Tax Avoidance and Business Location in a State Border Model

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Abstract

This paper examines the deterrent effect of state taxes on companies that locate close to a state border. Findings indicate that the sales tax lures companies from across the border, the personal income tax tends to act as a deterrent when reciprocal agreements are not in force, and the corporate income tax acts as a deterrent when reciprocal agreements are in force. Deterrent effects differ by industry, corporate status, and the intensity of nearby development. These differences are predicted by sorting models in which high bidders occupy a location. They also help to explain mixed patterns in previous literature.

Key Words: Tax deterrence, borders, sorting
JEL Codes: H2, H7, R0

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.

I. 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. We offer several innovations relative to previous work that help to clarify the mixed results in the literature, and which confirm the potential for tax deterrent effects. The first is that the size of local government may matter in addition to the manner in which local governments finance their expenditures. The second is that tax deterrent effects differ depending on the type of tax and the type of industry in question. We also show that the scale of nearby development affects the sensitivity of entrepreneurs to local tax conditions.

Our emphasis throughout the paper is on the *sorting* of new business activity into opposite sides of a state border in response to cross-border differences in state tax conditions. This is consistent with a focus on tax avoidance as in the quote above. We conduct our analysis using establishment-level data for roughly 96,000 newly created enterprises in 2002 and 2005. A key feature of the data is that our sample is restricted to establishments that are within easy commuting distance of a state border. We then

[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) and Schmenner (1975, 1982)). This began to change in the late 1980s and 1990s as studies by Bartik (1985, 1994), Papke (1991), 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).

evaluate the impact of cross-border differences in state tax conditions on the side of the border chosen by the business owner. In addition, we break state border regions into twenty mile long segments. This allows us to use border-segment fixed effects to control for unobserved time-invariant local (and state-wide) attributes associated with a given border segment. It also allows us to control for observable time-varying local attributes, such as the local level of agglomeration that may amplify or mitigate tax effects. The combination of these features does much to take into account other location-specific attributes that may be correlated with state tax conditions. By looking across the border, we compare areas that are approximately similar except for state tax conditions. By differencing over time we reduce the influence of remaining time invariant cross-border differences such as such as state right to work laws (e.g. Holmes (1998)) and local policies that could be correlated with state tax conditions. As will become apparent, this design yields revealing estimates of the deterrent effects of cross-border differences in state tax conditions.[2]

As alluded to above, we depart from most previous studies by decomposing tax conditions into two parts. In the first part, we consider the extent to which the *size* of local government expenditures (per capita) attracts or deters new business activity. In this sense, we implicitly recognize that local governments must balance their budgets, and therefore, that state-level taxes are linked to expenditures. If state government offers net value to the business community for an additional tax dollar, then larger state government should attract business; if the reverse is true, then larger state government will discourage business activity. This is analogous to early arguments by Brueckner (1979, 1982) who considered the impact of local property taxes on aggregate property values.[3] Nevertheless, most previous studies of tax-deterrent effects have tended to ignore government expenditures, and that likely contributes to mixed findings in the literature on tax deterrent effects.

[2] A limitation of our approach is that we take as given the decision of the entrepreneur to create a new establishment in a given border segment. Our results, therefore, while revealing of tax deterrent effects close to a jurisdiction border, do not necessarily generalize to deterrent affects across broad regions.

[3] Brueckner (1979, 1982) considers the extent to which property taxes increase aggregate property values. He argues that evidence of a positive relationship indicates that local governments add value to the local community through their tax and expenditure policies, while a negative relationship is indicative of inefficient local government.

We also consider the *manner* in which state government expenditures are financed. For this portion of the analysis we include separate controls for the share of expenditures financed through the corporate income tax, the personal income tax, and the sales tax. These three sources of tax revenue account for an important share of state government revenues and are often at the center of policy debates about the level and composition of local tax levies.[4] There is good reason to expect that industries differ in their sensitivity to the different types of taxation and related state-specific policies.

When considering 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 a sales tax. Moreover, even for industries such as retail that are subject to a sales tax, if demand for the broad product/service category is inelastic, then sellers would be expected to shift the burden of the sales tax onto consumers, mitigating deterrent effects on business activity. Recent evidence from Rosenthal and Ross (2010) provides support for this view for the retail sector. 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 overall. Together, these observations suggest that the sales tax may not be very much of a deterrent for many industries.

Companies that are currently incorporated or anticipate becoming so are likely more sensitive to the corporate income tax. As seen in Table 1b, 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 or 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.

[4] In Table 1a, note that in 2002 and 2005, on average, personal income tax and sales tax revenue both account for roughly 14 percent of state government revenues. Corporate income tax revenue comprises a smaller share of state government revenues, just 2-1/2 percent. However, these numbers hide the considerable variation across states in their reliance on the three different sources of tax revenues. It is also worth noting that the largest single source of state government revenues are employee contributions to state worker pension plans followed by grants from the federal government.

All companies rely on labor, including hired workers and the labor effort of the business owner(s). But states differ markedly in their personal income tax rates. With sufficiently mobile workers, employers would bear much of the burden of higher personal income taxes 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. While that may be true, two considerations suggest that such a conclusion could be hasty. The first is that workers may not be sufficiently mobile to push the burden of higher personal income taxes onto employers, at least in the short run. The second is that a number of pairs of adjacent states have reciprocal agreements in which workers are obliged to pay personal income tax to the state in which they live as opposed to the state in which they work. A complete listing of states with such agreements is provided in Table 1c. For companies locating within commuting distance of the state border, the presence of a reciprocal agreement should mitigate the deterrent effect of the state personal income tax since workers can choose to live on the tax advantaged side of the border while working on the other. On the other hand, because only a subset of states have entered into such agreements, failure to take account of reciprocal agreements has the potential to obscure the deterrent effect of the personal income tax and other forms of taxation for reasons that will be made clear later in the paper.

A further feature of our research design is that we allow tax deterrent effects to vary with the scale of local development. Only a handful of studies have considered this possibility. For at least three reasons, however, it is possible that state government tax and expenditure effects could differ with the local level of development. The first is that government services might be especially valuable in lightly developed areas where private investment is limited. If true, then one would expect the size of government to be relatively more of an attraction in lightly developed areas as compared to heavily developed areas. The second, and related consideration, is that agglomeration economies in previously developed areas (e.g. Duranton et al (2004), Rosenthal and Strange (2004), Glaeser and Gottlieb (2009), Combes et al (2010), Bleakely and Lin (2011)) may swamp any influence of changes in state government expenditure and tax policies. The third is that heavily developed areas are typically highly productive and

have higher nominal wages, consistent with the greater degree of labor productivity (e.g. Glaeser and Mare (2001), Rosenthal and Strange (2008)). With a progressive state income tax code, this suggests that the deterrent effects of the personal income tax may be amplified in heavily developed locations, ceteris paribus. We allow for these possibilities by experimenting with models stratified into low- and high-density locations. As will become apparent, findings indicate that tax avoidance effects do differ with the level of local development, but in a manner that varies with the type of tax.

Given the central role of the border design and double-differencing strategy, some further clarification of how the data are coded for these purposes will help to guide the rest of the discussion. For each of the lower 48 state borders, geographic information system (GIS) software is used to create buffer zones on both sides of the state border extending from 0 to 1 mile and from 0 to 10 miles from the border. Each buffer zone is then broken into twenty-mile long segments creating large numbers of wedges (polygons) running along both sides of the border. Opposing wedges on opposite sides of the border are matched using a methodology described later in the paper and are referred to as "wedge-pairs." Existing employment and arrivals of new businesses are then calculated for all zipcodes that extend into a given wedge and wedge-pair using 2-digit SIC industry data from the Dun and Bradstreet Marketplace files for the third quarters of 2002 and 2005.[5] This produces a data file with roughly 96,000 newly established companies (for the 0 to 10 mile buffer region), each of which is treated as a separate observation. We then estimate a series of models designed to evaluate the propensity of an individual company to locate on one side of the border versus the other controlling for cross-border differences in state tax conditions.

Three different types of models are estimated using these data. The simplest is estimated by ordinary least squares and relies on the single differencing of tax conditions across the state border. A second model adds state-pair fixed effects and thereby identifies tax effects based on changes in cross-border differences in tax conditions over time. A more robust model replaces state-pair fixed effects with wedge-pair fixed effects that difference away time-invariant unobserved factors at the very local level.

[5] A similar procedure was used in Rohlin (2011).

Both of these latter models implicitly difference the data twice, across the state border and across time periods.

Our double differencing approach is in the same spirit as recent border studies by Holmes (1998) and Cunningham (2007). These studies considered the impact of state-level right-to-work laws and local land use regulation, respectively.[6] Other even more recent studies by Duranton, Gobillon, and Overman (forthcoming) and Rathelot and Sillard (2008) have used border models to consider the effect of property taxes and local corporate income taxes, respectively.[7] We also build off of three recent papers by Devereux, Griffith, and Simpson (2007), Jofre-Monseny and Sole-Olle (2008), and Brulhart, Jametti, and Schmidheiny (2009). These papers have considered the possibility that agglomeration may mitigate the deterrent effects of business taxes and/or subsidies.[8] Devereux, Griffith, and Simpson (2007), for example, found that government subsidies have less impact on a firm's location decision in more highly developed areas. Our work is further motivated by recent studies in the agglomeration literature which show that nearby activity (even within one mile) matters much more to many entrepreneurs than activity outside of the immediate area (e.g. Rosenthal and Strange (2003, 2005), Arzaghi and Henderson (2008)). Our focus on activity very close to the state border echoes this literature.

Taken as a whole, our research design and estimates offer three broad insights. First, they help to explain the wide variety of tax-deterrent estimates obtained in previous studies. Second, they demonstrate that local government (state-level in this case) expenditure and 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. Third, as a broad characterization, for any given size of local government activity,

[6] Holmes (1998) was among the first to use border methods to analyze the impact of local of public policies. Comparing manufacturing activity just on either side of a state border, 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.

[7] Both Duranton, Gobillon, and Overman (2009) and Rathelot and Sillard (2008) instrument for local tax measures using local political variables such as the share of voters belonging to a more conservative political party. Both studies find that higher taxes negatively affect growth of existing businesses although Duranton et al (2009) do not find an effect on the creation of new businesses.

[8] See also Greenstone and Moretti (2004) and Greenstone, Hornbeck and Moretti (2010) for related work.

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.

The following section presents a simple conceptual model that motivates and guides our analysis. Section 3 presents our empirical approach. Section 4 describes the data including the creation of the border buffer zones and segments. Section 5 presents results and Section 6 concludes.

II. Conceptual motivation

2.1 Overview

This section provides a simple conceptual framework that helps to clarify conditions under which cross-border differences in state tax conditions may affect the sorting of business activity to either side of the border. The model is not intended to be comprehensive, but instead is designed to motivate the empirical work to follow.

2.2 Bidding for land

Suppose 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. The presence of different types of firms is considered shortly. Firms are price takers and sell their product for a price P that does not vary spatially. This would be typical of exporters, for example.[9] Output is produced using 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 get to enjoy S given its public good nature, and the firm's profit function is given by,

$$\pi(u) = P + \theta_1(u) + \theta_2 S(u) - R(u) \qquad (2.1)$$

[9] For retailers and other local service providers, price would likely vary with proximity to a state border because of differences in distance and related travel costs to potential customers. In earlier versions of this paper we modeled such effects. However, this complicates presentation of the conceptual model without changing the key qualitative results highlighted below or the motivation for the empirical work to follow. For that reason, the presentation below treats price as spatially invariant.

where *u* denotes a firm's location based on distance to the border and the side of the border on which the company is situated. The term $\theta_1(u)$ is the productivity advantage firms derive from proximity to attributes associated with location *u,* and *R*(*u*) is the cost of land at location *u*. It is important to recognize that areas adjacent to a state border may have features that could enhance, deter, or have no effect on development opportunities and firm productivity. For that reason, $\theta_1(u)$ varies across locations and likely in a non-linear manner with respect to proximity to the state border. Local government services *S* are state-specific and change in a discrete fashion upon crossing the state border. With competitive markets, profits are driven to zero and the firm's bid-rent is given by,

$$R(u) = P + \theta_1(u) + \theta_2 S(u) \quad . \tag{2.2}$$

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 state government services. We assume that only companies located on side 1 of the border are subject to the tax. Maintaining the zero profit condition, the bid-rents on sides 1 and 2 of the border are given below in expressions (2.3a) and (2.3b), respectively,

$$R_1(u) = P + \theta_1(u) + \theta_2 S_1 - \theta_3 T_1 \tag{2.3a}$$

$$R_2(u) = P + \theta_1(u) + \theta_2 S_2 \quad . \tag{2.3b}$$

These expressions have several implications for the impact of state taxes on the location of companies close to the border. With a single type of company bidding for land, taxes will tend to be fully capitalized into lower land values and will have little effect on the equilibrium spatial distribution of companies across the border. With two or more sectors bidding for land, it is straight forward to show that capitalization effects still occur but are reduced, and the tax-sensitive sector will tend to shift in relative terms and in equilibrium towards the low-tax side of the border.

