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Tax avoidance and business location in a state border model ☆

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ABSTRACT

Previous studies have struggled to demonstrate that higher taxes deter business activity. We revisit this issue by estimating the effect of changes over time in cross-border differences in state tax conditions on the tendency for new establishments to favor one side of a state border over the other. Identification is enhanced by taking account of previously overlooked reciprocal agreements that require workers to pay income tax to their state of residence as opposed to their state of employment. When reciprocal agreements are in force, higher personal income tax rates lure companies from across the border, while corporate income tax and sales tax rates have the opposite effect. Where reciprocal agreements are not in place, the results are largely reversed. These patterns are amplified in heavily developed locations, and differ in anticipated ways by industry and corporate/non-corporate status of the establishment. Overall, results strengthen the view that state-level tax policies do affect the location decisions of entrepreneurs and new business activity, but not in a way that lends itself to a one-size-fits-all summary.

The avoidance of taxes is the only intellectual pursuit that carries any reward – John Maynard Keynes, Attributed, A Dictionary of Scientific Quotations (1977), Alan L. MacKay, p. 140.

1. Introduction

There is truth in Benjamin Franklin's famous quote, "The only thing certain in life is death and taxes." But for local policy makers, the quote above from John Keynes demands more attention. That is because one way that entrepreneurs and households may seek to avoid taxation is by relocating to more tax advantaged locations. This idea was not lost on Tiebout (1956) and Hamilton (1976) in their seminal papers on the possibility that households may vote with their feet. It has also been the focus of numerous papers that have sought to measure the impact of local tax policy on business location decisions. A notable feature of those studies, however, is their lack of consensus as to whether local taxes discourage business, and the absence of a general structure that accounts for the mixed patterns of results.[1] This paper revisits these issues using a previously overlooked source of identification.

State-specific reciprocal agreements require workers to pay income tax to their state of residence as opposed to their state of employment. As shown in Table 1a, fifteen states currently have such agreements in place, all of which were signed between 1958 and 1990, and nearly all with bordering states. When a reciprocal agreement is in force, workers employed in high-tax states can in principle reduce their tax exposure by living on the low-tax side of the border, and in the process, reduce incentives for the entrepreneur to avoid locating on the high-tax side of the border. Drawing on this and other features of our model design,

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[1] Early literature on the impact of taxes on businesses location typically failed to find evidence of a notable deterrent effect, and in some cases even found that higher taxes "attract" businesses (Carlton, 1979, 1983; Schmenner, 1975, 1982). This began to change in the late 1980s and 1990s as studies by Bartik (1985, 1994), Papke (1991) and Hines (1996), and others offered evidence that higher taxes do deter businesses. However, most of the estimates were noisy or small relative to the effect of other policies (see Wasylenko (1997) for a review).

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Table 1a
State income tax reciprocal agreements.[a]

State	Has reciprocal agreement with	Year of inception	State	Has reciprocal agreement with	Year of inception
Illinois	Iowa	1973	Minnesota	Michigan	1984
	Kentucky	1971		North Dakota	1958
	Michigan	1971		Wisconsin	1968
	Wisconsin	1973	Montana	North Dakota	1982
Indiana	Kentucky	1977	New Jersey	Pennsylvania	1978
	Michigan	1968	Ohio	Indiana	1977
	Ohio	1977		Kentucky	1972
	Pennsylvania	1977		Minnesota	1984
	Wisconsin	1977		Pennsylvania	1978
Kentucky	Illinois	1971		West Virginia	1972
	Indiana	1977	Pennsylvania	New Jersey	1978
	Michigan	1968		Ohio	1978
	Ohio	1972		Virginia	1982
	Virginia	1964		West Virginia	1972
	West Virginia	1965	Virginia	Maryland	1992
	Wisconsin	1968		Pennsylvania	1978
Iowa	Illinois	1973		Kentucky	1964
Maryland	Pennsylvania	1990		West Virginia	1988
	Virginia	1992	West Virginia	Kentucky	1965
	West Virginia	1988		Maryland	1988
Michigan	Illinois	1971		Ohio	1972
	Indiana	1968		Pennsylvania	1972
	Kentucky	1968		Virginia	1988
	Minnesota	1984	Wisconsin	Illinois	1973
	Ohio	1972		Indiana	1977
	Wisconsin	1967		Kentucky	1968
				Michigan	1967
				Minnesota	1968

[a] *Source:* www.gaebler.com. Washington DC also has reciprocal agreements with each state in the U.S. but is dropped from our estimating sample.

our results indicate that entrepreneurs are drawn to tax advantaged locations, ceteris paribus, but in a manner that differs depending on the type of tax, industry, and other circumstances. The complicated way in which tax deterrent effects manifest themselves also helps to clarify why previous studies have struggled to confirm that taxes deter business activity.

We ask the following question: To what extent do cross-border differences in state tax conditions affect the side of the state border on which an entrepreneur chooses to locate a new establishment? Given that reciprocal agreements are designed to accommodate workers who live in one state and work in another, we restrict our attention to business activity within easy commuting distance of state borders. Our emphasis, therefore, is on the effect of cross-border differences in tax conditions on the *sorting* of new business activity just across state borders.[2]

The primary challenge we face in addressing this question is to control for unobserved factors that may be correlated with state tax conditions. This problem and related concerns about endogenous tax measures have plagued previous studies and likely contribute to their limited success in providing compelling evidence of tax deterrent effects. States with thriving economies, for example, may feel they can get away with setting higher tax rates, while states with weak economies may adopt low-tax policies in the hope of attracting business. Under these sorts of conditions, a simple OLS model would yield upward – positively – biased estimates of the influence of state tax policy on business activity, obscuring evidence of tax deterrent effects.

Several features of our modeling design help to control for unobserved factors that might bias estimates of tax deterrent effects. The first is that our border regions are small relative to their respective states. This will reduce the tendency for states to set policy based on anticipated economic growth in the border regions. Nevertheless, small geographic areas could be disproportionately important (as with New York City) or could mirror the broader state economy, either of which could cause state tax policy to respond to economic growth in the border regions. Accordingly, a second feature of our modeling design is to lag the tax and expenditure measures by two years in most specifications. This helps to (i) ensure that our tax and expenditure measures are predetermined which further reduces endogeneity and (ii) better matches the time period when the entrepreneur's business location decision was made given lags in the business creation process.[3]

A third feature of our modeling design is that we adopt a double differencing strategy that draws on comparisons across state borders and across time. To do this, we first use GIS methods to divide border areas into wedges roughly twenty miles long. New establishments and existing employment within easy commuting distance of the border are measured using data from Dun and Bradstreet MarketPlace files for 2002 and 2005. In all cases, we observe establishment location down to the zipcode level. Accordingly, each new establishment is assigned to the wedge that is most closely aligned to the zipcode in which the establishment is located. Entrepreneurs associated with a given wedge are then modeled as choosing whether to locate on one side of the border versus the other. Additional details on the creation of the border-wedges and the data are provided later in the paper. For now we emphasize that in most of our regression models we pool data

[2] As will become apparent, we estimate tax deterrent effects for samples stratified based on whether reciprocal agreements are or are not in force. Estimates from the latter are relevant when considering business location decisions between geographically distant states for which reciprocal agreements do not exist. In that sense our results are more general than for just the border area provided non-tax local attributes between comparison areas are held constant.

[3] We also estimate models in which the tax and expenditure variables are lagged four years, three years, one year, and zero years (contemporaneous). Results support using 2-year lags and are discussed later in the paper.

across the two time periods and include border-wedge fixed effects among the controls. Specifying our models in this manner removes the influence of local unobserved time-invariant cross-border factors.

Our emphasis on double differencing to facilitate identification is in the same spirit as recent border studies by Holmes (1998) and Chirinko and Wilson (2008). These studies considered the impact of state-level right-to-work laws and business investment tax credits, respectively.[4] Other recent studies by Duranton et al. (2011) and Rathelot and Sillard (2008) have layered instrument methods on top of spatial differencing to help identify the effect of local taxes, including property taxes and local corporate income taxes, respectively.[5] All of these border studies, including this paper, are based implicitly on the assumption that entrepreneurs view the choice between two relatively nearby locations as relevant. Recent studies in the agglomeration literature support that view in as much as they confirm that entrepreneurs tend to place disproportionate weight on economic conditions within even one mile or closer when choosing where to locate (e.g. Rosenthal and Strange (2003, 2005), Arzaghi and Henderson (2008)).[6]

A fourth key feature of our research design is that all of our models control for three types of taxes, the corporate income tax rate, the personal income tax rate, and the sales tax rate.[7] This is important because firms face multiple forms of taxation. If states treat alternate tax instruments as substitutes, focusing on a single tax may understate tax-deterrent effects to the extent that higher taxes of one type are offset by reductions in other forms of taxation. Nevertheless, nearly all previous studies examine the influence of just one type of tax. Recent work by Chirinko and Wilson (2008) is indicative of such studies. As part of their work, they examine the impact of cross-state differences in investment tax credits on manufacturing activity in adjacent counties just on either side of US state borders. Their estimates indicate only modest effects of tax treatment on cross-border differences in the relative count of manufacturing establishments. Our approach of controlling for all three types of tax rates noted above helps to reduce omitted variable bias that might contribute to this sort of limited evidence of tax-deterrence.[8] It also allows us to highlight systematic differences in the sensitivity of different types of companies to different types of taxation. Such differences provide a variety of testable priors that further enhance our ability to uncover evidence of tax deterrent effects.

The first such prior concerns the influence of reciprocal agreements. All companies rely on labor, including hired workers and the business owner(s). But states differ markedly in their personal income tax rates. With sufficiently mobile workers, employers operating facilities close to a state border would bear much of the burden of comparatively higher personal income tax rates which would then be capitalized into higher nominal wages. Such an outcome would suggest that higher personal income taxes would deter business activity across a broad range of industries. As discussed earlier, however, this should not be the case when reciprocal agreements are in force since workers could work in the high-tax state but live in and pay personal income tax to the low tax state. This intuition is developed further in the following section where we lay out a simple conceptual model.

