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What Determines the Level of Local Business Property Taxes?

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Abstract:

Conventional economic wisdom holds that the optimal level of business taxes recovers the exact cost of providing public services to businesses. I present an alternative model and derive conditions under which a self-interested decisionmaker picks tax rates to maximize an objective function that depends on business tax revenues, workers' labor earnings, and business profits. I show that, in this model, optimal business tax revenues may either be more or less than the cost of providing public services to a city's businesses.

Data from approximately 70 large U.S. cities over a 16-year period reveals that the mean commercial effective property tax rate is about 1.6 times the mean home effective tax rate. Conventional wisdom suggests that commercial effective tax rates (ETRs) should rise with the share of spending on business services, while the alternative theory suggests that commercial ETRs should rise with a city's desirability as a business location. Empirically, I explore three proxies for desirability as a business location: net-of worker compensation value added; adjusted land values; and population, since standard urban theory suggests that larger cities are more desirable business locations.

I report results from a large variety of regressions using various empirical proxies for a city's share of spending on business services, desirability as a business location, and an assortment of control variables on commercial ETRs. These regressions provide no support for the conventional wisdom—commercial ETRs are inversely related to the share of spending on business public services. There is mixed evidence to support the alternative hypothesis that commercial ETRs rise with a city's desirability as a business location. Commercial ETRs also rise with median home values but are not consistently associated with a city's economic or fiscal conditions.

JEL Classifications: H25 Business Taxes and Subsidies, H7 State and Local Government, R38 Government Policy

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I. Introduction

For many years economists have been aware that the literature lacks a well-articulated and coherent theory of state and local business taxation. In 1940 Paul Studenski wrote:

> Over the past half-century there has developed in this country a fairly elaborate structure of federal and state business taxes. This structure, as it is now constituted, is generally recognized to be singularly devoid of any plan and to be inconsistent in its underlying principles. . . . The time has arrived for the introduction of some order into the medley of unrelated, overlapping, and conflicting federal and state taxes on business. Such a task requires, however, the formulation of a sound theory of business taxation. Unfortunately, the amount of work done by our students of public finance toward the formulation of such a theory has not been very formidable. (p. 621)

Despite efforts by Studenski and others, the situation has not really changed. In 2007 Testa and Mattoon observed that "States continue to struggle with finding a sound conceptual basis in their approach to business taxation" (p. 838). A partial explanation for this omission could be that while "firms play a central role in all modern tax systems," "[f]irms are, for the most part, absent from the modern theory of optimal taxation. Their disappearance dates from the foundational models developed by Peter A. Diamond and James Mirrlees (1971) in which firms are simply mechanical vehicles for combining productive inputs into output in cost-minimizing proportions" (Kopczuk and Slemrod 2006, p. 130). It is possible that some economists may believe that general theories to explain business taxation are unnecessary since, as we try to teach our students, the ultimate incidence of taxes can, at least in theory, be traced to some group of individuals (O'Sullivan, Sheffrin and Perez 2008). With modest exceptions, some of which are discussed below, economists lack an empirically grounded positive theory to explain geographic and over-time variation in the state and local taxation of business and lack a normative theory that is tangible enough to be applicable to public policy debates.

The lack of a conceptual grounding for how states and municipalities tax businesses has not prevented economists from offering other perspectives on the topic. There is a voluminous, and often useful, academic literature focusing on the effects of state and local business taxation on the amount and location of employment and on the extent to which legal and accounting conventions can be used to circumvent taxation. In particular, there are many studies of state corporate income taxation (for example, see Goolsbee and Maydew 2000; Goolsbee 2004; Fox and Luna 2005;Ljungqvist, and Smolyansky 2014; Merriman 2015) and on the extent to which business tax incentives promote economic activity (see Bartik 1991; Weiner 2009; Kenyon, Langley, and Paquin 2012**).** While these studies may be methodologically sound and informative, in general, they do not help us understand the rationale behind the relative size of state and local taxes levied on households versus on businesses.

