this apparent concentration in the retail sector.

3 Empirical Analysis

This section presents some key patterns in state taxes and retail entry. We first provide details about our empirical setting of US retail establishment entry, along with the data we use to measure tax policies across markets. Later, we present empirical patterns that suggest a (potentially heterogeneous) relationship between tax policies on establishment entry.

3.1 Data

Our analysis relies on data about retail establishments, state taxes, and local market demographics. We now describe each of the components of our data.

3.1.1 Retail Establishments

To study the entry of retail establishments, we use the National Establishment Time-Series (NETS) Database. This database records each establishment's exact location, entry and exit

years, the number of employees, and the headquarter address.[4] We focus on the sub-sample of establishments with SIC codes that correspond to retail trade from 1990 to 2014. A list of the SIC codes along with establishment counts for each retail sector is included in Appendix A. As Rossi-Hansberg et al. (2021) point out, retail trade is among the industries that is well-captured by this data. Moreover, the services sector is most likely to be impacted by corporate taxes (Bighelli 2023). In particular, our database contains all relevant establishment locations in the US during the sample period. Since the retail sectors can be interpreted as selling non-tradable goods (i.e. goods targeting the local market instead of nation-wide or international markets (Zeugner 2013)), we treat the markets of the retail establishments as counties. Given this consideration, we organize each establishment's entry decision at the county-year level. Using these data, we construct the main outcome of interest, namely the establishment counts. The establishment counts are calculated using the total number of active establishments in a given county and year. Figure 1 provides a snapshot of the retail establishment counts in all counties. As shown, there is variation in the number of establishments between counties and over time. In light of this variation in size, we also distinguish between entry patterns among large versus small retail chains. We define a chain as being big if it has 10 or more outlets nationwide. This cutoff value is largely inspired by the thresholds municipal governments use to determine whether or not a retailer, based on its establishment count, should face a different set of zoning ordinances or regulations. For example, the threshold used by Provincetown is 10 (Greenfield 2010) and San Francisco's is 11 (Lagos and Dineen 2014), as retailers with location counts that exceed these thresholds must obtain special permits for further expansion. A small chain is defined as a retailer with 2 to 10 outlets nationwide. Finally, independents are those with only 1 outlet in total.[5] Here, we use the size of the chain (i.e., big vs. small) as a proxy for the firm's capability at capturing market share due to the lack of data on establishment-level

[4] Barnatchez et al. (2017) provides an assessment of the validity of the NETS database.

[5] In fact, some municipalities have used thresholds along these dimensions to enact "chain store bans." For example, San Francisco bans any retail firm with 11 nationwide establishments or more from entering certain neighborhoods (Klopack 2022).

revenues. Chain size might be a good proxy because a chain with many physical stores may help increase customer value, loyalty and re-patronage (Zhang et al. 2022).[6]

3.1.2 State Taxes

The state-level information about business taxes and incentives are obtained from proxies for tax intensity developed by the Panel Database on Incentives and Taxes (PDIT) available via the Upjohn Institute for Employment Research.[7] This database records tax rates and business incentives that corporations face, with a particular focus for new and expanding businesses, for 45 industries (including the retail trade sector) across 47 cities and 33 states in the U.S.from 1990 to 2015. In addition, the database contains predictions of the level of tax incentives a firm would receive in a city given its balance sheet. From this database, we extract for our empirical analysis the observed state-level taxes and incentives specific to the retail trade industries during our sample period of 1990-2014. We focus on the impact of the state's tax, which is calculated as an index via PDIT as the total tax net of the total incentives.[8] Items that contribute towards the total taxes include property, sales and corporate income tax, while those items that relate to the total incentives include the job creation, investment, research and development tax credit, property tax abatement, as well as a customized job training subsidy. These taxes are measured as a percentage of value-added for the corresponding industry or group of industries for a particular state or nation.

[6]The ample presence of a chain's physical stores offers customers more opportunities to engage in product inspections and multi-sensory shopping experiences; these activities that are especially important for experience goods (Nelson 1970, Peck and Wiggins 2006).

[7]This dataset is developed by Bartik (2017) using a "rules-based" approach. Slattery and Zidar (2020) describe the approach as involving "collecting data on the rules of each tax, tax credit, and incentive program offered in a locality and predicting the incentives for a firm given its activity and rules" (see page 101). This data has been used in previous research to study the impact of state tax policies on entrepreneurship (Fazio et al. 2019). Bartik (2017) indicates that the model used to construct the state-specific tax metrics "probably does a good job of capturing overall tax and incentive regime differences across states, including differences in property tax and abatement regimes, even if some of the property tax information may not represent all jurisdictions even in these metro areas." We note also that this data do not include sales taxes that consumers pay, as studied in Anderson et al. (2010), Baugh et al. (2018), and Luna (2004).

[8]Note that the tax measures in PDIT are deflated to 2015 dollars using the GDP-implicit price deflator, while incentives are discounted at 3% (Bartik 2017). The units of measurement for the total taxes and incentives are the same, which allows PDIT to add and subtract different components in the taxes together.

This normalization makes it easy to compare the impact of taxes across different industries and geographies. For our analysis, we focus on the subset of information in this database pertaining to taxes in the "retail trade" industry.[9]

Table 1: Relevant State Taxes that Impact Operating/Fixed Costs

Component	**Description**
Property taxes	Taxes the firm will pay that relate to the physical properties they own
Sales taxes	Taxes firm will pay on its business inputs (e.g., initial purchase of building materials, initial purchase of machinery)
Corporate income taxes	Taxes firm will pay that is based on their profits
Job creation credit	Tax credit firm receives for each job that is created
Investment credit	Tax credit that allows firms to deduct investment costs from their taxes
Research credit	Tax credit that allows firms to deduct R&D costs from their taxes
Property abatement	Subsidy offered on certain types of real estate or business opportunities
Job training subsidy	Subsidy offered to help cover personnel training costs

To better understand the different components of net tax and how these components impact the entry of retail establishments, we present a breakdown of each of these components in the empirical analysis (Table 1). That is, instead of net tax, we include each of the individual components, such as the property tax, sales tax, corporate income tax, job creation credit, investment credit, research credit, property abatement, and job training subsidy. Most of these taxes or incentives impact the operating/fixed costs (with the exception of corporate income taxes), and none of them relate to sales taxes.

Bartik (2017) indicates that among these items, a majority of the state's overall taxes are largely driven by property taxes, which make up about 65% of a state's business taxes. The database also does exclude certain taxes, like those pertaining to public utility, insurance premium, and severance. This omission would likely only impact the energy and utility

[9]Consistent with our categorization of retail for measuring establishment counts, PDIT's "retail trade" industry category is described as a "non-export-based industry."

sectors, which are not studied in our empirical analysis. Moreover, Bartik (2017) indicates an omission as well for the unemployment insurance taxes, using the justification that it is "questionable whether this tax should be included as a business tax, as it provides benefits to workers and indirectly to businesses."

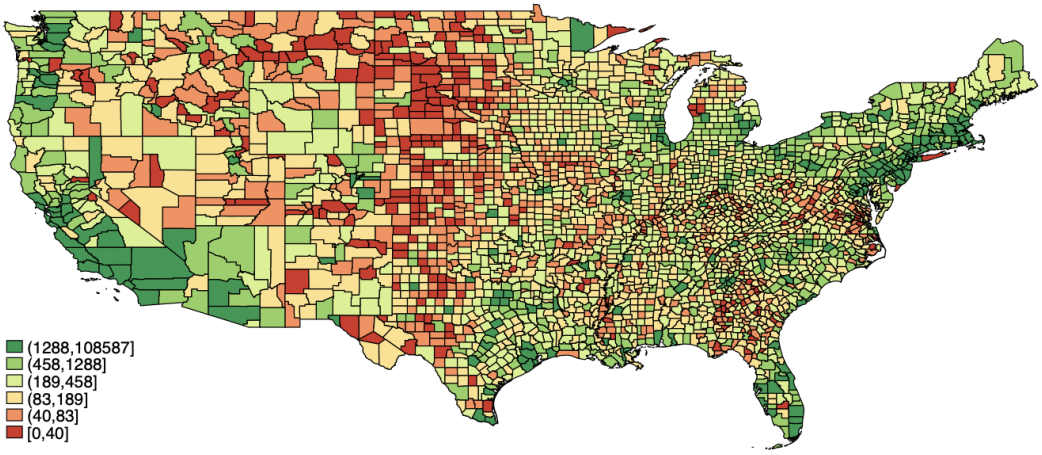
Figure 2 illustrates a snapshot of the geographic and temporal variation for the net taxes, where the light to dark blue ranges capture low to high net tax states. As can be seen, the state-level net tax ranges from 2% to 8%, with a lot of variations both across states and time. In particular, there are many bordering states with differential taxes. For example, New Mexico and Texas share a border, but New Mexico's net tax is about 2% higher than that of Texas in 1990. In 2000, the tax gap closes to about 1%, only to widen again in 2014 back to about 2%.

3.1.3 Market Size

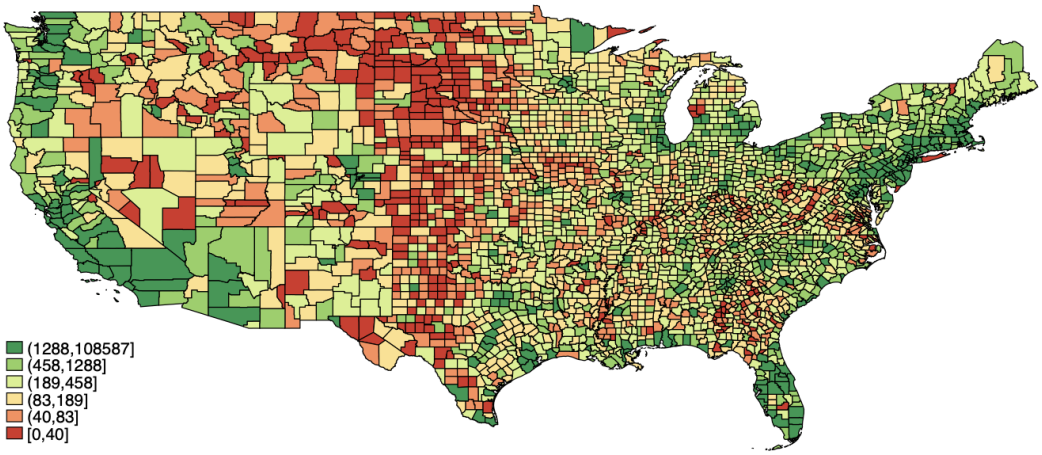
Finally, to proxy for market size, we obtain data about population and income at the county level from the US Census and American Community Survey. This market size proxy is consistent with typical research about retail entry (Bresnahan and Reiss 1991, Campbell and Hopenhayn 2005). Note that this information from the Census is unlikely to be perfect, especially for demographic information during years far removed from the decennial Census surveys (Chi 2024). For this reason, these characteristics are at best proxies, so all of our empirical analysis will necessitate the use of geographic and temporal fixed effects.