In the case of the sales tax, it is important to recognize that manufacturing, much of the service sector, and a notable segment of other non-retail industries are not subject to the tax. In contrast, retail customers typically pay the sales tax. Moreover, very close to a state border retail shoppers can easily engage in cross-border shopping in order to avoid paying higher sales tax. Close to the border, therefore, demand for in-state retail services is likely to be highly elastic in response to cross-border differences in sales tax rates. This would cause owners of retail outlets on the high tax side of the border to bear most of the burden of the cross-border sales tax differential, lowering their willingness to pay for space in the high tax state.[9] With land going to the highest bidder, in equilibrium retail establishments should occupy the low sales tax side of the border with manufacturing and other sectors occupying sites on the high sales tax side, ceteris paribus.[10]

Companies that are currently incorporated or anticipate becoming so are likely more sensitive to the corporate income tax. As seen in Table 1c, the share of newly established companies that begin as corporations differs by industry (e.g. manufacturing, wholesale trade, services) and accounts for a bit less than half of newly established companies in the United States (the rest are established as sole proprietorships and partnerships). The differing rates of incorporation across industries may contribute to differences in deterrent effects arising from state corporate income tax rates and related policies.

The arguments above suggest that even though most industries are affected by multiple forms of taxation, an entrepreneur's location decision is not likely to be equally sensitive to all three types of taxes highlighted above. Moreover, if one type of tax is

[4] Holmes (1998) was among the first to use border methods to analyze the impact of local of public policies. He found that states with right-to-work laws in place – which give workers the right to *not* join the union – enjoyed notably higher manufacturing employment growth since the 1940s. Border methods and double-differencing strategies have since been used to consider the impact of a range of public policies. Cunningham (2006, 2007), for example, compares patterns of development inside versus outside a growth control border in King County Washington before and after imposition of the urban growth boundary.

[5] Duranton, Gobillon, and Overman (2011) use the share of nearby voters who belong to a conservative political party to instrument for local tax measures. Rathelot and Sillard (2008) use regional tax rates to instrument for local taxes. Both studies find that higher taxes negatively affect growth of existing businesses although Duranton et al. (2011) do not find an effect on the creation of new businesses.

[6] Our paper is also related to tax competition studies that examine the propensity for jurisdictions to offer tax incentives as a way of attracting business activity (e.g. Brueckner and Saavedra (2001) and Hines (2006), to name just a few). That literature is based on the presumption that entrepreneurs are drawn to tax advantaged locations.

[7] Summary measures that characterize the distribution of revenues and tax rates across states for each of the three types of taxes are provided in Table 1b and are discussed later in the paper.

[8] For analogous reasons, we also control for the size of local government per capita expenditures. In our most simply specified models, smaller state government appears to attract business arrivals from the opposing side of the border. But in models that take state-border or border-wedge fixed effects into account, controls for size of state government mostly have little effect on business location decisions. It is worth noting that if state government offers net value to the business community for an additional tax dollar, then larger state government should attract business, analogous to early arguments by Brueckner (1979, 1982).

[9] Cross-border shopping is not nearly as viable for locations well into the interior of a state. For these locations, demand for in-state retail services is likely inelastic in response to cross-state sales tax differentials. In this instance, consumers would bear most of the burden of the sales tax and higher sales tax rates would not drive retail outlets to alternate locations. Rosenthal and Ross (2010) provide indirect evidence that supports this view. They show that at the metropolitan level, population size is nearly a perfect predictor of retail sector employment, consistent with inelastic demand for retail services over broad geographic areas.

[10] The argument above ignores any possible role for land use regulations as has been the norm in tax-deterrent studies. We believe this is reasonable in our case for two reasons. The first is that we analyze the impact of state-level tax policy whereas land use regulations are mostly determined at the local level. The second is that our double-differencing approach is implemented in a manner that differences out local factors along a given border segment. On the other hand, when considering the impact of local tax policy it may be important to recognize that tax rates and land use regulations may be jointly set to maximize local government tax revenue. Burnes et al. (2014) consider this point. They show that higher county sales tax rates in Florida are associated with a modest *increase* in retail employment and a decrease in manufacturing employment. This is opposite from the sort of predictions implied by our model as highlighted above. Burnes et al. (2014) suggest that their results could arise if local jurisdictions pair higher sales tax rates with zoning for big-box shopping mall style retail. They argue that this could crowd out opportunities for large-tract manufacturing developments.

Table 1b
State tax and expenditures for the 48 contiguous states.

Panel A: State revenue shares and expenditures for the 48 contiguous states[a]

Year	Sales tax revenue relative to expenditures[a]	Household income tax revenue relative to expenditures[a]	Corporate income tax revenue relative to expenditures[a]	Expenditures per capita
2002	0.135	0.129	0.018	$4650
2005	0.139	0.136	0.025	$5207

Panel B: State tax rates for the 48 contiguous states[b]

Year	Sales tax rate			Maximum personal income tax rate			Maximum corporate income tax rate		
	Median	Std. dev.	States with no tax	Median	Std. Dev.	States with no tax	Median	Std. Dev.	States with no tax
2000	5%	1.737	4	6%	2.709	6	7%	2.986	5
2003	5%	1.705	4	6%	2.750	6	7%	2.939	5

[a] Using 2005 as an example, other major sources of state government revenue include: Intergovernmental grants, primarily from the federal government and to a much lesser extent local government, roughly 24%; All other sources of tax, licensing, and general revenue, roughly 20%; State-owned utilities and liquor stores, roughly 1%; Insurance trust revenue for government retirement and social insurance programs including contributions by government workers and net earnings on fund investments, roughly 25%. See: U.S. Census Bureau, State & Local Government Finance, Historical Data: 2005, http://www.census.gov/govs/estimate/historical_data_2005.html.
[b] Tax rate values were obtained from the Tax Foundation website for 2000 and 2003 at the following URL: http://www.taxfoundation.org.

Table 1c
Corporate share of new business arrivals in the United States.[a]

Variable	2002:Q3		2005:Q3	
	Total	Percent corporations	Total	Percent corporations
Manufacturing	19,399	0.439	12,790	0.482
Wholesale trade	15,489	0.463	11,481	0.486
Retail	63,601	0.266	36,831	0.373
Finance and insurance	21,014	0.437	19,283	0.543
Services	122,968	0.325	100,429	0.473
Total	242,471	0.337	180,814	0.462

[a] Sample includes all establishments created in the previous 12 months throughout the United States. Data are from the Dun and Bradstreet MarketPlace file.

especially costly, that tax could dominate an entrepreneur's location decision and thereby reduce deterrent effects from other forms of taxation. When reciprocal agreements are not in force, all three types of taxes highlighted above have potential to directly affect a company's costs. However, with reciprocal agreements in place, the personal income tax should not affect establishment costs which should increase the deterrent effect of the corporate income tax and the sales tax. Evidence in support of this and the other priors developed above would highlight the complicated manner in which tax conditions affect behavior.

Results from our analysis largely support the priors above. This strengthens the view that state-level tax policies do affect the location decisions of entrepreneurs and new business activity, but not in a way that lends itself to a one-size-fits-all summary. As a broad characterization, entrepreneurs and new business activity are drawn to those locations in which they are relatively more sheltered from the cost of financing local government activities. This conclusion is reinforced by a variety of different robustness checks including alternate ways of matching locations across state borders.

To establish these results, we first present a simple conceptual model in the following section that motivates and guides our analysis. Section 3 lays out the empirical approach. Section 4 describes the data including the geocoding procedures used to divide border areas into wedges. Section 5 presents results and Section 6 concludes.

2. Conceptual motivation

2.1. Overview

This section highlights three key conceptual points that are relevant to the empirical work to follow. The first is that if all bidders for land were identical, then cross-border differences in tax conditions would be fully capitalized into land values. In this instance, tax differentials would have no effect on the side of a state border on which a business would choose to locate. The second is that with multiple sectors bidding for land (e.g. manufacturing, retail, residential), cross-border differences in tax conditions are only partially capitalized into land values. Under those conditions, tax differentials do affect where different types of companies locate. The third is that if a given sector does not pay a particular tax, equilibrium activity in that sector will tend to be drawn towards the high-tax side of the border if it competes for space with sectors that are subject to the tax in question. We highlight each of these points below.

2.2. One sector bidding for land

Suppose first that there is only one bidder for land, which we will refer to as the business sector, land markets are competitive, and all firms are identical. Firms are price takers and sell their product for P. Output is produced using one unit of land and public goods that are provided by the state government (S), including roads, infrastructure, and other services. All land is owned by absentee investors.

If firms are not taxed they still receive services from S given its public good nature, and the firm's profit function is given by,

$$\pi(u,d) = P + \theta_1 A(u,d) + \theta_2 S(u,d) - R(u,d) \tag{2.1}$$

where $d = \{1, 2\}$ for side 1 or side 2 of the border, u is the distance to the border, $A(u, d)$ are attributes at a given location, and $R(u, d)$ is the cost of land. More valuable attributes enhance productivity ($\theta_1 > 0$), but we impose no restriction regarding the manner in which A changes with distance and direction from the border. Local government services S are state-specific and change in a discrete

fashion upon crossing the state border. For that reason, S is sensitive to d. With competitive markets, profits are driven to zero and the firm's bid-rent is given by,

$$R(u,d) = P + \theta_1 A(u,d) + \theta_2 S(u,d) \tag{2.2}$$

Suppose now that the state on side 1 of the border imposes a tax on firms per unit output (T), which is used to help finance the given level of local government services. We assume that all companies located on side 1 of the border are subject to the tax but that companies on side 2 do not pay the tax. Maintaining the zero profit condition, the bid-rents on sides 1 and 2 of the border are given as below,

$$R(u,1) = P + \theta_1 A(u,1) + \theta_2 S(u,1) - \theta_3 T(1) \tag{2.3a}$$
$$R(u,2) = P + \theta_1 A(u,2) + \theta_2 S(u,2) \tag{2.3b}$$

In Fig. 1, we display the bid-rents for land on either side of the state border before and after side 1 imposes its tax. To simplify the exposition, we assume that productive attributes are increasing along a trend line moving towards the interior of State 2. For that reason, bid-rent is drawn as upward sloping, but we emphasize that the key points to follow are not sensitive to that assumption.

With T_1 set equal to zero, the bid-rent is given by segment $\overline{ab}$. Following the imposition of the side-1 tax, the bid-rent on side 1 shifts down by an amount equal to T_1 and the bid-rent function is given by $\overline{cdeb}$. Implicitly, we are assuming that land is inelastically supplied to firms. Side-1 landowners therefore absorb the entire burden of the tax (T), the equilibrium land rent function is given by $\overline{cdeb}$, and side 1 taxes do not affect the spatial distribution of business activity on either side of the border.