II. What are Business Taxes and How Do These Add Up?

Because the ultimate burden of all taxes must fall on some individual, there is an inherent ambiguity in the term "business tax." The usefulness of a particular definition will depend on the purpose of the inquiry. Kopczuk and Slemrod (2006) point out that firms remit the majority of tax revenues to government and focus on explaining the potential informational advantages of this arrangement. In practice, even defining business taxes as those remitted by firms leaves room for ambiguity since in some cases (e.g. the pass-through of withheld wages) such tax revenues are not considered business taxes and in others (e.g. sales taxes on business-to-business transactions) the firms that bear the impact incidence of the tax—i.e. the firms that pay the tax at the first stage—are not those who remit the tax. In practice, analysts have used relatively arbitrary definitions of business taxes, which are closely tied to what can easily be observed or estimated. Although analysts differ somewhat when defining business taxes, a general definition has now emerged.

The Advisory Commission on Intergovernmental Relations (ACIR 1967 and ACIR 1981) appears to have been the first to attempt a systematic quantification of state and local taxes on business. The 1981 ACIR report used U.S. Census and other data to measure business taxes in all 50 states at four points in time between 1957 and 1977. It found that roughly one-third of state and local taxes had an initial impact directly on businesses, the most important being property taxes, sales taxes, taxes on gross receipts, and the corporate income tax. The share of state and local business taxes was generally highest in the Southwest (Arizona, New Mexico, Oklahoma, Texas) and lowest in the Plains (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota). The business share of state and local taxes declined somewhat over the twenty-year period that the ACIR studied.

Tannenwald (1993) and Oakland and Testa (1996) refined the methodology used in ACIR (1981) and provided updated estimates. Oakland and Testa (1996) found a continued decline in business's share of state and local taxes through 1992. Property taxes were the largest business tax, accounting for about 43 percent of such taxes. Retail sales taxes and the corporate income tax each accounted for about 14 percent of business taxes.

Since 2002, the Council of State Taxation (COST)—a trade association whose objective is to preserve and promote the equitable and nondiscriminatory state and local taxation of multijurisdictional business entities—has commissioned the consulting firm Ernst & Young to measure state and local business taxes broken down by state and by type of tax. The report on fiscal year 2013 (Phillips et. al. 2014) finds that business taxes account for about 45 percent of all state and local tax revenues and equal 4.7 percent of gross state product (GSP). Phillips et al. (2014) find that the most important business tax is the property tax, which they estimate accounted for about 36 percent of all business taxes. The general sales tax on business inputs was the second biggest tax, accounting for 21 percent of business taxes, while the corporate income tax accounted for less than 8 percent of business taxes. The report found considerable variation across states with some (Alaska, North Dakota, Wyoming, and Vermont) having high business taxes as a share of GSP while others (Connecticut, North Carolina, and Oregon) collect a small share of GSP in business taxes.[1]

III. The Conventional Wisdom about State and Local Business Taxes and an Alternative Conceptualization

a. The Conventional Wisdom

Oakland and Testa (1996) express the conventional wisdom that most economists hold regarding state and local business taxes: "general business taxation should be structured so as to recover the costs of public services rendered to the business community. … Business benefits taxes…promote appropriate choices between private and public goods"(2). While Oakland and Testa (1996) state that, normatively, "taxation *should* be structured," they produce some

[1] Clearly, the relatively high business taxes in some states (e.g. Alaska, North Dakota, and Wyoming) are, at least in part, due to severance taxes on natural resources.

evidence that this does not hold as a *positive* proposition in practice. However, neither Oakland and Testa nor later researchers have offered a coherent positive theory of state and local taxation of business.

Perhaps because many economists find Oakland and Testa's (1996) intuition compelling, there seems to have been only limited effort to rigorously develop the normative argument. One of the few formal treatments of the question is Oates and Schwab (1991). It will be helpful to briefly retrace their derivation so as to contrast it with an alternative model I put forth below.