3.2 Summary of Empirical Analysis

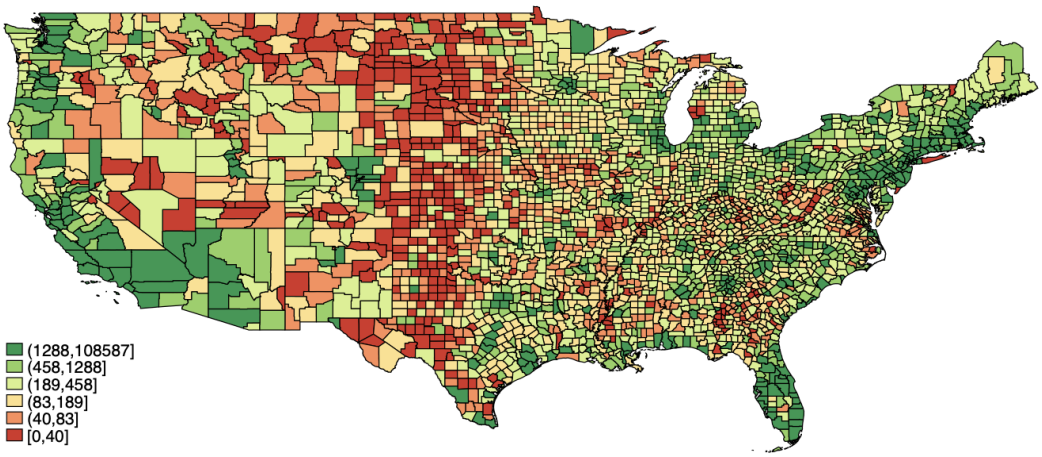
Descriptive patterns. Combining all sources, we have a panel data containing the the state tax policies and the number of retail establishments across over 60 retail sectors at the four-digit SIC code level in over 3000 counties in the US from 1990 to 2014. We first highlight some general patterns in state taxes and retail establishment entry over time. Figure 3 provides the average net taxes (Figure 3a), along with the total number of establishments



(a) 1990

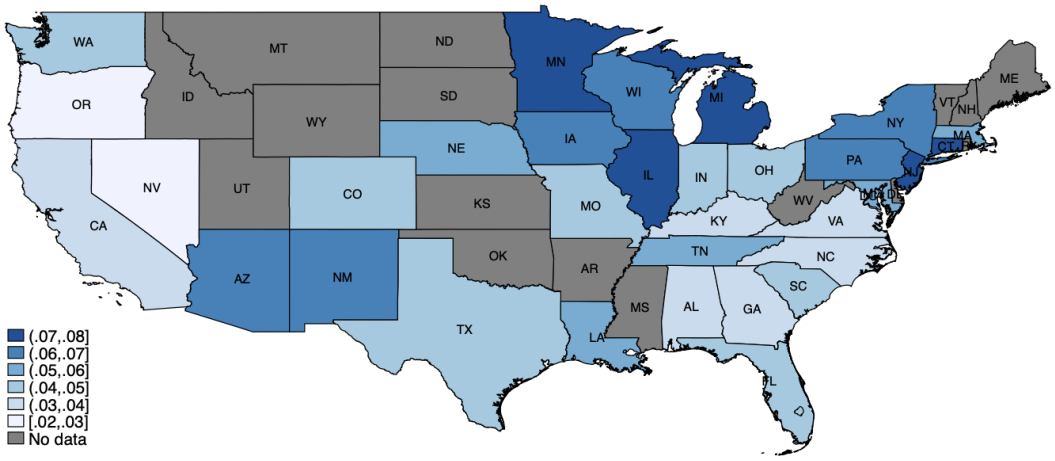


(b) 2000

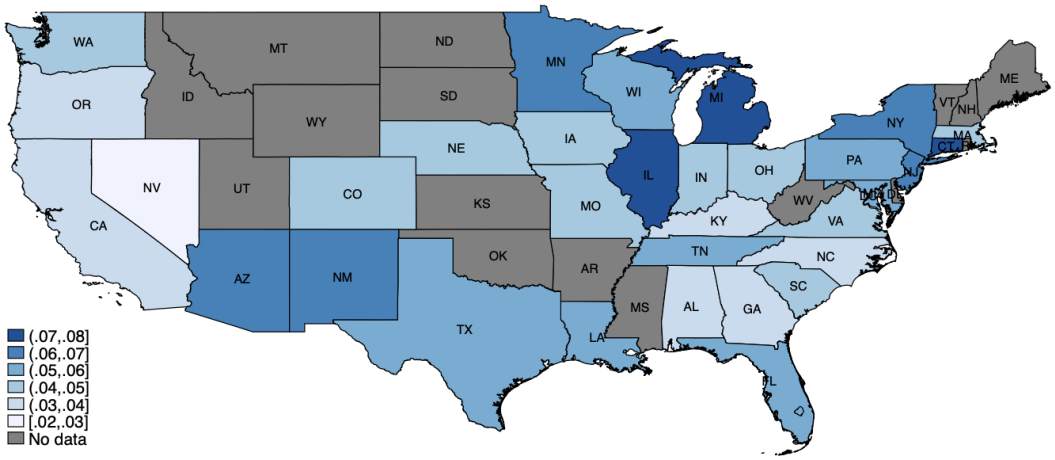


(c) 2014

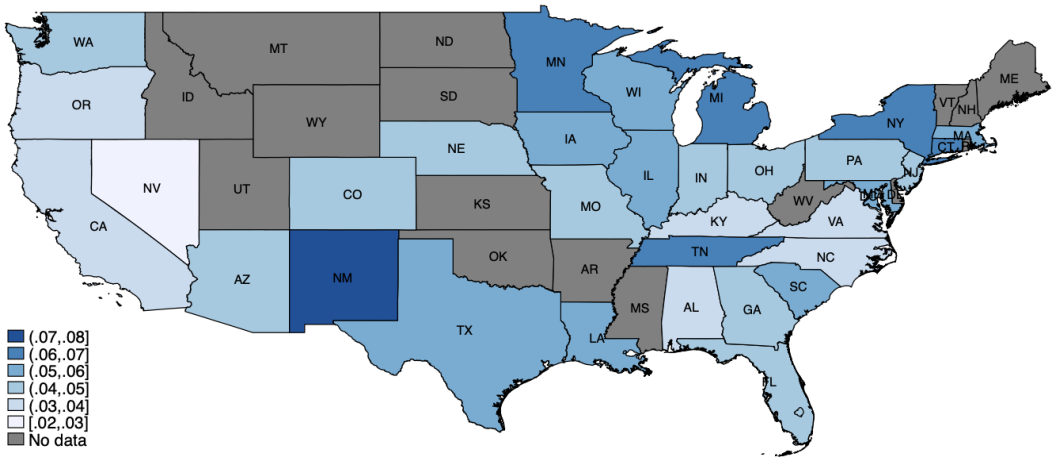
Figure 1: Geographic and Temporal Variation in Establishment Counts



(a) 1990



(b) 2000



(c) 2014

Figure 2: Geographic and Temporal Variation in Net Tax

(Figure 3b) over time. Retail establishments have been steadily increasing from 1990 to 2014. At the same time, the smallest chains have not experienced noticeable growth over time. Moreover, we have seen a steady rise in the national HHI,[10] suggesting increased market concentration in retail over time. We also note a trend of decreasing net taxes at the state level. This pattern is consistent with the introduction of tax reforms (beginning in the late 1980s) that have led to falling corporate tax rates (Chodorow-Reich et al. 2024).

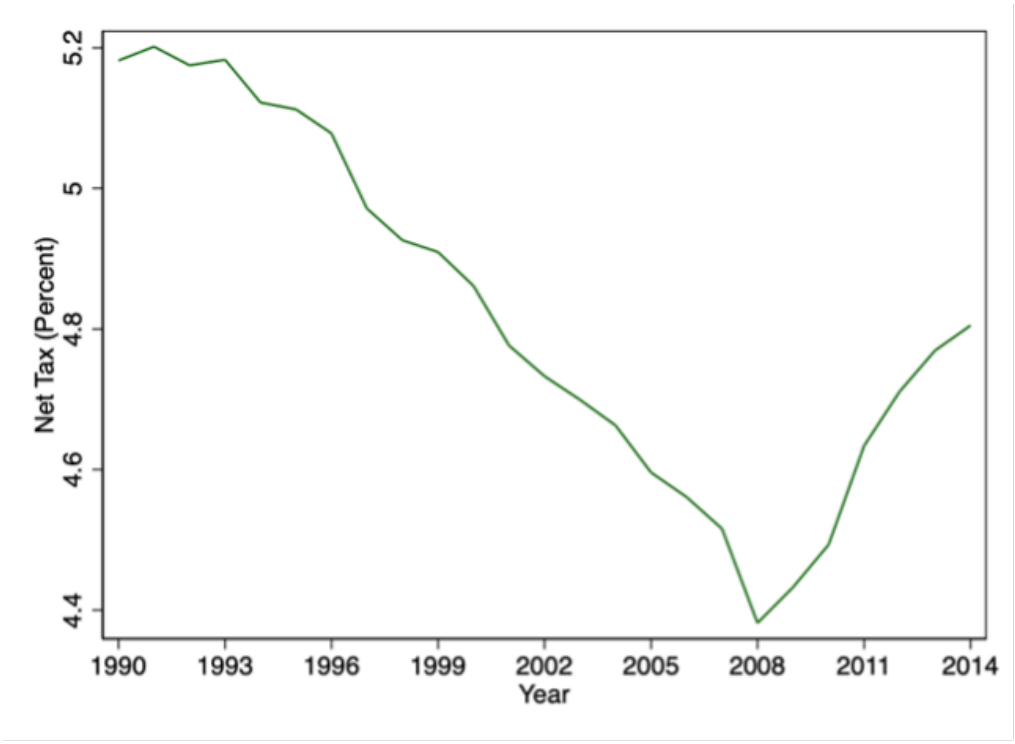
Relationship between taxes and retail entry. To proceed, we consider an analysis that utilizes both temporal and cross-sectional variation in the state tax policies. In particular, we use the following specification:

$$y_{mt} = \beta_0 + \beta_1 \text{Tax Decrease}_{mt} + \beta_2 \text{Population}_{mt} + \beta_3 \text{Income}_{mt} + \delta_t + \delta_m + \epsilon_{mt}, \qquad (1)$$