2.3. Two sectors bidding for land

Suppose now that there are two sectors bidding for land, type-I and type-II. Because the two sectors have different production functions, their valuation of local attributes differs and this causes their bid-rent functions to differ as well. The bid-rent functions for the two sectors are drawn in Fig. 2. In the absence of a tax, type-II companies outbid type-I firms for space to the right of point j while type-I firms are the high bidders to the left of point j. With competitive markets, land goes to the highest bidder and equilibrium land rents are given by the upper envelope of the bid-rent functions, $\overline{agk}$. In this example, type-II companies occupy land to the right of j while type-I companies are found to the left of j.

Suppose now that a tax T is imposed on side 1 of the border, but the tax applies only to type-I firms. With the downward shift in type-I bid-rent on side 1 of the border, the equilibrium land rent function is given by the new upper envelope of the bid-rent functions, $\overline{chnegk}$. As drawn in the figure, type-II firms outbid type-I firms in all locations to the right of point j as before, but also for land between points m and i which was formerly occupied by type-I firms. Type-I firms occupy land to the left of point i (as before), and also a segment of side-2 between points m and j.

This simple model has several implications. First, competition for space between multiple sectors bidding for land mitigates the degree to which taxes are capitalized into lower equilibrium land rents. This is illustrated by the fact that segment $\overline{hd}$ lies below segment $\overline{hn}$. Second, cross-border differences in tax conditions affect the equilibrium locations for *both* the sector subject to the tax and the tax sheltered sector. This arises from the sorting equilibrium when land is allocated to the highest bidder. It also sug-

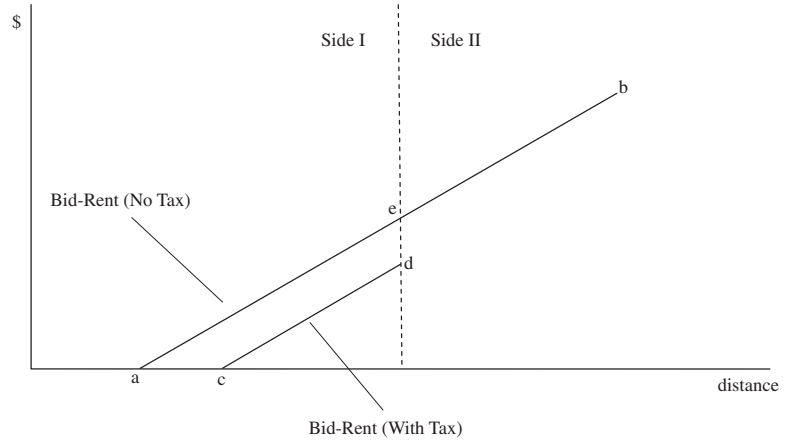

Fig. 1. One sector.

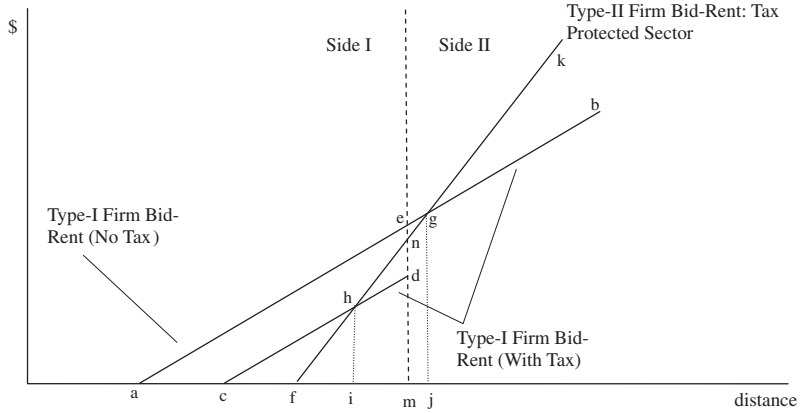

Fig. 2. Two sectors.

gests that in the empirical work to follow, it is important to consider the impact of different types of tax measures on the location patterns of all industries, even when an industry is not subject to a given tax. Third, as shown in Fig. 2, in equilibrium and holding all else equal, the tax sheltered sector is *attracted* to the high tax side of the border. This suggests that industries such as manufacturing that do not pay the sales tax should be attracted to the high sales tax side of the border, ceteris paribus, and that unincorporated companies should be drawn to the high corporate income tax side of the border. Similarly, with a reciprocal agreement in force, non-residential commercial and industrial activity should be attracted to the high personal income tax side of the border while residential activity will shift towards to the low-tax side of the border.

3. Empirical model

As emphasized earlier, the primary goal in the empirical work is to estimate the impact of cross-state border differences in tax conditions on the tendency of newly established companies to favor one side of the border over the other. Throughout, we work with establishment-level records and restrict our sample to newly created enterprises in 2002 and 2005 that are situated within easy commuting distance of a state border.

We begin with the following expression for the likelihood that a given entrepreneur would choose side 2 of a state border over side 1:

$$I_{it} = \theta_1(S_{1t} - S_{2t}) + \theta_2(T_{1t} - T_{2t}) + \theta_3(\Omega_{1w,t} - \Omega_{2w,t}). \quad (3.1)$$

In this expression, I_{it} equals 1 if entrepreneur i chooses side 2 of the state border and 0 if side 1. The terms $S_{1t} - S_{2t}$ and $T_{1t} - T_{2t}$ are the cross-border differences in state-level government expenditures and tax conditions corresponding to the border along which establishment i is located. The term $\Omega_{1w,t} - \Omega_{2w,t}$ represents the cross-border difference in all other attributes that might affect the profitability of choosing side 1 versus side 2 of the border. The subscript w denotes the segment (or "wedge" as described in the Introduction) that best describes a company's position along a state border. The subscript t represents the time period in which the company makes its location choice (2002 or 2005).

For a given set of measures for $S_{1t} - S_{2t}$ and $T_{1t} - T_{2t}$ (which are described in the following section), our primary challenge is to adequately control for the elements of $\Omega_{1w,t} - \Omega_{2w,t}$ so as to ensure that we obtain unbiased and consistent estimates of the primary parameters of interest, θ_1 and θ_2. We proceed by splitting $\theta_3(\Omega_{1w,t} - \Omega_{2w,t})$ into time-invariant $(\Omega_{1w} - \Omega_{2w})$ and time-varying components (e_{wt}). Substituting into (3.1) we obtain,

$$I_{it} = \theta_1(S_{1t} - S_{2t}) + \theta_2(T_{1t} - T_{2t}) + (\Omega_{1w} - \Omega_{2w}) + e_{wt}. \quad (3.2)$$

Given the specification in (3.2), it is apparent that we can control for $(\Omega_{1w} - \Omega_{2w})$ using border "wedge-pair" fixed effects given that we have two periods of data. Although we cannot rule out the possibility that the remaining term, e_{wt}, could be correlated with the tax measures, the various modeling features described in the Introduction substantially reduce such concerns. We estimate (3.2) using a linear probability model.

4. Data and summary statistics

4.1. State tax and expenditure conditions

The model outlined above requires measures of state-level tax conditions in each period, t. We address this as follows. State expenditure and population data were obtained from the U.S. Census Bureau website.[11] These data were used to compute state-level government expenditures per capita for each of the sample years, 2002 and 2005, and for each of the states in the continental U.S. Data on state tax rates were obtained from the Tax Foundation website while data for state revenues raised through a given tax were obtained from the U.S. Census Bureau website.[12]

As noted earlier, we focus on three prominent sources of state tax revenue: the corporate income tax, the personal income tax, and the sales tax. Panel A of Table 1b displays the share of state government expenditures financed through these three sources of revenue for both 2002 and 2005. It is noteworthy that the personal income tax and the sales tax both account for roughly 13–14% of state budgets while the corporate income tax contributes a much smaller share, just 2.5% in 2005. Together, these three sources of revenue comprise roughly 30% of state budgets.[13]

Panel B of Table 1b also demonstrates that there is considerable variation in tax rates across states. In 2000 and 2003, for the sales tax rate, the maximum personal income tax rate, and the maximum corporate income tax rate, the panel reports the median and standard deviation across states, in addition to the number of states for which the tax is not imposed. Notice that for each tax measure, the standard deviation is roughly half the size of the median, indicating that there is quite a bit of variation across states. In addition, for each tax, between four and six states do not levy the tax in question.

We measure tax conditions using the state tax rates in panel B of Table 1b. Specifically, we use each state's maximum corporate income tax rate, the maximum personal income tax rate, and the sales tax rate.[14] Identification of tax deterrent effects then requires that changes in cross-border differences in tax rates are exogenous to the entrepreneur's location decision. While we cannot provide direct empirical evidence to support that assumption, the various features of our research design outlined earlier help to mitigate concerns about endogeneity.

A second condition required for identification is that there must be sufficient numbers of adjacent states for which one or both of the adjacent states changed their tax rates between 2000 and 2003. Table 1d provides evidence on this point. Observe that between 2000 and 2003, six states changed their maximum corporate income tax rate, eleven states changed their maximum personal income tax rate, and five states changed their sales tax rate. Because most states border on multiple states, the number of instances in which cross-border differences in tax rates changed is much higher: 24 for the corporate income tax rate, 35 for the personal income tax rate, and 23 for the sales tax rate. Evidence presented later in the paper suggests that this level of variation is sufficient to identify tax deterrent effects.

[11] See http://www.census.gov/govs/state/historical_data.html for links to the data.

[12] For tax rates see, http://www.taxfoundation.org/taxdata/show/230.html. For tax revenues see: U.S. Census Bureau, State & Local Government Finance, Historical Data: 2005, the following URLs: http://www.census.gov/govs/estimate/historical_data_2005.html; http://www.census.gov/govs/state/historical_data.html.

[13] Most of the remaining portion of state budgets is derived from grants from the federal government (roughly 25%), all other forms of state taxes and licensing fees (roughly 20%), and insurance trust revenue for government retirement and social insurance programs including contributions by state government workers and net earnings on fund investments (roughly 25%). See: U.S. Census Bureau, State & Local Government Finance, Historical Data: 2005, http://www.census.gov/govs/estimate/historical_data_2005.html.