Oates and Schwab's basic model allows for a representative household that that gets utility [U] from a private consumption good [C] and a publicly provided good [G] that is purchased by the government at a price of [p_g] per unit. Firms employ a constant returns to scale production function $\left[F[\cdot]\right]$to combine labor [L], capital [K],and an input [X] that is purchased for them by the government at a price [p_x] to produce output [Q]. Labor is assumed to be fixed in each community and the ratio of the publicly provided good to private capital (i.e. [$\frac{X}{K}$]) is assumed to be the same for each firm. Workers (residents) earn a wage [w] equal to the marginal product of labor, pay a head tax [h] and receive fixed nonlabor income [y]. Capital is a paid an exogenously determined rate of return [r]. The government charges firms a tax [t] for each unit of capital located in the community. Lower-case letters (c,g,k,x) are the per-unit of labor counterparts of the upper case pair (C,G,K,X).

In Oates and Schwab's model, the government's problem is to pick the $g,x,t,$ and h to maximize the utility of a representative household subject to constraints imposed by firm and household behavior and government and household budget constraints, i.e.,[2]

. $$\max_{g,x,t,h} U[c,g] \quad (1)$$

s.t.

$$Q = Lf[k,x] \quad (1.1)$$

$$h + kt = p_g g + p_x x \quad (1.2)$$

$$y + w = c + h \quad (1.3)$$

$$w = f - kf_k - xf_x \quad (1.4)$$

[2] In my notation, the variables enclosed in square brackets (e.g. *N[t]*) are arguments of the function preceding the brackets. Functional arguments are omitted when there is no ambiguity. Subscripts indicate partial derivatives except that a subscript on price indicates the relevant good and an i subscript indicates the order in an array.

$$r = f_k + \left(\frac{x}{k}\right) f_x - t. \tag{1.5}$$

Constraint (1.1) is the production function, (1.2) is the government budget constraint, (1.3) is the household budget constraint, (1.4) determines the wage and the amount of capital in the community, which is mobile between communities, adjusts to satisfy equation (1.5).

Performing the standard calculus and algebraic manipulations yields the results that:

$$\frac{U_g}{U_c} = p_g \tag{2}$$

$$t = \left(\frac{x}{k}\right) f_x \tag{3}$$

$$p_x = f_x \tag{4}$$

Equation (2) is the usual condition that the ratio of the marginal utilities for two consumption goods must equal the ratio of their prices—otherwise the household budget could be reallocated to increase welfare. In this case, *c* is the numéraire with an assumed price of one and the government, acting as the agent for households, picks *g* to maximize utility.

Equation (3) represents a key idea since it determines *t*, the tax a firm pays for moving a unit of capital into the community. In Oates and Schwab's scheme, each unit of capital that enters the community imposes a cost on existing firms because it uses up some of the community's supply of *X*, which is collectively supplied and paid for but is not collectively consumed (i.e. it is subject to crowding). Equation (3) requires that the fee paid by the firm when bringing a unit of capital into the community is equal to the additional amount of *X* that it uses (i.e. $\left(\frac{x}{k}\right)$) times the output lost by other firms when they give up a unit of *X* (i.e. f_x). Thus, the tax compensates for existing firms' loss of production as a result of competing users of *X* when a new unit of capital enters. Note that Oates and Schwab's result in equation (3) depends on the ideas that *X* is a publicly provided private good and that *X* is distributed equally among all units of capital in the community.

Equation (4) requires that the marginal product of *X* is equal to its price. Were that not true households' utility could be improved by purchasing less *X* and more *C*.

Substituting equation (4) into equation (3) and multiplying through by *k* yields

$$tk = xp_x. \tag{5}$$

This equation embodies the conventional wisdom and the proposition advanced by Oakland and Testa (1996) that revenue from general business taxes (in this case tk) should recover the cost of public services rendered to businesses (in this case, xp_x).

b. Alternative Conceptualization: Business Property Taxes Capture Economic Profits

Oates and Schwab's model provides a baseline result showing the most efficient government choice under a given set of conditions.[3] While Oates and Schwab's model provides a useful conceptual baseline, its empirical relevance is open to question. Oakland and Testa (1996) find that in 1995 state and local taxes on business raised more than 2.4 times as much revenue as was needed to pay for government services to businesses located in Midwestern states (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Wisconsin). Similarly, in a more recent national study Phillips et. al. (2014) find that "on average, businesses paid [as much as] $3.26 for every dollar of government spending benefiting businesses." Empirical evidence, to be presented later in this paper, suggests that increases in government expenditures on business services are not necessarily correlated with increases in business taxes.