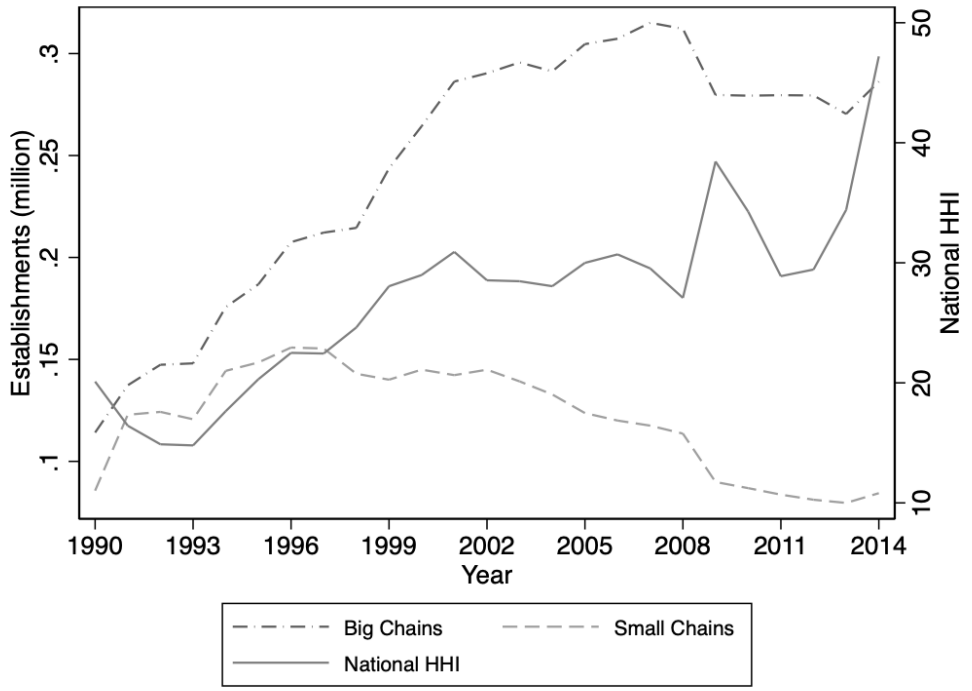
where the main treatment of interest is defined as $\text{Tax Decrease}_{mt} \in \{0, 1\}$, which is equal to 1 if market m experienced a decrease in the state tax measure from time period $t-1$ to t. As before, the outcome y_{mt} represents the establishment counts in market m at time t. In addition to the observable market characteristics, like population and income, we also have time and market fixed effects.

The results (Table 2) of this empirical analysis provide some key insights. The first main insight is that tax decreases are associated with a higher number of retail establishment counts. This finding is not surprising, as there is extensive evidence showing that tax cuts tend to stimulate firm growth (Fajgelbaum et al. 2019, Nallareddy et al. 2022, Sedlácek and Sterk 2019, Serrato and Zidar 2018, Suárez Serrato and Zidar 2016) and investment (Chodorow-Reich et al. 2024). In other words, the retail industry exhibits similar qualitative patterns as the broader economy when faced with tax cuts.

[10]The HHI is calculated using shares of outlets belonging to each firm. Here, the national HHI is calculated in a manner similar to Hsieh and Rossi-Hansberg (2022), whereby our calculations for this figure also aggregates observations to year-firm-sector.



(a) Averaged net taxes



(b) National establishment counts and HHI

Figure 3: Net Tax and Establishment Entry Dynamics

Table 2: State Tax Decreases and Establishment Counts

	All	Chains	Big Chains	Small Chains	Independents
Tax Decrease	22.06***	1.53***	1.25***	0.28	20.53***
	(4.92)	(0.55)	(0.38)	(0.27)	(4.74)
Population (10,000)	60.45***	11.14***	7.76***	3.38***	49.31***
	(9.81)	(1.28)	(1.26)	(0.80)	(9.78)
Income (1 million)	0.07***	0.00	0.01***	-0.01***	0.06***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
Observations	45956	45956	45956	45956	45956
R^2	0.98	0.98	0.98	0.97	0.97

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses establishment counts for all retail firms, Column (2) uses the establishment counts only for the retail chains, Column (3) uses the establishment counts only for the large retail chains, Column (4) uses the establishment counts for only the small retail chains, and Column (5) uses the establishment counts for only the independents.

Our second main insight is that these documented patterns appear to be more relevant for large chains than for small chains. This apparent asymmetry in these empirical patterns appears somewhat consistent with the claims made by Commission (2008). However, documented patterns do exhibit some nuances. In particular, the markedly larger inferred coefficient for the total count of all retail establishments, as compared with the number of establishments belonging to large chains, suggests that the tax cuts also have a large impact on independent retailers. This strong impact of taxes on local independents is consistent with the motivation for many state tax policies aimed at stimulating business activity; so the benefits from reduced taxes are unlikely to benefit the largest chains exclusively, as small (and perhaps the smallest) retail firms appear responsive to tax deductions as well. However, the benefits of business dynamism among local independent retailers might come at the cost of distortions in the landscape shaped by large and small retail chains. We return to this point in some of our theoretical analysis in Section 4.5.3.

As a robustness check, we consider a more restricted analysis that uses a subsample of observations that contain only counties along the state borders. This subsample might allow

Table 3: State Tax Decreases and Establishment Counts for Border Counties

	All	Chains	Big Chains	Small Chains	Independents
Tax Decrease	16.86***	2.25**	2.01***	0.24	14.61***
	(5.25)	(0.89)	(0.65)	(0.50)	(4.78)
Population (10,000)	47.73***	9.80***	6.90***	2.90**	37.94***
	(4.27)	(1.17)	(1.47)	(1.22)	(4.29)
Income (1 million)	0.04***	0.00***	0.01***	-0.01***	0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	15794	15794	15794	15794	15794
R^2	0.98	0.98	0.98	0.95	0.98

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses establishment counts for all retail firms, Column (2) uses the establishment counts only for the retail chains, Column (3) uses the establishment counts only for the large retail chains, Column (4) uses the establishment counts for only the small retail chains, and Column (5) uses the establishment counts for only the independents.

us to focus on counties that are plausibly comparable (Dell 2010, Holmes 1998)[11] as these contiguous border counties might face similar economic realities as their neighbors on the other side of the border. The findings from this analysis are summarized in Table 3, and they confirm that even when we use a subsample of comparable counties, the key empirical patterns remain. As before, tax decreases are associated with a greater number of retail establishments, and we observe that these effects are more prominent for large retail chains as compared with their smaller counterparts.

4 An Entry Model with Taxes

In this section, we present and analyze an oligopoly entry model and highlight potential asymmetry in the impact of uniform tax policies. This model illustrates the possibility of asymmetric responses to tax policies because of pre-existing firm strength (i.e., whether or not well-known retailers have disproportionately more to gain from entering in light of

[11] We refer the reader to the Appendix for a semiparametric approach (Dell 2010) that uses border identification (i.e., cross-sectional variation) only.

favorable tax policies). This strength might be a manifestation of a combination of demand and/or cost-based advantages. More generally, we this theoretical framework can be used to analyze heterogeneous firm responses to exogenous changes in the sunk cost of entry; whereby establishing the nature of this asymmetry or heterogeneity would be particularly relevant for assessing any public policies that have the potential to impact a firm's sunk entry costs.

4.1 Actions and Payoffs

For our theoretical analysis, we consider a game of entry with incomplete information. There are two firms in this industry, indexed by $i = 1, 2$. At the beginning of the game, they decide simultaneously whether or not to enter the market, which we denote $a_i \in \{0, 1\}$. For firm 1, the variable profit is 0 if it does not enter the market, 1 if it enters as a monopolist, and $\rho \in [0, 1]$ if it enters as a duopolist (i.e., with firm 2 entering at the same time). Firm 2's variable profit is defined analogously, except that its duopoly variable profit is $(1 - \rho)$. Here, the market size is normalized to be 1. We note here that the total demand is fixed, such that the presence of two firms (rather than just one) does not have a market expansion effect.

The parameter ρ can be interpreted as firm 1's relative strength, while $(1 - \rho)$ then represents firm 2's relative strength in the market. In reality, firm strength might come from demand or cost-based channels. Below, we provide examples of both, and illustrate how firm size can be used in the interpretation of ρ. This discussion is ultimately used to highlight a potential connection between our model and the earlier empirical analysis. More generally, establishing this interpretation might be relevant for future research, as firm size is often observable to empiricists.

Demand-based interpretation of ρ and firm size. We now provide a detailed discussion on the interpretation of ρ. One may view this parameter as capturing firm 1's reduced form profits from post-entry Cournot competition. In this digression, we derive a specific

theoretical example on how firm 1's size can be a potential proxy for its relative strength ρ via a plausible demand-based mechanism. To begin, consider a post-entry quantity setting game, in which firms 1 and 2 set quantities q_1 and q_2 in a given market. The total quantity supplied to the market is $Q = q_1 + q_2$. Each firm has a size, indicated by s_1 and s_2. The size of the firm can potentially create a source of differentiation between firms 1 and 2, as reflected in the price function $p_i = \alpha s_i - \beta Q$; that is, the size of the firm can change the intercept of the demand curve (i.e., stronger consumer loyalty to a brand, higher quality of products and services). Furthermore, to focus on demand-side differences between the firms, we set marginal costs to be 0. Given this formulation, one can solve the Cournot competition model. One can show that firm 1's payoffs at the equilibrium quantities q_1^* and q_2^*, has the following partial derivative with respect to firm 1's size, evaluated for the case in which both firms are around the same size (i.e., $s_1 \simeq s_2 \to s$): $\partial\Pi/\partial s = (\alpha s/3) \cdot (1 - 2\beta/3)(\alpha - 4\beta)$. From this expression, we can see that firm 1's payoffs will increase in its size provided that $\alpha > 4\beta$ and $\beta < 3/2$. Therefore, this example illustrates how firm size and ρ might exhibit similar properties, and thus, how firm size can be interpreted as one potential proxy for ρ via a demand-based mechanism. $\square$

Cost-based interpretation of ρ and firm size. Similar to our discussion above, we provide an alternative interpretation of ρ that is based on the relationship between firm size and the marginal cost of production. To proceed, we continue to frame our discussion around a Cournot competition model. As before, each firm has a size, indicated by s_1 and s_2. The difference now is that firm size can potentially lead to lower marginal costs of production, say from scale economies. We would thus set marginal costs of production to be $c_i = c - \delta s_i$. Moreover, we will consider a demand function where firms 1 and 2 are not differentiated, so $p = \alpha - \beta Q$. As in the first example, one can show that firm 1's payoffs at the equilibrium quantities q_1^* and q_2^*, has the following partial derivative with respect to firm 1's size, evaluated for the case in which both firms are around the same size (i.e.,

$s_1 \simeq s_2 \to s$): $\partial\Pi/\partial s = 1/3 \cdot (\alpha - c + \delta s - \alpha\beta\delta/3 - 2\beta(\alpha - \delta))$. From this expression, we can see that firm 1's payoffs will increase in its size provided that $s > (c - \alpha)/\delta$, $\alpha > 0$, $\beta > 0$, and $\alpha > \delta$. Therefore, this example illustrates how firm size and ρ might exhibit similar properties, and thus, how firm size can be interpreted as one potential proxy for ρ via a cost-based mechanism. □