These ideas are illustrated in Figures 1 and 2, which display the bid-rents for land on either side of the state border before and after side 1 imposes its tax. To simplify the presentation, we specify $\theta_1(u)$ linearly as $\theta_1 u$ and allow θ_1 to be negative. This causes the bid-rent to decline with distance from the

border. We emphasize that this is not necessary. If instead the border region was associated with diss-amenities or was of neutral appeal the same key results highlighted above would be obtained.

In Figure 1, with T_1 set equal to zero, bid-rent is given by segment $\overline{abc}$ and is symmetric with respect to the border. 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 $\overline{debc}$. Implicitly, this assumes that land is inelastically supplied. Side-1 landowners therefore absorb the entire burden of the tax (T) and the equilibrium land rent function is given by $\overline{debc}$. In this simple model, side 1 taxes affect the spatial distribution of business activity on either side of the border only through a possible inward shift in the side-1 edge of the urban zone from point *a* to point *d*.

Suppose now that there are two types of companies bidding for land, type-I and type-II. Because the two sectors have different attributes, their bid rent functions relative to the border also differ. Moreover, with competitive land markets, space goes to the highest bidder. The bid-rent functions for the two sectors are drawn in Figure 2. In the absence of a tax, as drawn, type-II companies outbid type-I firms for space inside of points *g* and *i* while type-I firms are the high bidders beyond those points. Accordingly, type-II firms will occupy space close to the border with type-I firms situated further from the border. Equilibrium land rents are given by the upper envelope of the bid-rent functions and are $\overline{aghic}$. Observe also that for this scenario, both types of companies locate on both sides of the border.

Suppose now that a tax T is imposed on type-I firms as before but type-II firms are not subject to the tax. 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, or $\overline{fhic}$. As drawn in the figure, type-I firms continue to outbid type-II firms for space beyond point *i* on side-2 of the border where there is no tax. However, on side 1 of the border where the tax is imposed, type-II firms occupy all of the land.

This model makes clear that competition for land among multiple sectors mitigates the degree to which taxes are capitalized into lower equilibrium land rents. This is illustrated by the difference between

segments $\overline{fe}$ and $\overline{de}$ on side-1 of the border. In addition, cross-border differences in tax conditions change the composition of companies on each side of the border. In relative terms, the low-tax side of the border becomes more attractive to the tax-sensitive sector while the tax-sheltered sector shifts towards the high-tax side of the border. It is this shifting of the composition of activity and related sorting that we investigate in the empirical work to follow.[10]

III. Empirical Model

This section describes the empirical model used to assess the tax-avoidance effects of state tax conditions. Central to our identification strategy is the use of differencing methods designed to control for unobserved factors. As emphasized earlier, we focus on the influence of cross-border differences in state tax conditions on the state of choice for entrepreneurs operating within easy commuting distance of the border. In the empirical work to follow, we work with establishment level records that allow us to evaluate the location choice of newly created enterprises in both 2002 and 2005. Our estimation procedure is based on the assumption that entrepreneurs choose the side of the border that maximizes profits. Because we restrict our attention to activity within easy commuting distance of the border, conditions differ on either side of the border primarily because of differences in state-level government expenditure and tax conditions. Our model outlined below also allows for idiosyncratic differences in other economic attributes on either side of the state border.

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

$$\mathrm{I}_{it} = \alpha_1(S_{1t} - S_{2t}) + \alpha_2(T_{1t} - T_{2t}) + \alpha_3(\Omega_{1w,t} - \Omega_{2w,t}) \quad . \tag{3.1}$$

[10] Over time, the shift in business activity towards side 2 would increase spillovers from the concentration of nearby industry increasing productivity on side 2 of the border relative to side 1. This would cause the bid-rent functions for type-I and type-II firms on side 2 of the border to shift up. To the extent that type-I and type-II firms differ in their sensitivity to such effects, their bid-rents on side-2 would also shift to different degrees, and this would further affect the spatial distribution of firm types on side 2 of the border. Nevertheless, as the change in side-2 bid-rents will only occur if the spatial distribution of firms has shifted towards side 2, the core prediction that the imposition of a tax on side 1 will reduce side-1's relative share of the tax sensitive industry is robust.

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 along the border in which a company is located – recall that border regions will be broken into 20-mile long segments in a manner to be described in the following section. The subscript *t* represents the time period in which the company makes its location choice. As noted earlier, we have two time periods in our data, the third quarter of 2002 and the third quarter of 2005. We estimate (3.1) using a linear probability model (e.g. ordinary least squares).

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 consistent estimates of the primary parameters of interest, α_1 and α_2. We proceed by splitting $\alpha_3(\Omega_{1w,t} - \Omega_{2w,t})$ into time-invariant (Ω_w) and time-varying components (e_{wt}). Substituting into (3.1) we obtain,

$$I_{it} = \alpha_1(S_{1t} - S_{2t}) + \alpha_2(T_{1t} - T_{2t}) + \Omega_w + e_{wt} \quad . \qquad (3.2)$$

Given the specification in (3.2), it is apparent that we can control for Ω_w using border-segment fixed effects since we have two periods of data. In principle, the remaining term, e_{wt} , could still present a problem but for several reasons noted earlier and discussed in detail in the following section we think a case can be made that it does not.

IV. Data, Tax Measures, 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 tax data were obtained from the U.S. Census Bureau

website.[11] For our measure of the size of state government, we compute the per capita level of expenditures in each state and for each of our sample years, 2002 and 2005.

Tax measures for each sample year are formed by dividing gross revenue from a particular tax by the level of state government expenditures. As noted earlier, separate measures are created for the corporate income tax, the personal income tax, and the sales tax. Table 1a 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 to 14 percent of state budgets while the corporate income tax contributes a much smaller share, just 2.5 percent in 2005.[12] Together, these three sources of revenue comprise roughly 30 percent of state budgets. Most of the remaining portion of state budgets is derived from grants from the federal government (roughly 25 percent), all other forms of state taxes and licensing fees (roughly 20 percent), 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 percent).[13]

There are advantages and disadvantages to measuring tax conditions in this fashion. In principle, one could instead specify the tax rates associated with each state's sales tax, as well as their corporate and personal income taxes. That approach, however, would be challenging from a measurement perspective because states differ with respect to the industries and products that are subject to a sales tax, and also because corporate and personal income taxes are typically levied based on progressive schedules that differ across states.[14] Controlling directly for tax rates in the empirical model also complicates a subtle but important issue. For the sorting/location problem analyzed in this paper, it is desirable to allow for alternative sources of state government revenue beyond the income and sales tax measures highlighted above. To understand why, consider the following.

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[11] See http://www.census.gov/govs/state/historical_data.html for links to the data.
[12] States differ widely in their use of the three different taxes, including omission of some tax instruments in some states.
[13] See: U.S. Census Bureau, State & Local Government Finance, Historical Data: 2005, http://www.census.gov/govs/estimate/historical_data_2005.html .
[14] State-specific exemptions, deductions, and other allowances compound this situation by modifying a state's tax code for qualifying individuals and businesses.

Business bid-rent functions are typically sensitive to multiple forms of taxation that affect a company's costs (e.g. both corporate and personal income tax). In addition, as illustrated in Figure 2, the equilibrium sorting of different types of activity across locations depends on the mix of bid-rents from competing sectors of the economy, including other industries. This means that the observed location decisions of individual companies will depend not only on those segments of the tax code that directly affect their costs, but also on all other revenue raising mechanisms that affect competing sector bid-rents for space close to the state border. Different elements of the state tax environment are also likely highly correlated. That correlation arises because, as emphasized earlier, states must balance their budgets. This means that for a given per capita level of state expenditures, greater reliance on one source of state government revenue implies less reliance on other sources of revenue. For all of these reasons, a wide range of highly correlated sources of state government revenue may affect the equilibrium location of a company relative to the state border. This suggests that there are advantages to controlling for *all* sources of state government revenue when evaluating tax-avoidance effects.

As noted above, we control for state tax conditions by measuring cross-border differences in the share of state expenditures financed from a given source of revenue (e.g. the personal income tax). In this fashion, we compare the degree to which adjacent states differ in their *reliance* on different sources of tax revenue. Measuring state tax conditions in this manner is straight forward from a measurement standpoint. Moreover, because revenue shares sum to one, this approach has the appealing feature of controlling for a state's entire budget in a manner that allows for the influence of alternative sources of state government revenue. Two key questions then arise: (i) are the tax measures are exogenous, and (ii) assuming exogeneity, how should one interpret the estimated coefficients on our tax measures?

Consider first the question of exogeneity. On this point, we note that for a given level of state government expenditures, our tax measures change in value with the underlying tax rates and also the underlying level of state-wide economic activity that is relevant to a given tax (e.g. employment, sales volume, etc.). Regarding the underlying tax rates, several features of our approach help to ensure that state tax rates can be treated as exogenous. The first is that we focus on the location decisions of newly

established companies for which, as an approximation, cross-border differences in state tax rates are largely pre-determined. Second, differencing over time helps to further strip away unobserved factors that could be correlated with state tax rates. Third, as highlighted in Figure 3, except for small states in the northeast, the border areas included in the study are small relative to the land area in any given state. This helps to further reduce the tendency of state governments to set their tax rates in response to concerns about business location decisions along the border. Together, these features of the research design help to reduce correlation between state tax rates and unobserved attributes along the border.

What remains is whether we can treat cross-border differences in state-wide economic activity as exogenous. On this point we believe the answer is yes and once again because of the border design of our empirical strategy. As the two sides of a wedge-pair become arbitrarily close, separated only by the state border, they increasingly belong to a common local labor market except for the influence of cross-border differences in state policy. For that reason, and because the two sides of our wedge-pairs are always close together, there is little reason to think that cross-border differences in state-wide economic activity would affect the side of a wedge-pair in which an entrepreneur would choose to locate a new business. Later in the paper we provide a direct test of this idea by experimenting with inclusion of cross-border differences in state-wide employment in the model. As anticipated, inclusion of this measure has no impact on the coefficients on our tax and expenditure measures and does little to help predict the side of a state border on which a company locates. For these reasons and those above, we believe a case can be made that our tax measures are exogenous.

Treating the tax measures as exogenous, how then should the estimated coefficients on the tax measures be interpreted? We emphasize again that our tax measures are given by the cross-border difference in the share of state expenditures financed from a given source of tax revenue. This focus is a natural complement to other parts of our analysis in which we consider the impact of the size of state government as measured by the per capita level of state government expenditures.

More important, suppose that states are on the upward sloping portion of their Laffer curves for the three tax measures considered. This is an empirical question, of course (and highly political), but

would be consistent with recent analysis of federal tax conditions (see Uhlig and Trabandt (2011)). It would also be consistent with at least some modicum of efficiency in the setting of state tax levels. That is because states operating on the downward sloping portion of their Laffer curves can increase tax revenues while reducing deadweight loss by lowering their tax rates. For these reasons, in the discussion to follow, we will assume that an increase in reliance on a particular source of tax revenue is associated with an increase in the underlying tax rate or rate schedule (bearing in mind that throughout we condition on the per capita level of state expenditures).