Taken together, this evidence from Oakland and Testa (1996) and Phillips et al. (2014) casts doubt on whether Oates and Schwab's model serves as a positive explanation for cross-geography and over-time variation in business taxation.[4] Moreover, the tensions in Oates and Schwab's model do not seem to mirror the political/public policy debate with regard to business taxation. Oates and Schwab's model might lead us to expect that existing firms would be reluctant to accept new entrants into the community because doing so would spread a fixed pot of business public services. Furthermore, in Oates and Schwab's model there is tension over the wages paid to residents but no possibility of unemployment. Anecdotally, the political debate (and much empirical literature) centers on the tradeoff between tax revenue and job creation.

[3] After presenting their basic model Oates and Schwab expand their analyses to allow for amenities and disamenities and limitations on household taxes. In these models the result in equation (5) does not always hold. Garcia-Mila and McGuire (2002) extend Oates and Schwab to allow for agglomeration economies. This leads to the conclusion that in some circumstances business tax payments should be less than the cost of business services received.

[4] Another stream of the theoretical literature dating to Zodrow and Mieszkowski (1986) predicts that observed local government property taxes will be *below* the optimal level. This seems in conflict with the conventional wisdom as embodied in Oates and Schwab, the empirical findings of Oakland and Testa (1996), and in other studies.

I present a related but alternative model which shows that, in contrast to Oates and Schwab, nonzero business taxes could be optimal even when the government provides no business services.[5] In this model decisionmakers, who are potentially the agents of a state's or city's residents, use business taxes to obtain government revenue which they may transfer to households. However, the decisionmakers must balance possible job losses against gains in revenue. Potential job gains motivate decisionmakers to subsidize businesses, so in this model net taxes could be either positive or negative (subsidies) even if the government did not provide any services to businesses.

In addition, decisionmakers may value business profits per se for a variety of reasons. Decisionmakers could value profits because they care about the welfare of small business-owners who live in the city (and potentially vote for the decisionmakers). They also could care about profits for more selfish reasons. For example, business profits might pay for campaign donations or personal largess.

This model is, in some senses, simpler, but in other ways is more complex than the one by Oates and Schwab. It is simpler because the basic story can be told without any reference to capital inputs and publicly provided goods that benefit either residents or firms. However, the model is more complex in the sense that, intrinsic to the story, is an assumption that firms are heterogeneous, with some more productive and others less so. I assume there is a "decisionmaker" that picks the business tax rate to maximize some objective function. The model takes no position on the identity of the decisionmaker who could be the median voter, an elected official, or some other entity. Let $U[C]$ = the decisionmaker's objective function.

The decisionmaker's problem is to pick t (the tax rate) to maximize an objective function that depends on a weighted sum of wages earned by residents, tax revenue, and profits accruing to businesses, constrained by the businesses' behavior:

$$U[C] \qquad (6)$$

$$\text{s.t. } \lambda_1 \mathrm{w} \sum_{i=1}^{N} (L_i)^{\#} + tN + \lambda_2 \sum_{i=1}^{N} \pi_i = C, \qquad (6.1)$$

[5] Of course, both my "alternative" model and Oates and Schwab's model can be thought of as variants of a more general model. Appendix A presents equations for the general model and assumptions necessary to derive Oates and Schwab's model and my model as special cases.

where w is the exogenously determined wage, $(L_i)^{\#}$ is the level of labor that maximizes profit of the ith firm (π_i), N is the number of firms that hire labor and pay taxes, and $\lambda_1(\lambda_2)$ is the weight that the decisionmaker attaches to a dollar of wages (profit). Capital, and other non-labor production inputs are not explicitly considered in the model. One way to reconcile this omission with more standard approaches is to treat each unit of capital as a firm or, equivalently, to assume that capital and labor are used in fixed proportions in the production function.[6] This treatment implies that the per-firm tax modeled here is equivalent to the per-unit-of-capital tax studied in Oates and Schwab.