Having established the demand-side contributions towards the profit from entering, we now discuss sunk costs that firms incur. In particular, there is a cost of entry, $\kappa < 1$, and each firm has private information about its own productivity, which we denote as ε_i. We assume that ε_i is i.i.d. and has a uniform distribution, U$[0, 1]$. The uniform distribution will allow analytical solutions to the entry game. Furthermore, ε_i is private information and is known only to i. These assumptions allow us to characterize the equilibrium entry probabilities in closed-form. The payoff of entering a market for firms 1 and 2 is defined as

$$\pi_1(a_1 = 1, a_2) = 1 - a_2(1 - \rho) - \kappa - \varepsilon_1, \tag{2}$$

$$\pi_2(a_1, a_2 = 1) = 1 - a_1\rho - \kappa - \varepsilon_2. \tag{3}$$

4.2 Strategies, Expectations and Equilibrium Entry

With the defined variable profits, sunk costs and private information, the entry conditions can be obtained for firms 1 and 2. As entry decisions are made simultaneously, firms form expectations about what their competitor will do (i.e., firm 1's expectation about $a_2 = 1$, and firm 2's expectation about $a_1 = 1$), their decision rules will be functions of choice probabilities, $\sigma_i = \Pr(a_i = 1) \in [0, 1]$. In particular, firm 1 will enter given its expectations about firm 2's choice probability if and only if

$$1 - (1 - \rho)\sigma_2 - \kappa \geq \varepsilon_1, \tag{4}$$

while firm 2 will enter given its expectations about firm 1's choice probability if and only if

$$1 - \rho\sigma_1 - \kappa \geq \varepsilon_2. \tag{5}$$

Given the assumption about the distribution for ε_i, we can write the choice probabilities for firms 1 and 2 as

$$\sigma_1 = 1 - (1 - \rho)\sigma_2 - \kappa, \tag{6}$$

$$\sigma_2 = 1 - \rho\sigma_1 - \kappa. \tag{7}$$

By expressing these strategy profiles as choice probabilities σ_1 and σ_2, we can use a Bayesian Nash Equilibrium (BNE) to characterize their optimal entry decisions, as defined below:

Definition 1. A strategy profile $\{\sigma_i^*\}_{\forall i}$ is a BNE if and only if $\pi_i(\sigma_i^*, \sigma_j^*) \geq \pi_i(\sigma_i, \sigma_j^*)$ for all $\sigma_i \in [0, 1]$.

These conditions reflect that neither firm 1 nor firm 2 has a unilateral incentive to deviate from their strategy profiles (σ_1^*, σ_2^*). Therefore, the BNE is obtained by solving a system of equations for σ_1 and σ_2:

$$\sigma_1^* = \frac{(1 - \kappa)\rho}{1 - \rho(1 - \rho)}, \tag{8}$$

$$\sigma_2^* = \frac{(1 - \kappa)(1 - \rho)}{1 - \rho(1 - \rho)}. \tag{9}$$

Here, the BNE is summarized by (σ_1^*, σ_2^*). In the next section, we explore the implications of taxes that impact the cost of entry (i.e., κ).

4.3 Taxes

Under the BNE, we consider a tax policy that increases the entry costs by τ. Note that results for a tax cut will mirror the ones discussed here. This policy would lead to different entry strategies for firms 1 and 2, which we denote as $\tilde{\sigma}_1$ and $\tilde{\sigma}_2$. The equilibrium strategies

with this tax policy are written as

$$\tilde{\sigma}_1 = \sigma_1^* - \frac{\tau\rho}{1-\rho(1-\rho)}, \tag{10}$$

$$\tilde{\sigma}_2 = \sigma_2^* - \frac{\tau(1-\rho)}{1-\rho(1-\rho)}. \tag{11}$$

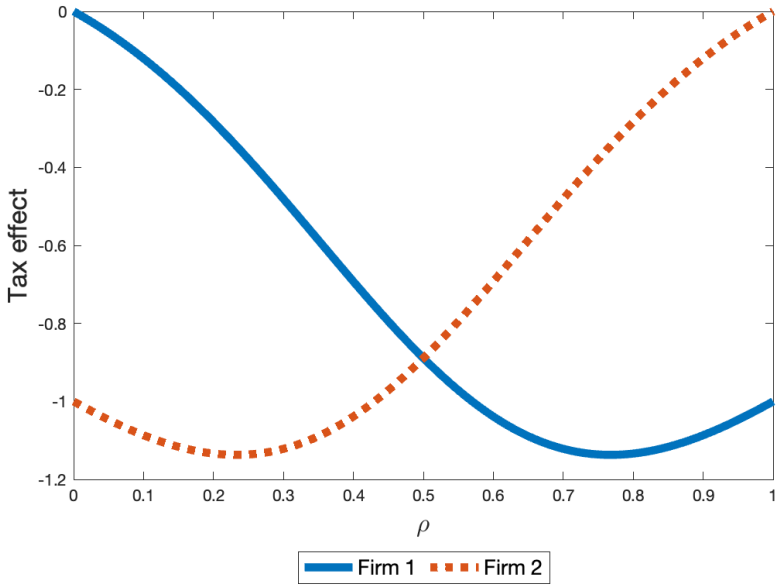
By comparing the equilibrium choice probabilities with and without this tax policy, we evaluate the tax effect. That is, $(\tilde{\sigma}_1 - \sigma_1^*)/\tau$ and $(\tilde{\sigma}_2 - \sigma_2^*)/\tau$ are both less than 0 for all $\rho \in [0, 1]$. This result implies that higher taxes will stifle establishment entry, and conversely, lower taxes will encourage establishment entry. That is, we will see more establishment entry in the industry (i.e., $\tilde{\sigma}_1 + \tilde{\sigma}_2 > \sigma_1^* + \sigma_2^*$), as a whole. These patterns underscore a potential industry-level benefit associated with favorable tax conditions on firm entry. However, the marginal impact of this policy differs between the two firms, except when $\rho = 0.5$ (i.e., firms 1 and 2 are equally strong in stealing business from each other).

Taxes and asymmetric effects. The result above confirms that it is possible for a tax policy, that is uniformly applied to all firms in an industry, to yield asymmetric effects across firms. For this exercise, the driver of this asymmetry is related to the relative strength of each firm, whereby this strength can be a function of its overall size and presence (Reddy et al. 1994, Smith 2006).

We can evaluate more closely the relationship between the firm's strength and the sensitivity to tax policies that impact the cost of entry. In particular, Figure 4 plots the tax effects on firms 1 and 2 across the range of ρ. This figure shows that firm 1 is more sensitive (i.e., negative response) to changes in tax policy when $\rho > 0.5$ (that is, firm 1 is stronger than 2). One way to interpret this result is that stronger firms (with respect to post-entry payoffs) will be more sensitive to changes to the tax policies. Therefore, favorable tax policies leads to disproportionately *more* entry among *stronger* firms.

A consequence of these asymmetric responses is that tax policies can potentially distort

Figure 4: Tax Effect and Firm Strength



the market landscape. This distortion would be minimized if firms had equal entry probabilities (i.e., $\tilde{\sigma}_1 = \tilde{\sigma}_2$). In other words, the greater the difference between $\tilde{\sigma}_1$ and $\tilde{\sigma}_2$, the higher the market concentration. To assess the extent to which taxes τ bifurcate the entry probabilities $\tilde{\sigma}_1$ and $\tilde{\sigma}_2$, we calculate the partial derivative of $(\tilde{\sigma}_1 - \tilde{\sigma}_2)$ as

$$\frac{\partial(\tilde{\sigma}_1 - \tilde{\sigma}_2)}{\partial \tau} = \frac{1 - 2\rho}{1 - \rho(1 - \rho)}, \tag{12}$$

which is equal to 0 if and only if $\rho = 0.5$. Moreover, the tax-induced bifurcation works to the detriment of firm 1 if $\rho > 0.5$, and works to the advantage of firm 1 if $\rho < 0.5$. In particular, if the tax is a subsidy on entry cost instead of an increase in cost, the tax-induced bifurcation will benefit the stronger firm (i.e. firm 1 if $\rho > 0.5$ and firm 2 if $\rho < 0.5$). From this perspective, uniform taxes have the potential to shift entry rates away from levels that minimize market concentration.

Taxes and underserved markets. This model also provides insights about the relationship between taxes and the prevalence of underserved markets (i.e., retail deserts). In the context of our model, underserved markets would be defined as those that neither firm 1 nor firm 2 enters. The probability of that occurring would be

$$\Psi = (1 - \sigma_1^*)(1 - \sigma_2^*), \tag{13}$$

and under a tax regime,

$$\tilde{\Psi} = (1 - \tilde{\sigma}_1)(1 - \tilde{\sigma}_2), \tag{14}$$

where the difference between these probabilities can be written as

$$\tilde{\Psi} - \Psi = \frac{2\tau\kappa\rho + \tau + \tau\rho^2(3 - 2\kappa) - 3\tau\rho + 2(1 - \kappa)\tau\rho^2 - \tau^2\rho^2}{(1 - \rho(1 - \rho))^2} \tag{15}$$

To minimize the prevalence of underserved markets, we would need a tax level $\hat{\tau}$ that maximizes the difference, $\tilde{\Psi} - \Psi$. In other words,

$$\hat{\tau} = \frac{2\kappa\rho + 1 + \rho^2(3 - 2\kappa) - 3\rho + 2(1 - \kappa)}{2\rho^2} \tag{16}$$

Based on the expression for $\hat{\tau}$, we see that $\hat{\tau}(\rho = 1) = (3 - 2\kappa)/2$, and $\hat{\tau}(\rho = 0.5) = 4.5 - 4\kappa$. Consequently, $\hat{\tau}(\rho = 1) < \hat{\tau}(\rho = 0.5)$ provided that $\kappa < 1$, which always holds. Here, a tax that minimizes the prevalence of underserved markets *decreases* with ρ (i.e., firm 1 becomes increasingly stronger). In other words, a market with a dominant firm might not be conducive for high tax that at the same time avoids creating a retail desert. This characterization of the tax effect highlights yet another potential distortion from taxes when firms are asymmetric in their strength.

Tax revenue and firm strength. Having established the asymmetric responses to uniform tax policies, we now explore these asymmetric responses under revenue-improving taxes.