Finally, as noted earlier, tax revenue shares sum to one. In addition, in the models to follow we include tax revenue shares for just corporate and personal income taxes and the sales tax. All other sources of state government revenue are omitted from the model and serve as the reference group. To simplify exposition, we refer to these other sources of state government revenue as non-tax sources of revenue.[15] Accordingly, for the discussion to follow, a positive coefficient on a given tax measure indicates that an increase in reliance on that measure relative to non-tax sources of revenue lures companies from across the border while a negative coefficient implies the opposite (deterrent) effect. Comparing coefficients across the three tax measures that are the primary focus of our analysis offers a different point of reference. As an example, if the personal income tax has a more negative coefficient than the sales tax, then this would suggest that relative to the sale tax, personal income taxes discourage business arrivals. We will revisit these interpretations later in the paper when the estimation results are discussed.

4.2 Creating the "wedge-pairs"

A key portion of our empirical strategy is to code data on business activity close to a state border into geographic units or polygons along the border which can be matched with nearby opposing polygons on the opposite side of the border. To code the data in this fashion, we first use geographic information

[15] This characterization is not strictly correct since included in the other revenue category are various sin taxes and other fees.

system (GIS) software to create 1 and 10 mile buffer zones on each side of all of the state borders in the United States. We then overlay on that map a 20 by 20 mile square grid. Only those grid squares that overlap state borders are retained. These are highlighted in Figure 3. For each such grid square, we then further restrict the area of interest to that portion which lies within the specified buffer zone (0 to 1 mile or 0 to 10 miles). That portion is then divided into two wedges on opposite sides of the state border and are matched as a "wedge-pair." Figure 4 illustrates.

In the figure, the heavy black line denotes a state border. The dashed lines describe the edge of the buffer drawn on either side of the state border. The thin vertical lines create wedge pairs made up of two adjacent wedges, one on either side of the border. Creation of wedge pairs would be straight forward if all state borders were straight lines. However, this is not always the case. To allow for more complicated state borders that curve and even turn back on themselves, a modification of the approach above is used. Details on that approach are provided in Appendix A.

4.3 Dun and Bradstreet data

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. The data provide information on different types of establishments aggregated to the zipcode level. Using these data, we are able to measure 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 convert the data into establishment level observations. 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). Only zipcodes that intersect a wedge are retained in the sample. All employment and business counts in each such zipcode are allocated to the intersecting wedge. If a

zipcode intersects more than one wedge, employment and business counts are allocated to the wedge with the greatest degree of overlap – this ensures that business activity in a given zipcode is counted only once.[16] By matching wedges into wedge-pairs as described in the previous sub-section, we can then evaluate which side of the state border each newly established business locates on as a function of the wedge-pair and state-level control measures.

Summarizing, as described above, we code our data so as to focus on new business arrivals in zipcodes within easy commuting distance of the state borders. For these purposes, we include newly established companies that are in zipcodes that extend to within either 1 or 10 miles of the state border depending on the buffer zone in question. Moreover, business activity in a given zipcode is "paired" with activity in opposing nearby zipcodes on the opposite side of the state border.

Table 2 reports the total number of newly established businesses in our sample for each buffer zone (0 to 1 mile and 0 to 10 miles), side of the state border (sides 1 and 2), and survey period (the third quarters of 2002 and 2005). Observe first that there are fewer newly created establishments in our sample in 2005 than in 2002. We address this difference by including a dummy variable for 2005 in all of the estimation models. Also apparent, there are more arrivals on side 2 than on side 1. Given the random assignment of side-1 and side-2 designations, this difference reflects either a tendency for grid squares that intersect a state border to be centered, on average, on side 2 of the border, or for side-2 designated areas to be more heavily developed. To address these possibilities, in some of the regression models to follow we include a control for the difference in area between opposing sides of a wedge-pair, calculated as 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, this wedge-area difference variable is replaced with wedge-pair fixed

[16] We also experimented with allocating newly created businesses in a given zipcode into a given wedge in proportion to the share of the zipcode that intersects that wedge. While appealing in some ways, this generates fractional numbers of arrivals in wedges, especially when only a small portion of a zipcode intersects the wedge and when there are few newly established companies in a given zipcode. The number of fractional arrivals was sufficiently numerous that we instead adopted the approach described above, in which we take account of all of the newly established companies in a zipcode that intersects at least one wedge.

effects that further control for any underlying tendency of 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 67,276 new establishments in zipcodes extending into the 0 to 1 mile buffer, and 96,434 new establishments in zipcodes extending into the 0 to 10 mile buffer. Comparing results from the two samples will help to establish the robustness of our estimates. As will become apparent, in most cases estimates are quite similar.

As described earlier, Figure 3 displays the border areas that are the focus of this study. Also shown in Figure 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 0 to 1 mile buffer and the 0 to 10 mile buffer. For each buffer, the table presents the distribution of total employment for the sample of new business arrivals. For both samples, panel A treats each establishment as a separate observation while panel B treats each wedge-pair as a separate observation. The heavily skewed distribution is evident with a very disproportionate share of establishments concentrated in the most heavily developed areas, mirroring the United States overall. We will draw on this stylized fact in some of the model specifications to follow.

V. 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 0 to 1 mile border region sample and the 0 to 10 mile border region sample. The key control measure in all of the models is the log ratio of the per capita level of state expenditures on side 2 of the border relative to side 1, and in the year in which the establishment is created (2002 or 2005). Also included is

the difference in the square mileage of the two wedges that comprise a given wedge-pair, and further a dummy variable for arrivals in the year 2005. When the models are estimated by ordinary least squares (OLS), the t-ratios reported are based on robust standard errors; when location-specific fixed effects are included the standard errors are clustered at the level of the specified fixed effects. In all cases, given the linear specification, the estimated coefficients on the key control variables have the usual marginal interpretation. In addition, for most of the discussion to follow we will focus on qualitative patterns among the estimated coefficients (e.g. signs and relative size). Magnitudes for select specifications will be discussed at the end.

For both buffer-zone samples, the results presented in the first column are obtained using OLS. This is essentially a single difference model in that the key control measures are expressed as cross border differences and identification is based on variation across wedge-pair locations and over time. For both distance bands, it is noteworthy that larger state government deters new arrivals relative to the opposing side of the border: the coefficient on the log ratio expenditure measure is -0.36 and -0.29 for the 0-to-1 and 0-to-10 mile samples, respectively. Both of these estimates are also highly significant, with t-ratios of 41 and 42, respectively. Taken at face value, this suggests that larger state government deters business. As suggested earlier, however, a concern with this specification is whether unobserved attributes close to the state borders might bias these estimates. Our remaining specifications help to address that possibility.

The second column for each buffer-zone sample includes controls for state-pair fixed effects. Identification in this specification is obtained 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 a sharp difference from the negative coefficients in the OLS model. It suggests that cross-border differences in state tax conditions are indeed correlated with cross-border differences in other unobserved attributes found along the state border.

To explore this issue further, the third column for each sample reports estimates based on a specification that includes wedge-pair fixed effects in place of the state-pair fixed effects. This strips

away time-invariant state-pair *and* local attributes in the border segment associated with a newly established enterprise. Observe that the coefficients on the log ratio of the expenditure variable are nearly identical to the middle columns in which we only control for state-pair fixed effects. This suggests that, at least with respect to the influence of the size of state government, unobserved local attributes in the immediate vicinity of a newly established enterprise have little influence on the impact of cross-border differences in state tax conditions. As will become apparent, however, this result is only partially robust to extensions of the model considered shortly, and for that reason, we favor the wedge-pair fixed effects specification in most of the estimation to follow.

5.2 State tax conditions

Table 5 repeats the analysis but adds controls that characterize the manner in which state governments finance their expenditures. As described earlier, these controls include the cross border difference in the share of state expenditures financed through the corporate income tax, the personal income tax, and the sales tax. It should be emphasized that the coefficients on these variables provide evidence of the impact of a given tax measure relative to "non-tax" sources of revenue, where non-tax in this context is defined as all state revenue apart from what is obtained from the three tax measures highlighted. As before, t-ratios reported for the OLS models are based on robust standard errors while for the fixed effect models standard errors are clustered at the level of the specified fixed effects.

Before discussing the coefficients on the tax measures some brief comments on the robustness of the different model specifications in Table 5 are in order. Notice that in all cases, the pattern of coefficients on the log ratio of per capita expenditures is nearly identical to that of Table 4. This suggests that the influence of the size of state government on the state of choice for entrepreneurs operating close to the border is largely independent of cross-border differences in the manner in which state governments finance their expenditures. This pattern persists through much of the rest of the paper, although there are some exceptions. Observe also that while the coefficients on the tax measures are similar in the state-pair and wedge-pair fixed effect models (the second and third specifications for each buffer-zone sample),

differences do occur. For that reason, in the discussion to follow we emphasize the wedge-pair fixed effect models. Finally, the last column for each buffer-zone sample adds the cross-border differences in state-wide employment to the wedge-pair fixed effect model. As discussed in Section 4.1, we do not expect this variable to have much influence on the estimated tax measure coefficients, and the patterns in Table 5 are consistent with that prior. As outlined earlier, this is consistent with the view that our tax measures are exogenous and that the coefficients on those measures are indicative of causal effects.

Consider now the estimated coefficients on the tax variables in the wedge-pair fixed effect models. Observe first that the signs of the coefficients from the 0-to-1 mile and 0-to-10 mile buffer-zone samples are always the same. Moreover, although there are some differences in the magnitude of the coefficients across the two samples, for the most part, the magnitudes of the coefficients are also quite similar. For these reasons, we will often focus on the 0-to-10 mile sample results for which the sample size is larger.

For the 0-to-10 mile sample, and concentrating on the wedge-pair fixed effect specification (without the state-level employment control), observe that the coefficient on the corporate income tax variable is positive 0.94 with a t-ratio of 1.73, the coefficient on the personal income tax variable is -0.22 with a t-ratio of -1.72, and the coefficient on the sale tax variable is 0.46 with a t-ratio of 3.04. This suggests that, relative to non-tax sources of state government revenue, increased reliance on the corporate income tax and sales tax as a way to finance state expenditures lures new business enterprises away from the adjacent state, while increased reliance on the personal income tax has the opposite effect.

These patterns are consistent with some of the priors developed earlier. In particular, recall that less than half of new establishments are incorporated and face a corporate income tax. Having controlled for cross-border differences in state expenditures, unincorporated businesses enjoy state expenditures financed through the corporate income tax and this may help to attract unincorporated companies to the high corporate income tax side of the border, all else equal. In principle, this could account for the positive coefficient on the corporate income tax share of expenditures. Nevertheless, while there is

appeal to this interpretation, other results presented later in the paper suggest that the influence of the corporate income tax is more complicated than suggested in Table 5.

Recall also that many industries are not subject to a sales tax. In addition, as a broad category, retail likely exhibits an inelastic demand which would allow retailers as a group to shift the burden of the sales tax onto consumers (e.g. Rosenthal and Ross (2010)). Conditional on the size of state government and the decision of companies to locate in the border region, we therefore expect the higher sales tax side of the border to attract new business relative to non-tax sources of state revenue and certainly in comparison to other sources of tax revenue; the estimates in Table 5 support that prior. As will become apparent, this result is largely robust to further analyses presented later in the paper.

In contrast, workers at all companies are subject to a personal income tax. For that reason, a plausible case can be made for the personal income tax to have a deterrent effect on choice of state for companies locating near the border. The patterns in Table 5 are consistent with that expectation. For the 0-to-1 mile sample the coefficient on personal income tax (in the wedge-pair fixed effect model) is -0.30 with a t-ratio of 2.18 while in the 0-to-10 mile sample the coefficient is -0.22 with a t-ratio of -1.72. As will become apparent, this result persists in most but not all of the specifications to follow.

5.3 Extensions

This section presents a series of extensions designed to illuminate the extent to which other factors affect the tendency of cross-border differences in state tax conditions to lure or repel establishments across a state border. These include differences in industry-specific attributes, corporate versus unincorporated status, the local scale of development (agglomeration), and the presence of reciprocal agreements that govern the state to which personal income tax is paid. We consider each of these conditions in turn, combining conditions in some instances.