I assume that decisionmakers attach a "weight" of one to business tax revenue. Since w is exogenous we could think of labor as being mobile in this model. Since firms face a profit constraint (see below), we can think of firms as being mobile in this model.

Firms pick the quantity of labor to maximize profits. They are hurt by taxes. The *ith* firm stays in business and hires labor only if profit is greater than or equal to zero:

$$\pi_i = max\begin{cases}(L_i)^{\alpha} + \theta_i - wL_i - t \\ 0\end{cases}. \tag{7}$$

θ_i is a firm-specific productivity bonus.[7] Equation (7) implies that if the firm stays in business it will maximize profit by choosing labor such that:

$$L_i = L_i^{\#} = L^{\#} = \left(\frac{w}{\alpha}\right)^{\left(\frac{1}{\alpha-1}\right)}. \tag{8}$$

Array the i potential firms in order of the size (biggest to smallest) of their θ_i. Assume these are determined by the following linear function, $\theta_i = \theta - \psi i$. Firm i stays in business if:

$$\left(L^{\#}\right)^{\alpha} - wL^{\#} - t \geq -\theta + \psi i \Rightarrow \left(\frac{1}{\psi}\right)\left(\left(L^{\#}\right)^{\alpha} - wL^{\#} + \theta - t\right) \geq i. \tag{9}$$

Define
$$N[t] = \left(\frac{1}{\psi}\right)\left(\left(L^{\#}\right)^{\alpha} - wL^{\#} + \theta - t\right). \tag{10}$$

Then there are $N[t]$ firms that make a nonnegative profit and therefore stay in business. The total profit earned by all firms is

[6] This assumption is common in the literature. See Burbidge, Cuff, and Leach (2006) and Baldwin and Okubo (2014).

[7] Although developed independently this profit function is similar in spirit to that used in Burbidge, Cuff, and Leach (2006).

$\sum_{i=1}^{N} \pi_i = \sum_{i=1}^{N} (L^{\#})^{\alpha} - wL^{\#} + \theta - \psi i - t = N\left((L^{\#})^{\alpha} - wL^{\#} + \theta - t\right) - \psi \sum_{i=1}^{N} i = N\psi N - \psi \sum_{i=1}^{N} i.$

Recall that $\sum_{i=1}^{N} i = \frac{N^2+N}{2}.$

Therefore $\sum_{i=1}^{N} \pi_i = \psi N^2 - \left(\frac{1}{2}\right)\psi(N^2 + N) = \left(\frac{1}{2}\psi\right)(N^2 - N).$

The decisionmaker's problem is to pick t to maximize:

$U\left[\lambda_1 \mathrm{wN} L^{\#} + tN + \lambda_2 \sum_{i=1}^{N} \pi_i\right] = U\left[\lambda_1 \mathrm{wN} L^{\#} + tN + \lambda_2 \left(\frac{1}{2}\psi\right)(N^2 - N)\right] = U[V].$

As long as U is monotonic in V the t that maximizes V also maximizes U.