In particular, we identify the tax level that can optimize government tax revenue and investigate how firm strength impacts the level. With uniform taxes, the partial revenue[12] received by the government is

$$T = (\sigma_1^* + \sigma_2^*)\tau, \tag{17}$$

where σ_1^* and σ_2^* represent firm 1 and 2's optimal entry strategies with entry costs $\kappa + \tau$. Given this tax revenue equation, along with the optimal entry strategies, the tax level that maximizes this objective function is written as:

$$\tau^* = \frac{1-\kappa}{(2\rho-2)^2}, \tag{18}$$

where we see that evaluated at $\rho = 0.5$, this tax level decreases with ρ, as

$$\frac{\partial \tau^*}{\partial \rho}|_{\rho=0.5} = -2(1-\kappa) < 0. \tag{19}$$

In other words, a marginal increase in firm 1's strength (i.e., ρ increase above 0.5) can lead to *lower* optimal tax levels. As the stronger firm has more to gain from entry when taxes decrease, this firm will be more responsive in terms of entry. This new analytical insight suggests that tax policies aimed at raising government revenue might further reinforce the benefits that strong firms receive from entering the market.

Summary. Our theoretical analysis demonstrates asymmetric responses to tax policy sensitivity in a model of strategic entry, and, in particular, the extent to which this asymmetric sensitivity relates to a firm's relative strength in the market. The main theoretical prediction from this example is that while tax increases (decreases) can deter (encourage) firm entry, firms will in most scenarios respond *asymmetrically* to uniform tax policies, as stronger firms will respond more to uniform tax changes. Thus, uniform tax policies have the potential to

[12]Note that the total revenue received would be $T = (\sigma_1^* + \sigma_2^*)\tau + 2\sigma_1^*\sigma_2^*\tau$. However, this revenue objective function would lead to an ill-defined value for the τ that solves the first order condition. For this reason, our discussion in this section will focus on a scenario in which the partial tax revenues are optimized with respect to τ.

distort the prevailing market landscape in our stylized theoretical example. Ultimately, this theoretical analysis highlights equilibrium entry behavior under tax policies that is qualitatively consistent with the preceding empirical findings.

4.4 Economic Interpretation of Asymmetric Response to Taxes

An implication of our theoretical (and earlier empirical) analysis is that uniform tax policies can lead to nonuniform entry strategies across firms.[13] In this section, we demonstrate how taxes would have to differ between both firms for balanced responses in entry. This difference highlights the potential economic magnitude of the heterogeneous responses to taxes between the two firms.

Theoretical background. To establish this notion of balanced response in entry, we consider a tax design that increases the cost for firms 1 and 2 by τ_1 and τ_2, respectively. The resulting entry costs under this tax policy would be $\kappa_1 = \kappa + \tau_1$ for firm 1, and $\kappa_2 = \kappa + \tau_2$ for firm 2. Symmetry of equilibrium entry rates would in theory be achieved if $\tilde{\sigma}_1 = \tilde{\sigma}_2$. Therefore, the tax rule used for one firm can be written as a function of the other firm's taxes:

$$\tau_1(\tau_2) = \left[1 - \frac{(1-\rho)}{\rho}\right](1-\kappa) + \frac{(1-\rho)}{\rho}\tau_2. \tag{20}$$

Based on this tax rule, we see that $\tau_1 = \tau_2$ when $\rho = 0.5$. Otherwise, a uniform tax policy will never achieve symmetric responses by firms for any other value of ρ. Policy makers could thus try to maximize their total tax revenues,

$$T = \tilde{\sigma}_1\tau_1 + \tilde{\sigma}_2\tau_2 + \tilde{\sigma}_1\tilde{\sigma}_1(\tau_1 + \tau_2). \tag{21}$$

[13] Designing tax policies under the context of oligopoly competition is not a new concept; see Anderson et al. (2001) and Besley (1989).

Total tax revenues are calculated based on the expected tax received if firm 1 or 2 is a monopolist (i.e., first two terms), or if both firms have entered (i.e., third term). Given the policy objective of $\tilde{\sigma}_1 = \tilde{\sigma}_2$, and the resulting relationship between τ_1 and τ_2, the optimal value[14] of $\tilde{\tau}_2$ would satisfy the following condition:

$$2\tau_2 \left(1 - \frac{(1-\rho)}{\rho}\right)(1-\kappa) + \frac{2\tau_2^2(1+\rho)}{\rho} = \frac{(1+\rho)(1-\kappa)^2}{\rho}. \tag{22}$$

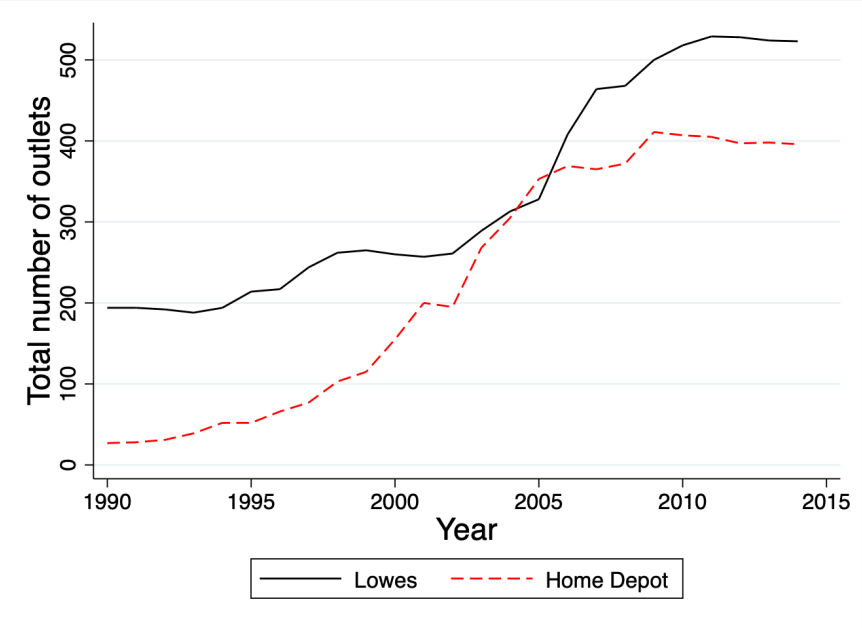
As the $\tilde{\tau}_2$ that satisfies this condition is a non-intuitive and complicated function of ρ and κ, we proceed this analysis with calibrated parameters. In particular, we will make use of a subset of our data in order to approximate ρ and κ for a specific retail sector, which in turn allows us to numerically calculate $\tilde{\tau}_1$ and $\tilde{\tau}_2$.

Case study: Home improvement chains. With the tax conditions derived from our model, we now highlight the economic magnitude of the heterogeneity in tax effects across retail firms via an empirical case study about competition between two major home improvement chains, Home Depot and Lowe's. These chains are the market leaders in the US, with a combined market share of about 50% for this retail sector (SeekingAlpha 2022). This case study will utilize a subset of the data from our empirical analysis in section 3. Between the two chains, Lowe's is the dominant one in terms of the total number of establishments. For almost all years in our sample, the total number of Lowe's outlets exceeds the total number of Home Depot outlets, with the exception of 2005 (see Figure 5). Furthermore, both chains are known to benefit from state tax breaks (Vara-Orta 2017). As taxes are potentially different across markets, one should view this exercise as a tax assessment for a single average or representative market.

The home improvement retail setting is an ideal context for calibrated model analysis, as there are two main competitors. To ensure a close match to the empirical environment we

[14] We obtain this optimal value by using the first order condition of T with respect to τ_2, along with the constraints $\tilde{\sigma}_1 = \tilde{\sigma}_2$ and the function $\tau_1(\tau_2)$ from equation above.

Figure 5: Industry Dynamics for the Home Improvement Retail Sector



Notes: This figure plots the total number of Lowe's (black solid line) and Home Depot (red dashed line) establishments each year.

use for the theoretical insights, we consider a subset of the markets that have *at most* one Home Depot outlet and/or one Lowe's outlet. We focus on this sub-sample to ensure that the probability of entry is bounded below 1 for each of the chains.

Table 4: Tabulation of Market Configurations for Lowe's and Home Depot

Lowe's/Home Depot	0	1
0	63,079	3,142
1	5,890	2,444

Based on this subsample of data, we can obtain calibrated values of the key entry model primitives that are needed to construct the optimal tax rules for $\tau_{HomeDepot}$ and τ_{Lowes}, so that entry responses are balanced. From the raw data patterns on the observed market configurations of Lowe's and Home Depot (see Table 4), we see that $\sigma^*_{HomeDepot} = \Pr(a_{HomeDepot} = 1) = 0.07$ and $\sigma^*_{Lowes} = \Pr(a_{Lowes} = 1) = 0.11$. If we define

$$\lambda = \frac{\sigma^*_{HomeDepot}}{\sigma^*_{Lowes}} = 0.64 \tag{23}$$

to be the ratio of the choice probabilities, we can calculate ρ as follows

$$\rho = \frac{\lambda}{1+\lambda} = 0.39, \tag{24}$$

while entry costs κ can be calibrated as

$$\kappa = 1 - \frac{\sigma^*_{HomeDepot}[1-\rho(1-\rho)]}{\rho} = 0.86. \tag{25}$$

These calibrated values can be used to calculate each firm's tax rule. Given this constraint for balanced firm entry, we can establish what tax levels should be set for Home Depot and Lowe's such that the total tax revenues are maximized. With the calibrated values from our data, we calculate these tax levels to be $\tilde{\tau}_{HomeDepot} = 0.09$ and $\tilde{\tau}_{Lowes} = 0.11$. Thus, for the taxes to induce symmetric entry decisions, we would need to impose lower taxes on Home Depot relative to Lowe's (i.e., about 22%). This noticeable difference in optimal taxes across the two firms suggests that the heterogeneous response to taxes would be non-negligible in economic magnitude.

4.5 Extensions

This section presents a few extensions of the model we have introduced. These extensions aim to demonstrate the scope of our model's main insights. In particular, we explore alternative models that relax assumptions about the functional form of taxes (Section 4.5.1), asymmetry of sunk entry costs (Section 4.5.2), and the presence of competitors beyond the two firms (Section 4.5.3).

4.5.1 Proportional Tax Policy

We consider an alternative uniform tax policy that is proportional to entry costs. That is, we consider entry costs $\kappa\tau$. When $\tau < 1$, the tax policy can be viewed as a subsidy or incentive, while $\tau > 1$ would relate to a tax that raises the entry cost. With this alternative tax policy, we can write the difference between the equilibrium choice probabilities with and without the tax policy as

$$\tilde{\sigma}_1 = \sigma_1^* - \frac{(1-\tau)\kappa\rho}{1-\rho(1-\rho)}, \tag{26}$$

$$\tilde{\sigma}_2 = \sigma_2^* - \frac{(1-\tau)\kappa(1-\rho)}{1-\rho(1-\rho)}. \tag{27}$$

These expressions can help us understand the differences between $(\tilde{\sigma}_1 - \sigma_1^*)$ and $(\tilde{\sigma}_2 - \sigma_2^*)$. In particular,

$$|\tilde{\sigma}_1 - \sigma_1^*| = |\tilde{\sigma}_2 - \sigma_2^*| + \frac{|1-\tau|\kappa}{1-\rho(1-\rho)}(2\rho - 1). \tag{28}$$

As can be seen, as long as $\rho > 0.5$, firm 1, the larger firm, will always be more responsive to tax policy than firm 2. Furthermore, an implication of the magnitude of this difference is that regardless of whether $\tau > 1$ or $\tau < 1$, a larger entry cost κ will exacerbate differences in the tax effects between the two firms. This insight might be useful in characterizing potential industry-specific heterogeneity in these asymmetric responses to tax policies between firms of various strengths, as some industries are characterized by large (or small) entry costs.