5.3.1 Differences across industries

Table 6 repeats our core wedge-pair fixed effect specification stratifying the sample by 1-digit industry for manufacturing, wholesale trade, retail, financial services and insurance, and services. Also reported is a pooled regression for the first four non-service industries. Panel A reports estimates for the 0-to1 mile buffer sample while panel B reports estimates for the 0-to-10 mile buffer sample.

The key patterns in Table 6 are as follows. First, outside of the service sector, which accounts for almost half of the establishments in the sample, most of the coefficient estimates are not significant. This is especially true for the 0-to-1 mile buffer sample and likely reflects in part the greatly weakened power of the regressions owing to the relatively small industry-specific sample sizes. Second, in most instances, there is little evidence of a significant size-of-government effect for any of the industries. Third, the corporate income tax has a negative but not significant effect in manufacturing (the corresponding t-ratios from the two samples are both close to 1) but a positive and marginally significant effect in services in the 0-to-10 mile buffer sample. Fourth, the personal income tax has a significant, negative deterrent effect in services and wholesale for both samples, and fifth, the sales tax has a positive and significant or marginally significant attraction for manufacturing, retail, and services in the 0-to-10 mile buffer sample.

Along with evidence from Table 5, the most robust message emerging from Table 6 appears to be that the sales tax has a broadly attractive effect relative to non-tax sources of state government revenue. For manufacturing and much of the service sector, this is intuitive since those industries are not subject to a sales tax. For retail, the evidence is suggestive that demand for retail within ten miles of a state border is inelastic. That would be consistent with recent work by Rosenthal and Ross (2010) which shows that retail employment at the metropolitan level is almost entirely driven by population size. Under such conditions, as a group, retail business owners would tend to shift the burden of the sales tax onto consumers. This could account for the attractive effect of the sales tax relative to other non-tax sources of state government revenue.

5.3.2 Corporate status

This section explores a different feature of the data that allows us to further illuminate the possible influence of the corporate income tax. For roughly two-thirds of our sample, we are able to identify whether the establishment is a corporation, a sole proprietorship, or a partnership. For these companies, Table 7 presents estimates of our core model stratified by corporate versus non-corporate status. Because only corporations pay corporate income tax, it seems intuitive that the corporate income tax would be less of an attraction (more of a deterrent) for corporations than for unincorporated companies. For unincorporated companies, one would expect the personal income tax to have relatively more of a deterrent effect, both in comparison to other forms of taxation for reasons noted earlier, and also relative to the corporate sector.

Results in Table 7 are mixed. For both buffer-zone samples that include only corporations, the coefficients on all three of the tax measures are positive, although only the corporate tax for the 0-to-1 mile buffer sample and the personal income tax for the 0-to-10 mile buffer sample approach statistical significance (with t-ratios of 1.73 and 1.87, respectively). On the other hand, for the unincorporated sector, a clear pattern emerges that echoes patterns outlined earlier: the corporate income tax has a positive but only marginally significant attraction, the personal income tax has a clear negative and significant deterrent effect, and the sales tax has a clear positive and significant attraction.

Comparing results across the two sectors, it is clear that the sales tax is more of an attraction for the unincorporated sector while the personal income tax is more of a deterrent. Relative to non-tax sources of state government revenue, we do not see compelling evidence that there is much difference in the deterrent or attraction effect of the corporate income tax: this is evident from the positive coefficients on the corporate income tax variable for both corporations and unincorporated companies. The models to follow shed further light on the corporate income tax and help to explain these results, at least in part.

5.3.3 The scale of local development

Table 8 considers the extent to which tax deterrent effects differ with the scale of local development. As noted earlier in the paper, it is possible that government services could play a more valuable role in lightly developed areas in which private investment is limited. On the other hand, it is also possible that tax-deterrent effects could be swamped in heavily developed areas by the lure of valuable agglomeration economies. Finally, in those same heavily developed areas, workers are more productive and earn higher wages. With progressive state income tax codes, this raises the possibility that the deterrent effect of the personal income tax could actually be larger in agglomerated locations. For these reasons, theory offers mixed guidance as to whether local concentrations of employment exacerbate or mitigate tax avoidance effects for companies operating close to the state border.

To address these issues, Table 8 reports the results from several specifications that consider the influence of the local level of agglomeration. As before, estimates are provided for both buffer-zone samples. In the first model (columns 1 and 5), we include state-pair fixed effects along with wedge-pair level controls for the cross-border difference in total and own-industry (2-digit) employment. These measures characterize the intensity of local development, both in general and in the 2-digit industry specific to the establishment in question. More agglomerated areas are subject to congestion which is costly, but also often enjoy valuable spillover effects that enhance productivity (e.g. Duranton and Puga (2004), Rosenthal and Strange (2004), Arzaghi and Henderson (2008), Glaeser and Gottlieb (2009), Combes et al (2010)). On balance, most previous studies in the agglomeration literature find that nearby own-industry activity attracts new business. Conditional on the presence of own-industry employment, patterns arising from the overall level of development have been mixed. The estimates in Table 8 are consistent with that prior literature. For both buffer zone samples, own-industry activity lures entrepreneurs from across the border, although the coefficient for the 0-to-10 mile sample is not significant. For the 0-to-1 mile sample, greater concentration of total employment deters business arrivals while the opposite is true for the 0-to-10 mile buffer sample. Most important for the purposes of this

paper, the expenditure and tax coefficients are largely unaffected by inclusion of the local agglomeration control variables, at least relative to the state-pair fixed effect model presented in Table 5.

The second specification in Table 8 (columns 2 and 6) repeats the wedge-pair fixed effect model from Table 5. This model is provided for reference relative to the remaining models for which the samples are stratified into locations for which total employment in a given wedge-pair is below or above the 95th percentile, respectively, as reported in Table 3b. This stratification results in a roughly similar number of establishment-level observations in the lightly and heavily developed areas.

For both buffer zone samples, a sharp pattern is apparent. In the lightly developed areas (columns 3 and 7), most of the model coefficients are insignificant. The primary exception is a positive and significant coefficient on the sales tax for the 0-to-1 mile sample; this is mirrored by a positive but insignificant coefficient in the 0-to-10 mile sample. In contrast, estimates based on companies in heavily developed areas (columns 4 and 8) exhibit a compelling pattern of tax effects: for both samples the influence of the corporate income tax is positive but not significant, the personal income tax has a clear negative and significant effect, and the sales tax has a strong positive and significant attraction. These patterns are qualitatively similar to those in Table 5 and suggest that it is the heavily developed locations that are most sensitive to state-level sources of tax revenue relative to non-tax sources of state government revenue. While the evidence for this stratification appears compelling, other specifications still to follow suggest that such a conclusion would be hasty.

5.3.4 Reciprocal agreements

There is an additional feature of state tax policy that has received almost no attention in previous work but which seems likely to affect tax deterrent (and attraction) effects. In many instances, adjacent states enact reciprocal agreements that govern the state to which an individual owes personal income tax. In the absence of a reciprocal agreement, workers pay income tax to the state in which they work. With a reciprocal agreement in place between two states, workers pay tax to the state in which they live. The set of reciprocal agreements in place during our sample period were all enacted many years prior to 2002 (see

Table 1c). With competitive labor markets, in the absence of a reciprocal agreement, businesses have an incentive to locate on the low-income tax side of the border in order to avoid having to compensate their workers for higher personal income taxes through higher wages. But if a reciprocal agreement is in place, workers can live and pay tax in the low tax state even while working in the adjacent state. Such behavior should serve to reduce the deterrent effect of the personal income tax, and especially for workers within easy commuting distance of the border.

New to the literature, Table 9 stratifies our core model into establishments located in border areas for which a reciprocal agreement is in force and those without a reciprocal agreement. Also shown once again for reference are the full sample results that do not account for reciprocal agreement status. A quick review of Table 9 makes clear that reciprocal agreements have a notable impact on the manner in which state expenditure and tax measures affect the state of choice for companies situated close to the border.

Observe first that for locations without a reciprocal agreement in force, both for the 0-to-1 mile buffer sample and the 0-to-10 mile sample, larger state government attracts newly established companies that might otherwise locate on the alternate side of the border. For the 0-to-1 mile sample, the coefficient on cross-border log differences in per capita expenditures is positive 0.18 with a t-ratio of 3.54; for the 0-to-10 mile sample the corresponding estimate is 0.12 with a t-ratio of 2.46. Notably, for locations in which a reciprocal agreement is in force, the influence of size of state government is not significant (and negative) for both samples. Recall that the coefficient on size of state government can be positive or negative depending on whether state government expenditures are perceived as generating net value for a given tax dollar paid by the business community. On the surface, this suggests that in locations without a reciprocal agreement, state government may conduct its affairs in a more efficient manner. It is difficult to say why this would occur. However, one possibility is that the absence of a reciprocal agreement increases the deterrent effect of state taxes and states must respond by being more efficient in their expenditure policies if they are to attract business. The patterns on the tax measures in Table 9 are potentially consistent with this interpretation, although other explanations may also contribute.

In Table 9, observe that in locations with a reciprocal agreement in force, the coefficients on the corporate income tax are negative and significant for both samples, the coefficients on the sales tax are small and insignificant, and the coefficients on the personal income tax are negative but not significant (with t-ratios of -1.34 and -1.38, respectively). In contrast, for locations without a reciprocal agreement in force, the pattern is similar to that of Table 5: positive significant coefficients on both the corporate income tax and the sales tax, and negative coefficients on the personal income tax (which is significant in the 0-to-1 mile sample).

On balance, these patterns indicate that when reciprocal agreements are not in force, relative to the personal income tax, both the corporate income tax and the sales tax tend to lure companies that might otherwise locate on the opposite side of the border. This suggests that of the three sources of tax revenue, businesses in such locations are most deterred by the personal income tax. However, in locations in which reciprocal agreements are in force, businesses operating close to the border are comparatively insulated from the adverse effects of the personal income tax. In such locations, the deterrent effect of the personal income tax diminishes relative to the other two sources of tax revenue to the point that the corporate income tax emerges as the tax that companies most seek to avoid.

5.3.5 Reciprocal agreements in lightly and heavily developed locations

From the previous two sections it is clear that both the level of local development and the presence of reciprocal agreements affect the tendency of companies operating close to the state border to choose their locations so as to avoid state taxes. This section explores these patterns further by stratifying each of the two buffer zone samples into four subsamples based on lightly and heavily developed areas in locations with and without reciprocal agreements. Estimates are reported in Table 10. Panel A displays results for the 0-to-1 mile sample while panel B displays results for the 0-to-10 mile sample. Note also that the reciprocal agreement estimates from Table 9 are provided for reference.

Reviewing both panels, a further striking set of patterns emerges. First, the coefficients on cross-border differences in state government expenditures are positive, especially large, and significant in

heavily developed locations without a reciprocal agreement. This echoes the reciprocal agreement results in Table 9 but differs from the agglomeration patterns in Table 8 where the corresponding coefficients are small and not significant.

The patterns on the corporate income tax coefficients are also largely similar to the reciprocal agreement patterns in Table 9: negative coefficients when reciprocal agreements are in force and positive when they are not. Moreover, for a given reciprocal agreement status, the corporate income tax coefficients differ little with the local level of agglomeration. This suggests that the deterrent/attraction effect of the corporate income tax is more sensitive to reciprocal agreements between adjacent states as compared to the local level of agglomeration. These patterns are mostly mirrored by the pattern of sales tax coefficients which are also largely similar to the reciprocal agreement patterns in Table 9 and not as sensitive to the local level of agglomeration.