Setting the derivative of V with respect to t equal to zero and rearranging leads to the condition that:

$$(2 - \lambda_2)\mathrm{t} = -\left(\lambda_1 wL^{\#} - \lambda_2 \left(\frac{1}{2}\psi\right)\right) + \left((L^{\#})^{\alpha} - wL^{\#} + \theta\right) - \lambda_2\left((L^{\#})^{\alpha} - wL^{\#} + \theta\right). \qquad (11)$$

In the special case with $\lambda_1 = \lambda_2 = 0$, the decisionmaker's goal is to maximize business tax revenue, and the decisionmaker is analogous to an ordinary monopolist. The decisionmaker sells access to the city at a price (t) and faces a linear downward sloping demand curve and a zero marginal cost since it costs the decisionmaker nothing to "supply" the marginal firm with access to the city. As in the usual introductory economics exercise, the monopolist with zero marginal costs sets the price such that marginal revenue is zero. The profit-maximizing price turns out to be one-half of the vertical intercept of the demand curve. In the example considered here, the intercept is the before-tax profit (equivalently, the value-added minus labor compensation or the "net value-added") of the most productive firm (i.e. the firm with the largest θ). The optimal tax in this case will be unambiguously positive, as illustrated in figure 1.

Notice that this result is in sharp contrast with Oates and Schwab. Their model implies that since the government is supplying no public services to businesses, the optimal solution is for firms to pay no taxes. That result would come about in my alternative model only if firms are indifferent about locating in the city (this is implicitly assumed in Oates and Schwab). Furthermore, in Oates and Schwab's model firms' tax rate should not vary with the city's desirability.

In the special case with $\lambda_1 = 1$ and $\lambda_2 = 0$, the decisionmaker (still a monopolist) cares about workers' earnings as well as generating tax revenue. This concern about worker earnings constrains the decisionmaker from extracting the maximum possible profit from firms in the form of tax revenue. In this case, the marginal firm brings two sorts of marginal benefits to the decisionmaker—additions to tax revenue and additions to wages. In the standard monopolist framework, the additional wages resulting from an additional firm can be thought of as a kind of negative marginal cost to the decisionmaker. That is, it is as if, the additional firm entering the city is *lowering* the decisionmaker's marginal costs. This is also depicted in figure 1.

The decisionmaker picks the tax rate such that MR=MC. Because MC is negative the optimal tax could be negative (i.e. it could be optimal to subsidize businesses) but, as shown in figure 1 it is also possible for the optimal tax to be positive though it must be less than the tax when $\lambda_1 = 0$ and $\lambda_2 = 0$.

In the special case $\lambda_1 = 0$ and $\lambda_2 = 1$, the decisionmaker does not value worker earnings but does care about the profit earned by firms. In this situation, despite the fact that taxes will drive some businesses out of the city and lower aggregate profits, the optimal tax is unambiguously positive as long as at least one firm values being located in the city ($\theta > 0$). This is illustrated in figure 2, which modifies figure 1 by adding a function that shows the profit of the marginal firm graphed against the number of firms. This is shown in the negative portion since it appears as a negative marginal cost to the decisionmaker when s/he raises the tax rate.

Somewhat surprisingly the tax in this case must be positive. Figure 2 clarifies the geometry of this result. The function graphing the marginal firm's profit is a mirror image of the willingness-to-pay (WTP) function in the figure's positive portion. Because these two curves are mirror images they cross the horizontal axis at the same point. The marginal revenue curve therefore must cut the marginal firm's profit curve before the WTP curve crosses the horizontal axis. The corresponding point on the WTP curve (i.e. the optimal tax rate) will be positive.

The economic intuition is also straightforward. In this case, the decisionmaker cares both about tax revenue and firm profits. Higher tax rates raise more revenue but lower firm profits. However, the marginal change in firm profits diminishes as the tax rate increases. The optimal tax will be lower than if the decisionmaker did not care about profit but will still be positive.

The final special case with $\lambda_1 = \lambda_2 = 1$ is simply an amalgam of the two previous special cases. The decisionmaker cares about profits accruing to businesses as well as wages accruing to workers and tax revenue. The decisionmaker again picks the tax such that MR=MC, where the new MC is the sum of workers' wages and the profit earned by the marginal firm.

As shown in figure 2, if the decisionmaker cares about the profits earned by firms as well as the wages earned by workers, the optimal tax will be somewhat lower than in the previous cases but could still be either negative (a subsidy) or positive.