4.5.2 Asymmetric Entry Costs

Now we consider the case firms have different entry costs. In this section, we explore the extent to which differences in entry costs can impact the relationship between firm strength and responsiveness to tax policy. Finally, we note that this scenario is relevant only when a proportional tax policy is implemented.

Let κ_1 and κ_2 denote the entry costs for firm 1 and firm 2 respectively. It is intuitive to assume that if $\rho > 0.5$ (i.e., firm 1 is the largest firm), then $\kappa_1 > \kappa_2$. This is because higher-

quality or more competitive firms are likely to have a higher entry cost. In our empirical context with respect to large and small chains in particular, larger chains with many stores in a market can be more attractive to consumers because they are easy to access (i.e., consumers do not need to travel far to shop at their stores). In this case, the larger chain would incur a higher entry cost because it opens many stores in a market. Each store would require an entry cost to establish the store. Although larger chains usually enjoy economies of scale in entry cost, the total entry cost associated with opening many stores would exceed that of the smaller chain that does not have many stores.

Following equations 26 and 27, we can show that the following equation holds:

$$|\tilde{\sigma}_1 - \sigma_1^*| = |\tilde{\sigma}_2 - \sigma_2^*| + \frac{|1-\tau|\kappa_2}{1-\rho(1-\rho)}\left[\left(\frac{\kappa_1}{\kappa_2}+1\right)\rho - 1\right]. \tag{29}$$

As can be seen, a higher κ_1 would exacerbate the difference in the responsiveness of stronger versus weaker chains to tax policies. This scenario might be plausible if stronger chains also required larger sites for their retail locations. This difference in responsiveness is loosely consistent as well with the possibility that stronger firms are better equipped to avoid tax (Glovera and Levineb 2021). A proportional tax would ultimately further contribute towards the benefits of tax avoidance, especially for firms with large costs of entry.

4.5.3 Presence of Competitive Fringe

The extension we consider here incorporates the presence of independent retail firms. We will treat these independents as a competitive fringe. This analysis is motivated by the fact that retail sectors often consist of a combination of large retail chains as well as local independents. By introducing local independents into the model, we can explore the tax effect relationship between strength of the oligopoly firms and the number of independents.

The entry decision process is subtly different for the independents, if we interpret them to behave as the competitive fringe. Here, the N independent retailers take the equilibrium

firm 1 and 2 decisions, σ_1^* and σ_2^*, as given. Given firm 1 and 2's equilibrium entry decisions, the expected industry revenue left for the competitive fringe is $1 - \sigma_1^*\rho - \sigma_2^*(1-\rho)$, which can be written as:

$$\frac{\rho + \kappa + 2\kappa\rho^2 - 2\rho\kappa - \rho^2}{1 - \rho(1-\rho)}. \tag{30}$$

Therefore, the equilibrium number of independent retail firms, N^* that satisfies the zero profit condition can be written as:

$$N^* = \frac{\rho + \kappa + 2\kappa\rho^2 - 2\rho\kappa - \rho^2}{\kappa[1 - \rho(1-\rho)]}. \tag{31}$$

Suppose, as in our earlier analysis, that there is a tax policy that increases the sunk entry costs κ by τ. We can then compare the total number of independent retail firms with and without the added tax on entry costs via the ratio $\tilde{N}/N^*$, where $\tilde{N}$ is the equilibrium number of firms under when there are taxes τ. This ratio is as follows:

$$\Delta = \frac{\tilde{N}}{N^*} = \frac{\kappa(\rho + (\kappa+\tau) + 2(\kappa+\tau)\rho^2 - 2\rho(\kappa+\tau) - \rho^2)}{(\kappa+\tau)[\rho + \kappa + 2\kappa\rho^2 - 2\rho\kappa - \rho^2]}. \tag{32}$$

With this expression, we can see how this ratio changes as ρ increases by a small amount from 0.5. Its derivative, with respect to ρ evaluated at 0.5 is,

$$\frac{\partial\Delta}{\partial\rho}|_{\rho=0.5} = \frac{3\kappa(\kappa+\tau)[\frac{1}{2}(\kappa+\tau+1) - \frac{1}{4}(\kappa+\tau)(2\kappa+1)]}{[(\kappa+\tau)^2(\rho + \kappa + 2\kappa\rho^2 - 2\kappa\rho - \rho^2]^2}, \tag{33}$$

which is negative when the tax is sufficiently low:

$$\tau < \frac{\kappa(2\kappa-1) - 1}{1 - 2\kappa}. \tag{34}$$

This condition restricts the cost of entry κ to be sufficiently high, such that $\kappa > 0.5$ and $\kappa(2\kappa - 1) < 1$. Under these conditions, we have demonstrated that firm 1's strength ρ not only amplifies its own response to taxes, but also, the impact of a tax change on the

number of independent retail firms. This analytical result is consistent with the general empirical patterns we documented in Section 3.2, as the impact of a state tax decrease on retail establishment entry is most noticeable for large chains *and* independents.

Taken together, our empirical and theoretical findings suggest that tax cuts need not necessarily benefit only the largest retail firms and that avoidance of such policies as a means to restrain the dominance of these firms could come at the cost of many small independent retailers that would otherwise benefit from tax cuts. For this reason, the potential asymmetric effects of tax policy on the market structure could be more nuanced than what Commission (2008) portrays it to be, as the retailers that are most responsive to such policies appear to be at the tail ends of the size distribution.

5 Conclusion

We present new insights about the impact of place-based tax policies on shaping local retail landscapes. Using comprehensive data that captures retail entry across the US, we demonstrate that the impact of tax policies is asymmetric across firms of different sizes. The empirical analysis confirms that the inferred tax effects on establishment entry are disproportionately driven by the largest retail firms. In other words, policies that *decrease* taxes will ultimately *reinforce* the growth of already dominant retail firms. With a model of entry with taxes, we posit one potential mechanism behind the documented empirical patterns, by showing that stronger firms with respect to demand or cost-based size advantages are more sensitive to tax policy changes, and thus, *favorable* tax policies will disproportionately *increase* entry among large retail chains (as compared to smaller chains). Furthermore, in an empirical case study about the home improvement retail sector (i.e., Home Depot and Lowe's), we provide an illustration about the potential economic magnitude associated with asymmetric responses to uniform tax policy.

Our analysis abstracts away from potential bidding by local government, as it has been demonstrated that local governments might compete against one another as a means to

attract firms and local investment (Lin 2024, Slattery 2022). This competition might lead to increasingly attractive tax policies aimed at enticing firm entry. Given that our theoretical and empirical analysis shows that tax cuts can lead to decreased competitiveness in retail, it might be worthwhile for future research to investigate the extent to which this state-vs-state bidding exacerbates the asymmetric tax effects that induce already dominant retailers to become even more dominant.

These findings may also have implications for discussions about the efficiency and incidence effects of place-based policies in public finance (Suárez Serrato and Zidar 2016). The amplification of dominant retailers' market power from favorable state tax policies might yield negative incidence effects, as past research has shown that the entry of large chains might have a negative impact on localized wages (Basker 2007). However, at the same time, the proliferation of large chains could lead to efficiency and productivity gains (Choi et al. 2024, Smith et al. 2024), and thus be welfare-improving (Basker 2005b).

There remains ambiguity about the macroeconomic implications of place-based tax policies in the retail sector. As retail contributes about 6% of the overall GDP, tax policies that have asymmetric impact across retail firms of different sizes might lead to broader effects on employment and customer welfare. Moreover, there might be some value of linking the disproportionate sensitivity to tax policies among the largest firms with observations of increasing markups/concentration at national level and decreasing business dynamism over time (Affeldt et al. 2021, Akcigit and Ates 2021, Cao et al. 2017, Covarrubias et al. 2020, De Loecker and Eeckhout 2018, De Loecker et al. 2020, Feenstra et al. 2022, Grullon et al. 2019, Gutiérrez and Philippon 2017, Jiang et al. 2020, Kwon et al. 2023, Leung and Li 2022, Liu et al. 2022, Smith and Ocampo 2022, West 2018). These patterns of increasing concentration seem especially prevalent in the services sector (Hsieh and Rossi-Hansberg 2022), which would be a part of retail.

Finally, the presence of a link between tax policies and firm entry suggests that these policies could offer a helpful source of exogenous variation for the purpose of identifying

structural models of entry. To complement past research about the role of tax rates for estimating consumer-side demand systems (Dearing 2022, He and Su 2023, Hollenbeck and Uetake 2021, Zoutman et al. 2018), new research could explore the identification power of tax policies for estimating supply-side models that characterize firm decisions.

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Online Appendix

Table of Contents

A List of the Retail Sectors in NETS Data **2**

B Border Identification **4**

B.1 Sensitivity Analysis for Firm Size Cut-Offs 9

B.2 Cross-Sector Heterogeneity in the Tax Effects 9

A List of the Retail Sectors in NETS Data

We present a tabulation of the establishments across different retail sectors (i.e., SIC 4-digit classification) in Table A1. This table shows that each retail sector is well-represented. The retail sectors that have disproportionately more establishments include grocery stores and women's clothing. Among the sectors with the lowest establishment counts are newsstands and luggage stores.