In contrast to the corporate income tax and sales tax, the pattern for the personal income tax coefficients in Table 10 appears to be sensitive to both the presence of reciprocal agreements and the local level of agglomeration. Notice that most of the coefficients on the personal income tax are negative but very imprecisely estimated (and not significant). However, for the 0-to-1 mile sample in heavily developed areas without a reciprocal agreement the coefficient is -0.53 with a t-ratio of -2.35. This pattern is consistent with the view that (i) reciprocal agreements matter for companies operating very close to the border, and (ii) that higher wages in agglomerated locations amplify the deterrent effect of personal income taxes for companies operating very close to the state border.[17]

[17] We also stratified Table 10 by corporate status, results from which are presented in Tables B-1a and B-1b of Appendix B. On a qualitative basis, the patterns in Appendix B are mostly consistent with those in Table 10 although the precision of our estimates suffers with the further reduction in the size of the estimating samples. The most noteworthy result in Tables B-1a and B-1b is that the corporate income tax has a deterrent effect on unincorporated companies (sole proprietorships and partnerships) operating in lightly developed areas for which a reciprocal agreement is in force: for the 0-to-1 mile sample the coefficient is -6.77 with a t-ratio of -3.75 while for the 0-to-10 mile sample the coefficient is -5.36 with a t-ratio of -3.43. Negative but not significant coefficients are also obtained for unincorporated companies operating in heavily developed areas for which a reciprocal agreement is in force. In principle, one might have anticipated positive coefficients for these estimates since unincorporated companies do not pay corporate income tax. However, we cannot rule out the possibility that newly established unincorporated companies anticipate becoming corporations in the future. To the extent that is true, and in the presence of reciprocal agreements that reduce the deterrent effect of the personal income tax, that may account for the negative coefficient on the corporate income tax measure. To explore the influence of the corporate income tax

5.3.5 Magnitudes

To complete our discussion, some brief comments about the magnitude of our estimates is in order. For these purposes we will mostly focus on the coefficient estimates in Table 9 which stratifies the samples by reciprocal status. Consider now an entrepreneur operating close to the border of state X.

Suppose that state X reduces its reliance on the corporate income tax as a source of revenue by 2 percentage points – about equal to the mean revenue share reported in Table 1a – and makes up the shortfall through an increase in non-tax sources of revenue. With a reciprocal agreement in place, the relevant coefficient from Table 9 would round to -2 and the likelihood that the entrepreneur would choose to locate in state X would be reduced by 4 percentage points. If instead a reciprocal agreement is not in place, the relevant coefficient in Table 9 would be close to positive 2 and the policy change would increase the likelihood that the company would locate in state X by roughly 4 percentage points.

Suppose instead that state X reduces its reliance on the sales tax by 13 percentage points (the mean in Table 1a). Without a reciprocal agreement in place the corresponding coefficient on the sales tax in Table 9 is roughly 0.6. This suggests that the policy change would increase the likelihood that an entrepreneur would locate in state X by roughly 7.8 percentage points.

For the personal income tax, suppose the entrepreneur is operating in a zipcode that extends to within 1 mile of the border in a heavily developed area and also that state X is not subject to a reciprocal agreement (panel A of Table 10). Recall also that the corresponding personal income tax coefficient in Table 10 is roughly -0.5. For such locations, reducing reliance on the personal income tax as a source of revenue by 13 percentage points (the mean in Table 1a) would reduce the likelihood that the entrepreneur locates in State X by 7.3 percentage points. If instead the personal income tax coefficient is closer to the value -0.25 as in Table 5, the deterrent effect is about 3.7 percentage points.

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further, we also attempted to stratify the models in Appendix B to allow for corporate income tax apportionment formulas which differ across states (e.g. Goolsbee and Maydew (2000), Klassen and Shackelford (1998), and Gordon and Wilson (1986)). Sample sizes from that exercise became sufficiently small that reliable estimates could not be obtained and are not reported for that reason.

The precise magnitude of these estimates is subject to error. Nevertheless, the simulations above suggest that tax deterrent and attraction effects are large enough to make a difference for border communities and this is something that state governments and others should recognize.

VI. Conclusions

This paper has revisited an old question that has eluded efforts to provide a stable and clear answer: to what extent do local taxes deter business activity? Any number of 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 – or far from – 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. This focus entails tradeoffs. It reduces the degree to which our findings generalize to the level of business activity across broader regions, but it increases our ability to control for unobserved factors and thereby enhances the reliability of our estimates. Moreover, despite the focus on activity close to state borders, a number of the central findings of the paper likely generalize to other settings.

Most important, our findings demonstrate that there is no simple or uniform approach one can take when evaluating tax deterrent effects. That is because tax effects differ with the type of tax, the type of industry, ownership structure of the company (e.g. corporate versus non-corporate), the local level of agglomeration, and other policies such as reciprocal agreements that require workers to pay personal income tax to their state of residence as opposed to the state in which they work. Given the sensitivity of our estimates to these considerations, it is not surprising that much of the previous literature on the deterrent effects of local taxation has yielded complicated and mixed results.

Nevertheless, our research design does allow us to offer some general observations. As an example, new to this paper, state reciprocal agreements appear to have a pronounced effect on the deterrent effects of different sources of state tax revenue. In locations without a reciprocal agreement in place, relative to non-tax sources of state revenue, the corporate income tax and the sales tax tend to lure companies from across the border while the personal income tax has a deterrent effect that is especially apparent in heavily developed areas. When a reciprocal agreement is in force, the corporate income tax emerges as the tax with the greatest deterrent effect, both in comparison to the other taxes and also in comparison to non-tax sources of revenue.

The tendency of some types of taxes to attract business activity might seem surprising at first but is actually quite intuitive. Having controlled for the size of state government and related services, entrepreneurs will tend to be drawn towards those locations in which they are sheltered from the cost of financing local government activity. This helps to explain why the sales tax has a predominantly attractive effect on manufacturing and the service sector since most segments of these industries are not subject to the tax. For analogous reasons, our modeling approach also helps to explain why unincorporated companies appear to be notably more deterred by the personal income tax as opposed to the corporate income tax, and why the deterrent effect of the personal income tax is more difficult to identify in border regions in which reciprocal agreements are in place.

Taken as a whole, our research design and estimates offer three broad insights that are likely to generalize to areas well beyond the border regions of individual states. First, they help to explain the wide variety of tax-deterrent estimates obtained in previous studies. Second, they demonstrate that local government (state-level in this case) expenditure and 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. Third, as a broad characterization, for any given size of local government activity, entrepreneurs and new business activity tend to be drawn to locations in which they are relatively more sheltered from the cost of financing local government activities. State lawmakers, therefore, should take seriously the possibility that tax conditions may deter entrepreneurs from locating within their borders.