[14] Most states specify progressive tax schedules for the corporate and personal income tax rates, in addition to a variety of exemptions, deductions, and other allowances that affect the effective tax rate faced by a given business owner. We implicitly assume that the maximum rates are correlated with the rates that business owners expect to pay allowing for all other features of a state's tax code. See Slemrod (2004), Goolsbee and Maydew (2000), or Graham (1996) as examples of other studies that have grappled with how to measure effective tax rates.

Table 1d
Changes in state tax rates between 2000 and 2003.

	States that changed their tax rate	Adjacent states for which the cross-border difference in tax rate changed
Maximum corporate income tax rate	6	24
Maximum personal income tax rate	11	35
Sales tax rate	5	23

4.2. Matching business locations across state borders

A key feature of our empirical strategy is to match nearby business locations on opposite sides of a state border, restricting our focus to locations within easy commuting distance of the border. As noted in the Introduction and discussed in the following subsection, we observe establishment locations at the zipcode level. Partly for that reason, and also because zipcodes and portions of state borders are of irregular shape, we match small clusters of zipcodes that are approximately opposite each other just on either side of a state border. This entails a multiple step procedure as follows.

To begin, we use geographic information system (GIS) software to lay down a 20 by 20 mile grid across the continental United States. Only grid squares that intersect state borders are retained (see Fig. 3), and each is divided into pieces by the intersecting state borders. Each piece is then referred to as a "wedge" and pairs of wedges on opposite sides of a state border that belong to the same grid square are referred to as a "wedge-pair."

We next create a 10 mile buffer zone on each side of all of the lower 48 state borders in the United States and overlay a zipcode map on top of the border grid squares and buffer zones. Using GIS software, we retain only those zipcodes that lie at least partly within the 10-mile buffer and which intersect or lie entirely within a given wedge. This defines the set of zipcodes used in the analysis to follow (see Fig. 4 for an illustration). A second of zipcodes is similarly formed using a 1-mile buffer and is used as a robustness check. In both cases, each zipcode included in the sample is assigned to the wedge that it most overlaps and for that reason is associated with only one wedge. Multiple zipcodes, however, can be assigned to a single wedge so that the geographic area of the zipcode cluster assigned to a given wedge is equal to the union of the boundaries that delineate the corresponding zipcodes. In this way, each wedge-pair is assigned two clusters of zipcodes that are roughly opposite each other on opposing sides of a state border, and which are very close to the border.[15]

Importantly, all establishments throughout a zipcode are coded as belonging to the wedge to which the zipcode is assigned. In the analysis to follow, entrepreneurs are then modeled as choosing whether to locate their establishments in the zipcode cluster on one side of a wedge-pair versus the other.

4.3. Dun and Bradstreet data and summary measures

Data on business activity for the analysis were obtained from the Dun and Bradstreet (D&B) Marketplace files for the third quarters of 2002 and 2005.[16] In developing this data file, Dun and Bradstreet first obtains establishment-level data and then markets those data in the MarketPlace file aggregated to zipcode and higher levels of geography.[17] Using these data, we obtain zipcode-level counts of existing and newly created (in the previous 12 months) establishments and their corresponding employment for different 2-digit SIC (Standard Industrial Classification) industries.

Although we obtain our data aggregated to the zipcode level, we are able to disaggregate the data back to the root establishment level observations collected by Dun and Bradstreet. That is because all of the key control measures in our model are state- or wedge-pair level measures for a given 2-digit SIC industry. We know how many newly established companies are present for a given 2-digit SIC/zipcode, denoted here as x. We then create x observations for that 2-digit SIC/zipcode, each of which is associated with the same set of location-specific control variables (e.g. state tax measures). Using these data, we estimate linear probability models as described in Section 3 that evaluate the likelihood that an establishment locates on a given side of the state border as a function of wedge-pair and state-level control measures. It is worth emphasizing that there is no approximation in this procedure: we are simply recovering the original root establishment-level observations.

Table 2 reports summary measures for newly established businesses in our data. We do this for both the 10-mile and 1-mile buffer samples. In addition, for each wedge-pair, the side that is situated in the state that appears earlier in alphabetical order is always labeled as side 1 while the other is labeled as being on side 2. This labeling convention is adopted throughout the remainder of the paper.

Observe first that there are fewer newly created establishments in our sample in 2005 than in 2002. In the regression models to follow we address this by including a dummy variable for 2005 in all of the regressions. Also apparent, there are more arrivals on side 2 than on side 1. Given the random assignment of state-pair side-1 and side-2 designations, this difference either reflects a tendency for grid squares to be positioned more on side 2 of the state borders, or for side-2 designated areas to be more heavily developed. To address these possibilities, in some of the models to follow we include a control for the area of the wedge on side 2 of a wedge-pair (in square miles) minus the area of the wedge on side 1. In our more robust models, we instead include wedge-pair fixed effects which capture any differences in the areas represented by two paired wedges along with any underlying tendency for one side of the wedge-pair to be more heavily developed than the other.

Summing all arrivals associated with a given buffer zone, notice that there are 68,272 new establishments in zipcodes assigned to the 1-mile buffer sample and 97,163 new establishments in zipcodes assigned to the 10-mile buffer sample. The two samples are relatively similar in size because many of the zipcodes assigned to the 10-mile buffer sample extend to within 1 mile of the state border and are assigned to the 1-mile buffer sample as well. In most cases estimates from the regression models to follow are

[15] There is one location in the United States where four states meet (the "four corners" region of Arizona, New Mexico, Colorado, and Utah) and several locations where three states meet (see Fig. 4, for example). For that reason, in the 10-mile buffer sample, 70 of the 877 wedge-pairs contain wedges that are matched with more than one state and therefore belong to more than one wedge-pair. Dropping these locations did not affect our results but reduced the sample size. We therefore retain these locations and rely on clustering at the state-pair level to control for any repetition of information across wedge-pairs.

[16] Dun and Bradstreet data include nearly all establishments apart from part-time schedule-C filers. The data have been used in a number of recent studies including Rosenthal and Strange (2001, 2003, 2005) and Rosenthal and Ross (2010) who use data from the MarketPlace files. Kolko and Neumark (2010) and Kolko (2012) use a panel version of the data referred to as the National Establishment Time-Series (NETS) that was jointly developed by Don Walls and Dun and Bradstreet.

[17] Dun and Bradstreet markets the data in this form to permit users to first analyze the composition of establishments at zipcode and higher levels of geography. A software utility packaged along with the MarketPlace file then enables users to select out individual establishment identifiers for companies that meet a user's selection criterion (e.g. all 1-year old establishments in a given SIC category in a given zipcode). Using these identifiers, a user can then purchase additional establishment-level data on the selected companies from Dun and Bradstreet.

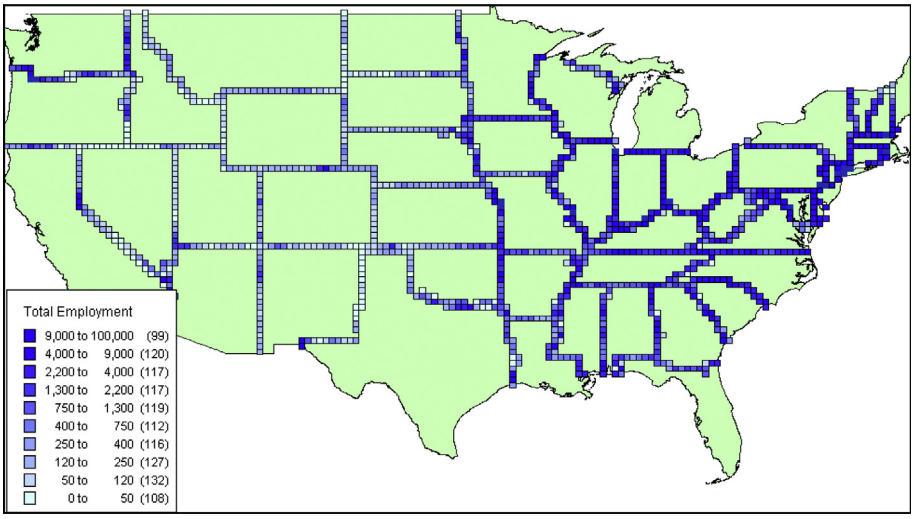

Fig. 3. Border region total employment.

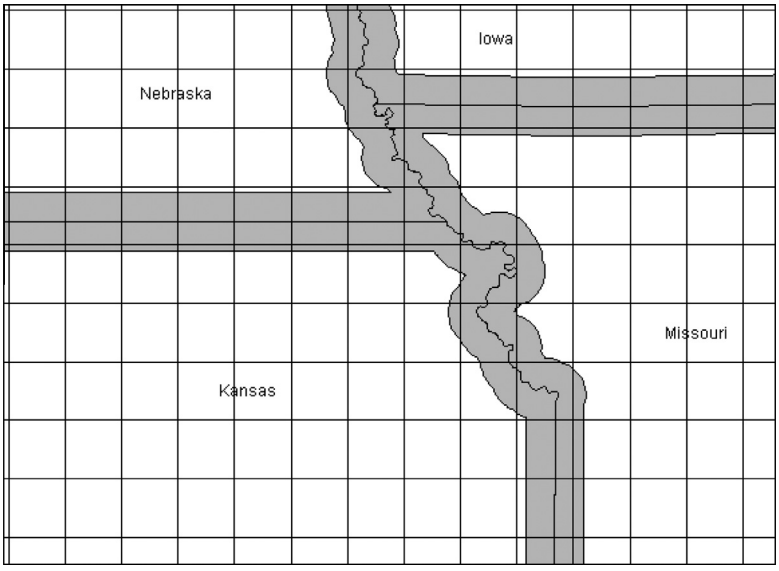

Fig. 4. 20-by-20 mile Grid squares overlaid on 10-mile state border buffers.

Table 2
Total number of new business arrivals.

Variable	2002 Side 1	2002 Side 2	2005 Side 1	2005 Side 2	Total
1 Mile buffer sample[a]	14,795	21,607	14,150	17,720	68,272
10 Mile buffer sample[a]	22,131	29,745	20,825	24,462	97,163

[a] As described in the text, the 1-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 1 mile of a state border. The 10-mile buffer sample is analogous and is based on a ten mile buffer.