Table A1: Tabulation of Establishment Counts Across SIC 4-Digit Classification

SIC		Counts	SIC		Counts
5211	Lumber and Other Building Materials Dealers	51262	5713	Floor Covering Stores	48942
5231	Paint, Glass, and Wallpaper Stores	30364	5714	Drapery, Curtain, and Upholstery Stores	4612
5251	Hardware Stores	26637	5719	Miscellaneous home furnishings Stores	24682
5261	Retail Nurseries, Lawn and Garden Supply Stores	20818	5722	Household Appliance Stores	14207
5271	Mobile Home Dealers	5783	5731	Radio, Television, and Consumer Electronics Stores	22959
5311	Department Stores	27484	5734	Computer and Computer Software Stores	37180
5331	Variety Stores	37335	5735	Record and Prerecorded Tape Stores	14647
5399	Miscellaneous General Merchandise Stores	11771	5736	Musical Instrument Stores	10862
5411	Grocery Stores	200385	5912	Drug Stores and Proprietary Stores	62802
5421	Meat and Fish (Seafood) Markets, Including Freezer Provisioners	12402	5921	Liquor Stores	38473
5431	Fruit and Vegetable Markets	8578	5932	Used Merchandise Stores	62829
5441	Candy, Nut, and Confectionery Stores	9692	5941	Sporting Goods Stores and Bicycle Shops	63001
5451	Dairy Products Stores	4023	5942	Book Stores	19902
5461	Retail Bakeries	52622	5943	Stationery Stores	10023
5499	Miscellaneous Food Stores	40350	5944	Jewelry Stores	48372
5511	Motor Vehicle Dealers (New and Used)	60057	5945	Hobby, Toy, and Game Shops	34934
5521	Motor Vehicle Dealers (Used Only)	48300	5946	Camera and Photographic Supply Stores	2212
5531	Auto and Home Supply Stores	73681	5947	Gift, Novelty, and Souvenir Shops	83989
5541	Gasoline Service Stations	73420	5948	Luggage and Leather Goods Stores	1803
5551	Boat Dealers	9104	5949	Sewing, Needlework, and Piece Goods Stores	16186
5561	Recreational Vehicle Dealers	3836	5961	Catalog and Mail-Order Houses	21569
5571	Motorcycle Dealers	10448	5962	Automatic Merchandising Machine Operators	19079
5599	Automotive Dealers, Not Elsewhere Classified	21407	5963	Direct Selling Establishments	50045
5611	Men's and Boys' Clothing and Accessory Stores	17597	5983	Fuel Oil Dealers	4838
5621	Women's Clothing Stores	91767	5984	Liquefied Petroleum Gas (Bottled Gas) Dealers	6837
5632	Women's Accessory and Specialty Stores	13009	5989	Fuel Dealers, Not Elsewhere Classified	1512
5641	Children's and Infants' Wear Stores	9048	5992	Florists	35803
5651	Family Clothing Stores	23799	5993	Tobacco Stores and Stands	9336
5661	Shoe Stores	29260	5994	News Dealers and Newsstands	1808
5699	Miscellaneous Apparel and Accessory Stores	32398	5995	Optical Goods Stores	23012
5712	Furniture Stores	53926	5999	Miscellaneous Retail Stores, Not Elsewhere Classified	250989

Note: This table shows the number of establishments by industry in 2014.

B Border Identification

Figure A1 illustrates the geographic and temporal variation in the number of establishments for the border counties, and Table A2 shows the variation in the data that can be exploited to identify causal effects.

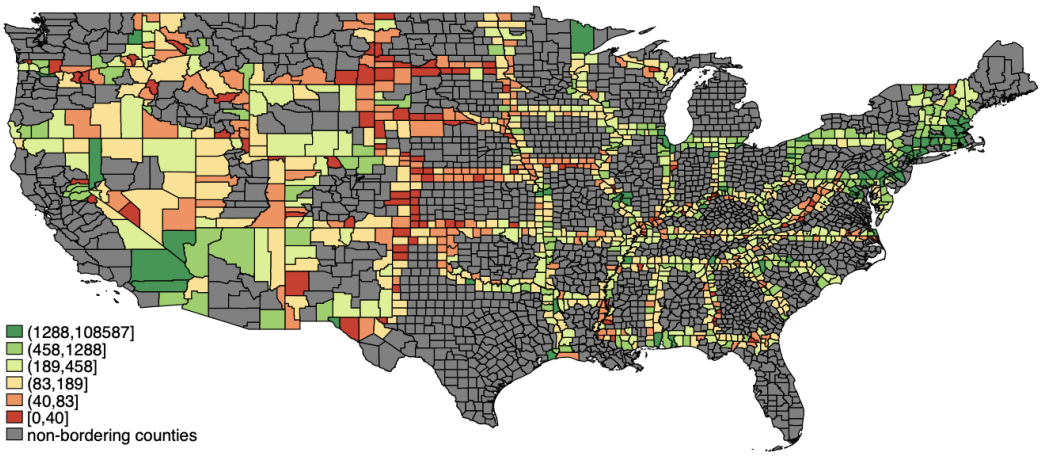
In Table A2, the total number of establishments and the number of establishments per capita are listed for neighboring counties, whereby one county has relatively higher taxes than the other. This comparison showcases the potential identification power of using the spatial discontinuity in the form of state borders. As shown in the table, the number of establishments per capita is larger on the side of the border with lower taxes. Although the total number of establishments follows the reverse pattern, it may simply be that counties in higher tax states have a bigger population. For this reason, in our analysis we control the population.

Table A2: Average Establishment Counts on Both Sides of the State Border

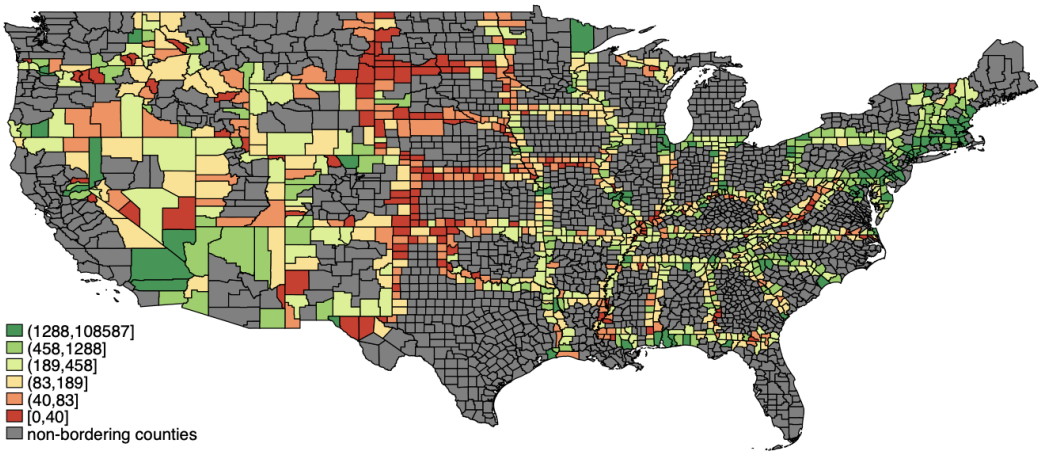
Distance from Border (km)	Establishment Counts	Establishment Counts per 10000 Capita
	Higher Tax Side of Border	
>100	1997	79
75-100	1391	71
50-75	564	71
25-50	674	73
1-25	844	71
0	767	74
	Lower Tax Side of Border	
0	723	77
1-25	689	73
25-50	491	77
50-75	392	75
75-100	636	72
>100	787	78

Note: This table shows the number of establishments in counties located on both sides of the state border. The first column measures the minimum distance from a county to its closest state border.

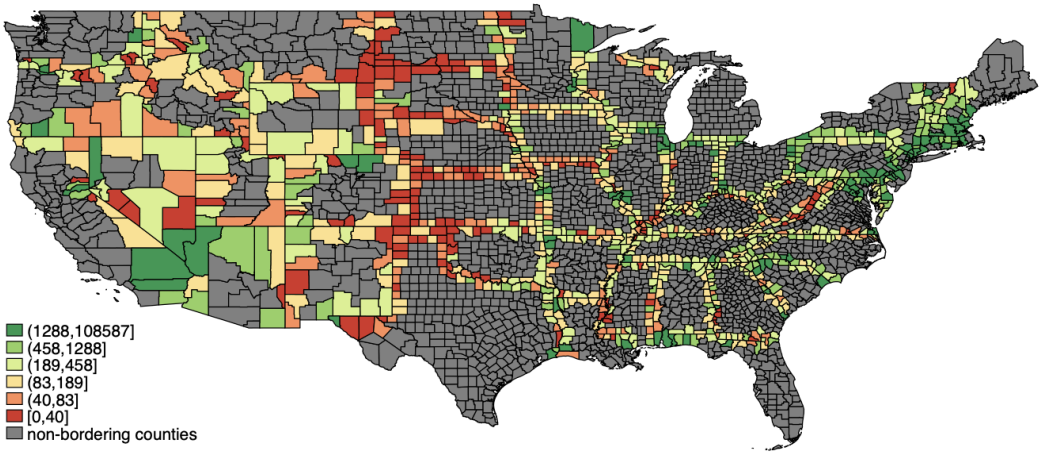
To formally explore cross-sectional variation in state tax policies and establishment entry, this section presents a border identification approach (Dell 2010, Holmes 1998). Specifically, we compare counties that border state boundaries. On one side of the border, counties are likely subject to a different set of tax policies than those counties on the other side. This identification strategy relies on the assumption that contiguous border counties serve



(a) 1990



(b) 2000



(c) 2014

Figure A1: Geographic and Temporal Variation in Establishment Counts for Border Counties

as adequate controls.[15] With this border identification strategy, we estimate the following semiparametric specification:

$$y_{mt} = \beta_0 + \beta_1 \text{Tax}_{st} + \beta_2 \text{Population}_{mt} + f(\text{Geographic Location}_m) + \phi_b + \delta_t + \varepsilon_{mt}, \quad (35)$$

where the dependent variable, y_{mt}, measures the outcome of interest (i.e., establishment counts) in county m and year t. For the establishment-counts regression, we aggregate the number of establishments across all retail sectors to the county and year level. Moreover, we incorporate retail sector fixed effects to account for difference in retail sector composition across borders. Furthermore, Tax_{st} is state-retail net tax in state s in year t, and δ_t represents year fixed effects. Population_{mt} is the population for county m in year t. The geographic controls are incorporated in the specification using $f(\text{Geographic Location}_i)$, which is a standard regression discontinuity polynomial. This term controls for geographic heterogeneity via a smooth function of geographic location (i.e., longitude, latitude). For our analysis, we will consider linear, quadratic, cubic, and quartic functional form specifications for $f(\text{geographic location}_i)$.[16] Furthermore, ϕ_b is state border fixed effects, which ensure that the comparison is between county m and its neighboring county on the same state border, but not between different state borders.

We first demonstrate the existence of tax effects on overall retail entry. The results from all of the specifications we consider are presented in each of the tables. These general findings are summarized in Table A3. All of the specifications in Table A3 confirm that an increase in net tax will reduce the establishment counts. For the specification that uses border identification with flexible geographic controls, we see that a 1% increase in net tax will reduce the number of establishments in a given county by about 22 to 24 (from an average of about 740 establishments) for the specifications that compare bordering counties.

[15] That is, these contiguous border counties have similar underlying economic conditions as their neighbors on the other side of the border. In particular, we need sufficient differences in net taxes within cross-state county-pairs. Moreover, counties would ideally be more similar to its cross-state counterpart than to a randomly chosen county.

[16] For example, if (x, y) represent latitude and longitude for an establishment, then a cubic polynomial function can be written as $\alpha_1 x + \alpha_2 y + \alpha_3 xy + \alpha_4 x^2 + \alpha_5 y^2 + \alpha_6 x^3 + \alpha_7 y^3 + \alpha_8 x^2 y + \alpha_9 xy^2$.