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Figure 1: One Sector

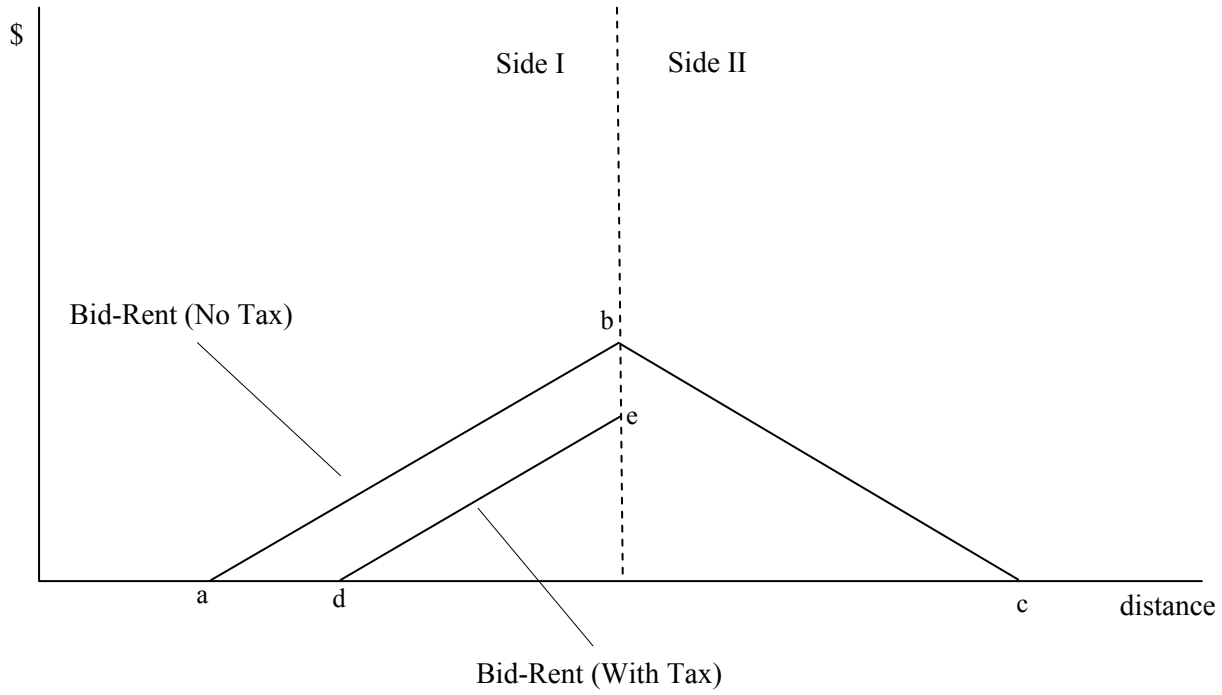


Figure 2: Two Sectors

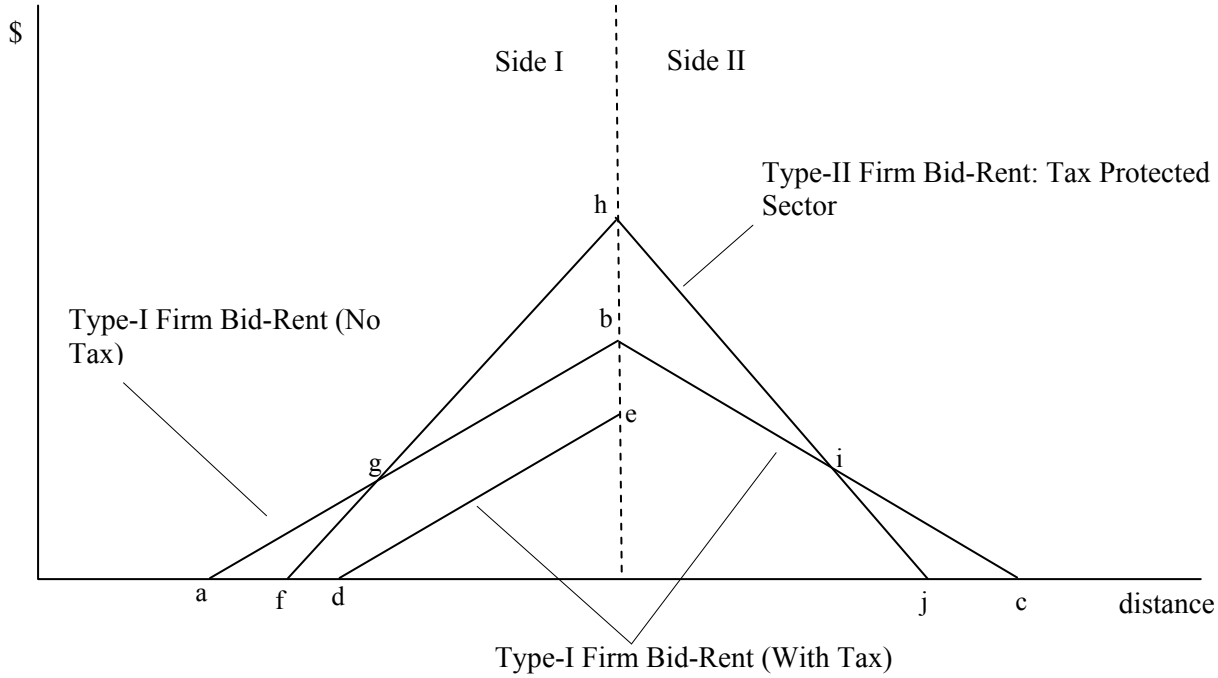


Figure 3: Border Region Total Employment

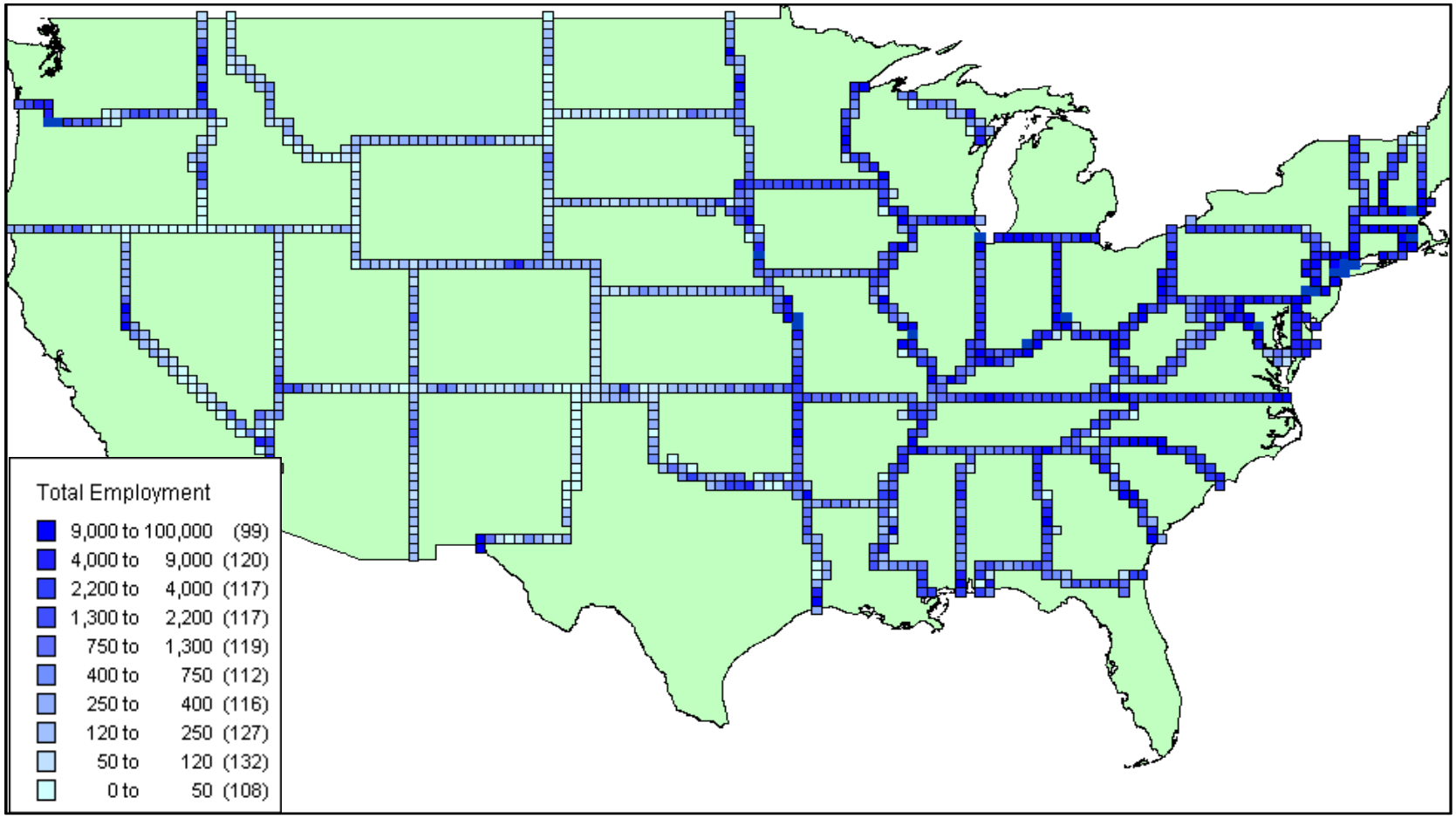


Figure 4: Creation of Wedge Pairs

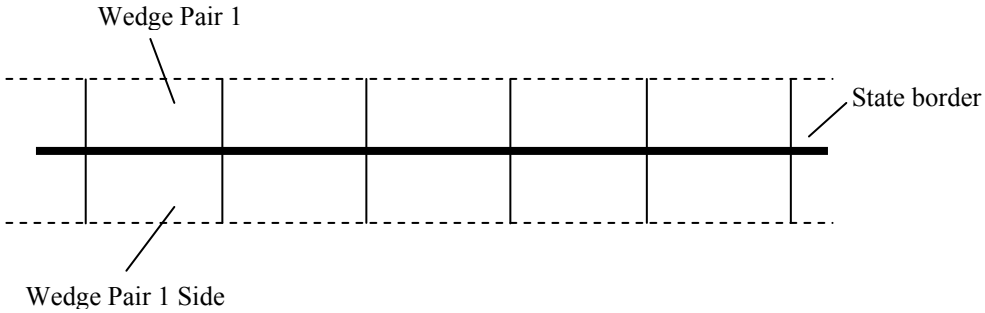


Table 1a: State Revenue Shares and Expenditures for the 48 Contiguous States

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	$4,650
2005	0.139	0.136	0.025	$5,207

[a] For 2005, 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 percent; All other sources of tax, licensing, and general revenue, roughly 20 percent; State-owned utilities and liquor stores, roughly 1 percent; Insurance trust revenue for government retirement and social insurance programs including contributions by government workers and net earnings on fund investments, roughly 25 percent. See: U.S. Census Bureau, State & Local Government Finance, Historical Data: 2005, http://www.census.gov/govs/estimate/historical_data_2005.html .

Table 1b: Corporate Share of New Business Arrivals in the United States[a]

	2002:Q3		2005:Q3	
Variable	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 & 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.

Table 1c: 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	Maryland	Pennsylvania	1990
	Kentucky	1971		Virginia	1992
	Michigan	1971		West Virginia	1988
	Wisconsin	1973	Michigan	Minnesota	1984
Indiana	Kentucky	1977		Ohio	1972
	Michigan	1968		Wisconsin	1967
	Ohio	1977	Minnesota	North Dakota	1958
	Pennsylvania	1977		Wisconsin	1968
	Wisconsin	1977	Montana	North Dakota	1982
Kentucky	Michigan	1968	New Jersey	Pennsylvania	1978
	Ohio	1972	Ohio	Pennsylvania	1978
	West Virginia	1965		West Virginia	1972
	Wisconsin	1968	Pennsylvania	Virginia	1982
	Virginia	1964		West Virginia	1972
			Virginia	West Virginia	1988

[a]The reciprocal agreement data comes from www.gaebler.com. Note that Washington DC is not included in this list despite having reciprocal agreements because Washington DC is not included in this study.

Table 2: Total Number of New Business Arrivals[a]

Variable	2002 Side 1	2002 Side 2	2005 Side 1	2005 Side 2	Total
0 up to 1 Mile	14,645	21,353	13,947	17,331	67,276
0 up to 10 Miles	21,860	29,712	20,566	24,296	96,434

Table 3: Wedge-Pair Employment Counts in 2002:Q3

Panel A: Each Establishment Treated as a Separate Observation

Percentile	0 to 1 Mile Buffer Zone	0 to 10 Mile Buffer Zone
5th	10,594	13,779
25th	32,596	48,854
50th	82,441	139,607
75th	288,511	465,073
95th	3,522,033	3,936,475
Mean	547,247	620,103
Observations	67,276	96,434

Panel B: Each Wedge-Pair Treated as a Separate Observation

Percentile	0 to 1 Mile Buffer Zone	0 to 10 Mile Buffer Zone
5th	2,620	2,647
25th	7,375	7,723
50th	14,033	16,013
75th	30,203	35,424
95th	91,815	135,454
Mean	33,428.48	44,868.15
Observations	832	869

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 parenthesis)

	0 up to 1 Mile Buffer Sample			0 up to 10 Mile Buffer Sample		
	OLS	State Pair FE	Wedge-Pair FE	OLS	State Pair FE	Wedge-Pair FE
$Log(PerCapExp_2/PerCapExp_1)$[a]	-0.3605	0.1004	0.0991	-0.2906	0.0168	0.0331
	(-41.01)	(1.23)	(1.98)	(-41.93)	(0.25)	(0.66)
$Area_2 - Area_1$ (sq miles)[b]	0.0072	0.0089	-	0.0021	0.0024	-
	(171.41)	(6.49)	-	(181.34)	(10.66)	-
Year 2005	-0.0357	-0.0240	-0.0184	-0.0319	-0.0219	-0.0190
	(-10.17)	(-2.83)	(-3.88)	(-11.06)	(-3.00)	(-4.02)
Observations	67848	67848	67848	96370	96370	96370
State Fixed Effects	-	104	-	-	105	-
Wedge-Pair Fixed Effects	-	-	861	-	-	882
Root MSE	0.46	0.43	0.37	0.45	0.42	0.36
R-Squared (within FE)	-	0.1011	0.0007	-	0.1895	0.0007
Adj. R-Squared (total)	0.1513	0.2509	0.4362	0.1935	0.2998	0.4666

[a] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[b] $Area_2$ and $Area_1$ are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

Table 5: Tax Measures

Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

	0 up to 1 Mile Buffer Sample				0 up to 10 Mile Buffer Sample			
	OLS	State FE	Wedge-Pair FE	Wedge-Pair FE with State Emp	OLS	State Pair FE	Wedge-Pair FE	Wedge-Pair FE with State Emp
Log($PerCapExp_2$/$PerCapExp_1$)[a]	-0.3152	0.1240	0.1250	0.1248	-0.2725	0.0296	0.0510	0.0516
	(-32.63)	(1.44)	(2.42)	(2.42)	(-33.54)	(0.41)	(0.98)	(1.00)
$CorpTaxRev/Exp_2$ – $CorpTaxRev/Exp_1$[b]	-0.3718	0.7515	0.8977	0.8716	-0.6545	0.6829	0.9433	0.8733
	(-2.68)	(0.60)	(1.38)	(1.32)	(-5.72)	(0.81)	(1.73)	(1.58)
$IncTaxRev/Exp_2$ – $IncTaxRev/Exp_1$[b]	-0.2236	-0.2812	-0.2953	-0.3018	-0.0347	-0.2453	-0.2196	-0.2434
	(-9.37)	(-1.27)	(-2.18)	(-2.21)	(-1.67)	(-1.56)	(-1.72)	(-1.87)
$SalesTaxRev/Exp_2$ – $SalesTaxRev/Exp_1$[b]	0.2095	0.5619	0.3756	0.3771	0.1620	0.5172	0.4649	0.4694
	(7.58)	(3.17)	(2.93)	(2.96)	(7.26)	(3.63)	(3.04)	(3.12)
Total State Employment Side 2	-	-	-	0.0000	-	-	-	0.0000
– Total State Employment Side 1	-	-	-	(0.50)	-	-	-	(1.45)
$Area_2$ – $Area_1$ (sq miles)[c]	0.0074	0.0089	-	-	0.0021	0.0024	-	-
	(158.65)	(6.50)	-	-	(173.10)	(10.63)	-	-
Year 2005	-0.0347	-0.0225	-0.0155	-0.0152	-0.0339	-0.0204	-0.0161	-0.0148
	(-9.82)	(-2.52)	(-3.12)	(-3.00)	(-11.66)	(-3.09)	(-3.67)	(-3.39)
Observations	67,848	67,848	67,848	67,848	96,370	96,370	96,370	96370
State-Pair Fixed Effects	-	104	-	-	-	105	-	-
Wedge-Pair Fixed Effects	-	-	861	861	-	-	882	882
Root MSE	0.45	0.43	0.37	0.37	0.45	0.42	0.36	0.36
R-Squared (within FE)	-	0.1015	0.0010	0.0010	-	0.1898	0.0011	0.0011
Adj. R-Squared (total)	0.1557	0.2512	0.4364	0.4364	0.1951	0.3008	0.4668	0.4668

[a] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[b] Exp_1 and Exp_2 are the state levels of expenditures on sides 1 and 2 of the border.
[c] $Area_2$ and $Area_1$ are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