Table 3
Wedge-pair employment counts in 2002: Q3.

Percentile	1 Mile buffer sample[a]	10 Mile buffer sample[a]
5th	2538	2605
25th	7070	6997
50th	14,399	16,076
75th	30,909	35,367
95th	89,351	139,594
Mean employment	33,553	44,809
Number of wedge-pairs	841	877

[a] Each wedge-pair was treated as a separate observation when calculating the distribution of employment across wedge-pairs above. As described in the text, the 1-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 1 mile of a state border. The 10-mile buffer sample is analogous and is based on a ten mile buffer.

quite similar for the two buffer zone samples. Because the 10-mile buffer yields a larger sample we mostly focus on that sample and only report 1-mile buffer sample results for the simplest specifications.

As described earlier, Fig. 3 displays the border areas that are the focus of this study. Also shown in Fig. 3 is the intensity of development along a given segment of a border, with darker regions indicating more intensive development. The figure makes apparent that the density of development along the border region is highly skewed, with relatively few intensively developed areas and many lightly developed regions. Table 3 quantifies that distribution for both the 1 mile buffer and 10 mile buffer samples. For each sample, the table presents the distribution of total employment for the sample of new business arrivals treating each wedge-pair as a separate observation. The heavily skewed distribution is evident with high concentrations of employment present in relatively few locations, mirroring the United States overall. We will draw on this stylized fact in some of the model specifications to follow.

Table 4
Size of state government. Dependent variable is 1 if arrival on side 2 and 0 if arrival on side 1 (t-stats are reported in parentheses[b]).

	1 Mile buffer sample[a]			10 Mile buffer sample[a]		
	OLS	State Pair FE	Wedge-Pair FE	OLS	State Pair FE	Wedge-Pair FE
$\text{Log}(\text{PerCapExp}_2/\text{PerCapExp}_1)$[c]	−0.3554	0.0795	0.0644	−0.2950	0.0296	0.0254
	(−4.43)	(0.83)	(0.70)	(−3.87)	(0.36)	(0.32)
$\text{Area}_2 - \text{Area}_1$ (sq miles)[d]	0.0072	0.009	–	0.0021	0.0024	–
	(10.74)	(6.35)	–	(9.89)	(11.14)	–
Year 2005	−0.0309	−0.0227	−0.0159	−0.0270	−0.0193	−0.0166
	(−2.56)	(−2.53)	(−2.11)	(−2.94)	(−2.68)	(−2.64)
Observations	68,272	68,272	68,272	97,163	97,163	97,163
State-Pair fixed effects	–	105	–	–	104	–
Wedge-Pair fixed effects	–	–	841	–	–	877
R-Square (non-differenced data)	0.149	0.244	0.440	0.192	0.296	0.469
R-Square (total, differenced data)	–	0.121	0.000	–	0.174	0.000
Root MSE	0.455	0.429	0.372	0.446	0.416	0.363

[a] As described in the text, the 1-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 1 mile of a state border. The 10-mile buffer sample is analogous and is based on a ten mile buffer.
[b] Standard errors are clustered at the state-pair level in all of the models.
[c] PerCapExp_1 and PerCapExp_2 are the state per capita levels of expenditures on sides 1 and 2 of the border.
[d] Area_2 and Area_1 are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

5. Results

5.1. Size of state government

We begin with the simplest specification that considers only the impact of the size of state government on the location of newly established enterprises. In Table 4, we present results using both the 1 mile buffer sample and the 10 mile buffer sample. Three sets of estimates are provided for each sample based on OLS, state-pair fixed effect, and wedge-pair fixed effect specifications. In all cases, the key control measure is the log ratio of the per capita level of state expenditures on side-2 of the border relative to side-1. As with the tax measures to follow per capita expenditures are lagged two years relative to when the establishment is created. Also included in the OLS and state-pair fixed effect models is the difference in the square mileage of the two wedges that comprise a given wedge-pair, and a dummy variable for arrivals in the year 2005. Given the focus on state-pair differences in per capita expenditures (and the tax measures to follow), the standard errors in all of the models are clustered at the state-pair level. In all cases, the estimated coefficients on the slope variables have the usual marginal interpretation associated with a linear specification.

Identification in the OLS models is based on variation across wedge-pair locations and years. For both buffer samples, the OLS estimates indicate that larger state government is associated with fewer arrivals: the coefficient on the log ratio expenditure measure is −0.355 and −0.295 for the 1 and 10 mile buffer samples, respectively. Both of these estimates are also highly significant. Taken at face value, this suggests that smaller state government attracts business activity. As suggested earlier, however, a concern with the OLS specification is whether unobserved attributes close to the state borders might bias these estimates.

The second column for each buffer sample includes controls for state-pair fixed effects. Identification in this specification is obtained only from temporal variation in cross-border activity since time-invariant state-pair border attributes are differenced away. Notably, the coefficient on the log ratio of per capita expenditures becomes positive for both samples, but is also small and insignificant in each instance. This is in sharp contrast to the negative coefficients in the OLS model. It also suggests that cross-border differences in state tax conditions are indeed correlated with cross-border differences in unobserved attributes that affect the side of the border on which a company locates.

To explore this issue further, the third column for each sample reports estimates based on the wedge-pair fixed effect specification. This strips away time-invariant state-pair and local attributes in the border segment in which a newly established enterprise is located. Observe that the coefficients on the expenditure variable are nearly identical to the state-pair fixed effect models. This result is suggestive that local unobserved attributes are not highly correlated with cross-border tax differentials after controlling for state-pair fixed effects.

5.2. State tax conditions

Table 5 extends the model by adding controls for the three state tax rates described earlier. As above, the standard errors are clustered at the state-pair level in all of the models. To conserve space, both in Table 5 and in the tables to follow, only results from the 10-mile buffer sample are reported (results from the 1-mile buffer sample are similar).

In all of the tables to follow the magnitude of the tax coefficients should be interpreted as follows. First, note that the tax variables are expressed in units such that a 1.0 increase in a given tax variable is equivalent to a 1 percentage point increase in the side-2 tax rate relative to side-1. Second, recall that we are running a linear probability model using a dependent variable that equals 1 if the entrepreneur chooses side 2 and 0 if side-1. Accordingly, if the coefficient on a given tax measure was −0.5, this would imply that, on average, a one percentage point increase in the side-2 tax rate relative to side-1 would reduce the probability that the entrepreneur locates on side 2 by 50% points. Bearing this in mind, for most of the discussion to follow we will focus on qualitative patterns and then return to the magnitude of effects at the end of the results section.

In Table 5, notice that the coefficients on the log ratio of per capita expenditures are similar to those in Table 4. In addition, although not shown, dropping the expenditure variable had little effect on the tax coefficients in Table 5 and in the tables to follow.[18] Observe also that the coefficients on the tax rates are similar in the state-pair and wedge-pair fixed effect models, analogous to patterns in Table 4.

Focusing on the coefficient values in Table 5, for the OLS model the tax coefficients are positive and highly significant for all three tax instruments. However, adding location fixed effects to the models causes the results to change dramatically. The coefficients

[18] This suggests that close to the border, the influence of the size of state government on business location is largely independent of cross-border differences in the manner in which state governments finance their expenditures.

Table 5
Tax measures. Dependent variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; *t*-stats are reported in parentheses[b]).

	OLS	State Pair FE	Wedge-Pair FE
$\text{Log}(\text{PerCapExp}_2/\text{PerCapExp}_1)$[c]	−0.3467	0.0252	0.0210
	(−47.39)	(0.31)	(0.27)
Max corp tax rate (Side 2 – Side 1)	0.0055	−0.0014	−0.0011
	(7.23)	(−0.14)	(0.12)
Max personal tax rate (Side 2 – Side1)	0.0070	−0.0010	−0.0003
	(9.43)	(−0.15)	(0.05)
Sales tax rate (Side 2 – Side 1)	0.0120	0.0062	0.0069
	(15.74)	(1.07)	(1.34)
$\text{Area}_2 - \text{Area}_1$ (sq miles)[d]	0.0022	0.0024	–
	(178.93)	(11.11)	–
Year 2005	−0.0226	−0.0194	−0.0164
	(−7.82)	(−2.82)	(−2.80)
Observations	97,163	97,163	97,163
State-Pair fixed effects	–	104	–
Wedge-Pair fixed effects	–	–	877
R-Square (non-differenced data)	0.201	0.230	0.458
R-Square (total, differenced data)	–	0.177	0.002
Root MSE	0.444	0.416	0.365

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level in all of the models.
[c] PerCapExp_1 and PerCapExp_2 are the state per capita levels of expenditures on sides 1 and 2 of the border.
[d] Area_2 and Area_1 are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

on the corporate income and personal income tax rates become negative, small, and not significant. This is suggestive that states with strong, growing economies tend to set higher corporate and personal income tax rates causing simple OLS models to understate the deterrent effect of higher tax rates on business activity. The coefficients on the sales tax rate in the fixed effect models are both positive but about half the magnitude of the OLS estimate and not significant. This is also suggestive that OLS models yield estimates of the tax coefficients that are biased towards more positive numbers. For now, and more generally, the patterns just noted provide limited support for the idea that local taxes deter arrivals of new businesses, echoing results from early papers in the literature. This changes when reciprocal agreements are taken into account.

5.3. Reciprocal agreements and the personal income tax

Recall that if a reciprocal agreement is in force, then individuals pay personal income tax to their state of residence, while if a reciprocal agreement is not in force, then individuals pay personal income tax to the state in which they are employed. In the absence of a reciprocal agreement, therefore, individuals employed on the high tax side of the border should receive higher nominal wages. Otherwise, they would seek employment on the low tax side of the border until wages adjust and a spatial equilibrium is attained. If instead, reciprocal agreements are in force, business establishments within easy commuting distance of the border are sheltered from wage capitalization because workers can live on the tax-advantaged side of the border regardless of where they work. This will tend to draw business activity to the high personal income tax side of the border while increasing the tendency for residential developers to outbid business establishments for space on the low-tax side of the border. Sheltering the business sector from the personal income tax should also increase the relative weight entrepreneurs place on the corporate income tax and the sales tax when deciding which side of the border on which to locate, causing the deterrent effect of these taxes to increase. These priors are considered in Table 6 where we present regressions for locations with and without a reciprocal agreement in force. To conserve space, only estimates based on the wedge-pair fixed effect specification are presented in Table 6 and in the tables to follow. As before all of the standard errors are clustered at the state-pair level.