Table A3: Relationship Between Establishment Counts and Net Taxes

	Border	Border	Border	Border	Border
Net Tax (percent)	-24.14**	-23.36**	-22.08**	-23.73**	-21.76*
	(11.40)	(11.15)	(10.92)	(11.04)	(11.96)
Population (10,000)	59.93***	59.95***	60.08***	60.12***	60.27***
	(3.82)	(3.76)	(3.82)	(3.82)	(3.80)
Border FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Geo Control	No	Linear	Quadratic	Cubic	Quartic
Observations	15794	15794	15794	15794	15794
R^2	0.92	0.92	0.92	0.92	0.92

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses the specification that compares bordering counties; Columns (2)-(5) use bordering counties with linear, quadratic, cubic and quartic functions to control for geography. Standard errors are clustered by county.

For our next set of analysis, we continue to use the number of establishments as the main outcome of interest, except now, we estimate two different specifications based on the number of establishments for the large (Table A4) or small (Table A5) chains, as well as independents (Table A6). Note that while our discussion in this section is focused on specifications using the 10 store cut-off to distinguish between large versus small chains, we demonstrate robustness of our main findings for alternative thresholds.

Table A4: Relationship Between Establishment Counts and Net Taxes (Big Chains)

	Border	Border	Border	Border	Border
Net Tax (percent)	-4.68**	-4.61**	-4.57**	-4.73**	-4.49*
	(2.22)	(2.19)	(2.16)	(2.19)	(2.29)
Population (10,000)	7.52***	7.52***	7.53***	7.54***	7.56***
	(0.41)	(0.40)	(0.41)	(0.41)	(0.41)
Border FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Geography Control	No	Linear	Quadratic	Cubic	Quartic
Observations	15794	15794	15794	15794	15794
R^2	0.90	0.91	0.91	0.91	0.91

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses the specification that compares bordering counties; Columns (2)-(5) use bordering counties with linear, quadratic, cubic and quartic functions to control for geography. Standard errors are clustered by county.

Table A5: Relationship Between Establishment Counts and Net Taxes (Small Chains)

	Border	Border	Border	Border	Border
Net Tax (percent)	1.83	1.81	1.86	1.82	2.29*
	(1.37)	(1.38)	(1.39)	(1.36)	(1.37)
Population (10,000)	3.49***	3.49***	3.50***	3.51***	3.53***
	(0.19)	(0.19)	(0.19)	(0.20)	(0.20)
Border FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Geography Control	No	Linear	Quadratic	Cubic	Quartic
Observations	15794	15794	15794	15794	15794
R^2	0.81	0.81	0.81	0.82	0.82

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses the specification that compares bordering counties; Columns (2)-(5) use bordering counties with linear, quadratic, cubic and quartic functions to control for geography. Standard errors are clustered by county.

Table A6: Relationship Between Establishment Counts and Net Taxes (Independents)

	Border	Border	Border	Border	Border
$NetTax(percent)$	-21.29**	-20.57**	-19.37*	-20.82**	-19.57*
	(10.29)	(10.06)	(9.87)	(9.98)	(10.74)
$Population(10,000)$	48.93***	48.95***	49.05***	49.07***	49.18***
	(3.34)	(3.28)	(3.33)	(3.32)	(3.31)
Observations	15794	15794	15794	15794	15794
R^2	0.90	0.90	0.91	0.91	0.91

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Column (1) uses the specification that compares bordering counties; Columns (2)-(5) use bordering counties with linear, quadratic, cubic and quartic functions to control for geography. Standard errors are clustered by county.

This analysis shows that net taxes (Table A3) impact large chains more so than small chains, as the net tax effect is negative and statistically significant only for the largest chains.[17] One way to interpret this result is that decreases in state tax will lead to growth in establishment counts among the already large chains. At the same time, we see a noticeable impact of tax decreases on the number of independent establishments. Collectively, these patterns suggest that tax policies aimed at benefiting the local independents may have a byproduct of disproportionately impacting the large chains (in a positive or negative way).

[17] If we view entry as a form of investment, these patterns are qualitatively similar to past research that has shown little impact of corporate tax policies on small businesses in Finland (Harju et al. 2022).

B.1 Sensitivity Analysis for Firm Size Cut-Offs

Here, we replicate our main findings about the differential impact of taxes for large and small firms using alternative cut-off thresholds. In particular, the specifications that use alternative cut-offs are presented in Table A7. This sensitivity analysis illustrates that the noticeable net tax effects for big chains (and not small chains) holds for all alternative cut-offs we consider.

Table A7: Relationship Between Establishment Counts and Net Taxes for Different Cut-offs

	(1)	(2)	(3)	(4)	(5)
	Big Chains				
$NetTax(percent)$	-4.73**	-4.72**	-4.67**	-4.77**	-4.82**
	(2.19)	(2.18)	(2.15)	(2.13)	(2.11)
$Population(10,000)$	7.54***	7.25***	7.08***	6.94***	6.84***
	(0.41)	(0.39)	(0.37)	(0.35)	(0.34)
	Small Chains				
$NetTax(percent)$	1.82	1.81	1.76	1.86	1.91
	(1.36)	(1.43)	(1.48)	(1.52)	(1.55)
$Population(10,000)$	3.51***	3.80***	3.97***	4.11***	4.21***
	(0.20)	(0.22)	(0.24)	(0.25)	(0.26)
$BorderFE$	Yes	Yes	Yes	Yes	Yes
$YearFE$	Yes	Yes	Yes	Yes	Yes
$GeoControl$	Cubic	Cubic	Cubic	Cubic	Cubic
Cut-off	10	15	20	25	30
Observations	15794	15794	15794	15794	15794

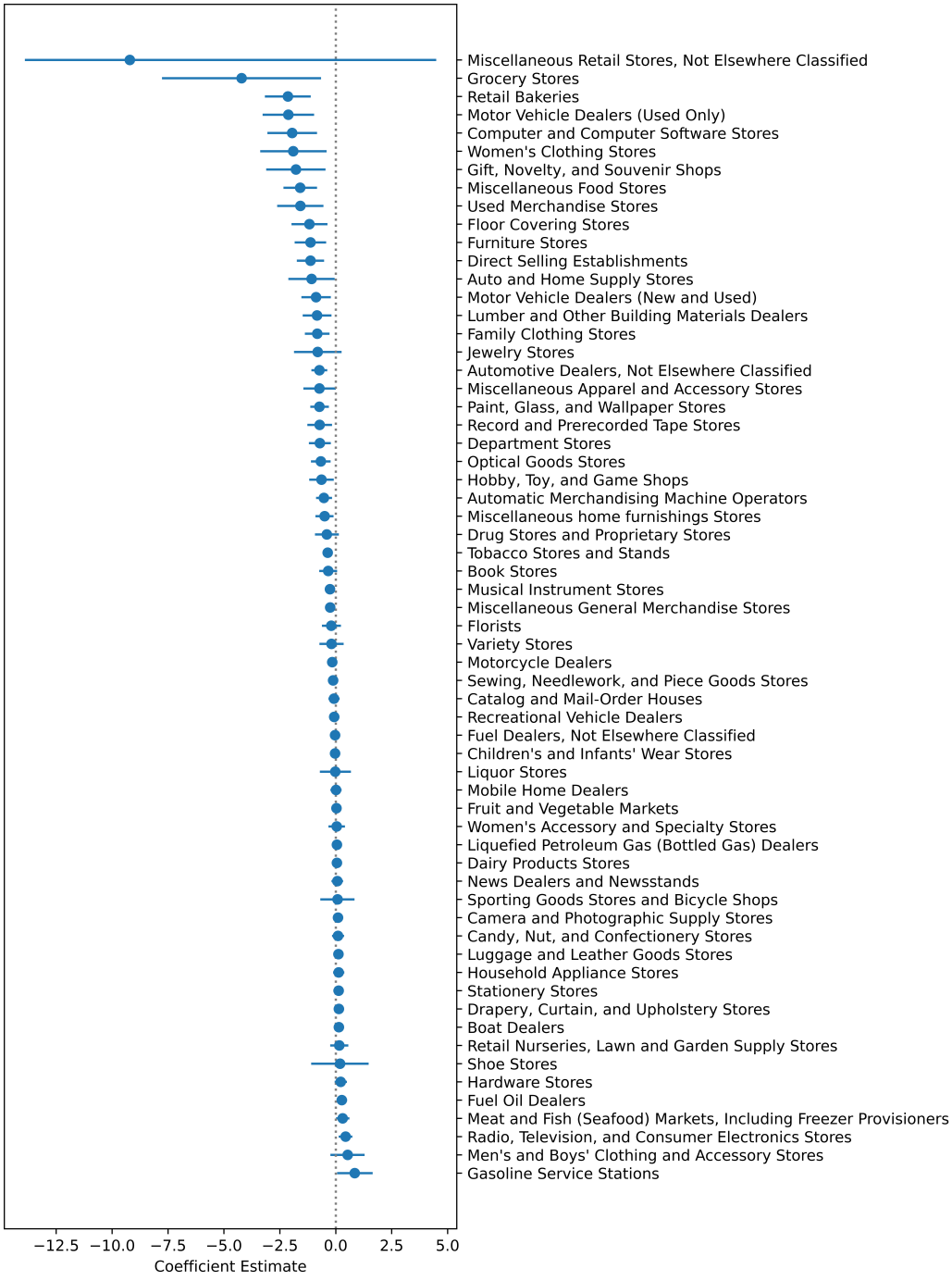
Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Each column provides the results from a specification using a different cut-off for labeling retailers as being large chains. In particular, we consider cut-offs of 10 (Column 1), 15 (Column 2), 20 (Column 3), 25 (Column 4), and 30 (Column 5) establishments nationwide for retailer to be considered large. Moreover, we use the specification that involves bordering counties with cubic functions to control for geography. Standard errors are clustered by county.

B.2 Cross-Sector Heterogeneity in the Tax Effects

There also appears to be some heterogeneity in the tax effect in different retail sectors. From Figure A2, the inferred effects appear to be more pronounced (and statistically significant) for grocery stores, bakeries, used car dealerships, computer stores, and women's clothing stores. As alluded to in our theoretical analysis, the size of entry costs can potentially amplify tax effects and thus lead to heterogeneous tax effects across retail sectors. In particular, it is worth noting that retailers that tend to require large parcels of land for their establishments

(e.g., grocery and department stores) exhibit statistically significant tax effects, whereas retail sectors that have smaller-sized establishments (e.g., liquor stores, children's shoe stores, newsstands) exhibit almost no tax effects.

Figure A2: Tax Effect on Retail Entry Across Retail Sectors



Notes: This plot presents the effect of state taxes on establishment counts using the specification from column 5 of Table A3. The dot represents the estimated tax effect, while the horizontal blue line represents the confidence interval. Results are presented for each of the retail sectors (over 60 of them).