Table 6: Stratification by Industry

Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

Panel A: 0 to 1 Mile Buffer Sample

	All Industries	Manufacturing	Wholesale	Retail	Finance-Ins	Services	Not Services
$Log(PerCapExp_2/PerCapExp_1)$[a]	0.1250	-0.3305	0.3671	-0.0392	-0.2568	0.1394	0.1088
	(2.42)	(-1.36)	(2.03)	(-0.45)	(-1.17)	(2.20)	(1.73)
$CorpTaxRev/Exp_2 – CorpTaxRev/Exp_1$[b]	0.8977	-3.1592	1.6839	0.0147	1.8947	1.0534	0.7410
	(1.38)	(-1.37)	(0.97)	(0.02)	(0.63)	(1.38)	(1.00)
$IncTaxRev/Exp_2 – IncTaxRev/Exp_1$[b]	-0.2953	-0.1996	-0.9425	-0.0383	0.2094	-0.3092	-0.2679
	(-2.18)	(-0.34)	(-2.35)	(-0.18)	(0.35)	(-1.83)	(-1.72)
$SalesTaxRev/Exp_2 – SalesTaxRev/Exp_1$[b]	0.3756	0.4371	0.1477	0.2123	-0.1365	0.3279	0.4116
	(2.93)	(1.35)	(0.43)	(1.24)	(-0.28)	(1.93)	(3.06)
Year 2005	-0.0155	-0.0354	0.0039	-0.0176	-0.0011	-0.0157	-0.0164
	(-3.12)	(-1.66)	(0.27)	(-2.46)	(-0.05)	(-2.58)	(-2.84)
Observations	67,848	2,310	3,770	15,078	2,126	31,311	36,537
Wedge-Pair Fixed Effects	861	234	347	686	190	752	788
Root MSE	0.37	0.36	0.35	0.37	0.34	0.37	0.37
R-Squared (within FE)	0.0010	0.0031	0.0033	0.0006	0.0027	0.0011	0.0010
Adj. R-Squared (total)	0.4364	0.4545	0.4947	0.4369	0.5279	0.4431	0.4335

Panel B: 0 to 10 Mile Buffer Sample

	All Industries	Manufacturing	Wholesale	Retail	Finance-Ins	Services	Not Services
$Log(PerCapExp_2/PerCapExp_1)$[a]	0.0510	-0.2094	0.3395	-0.0012	-0.2748	0.0505	0.0486
	(0.98)	(-1.06)	(2.10)	(-0.01)	(-1.29)	(0.69)	(0.83)
$CorpTaxRev/Exp_2 – CorpTaxRev/Exp_1$[b]	0.9433	-1.9967	0.2935	0.4294	0.8418	1.2355	0.6552
	(1.73)	(1.04)	(0.22)	(0.54)	(0.38)	(1.77)	(1.13)
$IncTaxRev/Exp_2 – IncTaxRev/Exp_1$[b]	-0.2196	-0.0828	-0.6937	0.0314	0.7702	-0.3524	-0.0825
	(-1.72)	(-0.17)	(-1.99)	(0.14)	(1.36)	(-2.11)	(-0.58)
$SalesTaxRev/Exp_2 – SalesTaxRev/Exp_1$[b]	0.4649	0.4348	0.3946	0.2625	-0.0014	0.5243	0.4065
	(3.04)	(1.65)	(1.22)	(1.75)	(-0.01)	(2.97)	(2.69)
Year 2005	-0.0161	-0.0456	-0.0086	-0.0148	-0.0082	-0.0142	-0.0175
	(-3.67)	(-3.03)	(-0.72)	(-2.39)	(-0.46)	(-2.47)	(-3.70)
Observations	96,370	3,713	5,357	20,684	3,422	44,568	51,802
Wedge-Pair Fixed Effects	882	270	383	716	217	785	811
Root MSE	0.36	0.36	0.34	0.36	0.34	0.36	0.36
R-Squared (within FE)	0.0011	0.0030	0.0025	0.0006	0.0032	0.0013	0.0010
Adj. R-Squared (total)	0.4668	0.4732	0.5310	0.4697	0.5176	0.4748	0.4632

Table 7: Corporate Versus Non-Corporate Status

Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are in parenthesis)

	0 up to 1 Mile Buffer Sample		0 up to 10 Mile Buffer Sample	
	Corporations	Sole Proprietorships and Partnerships	Corporations	Sole Proprietorships and Partnerships
$Log(PerCapExp_2/PerCapExp_1)$[a]	0.1513	0.1410	0.0098	0.0656
	(1.28)	(1.93)	(0.09)	(0.82)
$CorpTaxRev/Exp_2 - CorpTaxRev/Exp_1$[b]	2.0983	0.5968	0.6755	1.3815
	(1.73)	(0.72)	(0.60)	(1.90)
$IncTaxRev/Exp_2 - IncTaxRev/Exp_1$[b]	0.1248	-0.4296	0.4083	-0.5583
	(0.56)	(-1.91)	(1.87)	(-2.40)
$SalesTaxRev/Exp_2 - SalesTaxRev/Exp_1$[b]	0.0886	0.6198	0.1222	0.6691
	(0.48)	(2.73)	(0.74)	(2.83)
Year 2005	-0.0050	-0.0156	-0.0094	-0.0108
	(-0.56)	(-2.28)	(-1.36)	(-1.77)
Observations	25,439	26,194	36,980	36,444
Wedge-Pair Fixed Effects	720	770	733	787
Root MSE	0.37	0.38	0.36	0.37
R-Squared (within FE)	0.0010	0.0001	0.0008	0.0015
Adj. R-Squared (total)	0.4507	0.4199	0.4891	0.4413

[a] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[b] Exp_1 and Exp_2 are the state levels of expenditures on sides 1 and 2 of the border.
[c] $Area_2$ and $Area_1$ are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

Table 8: Agglomeration

Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

	0 up to 1 Mile Buffer Sample				0 up to 10 Mile Buffer Sample			
	Full Sample State Pair FE	Full Sample Wedge-Pair FE	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Full Sample State Pair FE	Full Sample Wedge-Pair FE	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)
$Log(PerCapExp_2/PerCapExp_1)$[a]	0.1604	0.1250	0.0937	0.0998	0.0060	0.0510	0.0513	-0.2444
	(1.81)	(2.42)	(1.70)	(0.47)	(0.08)	(0.98)	(0.93)	(-1.21)
$CorpTaxRev/Exp_2 – CorpTaxRev/Exp_1$[b]	0.7630	0.8977	-0.0405	2.5660	0.6775	0.9433	0.5228	0.4319
	(0.64)	(1.38)	(-0.06)	(1.59)	(0.75)	(1.73)	(0.81)	(0.40)
$IncTaxRev/Exp_2 – IncTaxRev/Exp_1$[b]	-0.3100	-0.2953	-0.0986	-0.8193	-0.2450	-0.2196	0.0418	-0.7655
	(-1.51)	(-2.18)	(0.64)	(-2.50)	(-1.41)	(-1.72)	(0.27)	(-3.03)
$SalesTaxRev/Exp_2 – SalesTaxRev/Exp_1$[b]	0.1205	0.3756	0.3429	0.8064	0.8363	0.4649	0.2210	0.7501
	(0.34)	(2.93)	(1.87)	(4.36)	(5.58)	(3.04)	(1.06)	(4.64)
Total employment side 2	-1.50E-07	-	-	-	8.00E-08	-	-	-
– Total employment side 1	(-3.61)	-	-	-	(3.28)	-	-	-
Own industry employment side 2	7.00E-08	-	-	-	7.00E-08	-	-	-
– Own industry employment side 1	(1.73)	-	-	-	(1.00)	-	-	-
$Area_2 – Area_1$ (sq miles)[c]	0.0139	-	-	-	0.0019	-	-	-
	(9.45)	-	-	-	(10.34)	-	-	-
Year 2005	-0.0303	-0.0155	-0.0119	-0.0199	-0.0162	-0.0161	-0.0150	-0.0279
	(-2.87)	(-3.12)	(-2.12)	(-1.28)	(-2.47)	(-3.67)	(-2.76)	(-2.86)
Observations	67,120	67,848	38,921	28,927	96,275	96,370	48,123	48,247
State-Pair Fixed Effects	104	-	-	-	105	-	-	-
Wedge-Pair Fixed Effects	-	861	811	50	-	882	829	53
Root MSE	0.43	0.37	0.38	0.36	0.41	0.36	0.37	0.36
R-Squared (within FE)	0.1084	0.0010	0.0006	0.0025	0.2002	0.0011	0.0007	0.0023
Adj. R-Squared (total)	0.2573	0.4364	0.4191	0.4424	0.3090	0.4668	0.4598	0.4699

[a] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[b] Exp_1 and Exp_2 are the state levels of expenditures on sides 1 and 2 of the border.
[c] $Area_2$ and $Area_1$ are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

Table 9: Reciprocal Agreements

Dependent Variable is 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

	0 up to 1 Mile Buffer Sample			0 up to 10 Mile Buffer Sample		
	Full Sample	Reciprocal Agreements	No Reciprocal Agreements	Full Sample	Reciprocal Agreements	No Reciprocal Agreements
$Log(PerCapExp_2/PerCapExp_1)$[a]	0.1250	-0.0454	0.1811	0.0510	-0.2346	0.1195
	(2.42)	(-0.17)	(3.54)	(0.98)	(-0.94)	(2.46)
$CorpTaxRev/Exp_2 - CorpTaxRev/Exp_1$[b]	0.8977	-2.2889	2.0930	0.9433	-1.8973	1.7931
	(1.38)	(-1.86)	(2.94)	(1.73)	(-1.87)	(3.15)
$IncTaxRev/Exp_2 - IncTaxRev/Exp_1$[b]	-0.2953	-0.7436	-0.2207	-0.2196	-0.6897	-0.0719
	(-2.18)	(-1.34)	(-1.71)	(-1.72)	(-1.38)	(-0.62)
$SalesTaxRev/Exp_2 - SalesTaxRev/Exp_1$[b]	0.3756	-0.1387	0.5917	0.4649	0.0910	0.6525
	(2.93)	(-0.13)	(4.79)	(3.04)	(0.10)	(4.68)
Year 2005	-0.0155	-0.0289	-0.0148	-0.0161	-0.0265	-0.0190
	(-3.12)	(-2.56)	(-2.76)	(-3.67)	(-3.00)	(-3.77)
Observations	67,848	16,042	51,806	96,370	24.847	71,523
Wedge-Pair Fixed Effects	861	203	658	882	196	686
Root MSE	0.37	0.44	0.35	0.36	0.42	0.34
R-Squared (within FE)	0.0010	0.0014	0.0031	0.0011	0.0009	0.0023
Adj. R-Squared (total)	0.4364	0.2358	0.4973	0.4668	0.2898	0.5292

[a] $PerCapExp_1$ and $PerCapExp_2$ are the state per capita levels of expenditures on sides 1 and 2 of the border.
[b] Exp_1 and Exp_2 are the state levels of expenditures on sides 1 and 2 of the border.
[c] $Area_2$ and $Area_1$ are the square mileage of the wedges from sides 2 and 1 that belong to a given wedge pair.