In Table 6 notice that with reciprocal agreements in force the personal income tax attracts companies from across the border while the corporate income tax and the sales tax act as a deterrent. These effects are also statistically significant, a result that is largely robust to refinements of the model in the tables to follow. In contrast, when reciprocal agreements are not in force the coefficients on the corporate income tax, personal income tax, and sales tax are all of opposite sign, smaller in magnitude, and not significant with *t*-ratios of 0.36, −1.27, and 1.37, respectively. We should emphasize that although these estimates are not significant they become more noteworthy in some of the more fully specified models to follow.[19]

5.4. Differences across industries and the sales tax

In this section, we focus primarily on the sales tax for which we have sharp priors about different effects across industries. Recall that most retail activity is subject to the sales tax. In contrast, only a subset of the service sector is subject to the sales tax and manufacturing establishments only rarely face the sales tax. This suggests that the retail sector ought to be most prone to deterrent effects of the sales tax while manufacturing should if anything be attracted to the high sales tax side of the border. Estimates in Table 7 largely confirm these priors.

Table 7 repeats the analysis from Table 6 with separate regressions for Manufacturing, Retail, and Services. Notice that when reciprocal agreements are in place, a higher sales tax rate deters business arrivals. This is true for all three industries, but the coefficient is especially large and significant for retail (−0.116 with a *t*-ratio of −4.52), moderate for services (−0.045 with a *t*-ratio of −2.11), and smaller and not significant for manufacturing. Observe also that for retail and services, the corporate income tax has a significant deterrent effect while the personal income tax has a positive and significant influence (the corresponding coefficients

[19] This is especially true for the effects of the sales tax and the personal income tax when we allow for the influence of corporate status (Table 8) and density of local development (Table 9), the influence of the sales tax on manufacturing (Table 7), and the effect of the corporate income tax on corporations (Table 8).

Table 6
Reciprocal agreements. Dependent variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; *t*-stats are in parentheses[b]).

	Full sample	Reciprocal agreements	No reciprocal agreements
Log($PerCapExp_2$/$PerCapExp_1$)[c]	0.0210	0.1388	0.0415
	(0.27)	(0.72)	(0.58)
Max corp tax rate (Side 2 – Side 1)	−0.0011	−0.3402	0.0028
	(−0.12)	(−5.96)	(0.36)
Max personal tax rate (Side 2 – Side1)	−0.0003	0.0197	−0.0081
	(−0.05)	(2.17)	(−1.27)
Sales tax rate (Side 2 – Side 1)	0.0069	−0.0571	0.0067
	(1.34)	(−2.90)	(1.37)
Year 2005	−0.0164	0.0105	−0.0203
	(−2.80)	(0.96)	(−3.15)
Observations	97,163	24,924	72,239
Wedge-Pair fixed effects	877	196	681
R-Square (non-differenced data)	0.458	0.302	0.513
R-Square (total, differenced data)	0.002	0.001	0.000
Root MSE	0.365	0.417	0.346

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.

Table 7
Reciprocal agreements and stratification by industry. Dependent variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; *t*-stats are in parentheses[b]).

	Reciprocal agreements			No reciprocal agreements		
	Manufacturing	Retail	Services	Manufacturing	Retail	Services
Log($PerCapExp_2$/$PerCapExp_1$)[c]	0.8351	0.0071	0.0906	0.1016	−0.1152	0.1039
	(1.25)	(0.03)	(0.50)	(0.37)	(−1.01)	(1.19)
Max corp tax rate (Side 2 – Side 1)	−0.4527	−0.3291	−0.4309	0.0112	−0.0037	0.0030
	(−1.37)	(−2.96)	(−6.97)	(0.73)	(−0.53)	(0.37)
Max personal tax rate (Side 2 – Side1)	−0.0363	0.0231	0.0294	−0.0091	−0.0063	−0.0088
	(−1.45)	(2.30)	(2.89)	(−0.58)	(−1.45)	(−1.30)
Sales tax rate (Side 2 – Side 1)	−0.0341	−0.1158	−0.0452	0.0192	0.00001	0.0070
	(−0.58)	(−4.52)	(−2.11)	(3.22)	(0.00)	(1.45)
Year 2005	−0.0396	0.0353	0.0100	−0.0191	−0.0168	−0.0235
	(−1.33)	(3.45)	(0.81)	(−1.10)	(−2.55)	(−3.27)
Observations	926	4,769	12,527	2,782	16,218	32,465
Wedge-Pair fixed effects	73	162	176	200	552	607
R-Square (non-differenced data)	0.275	0.338	0.299	0.528	0.493	0.524
R-Square (total, differenced data)	0.017	0.006	0.000	0.002	0.001	0.001
Root MSE	0.425	0.406	0.417	0.338	0.351	0.342

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.

for manufacturing are not significant). These patterns reinforce the view that reciprocal agreements enhance the deterrent effect of tax instruments other than the personal income tax. The patterns just noted also support the view that deterrent effects from the sales tax should be more pronounced for retail activity than for services and smaller still for manufacturing.

When reciprocal agreements are not in force, the pattern is different. In that instance, the sales tax tends lure manufacturing establishments from across the border with a positive coefficient of 0.019 and a *t*-ratio of 3.22. The coefficient for services is smaller and only weakly significant while the coefficient on retail is essentially zero. These patterns suggest that in the absence of a reciprocal agreement the sales tax tends to attract non-retail establishments while the deterrent effect of the sales tax on retail establishments disappears.

5.5. Corporate status and the corporate income tax

Table 8 revisits the models in Table 6 once again, but this time separate models are run for establishments that are corporations and those that are either sole proprietorships or partnerships.[20] As discussed earlier, because only corporations pay corporate income tax, the deterrent effect of the corporate income tax seems likely to be more pronounced for corporations.

In the absence of a reciprocal agreement results are more nuanced relative to patterns in the earlier tables. For sole proprietorships and partnerships, it is noteworthy that the personal income tax has a clear significant deterrent effect with a coefficient of −0.014 and a *t*-ratio of −3.05, while the coefficients on the corporate and sales tax measures are positive, smaller, and less significant (with *t*-ratios of 1.00 and 1.90, respectively). In contrast, for corporations, the corporate income tax has a strong, significant deterrent effect with a coefficient of −0.32 and a *t*-ratio of −3.44, the sales tax has a more modest deterrent effect (the coefficient is −0.089 with a *t*-ratio of −3.11), and the personal income tax has a positive and significant effect (the coefficient is 0.036 with a *t*-ratio of 3.37). This pattern suggests that corporations tend to

[20] We are able to identify the ownership structure for roughly two-thirds of our sample.

Table 8
Reciprocal agreements and corporate versus non-corporate status. Dependent variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; t-stats are in parentheses[b]).

	Reciprocal agreements		No reciprocal agreements	
	Corporations	Sole proprietorships and partnerships	Corporations	Sole proprietorships and partnerships
$Log(PerCapExp_2/PerCapExp_1)$[c]	0.3434	−0.1688	0.2312	0.1168
	(2.43)	(−1.50)	(0.88)	(1.23)
Max corp tax rate (Side 2 – Side 1)	−0.6963	−0.0028	−0.3200	0.0065
	(−11.90)	(−0.30)	(−3.44)	(1.00)
Max personal tax rate (Side 2 – Side1)	0.0138	0.0110	0.0363	−0.0142
	(1.91)	(1.58)	(3.37)	(−3.05)
Sales tax rate (Side 2 – Side 1)	−0.0023	0.0039	−0.0889	0.0088
	(−0.12)	(1.55)	(−3.11)	(1.90)
Year 2005	−0.0144	0.0064	0.03174	−0.0224
	(−1.15)	(0.64)	(2.38)	(−2.97)
Observations	10,044	28,385	9,810	28,340
Wedge-Pair fixed effects	183	615	186	660
R-Square (non-differenced data)	0.319	0.545	0.296	0.487
R-Square (total, differenced data)	0.000	0.000	0.006	0.000
Root MSE	0.411	0.335	0.419	0.354

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.

Table 9
Reciprocal agreements and stratification by agglomeration. Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; t-stats are in parentheses[b]).

	Reciprocal agreements		No reciprocal agreements	
	Lightly developed (<95th Pctl)[d]	Heavily developed (>95th Pctl)[d]	Lightly developed (<95th Pctl)[d]	Heavily developed (>95th Pctl)[d]
$Log(PerCapExp_2/PerCapExp_1)$[c]	−0.0376	0.2049	0.0810	0.0572
	(−0.20)	(0.67)	(0.76)	(0.49)
Max corp tax rate (Side 2 – Side 1)	−0.1666	−0.5243	−0.0022	0.0135
	(−2.39)	(−3.09)	(−0.29)	(1.81)
Max personal tax rate (Side 2 – Side1)	−0.0066	0.0241	0.0008	−0.0201
	(−0.37)	(3.60)	(0.12)	(−3.24)
Sales tax rate (Side 2 – Side 1)	−0.0529	−0.0649	−0.0004	0.0173
	(−2.73)	(−2.16)	(−0.17)	(4.04)
Year 2005	0.0156	0.0103	−0.0175	−0.0212
	(1.21)	(0.59)	(−2.38)	(−1.48)
Observations	10,268	14,656	36,956	35,283
Wedge-Pair fixed effects	180	16	652	29
R-Square (non-differenced data)	0.414	0.225	0.462	0.546
R-Square (total, differenced data)	0.012	0.001	0.018	0.000
Root MSE	0.381	0.434	0.366	0.330

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[d] Lightly and heavily developed locations are defined as those less than or greater than the 95th percentile as defined in Table 3.

choose away from locations with higher corporate income tax and sales tax rates even if doing so exposes the corporation to potentially costly higher personal income tax rates.

When reciprocal agreements are present the results are different. Regardless of corporate status, the personal income tax attracts establishments (with *t*-ratios of 1.91 and 1.58 for corporations and unincorporated companies, respectively). Notice also that for corporations, the coefficient on the corporate income tax is −0.696 (with a *t*-ratio of −11.90). This estimate is twice as large as when reciprocal agreements are not in force (in column 3). Together these results confirm that when the costly effects of the personal income tax are mitigated (as when a reciprocal agreement is present), the corporate income tax has an especially large deterrent effect on exactly those companies that are most subject to the tax. On the whole, the patterns in the table once again reinforce the view that entrepreneurs seek tax-sheltered locations allowing for the idiosyncratic features of the company in question.

5.6. Robustness

This section reports estimates from three sets of models designed to explore the robustness of our core findings. In all cases we use Table 6 as the base case and modify the specifications in that table. Table 9 allows for interactions between the local scale of development and tax deterrent effects. Table 10a experiments with alternate ways of measuring state tax conditions, Table 10b varies the degree to which the tax and expenditure measures are lagged from 4 to 0 years, and Table 10c explores the influence of alternative ways of specifying geography and state borders.

Table 10a
Alternative Measures of State Tax Conditions. Dependent Variable is 1 if arrival on State 2 and 0 if arrival on State 1 (10 mile buffer sample[a]; t-stats are in parentheses[b]).

	Marginal personal income tax rate for the average earning adult in the state		Median personal and corporate income tax rates in the state tax schedules	
	Reciprocal agreements	No Recip agreements	Reciprocal agreements	No Recip agreements
Log($PerCapExp_2/PerCapExp_1$)[c]	0.1588	0.0601	−0.2106	0.0551
	(0.77)	(0.79)	(−1.39)	(0.70)
Corp income tax rate (Side 2 – Side 1)	−0.3476	−0.0011	−0.0098	0.0054
	(−6.05)	(−0.14)	(−0.64)	(0.78)
Personal income tax (Side 2 – Side1)	0.0232	−0.0018	0.0535	−0.0004
	(1.67)	(−0.96)	(4.71)	(−0.25)
Sales tax (Side 2 – Side 1)	−0.0570	0.0068	−0.0620	0.0073
	(−2.91)	(1.38)	(−0.72)	(1.47)
Year 2005	0.0098	−0.0200	−0.0051	−0.0180
	(0.87)	(−2.89)	(−0.58)	(−2.59)
Observations	24,924	72,239	24,924	72,239
Wedge-Pair fixed effects	196	681	196	681
R-Square (non-differenced data)	0.302	0.513	0.302	0.513
R-Square (total, differenced data)	0.001	0.004	0.001	0.005
Root MSE	0.417	0.346	0.417	0.346

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the state-pair level.

Table 10b
Alternative Lags of Tax and Expenditure Measures. Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1 (10 mile buffer sample[a]; t-stats are in parentheses[b]).

	Contemporaneous maximum corporate, personal, and sales tax rates		1-year Lagged maximum corporate, personal, and sales tax rates		2-year Lagged maximum corporate, personal, and sales tax rates		3-year Lagged maximum corporate, personal, and sales tax rates		4-year Lagged maximum corporate, personal, and sales tax rates	
	Reciprocal agreements (1)	No Recip agreements (2)	Reciprocal agreements (3)	No Recip agreements (4)	Reciprocal agreements (5)	No Recip agreements (6)	Reciprocal agreements (7)	No Recip agreements (8)	Reciprocal agreements (9)	No Recip agreements (10)
Log($PerCapExp_2/PerCapExp_1$)[c]	−0.3119	0.0295	0.3552	−0.0147	0.1388	0.0415	0.1159	0.0718	0.2419	0.0110
	(1.90)	(0.43)	(1.26)	(−0.19)	(0.72)	(0.58)	(0.49)	(1.08)	(0.76)	(0.12)
Corp income tax rate (Side 2 – Side 1)	0.0029	0.0105	−0.3888	−0.0086	−0.3402	0.0028	0.0131	−0.0118	0.0806	0.0058
	(0.17)	(1.80)	(−5.13)	(−1.89)	(−5.96)	(0.36)	(0.84)	(−3.48)	(1.11)	(1.10)
Personal income tax (Side 2 – Side1)	0.0342	−0.0037	0.0126	0.0069	0.0197	−0.0081	0.0103	0.0001	0.0452	−0.0006
	(5.32)	(−1.15)	(2.33)	(1.05)	(2.17)	(−1.27)	(3.97)	(0.06)	(1.77)	(−0.04)
Sales tax (Side 2 – Side 1)	−0.0030	0.0090	−0.2956	0.0076	−0.0571	0.0067	0.0673	0.0073	0.0080	0.0114
	(−0.03)	(2.05)	(−4.50)	(1.74)	(−2.90)	(1.37)	(0.88)	(0.42)	(0.19)	(0.73)
Year 2005	−0.0032	−0.0177	0.0106	−0.0212	0.0105	−0.0203	−0.0067	−0.0213	0.0010	−0.0207
	(−0.37)	(−3.01)	(0.69)	(−3.17)	(0.96)	(−3.15)	(−0.54)	(−3.39)	(0.06)	(−2.52)
Observations	24,924	72,239	24,924	72,239	24,924	72,239	24,924	72,239	24,924	72,239
Wedge-Pair fixed effects	196	681	196	681	196	681	196	681	196	681
R-Square (non-differenced data)	0.302	0.521	0.302	0.521	0.303	0.521	0.302	0.522	0.302	0.521
R-Square (total, differenced data)	0.0063	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
Root MSE	0.417	0.346	0.417	0.346	0.417	0.346	0.417	0.346	0.416	0.342

[a] As described in the text, the 10-mile buffer sample includes new business establishments in zipcodes that lie at least partly within 10 miles of a state border.
[b] Standard errors are clustered at the level of the wedge-pair fixed effect models.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.

5.6.1. The scale of local development

Recent papers by Devereux et al. (2007), Jofre-Monseny and Sole-Olle (2007), and Brulhart et al. (2009) have considered the possibility that agglomeration may mitigate the deterrent effects of taxes and/or subsidies.[21] Devereux et al. (2007), for example, found that government subsidies have less impact on a firm's location decision in more highly developed areas. We consider this possibility in Table 9 by stratifying wedge-pair samples into lightly developed versus heavily developed areas for locations with and without reciprocal agreements.[22]

Observe that when reciprocal agreements are present the corporate income tax and the sales tax deter business arrivals for both subsamples. In contrast, the personal income tax has no discernible effect on establishment location in lightly developed areas but a strong attractive effect in heavily developed locations (with a coefficient of 0.024 and a *t*-ratio of 3.60).

When reciprocal agreements are not present, in lightly developed locations tax deterrent effects are absent for all three taxes. In heavily developed locations, the tax coefficients all have the same signs as in Table 6 but are notably larger in magnitude and clearly significant. The coefficients and *t*-ratios for the three taxes are, respectively, 0.0135 and 1.81 for the corporate income tax, −0.020 and −3.24 for the personal income tax, and 0.017 and 4.04 for the sales tax. It is worth emphasizing that the deterrent effect of the personal income tax occurs primarily in heavily developed areas. This differs from recent studies referenced above

[21] See also Greenstone and Moretti (2004) and Greenstone et al. (2010) for related work.
[22] A wedge-pair is defined as heavily developed if it is among the 5% most densely developed wedge-pairs in the sample based on total employment in 2002 as described in Table 3.

which found that agglomeration mitigated tax deterrent effects. Nevertheless, labor productivity and wages are higher in densely developed locations (e.g. Glaeser and Mare, 2001; Duranton and Puga, 2004; Rosenthal and Strange (2003); Rosenthal and Strange, 2008; Arzaghi and Henderson, 2008; Glaeser and Gottlieb, 2009; Combes et al., 2010). With a progressive state income tax code, this could amplify the deterrent effect of the personal income tax in heavily developed locations and may contribute to the patterns in Table 9.

5.6.2. Alternate measures of state tax rates and per capita expenditures

Tables 10a and 10b re-specify the models in Table 6 using alternate measures of a state's tax environment. In Table 10a we consider alternatives to using the maximum personal income and corporate income tax rates given the progressive nature of these taxes. In Table 10b we consider alternate lags of the tax measures. In both tables, results are stratified by reciprocal agreement status and standard errors are clustered at the state-pair level.

In Table 10a, observe that the first two columns replace the 2-year lag of a state's maximum personal income tax rate with the 2-year lag of the marginal personal income tax rate faced by the average earning adult in the state. This yields results very similar to those reported in Table 6, both when a reciprocal agreement is in force and when it is not in force.

Columns 3 and 4 in Table 10a use 2-year lags of the median tax rates in each state's tax schedule for both the corporate income tax and the personal income tax. When a reciprocal agreement is not in force, results are once again similar to those in Table 6. However, when a reciprocal agreement is present, the pattern in Table 10a suggests a much smaller deterrent effect of the corporate income tax, a more positive coefficient (larger attractive effect) for the personal income tax, and a similar but less precise estimate of the deterrent effect of the sales tax.

Overall, the primary lesson from Table 10a is that the manner in which one characterizes a state's tax environment affects estimates and perceptions of the deterrent and attractive influence of different types of taxes. This is not surprising and is an inescapable feature of complicated tax systems as with a progressive income tax. Nevertheless, on the assumption that most new business owners aspire to be successful and anticipate facing tax rates higher up in the tax schedules, we favor using the maximum tax rates for the personal income tax and corporate income tax.[23]

Table 10b displays results based on different lags of the tax and expenditure variables from four year lags up to contemporaneous values. In considering the estimates in this table, it is important to recognize that there is a lag between the time an entrepreneur decides to open a business and when the establishment is created. This suggests that modestly lagged tax and expenditure measures should be most relevant in explaining business location decisions. Contemporaneous measures effectively lead business location decisions and are more prone to being endogenous for that reason; very deeply lagged measures may not have been considered by entrepreneurs and should have limited effect on their location decisions. In these later instances we do not expect the corresponding model estimates to provide compelling evidence of tax deterrence. Results in Table 10b largely support these priors.