Table 10: Reciprocal Agreements and Agglomeration

Dependent Variable 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

Panel A: 0 to 1 Mile Buffer Sample

	Reciprocal Agreements In Force			No Reciprocal Agreements		
	Full Sample	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Full Sample	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)
$Log(PerCapExp_2/PerCapExp_1)$[a]	-0.0454	-0.2703	0.8201	0.1811	0.1249	0.3531
	(-0.17)	(-1.03)	(0.78)	(3.54)	(2.20)	(2.50)
$CorpTaxRev/Exp_2 - CorpTaxRev/Exp_1$[b]	-2.2889	-4.3908	-4.6515	2.0930	1.3326	3.9913
	(-1.86)	(-3.78)	(-1.44)	(2.94)	(1.64)	(2.70)
$IncTaxRev/Exp_2 - IncTaxRev/Exp_1$[b]	-0.7436	-0.3086	-0.6686	-0.2207	-0.0232	-0.5330
	(-1.34)	(-0.49)	(-0.47)	(-1.71)	(-0.15)	(-2.35)
$SalesTaxRev/Exp_2 - SalesTaxRev/Exp_1$[b]	-0.1387	0.6099	-2.2030	0.5917	0.5402	0.9981
	(-0.13)	(0.65)	(-0.92)	(4.79)	(2.87)	(5.87)
Year 2005	-0.0289	-0.0107	-0.0577	-0.0148	-0.0130	-0.0192
	(-2.56)	(-0.78)	(-3.76)	(-2.76)	(-2.00)	(-1.50)
Observations	16,042	8,941	7,101	51,806	29,980	21,826
Wedge-Pair Fixed Effects	203	188	15	658	623	35
Root MSE	0.44	0.41	0.46	0.35	0.37	0.32
R-Squared (within FE)	0.0014	0.0017	0.0040	0.0019	0.0014	0.0038
Adj. R-Squared (total)	0.2358	0.3117	0.1401	0.4973	0.4506	0.5427

Panel B: 0 to 10 Mile Buffer Sample

	Reciprocal Agreements In Force			No Reciprocal Agreements		
	Full Sample	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Full Sample	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)
$Log(PerCapExp_2/PerCapExp_1)$[a]	-0.2346	-0.2137	-0.1254	0.1195	0.0758	0.1809
	(0.94)	(-0.84)	(-0.22)	(2.46)	(1.32)	(1.21)
$CorpTaxRev/Exp_2 - CorpTaxRev/Exp_1$[b]	-1.8973	-3.6302	-3.6232	1.7931	1.5532	2.0967
	(-1.87)	(-3.50)	(-1.28)	(3.15)	(2.09)	(2.48)
$IncTaxRev/Exp_2 - IncTaxRev/Exp_1$[b]	-0.6897	-0.4685	-1.0187	-0.0719	0.1048	-0.1886
	(-1.38)	(-0.77)	(-1.12)	(-0.62)	(0.68)	(0.92)
$SalesTaxRev/Exp_2 - SalesTaxRev/Exp_1$[b]	0.0910	1.0600	-0.6389	0.6525	0.3253	0.9042
	(0.10)	(1.11)	(-0.35)	(4.68)	(1.49)	(5.29)
Year 2005[d]	-0.0265	0.0010	-0.0561	-0.0190	-0.0202	-0.0242
	(-3.00)	(0.09)	(-3.93)	(-3.77)	(-3.10)	(-2.64)
Observations	24,847	10,484	14,363	71,523	37,639	33,884
Wedge-Pair Fixed Effects	196	179	17	686	650	36
Root MSE	0.42	0.40	0.44	0.34	0.36	0.32
R-Squared (within FE)	0.0009	0.0012	0.0024	0.0023	0.0016	0.0038
Adj. R-Squared (total)	0.2898	0.3699	0.2050	0.5292	0.4814	0.5811

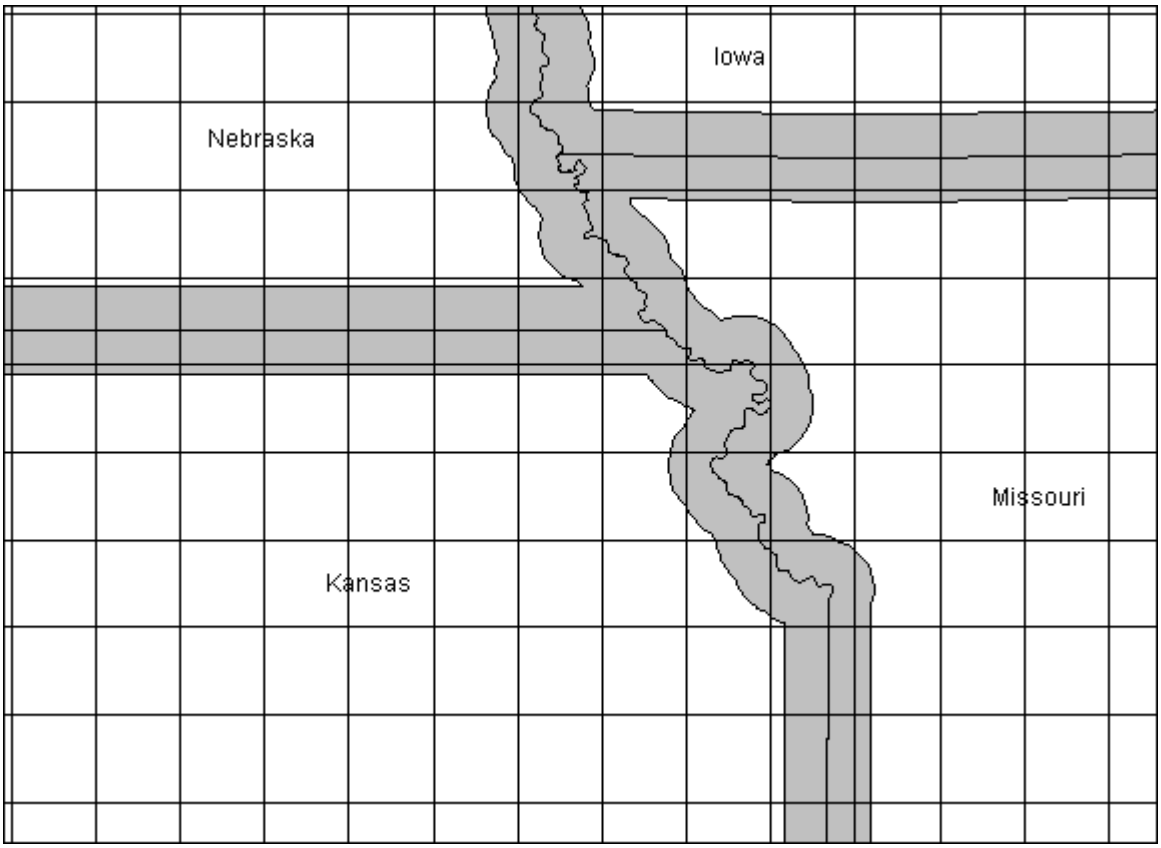
Appendix A: Creation of Wedge-Pairs Along the State Borders

Although we initially obtain our business data at the zipcode level, the geographic shape and size of zipcodes is extremely heterogeneous making cross-border comparisons of "adjacent" zipcodes difficult. As an alternative, we use Geographic Information Systems (GIS) software (MapInfo and MapBasic) to recode the data to wedge polygons that can more readily be matched across state borders as described earlier. To do this we first create buffer zones extending one and ten miles out on either side of a state border. If all borders were always straight, we could easily splice these distance buffers into wedges where each wedge would have an opposite directly across the state border of identical size and shape. Figure 4 provides an illustration of such a situation as described in the text. But because state borders are often not straight a more complicated procedure was developed to facilitate creation of matched polygons or "wedge-pairs" on opposite sides of a state border.

Our solution to the problem is illustrated in Figure A-1. The figure provides a snapshot of the border region of Nebraska, Kansas, Missouri, and Iowa. Both for this region and for the entire United States, 20-by-20 mile grid was overlaid on the 1- and 10-mile wide distance buffers (shown in the shaded areas in the figure) drawn on either side of a state boundary. Polygons are then created within each individual grid square corresponding to the portion of area within a given distance buffer that lies within the square. Opposing polygons on either side of the state border within the given grid square and within a distance buffer of similar distance to the border are then matched. That matched pair becomes a "wedge-pair" as described in the text.

As further described in the text, we converted zipcode level D&B business data into establishment level observations. Only zipcodes that extend into a wedge are retained in the analysis. All employment and business counts in each zipcode are allocated to the intersecting wedge. If a zipcode intersects more than one wedge, then the employment and establishment counts are allocated to the wedge with the greatest degree of overlap. This ensures that each establishment is treated as a single observation.

Figure A-1: 20-by-20 mile Grid Squares Overlaid on 10-mile State Border Buffers



Appendix B: Supplemental Tables – Corporate Status

Table B-1a: Reciprocal Agreements, Agglomeration, and Corporate Status – 0 to 1 Mile Buffer Sample

Dependent Variable 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

	Corporations				Sole Proprietorships and Partnerships			
	Reciprocal Agreements		No Reciprocal Agreements		Reciprocal Agreements		No Reciprocal Agreements	
	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)
$Log(PerCapExp_2/PerCapExp_1)$[a]	-0.5209	0.8492	0.1065	1.0981	0.0896	0.4172	0.1024	0.0572
	(-1.37)	(1.04)	(0.87)	(2.81)	(0.27)	(0.38)	(1.19)	(0.33)
$CorpTaxRev/Exp_2 – CorpTaxRev/Exp_1$[b]	-2.8490	-6.1942	2.8640	5.8644	-6.7660	-2.5669	0.7702	3.6508
	(-1.67)	(-2.58)	(2.26)	(2.82)	(-3.75)	(-0.87)	(0.67)	(2.84)
$IncTaxRev/Exp_2 – IncTaxRev/Exp_1$[b]	0.6937	0.8790	0.2030	0.5888	-0.1967	-3.1033	0.0847	-0.9381
	(0.79)	(0.92)	(0.62)	(1.06)	(0.21)	(-2.30)	(0.33)	(-3.19)
$SalesTaxRev/Exp_2 – SalesTaxRev/Exp_1$[b]	-0.4641	-6.5043	0.3425	0.9527	1.6052	0.7009	0.7837	1.1680
	(-0.36)	(-2.95)	(1.23)	(2.52)	(1.21)	(0.26)	(2.78)	(3.30)
Year 2005	-0.0395	-0.1024	0.0169	-0.0186	0.0135	-0.0610	-0.0158	-0.0167
	(-2.45)	(-5.23)	(1.48)	(-0.97)	(0.75)	(-3.13)	(-1.71)	(-1.17)
Observations	3,190	2,975	9,534	9,740	3,425	2,775	12,100	7,894
Wedge-Pair Fixed Effects	159	13	518	30	165	13	559	33
Root MSE	0.41	0.47	0.37	0.31	0.42	0.46	0.37	0.32
R-Squared (within FE)	0.0028	0.0109	0.0016	0.0065	0.0041	0.0081	0.0020	0.0044
Adj. R-Squared (total)	0.3247	0.1037	0.4628	0.5612	0.2804	0.1620	0.4414	0.5121

Table B-1b: Reciprocal Agreements, Agglomeration, and Corporate Status – 0 to 10 Mile Buffer Sample

Dependent Variable 1 if arrival on side 2 and 0 if arrival on side 1
(t-stats are reported in parenthesis)

	Corporations				Sole Proprietorships and Partnerships			
	Reciprocal Agreements		No Reciprocal Agreements		Reciprocal Agreements		No Reciprocal Agreements	
	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)	Lightly Developed (< 95th Percentile)	Heavily Developed (> 95th Percentile)
$Log(PerCapExp_2/PerCapExp_1)$[a]	-0.6263	0.5057	0.0686	0.2850	0.1158	-0.3263	0.0610	-0.0630
	(1.60)	(0.40)	(0.57)	(1.50)	(0.35)	(-0.41)	(0.57)	(-0.25)
$CorpTaxRev/Exp_2 – CorpTaxRev/Exp_1$[b]	-1.5848	-7.3284	2.8963	-0.1570	-5.3630	-1.3319	1.4250	2.7275
	(-1.04)	(-1.94)	(2.20)	(-0.08)	(-3.43)	(-0.45)	(1.54)	(1.89)
$IncTaxRev/Exp_2 – IncTaxRev/Exp_1$[b]	1.0504	1.6750	0.4208	0.8348	-0.7699	-3.1090	-0.0117	-0.7688
	(1.09)	(0.65)	(1.37)	(2.09)	(0.87)	(3.19)	(-0.04)	(-1.74)
$SalesTaxRev/Exp_2 – SalesTaxRev/Exp_1$[b]	-0.5444	-6.4766	0.4959	0.2831	1.4850	1.9058	0.5764	1.0913
	(-0.39)	(-1.27)	(1.33)	(1.77)	(1.25)	(0.84)	(1.89)	(3.49)
Year 2005	-0.0412	-0.0790	0.0055	-0.0232	0.0287	-0.0632	-0.0148	-0.0168
	(-2.52)	(-2.97)	(0.54)	(-1.45)	(1.76)	(-3.25)	(-1.78)	(-0.98)
Observations	3,673	6,203	11,881	15,223	3,856	5,640	14,946	12,002
Wedge-Pair Fixed Effects	158	16	529	30	159	17	578	33
Root MSE	0.38	0.43	0.36	0.31	0.39	0.44	0.36	0.33
R-Squared (within FE)	0.0031	0.0074	0.0022	0.0015	0.0042	0.0050	0.0014	0.0053
Adj. R-Squared (total)	0.4174	0.2144	0.4901	0.6089	0.3754	0.2050	0.4589	0.5475