We begin with the 4-year lagged models in columns 9 and 10. For these models there is little evidence of tax deterrent effects regardless of reciprocal agreement status. The 3-year lagged estimates begin to provide some signal. Notice for example, that there is a significant deterrent effect of the corporate income tax when reciprocal agreements are absent (column 8) and a significant positive effect of the personal income tax in the absence of reciprocal agreements (column 7). The 2-year lagged models in columns 5 and 6 are taken from Table 6. As previously discussed, these estimates indicate substantial evidence of tax effects when reciprocal agreements are present but limited tax effects in the absence of a reciprocal agreement. One-year lagged models are presented in columns 3 and 4. Estimates from this specification are similar to those based on two-year lags with the exception that the deterrent effect of the sales tax when a reciprocal agreement is present is especially large. Results in columns 1 and 2 are based on contemporaneous tax measures. When reciprocal agreements are present, there is a strong positive coefficient on the personal income tax but no effect from the other taxes in contrast to the 1- and 2-year lagged model estimates. When reciprocal agreements are absent results are qualitatively similar to those in Table 6 in that there is only modest evidence of tax deterrent effects.

Overall, results in Table 10b are consistent with the view that modestly lagged tax measures seem to best capture the information upon which business owners base their location decisions. As argued elsewhere, we favor using 2-year lagged values of the tax measures as our primary measures of local tax conditions but we recognize that other reasonable lags of the tax variables could be used as with the 1-year lag.

5.6.3. Alternate borders

Table 10c presents a series of models that explore alternative geographic measures of the border region. As above, in all cases we treat the core models in Table 6 as the baseline and cluster the standard errors at the state-pair level. In most of the specifications, estimates are presented for the full sample and also for the samples stratified by reciprocal agreement.

The first three groups of estimates (in columns 1–7) provide evidence on whether cross-state differences in tax conditions attenuate with distance between two sites. Column 1 examines this question by randomly matching each wedge in our full sample with an alternate wedge drawn from a non-adjacent state. The coefficients in this model are mostly small and insignificant and provide little evidence of tax deterrence.[24]

Columns 2–4 in Table 10c retain the true borders and original wedge-pairs from Table 6 but only examine economic activity within five miles of state borders. Columns 5–7 repeat the exercise focusing on activity five to ten miles of the state borders. Estimates in these models are mostly similar to patterns in Table 6. This suggests that our results are largely robust regardless of whether we use the five-mile buffer zone or the 5–10 mile buffer zone in constructing our samples.

The last three columns in Table 10c experiment with a placebo test. In this instance, we create a fictitious border 5 miles into the

[23] Some cross-country studies have used tax revenue shares instead of tax rates when evaluating the impact of taxes. This is typically done when cross-country differences in tax codes are so complicated as to preclude direct comparisons of tax rates (see Slemrod (2004), for example). We use tax rates instead of revenue shares for three reasons. First, tax rates enter into a company's cost function and better fit the model in Section 2. Second, revenue shares sum to one which requires that one source of revenue be omitted from the model. As a result, coefficients on revenue shares must be interpreted relative to the influence of the omitted group which complicates assessment of tax effects. Third, revenue shares vary with both tax rates and the level of activity in a particular sector (e.g. the level of sales) whereas our focus is on the influence of tax rates.

[24] It is worth noting that because we create matches between non-adjacent states, the wedges belonging to a given wedge-pair are geographically distant and reciprocal agreements are generally not in force (see Table 1b, for example). In that sense, the results in the first column of Table 10b are qualitatively similar to the no-reciprocal agreement model in column 3 of Table 6. Nevertheless, the border design in Table 6 is a fundamentally different model as it does a better job of controlling for unobserved local attributes. For that reason we emphasize the absence of deterrent effects in column 1 of Table 10b as opposed to the similarity with Table 6.

Table 10c
Alternative Geographic Borders. Dependent Variable is 1 if arrival on State 2 and 0 if arrival on State 1 (t-stats are in parentheses[b]).

	Wedge Pairs in non-adjacent states	Wedge Pairs in adjacent states in the 0 to 5 mile border			Wedge Pairs in adjacent states in the 5 to 10 mile border			Pseudo-border 5 miles into interior of state 2		
	No Recip agreements[a] (1)	Full sample (2)	Reciprocal agreements (3)	No Recip agreements (4)	Full sample (5)	Reciprocal agreements (6)	No Recip agreements (7)	Full sample (8)	Reciprocal agreements (9)	No Recip agreements (10)
Log($PerCapExp_2$/ $PerCapExp_1$)[c]	0.0643	−0.0105	0.0505	0.0342	0.1318	0.2223	0.1332	−0.0112	0.0235	−0.0188
	(1.18)	(−0.14)	(0.23)	(0.54)	(1.21)	(0.80)	(1.12)	(−0.36)	(0.39)	(−0.51)
Max corp tax rate	0.0036	−0.0033	−0.3208	0.0005	0.0011	−0.4867	0.0030	0.0009	−0.0563	0.0009
(Side 2 – Side 1)	(0.90)	(−0.38)	(−5.36)	(0.06)	(0.10)	(−4.31)	(0.29)	(0.33)	(−1.51)	(0.40)
Max personal tax rate	0.0089	−0.0002	0.0199	−0.0069	0.0055	0.0271	−0.0051	0.0045	0.0009	0.0073
(Side 2 – Side1)	(1.69)	(−0.03)	(1.88)	(−1.15)	(0.67)	(3.23)	(−0.43)	(1.67)	(0.84)	(1.28)
Sales tax rate	−0.0017	0.0067	−0.0635	0.0067	0.0102	−0.0839	0.0102	0.0003	−0.0066	0.0006
(Side 2 – Side 1)	(−1.30)	(1.20)	(−2.77)	(1.29)	(2.09)	(−2.96)	(2.32)	(0.50)	(−0.55)	(0.83)
Year 2005	0.0007	−0.0137	0.0120	−0.0181	−0.0240	0.0066	−0.0269	−0.0013	0.0022	−0.0027
	(0.19)	(−2.32)	(0.99)	(−2.99)	(−2.94)	(0.48)	(−2.91)	(−0.58)	(0.95)	(−0.84)
Observations	98,175	88,104	22,795	65,309	53,011	15,310	37,701	38,293	13,522	24,771
Wedge-Pair Fixed Effects	975	901	206	695	410	93	317	333	85	248
R-Square (non-differenced data)	0.753	0.468	0.296	0.529	0.316	0.201	0.359	0.071	0.050	0.077
R-Square (total, differenced data)	0.0029	0.000	0.002	0.000	0.010	0.007	0.021	0.001	0.001	0.000
Root MSE	0.244	0.361	0.418	0.339	0.413	0.445	0.400	0.481	0.489	0.477

[a] 10-Mile buffer sample used as described for Table 6. This includes new business establishments throughout the entirety of any zipcode that is at least partially within ten miles of the state border.
[b] Standard errors are clustered at the state-pair level.
[c] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.

interior of state-2 and examine the influence of the true cross-state tax differentials on arrivals within five miles of the new pseudo-border.[25] Relative to Table 6, evidence of tax deterrence largely disappears in this model as reflected in the insignificant tax coefficients. This is consistent with the view that the true state border has a noteworthy influence on establishment location patterns while the pseudo border does not.

Summarizing, the different models in Table 10c confirm that state borders have meaningful deterrent effects on business location patterns that attenuate with sufficient geographic distance.

5.7. Magnitudes

To complete our discussion some brief comments about the magnitude of our estimates is in order. For these purposes we focus on the coefficient estimates in Tables 6 and 8 (agglomeration).

Suppose that reciprocal agreements are not in force and side-2 of a state border reduces the maximum personal income tax rate by one percentage point relative to the state on the opposite side of the border. Based on the estimates in column three of Table 6, this would reduce the likelihood that an establishment would locate on side-2 of the border by 0.81% points. If instead we restrict attention to heavily developed locations as in the final column of Table 8, the corresponding effect would be −2.01% points. Analogous estimates for a one percentage point increase in the sales tax rate are 0.67% points (in Table 6) and 1.73% points for densely developed locations (in Table 8).

With a reciprocal agreement in place, estimates from Table 6 indicate that an increase in the side-2 personal income tax of one percentage point would increase the likelihood of a company choosing side-2 by 1.97% points. Corresponding values for the sales tax and the corporate income tax are roughly −5.71% points and −34.02% points, respectively. These effects are even larger in densely developed areas (column 3 of Table 8).

It should be emphasized that there is a wide confidence band around several of these estimates. Nevertheless, the weight of evidence presented above suggests that tax deterrent effects among companies locating close to state borders are both statistically significant and large enough in magnitude to warrant attention by policy makers.

6. Conclusions

This paper has revisited an old question that has eluded efforts to provide a clear answer: to what extent do local taxes deter business activity? Numerous measurement and econometric issues have made this a challenging question to address for reasons that are well appreciated in the literature. For that reason, our goals throughout the paper have been targeted. Our focus has been on the influence of state government policy on the *sorting* of establishments across state lines for those companies that operate within easy commuting distance of a state border. In that regard, we do not address the impact of state policy on the overall *level* of business activity close to a state border. Instead, we consider the tendency of entrepreneurs operating close to a state border to avoid adverse tax effects through their choice of state.

New to this paper, we provide the first ever analysis of state reciprocal agreements that require individuals to pay personal income tax to their state of residence as opposed to their state of employment. Controlling for that feature of the tax code proves to be a powerful source of identification. When reciprocal agreements are in force, higher personal income tax rates tend to lure companies from across the border while higher corporate income and sales tax rates act as a deterrent. The reverse is often true when reciprocal agreements are not in force but that particular pattern is more sensitive to other features of the model specification.

The tendency for higher tax rates to sometimes lure companies from across a state border might seem surprising at first but is actually quite intuitive: entrepreneurs will bid more for space in

[25] This exercise evaluates the extent to which state-2 versus state-1 differences in tax conditions affect arrivals of companies in the 5-to-10 mile zone in state-2 versus the 0-to-5 mile zone in state-2. We obtained nearly identical results when we considered analogous location patterns in state-1.

tax sheltered locations, ceteris paribus, and will be drawn to such locations in equilibrium. Our findings also suggest that tax deterrent effects are sufficiently large in magnitude to be economically important, even allowing for a wide confidence band around the estimates.

Additional findings demonstrate that tax deterrent effects differ with the type of tax, type of industry, ownership structure of the company (e.g. corporate versus non-corporate), and the local level of agglomeration. Given the sensitivity of our estimates to these considerations and also the influence of reciprocal agreements, it is not surprising that many previous studies have struggled to find convincing evidence of tax deterrent effects. Nevertheless, taken as a whole, our research design and estimates reinforce the view that taxes do affect business activity and that new businesses are drawn to locations in which they are relatively more sheltered from higher taxes.

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