The alternative model presented here is primarily intended to counterbalance the conventional wisdom that business tax revenues equal to the cost of providing business services are a natural or optimal outcome. The model could be extended in a number of directions to allow for public goods benefiting households, a nonzero profit constraint that varied across cities, time or industries, and a tax on households, among other things. None of these refinements would change the fundamental story that decisionmakers who care about tax revenues and/or household earnings may find it optimal to set business tax rates that are not equal to the cost of providing public services to businesses.

Even in the stripped-down version presented above, the empirical implications of the alternative model are quite distinct from the conventional wisdom suggesting that we can explain variation in business tax payments by variation in government expenditures for providing services to businesses. Rather, the alternative model suggests that business tax payments vary with the market power of government decisionmakers. In particular, this model predicts that business taxes will be higher in cities where firms have more profit opportunities, although the business tax rate will also depend on the degree to which decisionmakers wish to attract jobs and profit to the city. In the next sections of this paper I empirically explore some of the determinants of the largest state and local business tax—the business property tax.

IV. Data about Business Property Taxes

a. Sources and Extent of Data about Business Property Taxes

As discussed above, the consensus among analysts is that the property tax and the sales tax are the largest state and local taxes that have a direct impact on businesses, with the corporation income tax a distant third behind them. It is often difficult to study the property and sales taxes levied on businesses because these taxes are administered through the same system that collects similar taxes from households. For example, states typically do not track and the U.S. Census Bureau does not report either the sales tax base attributable to business-to-business sales or the revenues deriving from that base. Ring (1989 and 1999) developed a basic methodology for obtaining rough estimates of the nonhousehold share of sales tax revenues. A modified form of this methodology continues to be used in most studies of state and local business taxation (Phillips et. al. 2014).

Scholars have slightly better information about the size of the business property tax base and business property tax payments. Many states do separately track and report the assessed value of business real estate. Yet few report complete information about the myriad tax incentives, deferments, and other devices businesses and households use to reduce their property tax payments (see Kenyon, Langley, and Paquin 2012).

In the absence of well-organized and comparable administrative data about business property taxes, analysts must assemble the data independently. Fortunately, since 1995 the Minnesota Center for Fiscal Excellence (henceforth "the Center") has compiled and published[8] its *50-State Property Tax Comparison Study* of the effective tax rates for several classes of property. Since 2005 the study has included data about parcels located in the largest city of each state (plus an additional city for Illinois and New York), the District of Columbia, and the largest fifty cities in the United States.[9] Data for the report are collected from state and local websites where available. When the necessary data was not available the Center used a contact-verification approach in which state or local tax experts were asked to provide information and provided verification when necessary.

The Center uses a simulation methodology to calculate the effective property tax rates (ETRs) for representative parcels of particular types of property. The simulated net property tax on each parcel is calculated by taking into account the local sales ratio (i.e. the ratio of assessed value to market value) for that class of property, the classification rate, and applicable

[8] Studies were published in 1995, 1998, 2000, 2002, and each year since 2004. In some years the report has been done in cooperation with the National Taxpayers Conference. In recent years the Lincoln Institute of Land Policy has partnered with the Center to publish the report.
[9] Tables on the 50 largest U.S. cities were added beginning in 2005.

property tax credits where available.[10] Special property tax provisions that apply to less than half of taxpayers in a given class are omitted from the calculations. The ETR is calculated as the simulated tax payment divided by the assumed market value.[11]

b. Descriptive Information about Business Property Taxes

Some descriptive information about the data is given in table 2. Data from 1995 is not reported because that year the study did not include values for the median-priced home. Property tax rates are commonly expressed and sometimes more conveniently discussed in units of mills equal to 10 times the percentage rate. Table 2 shows that in each year the mean ETRs on owner-occupied homes were 13 to 15 mills (between 1.3 and 1.5 percent of market value) while the mean ETRs on commercial parcels were between 18 and 22 mills. In this paper I use commercial ETRs as a proxy for business property taxes.

The means of the ratio of the two ETRs (henceforth the "ETR ratio") were between 1.56 and 1.76 over this 16-year period. Columns (7) and (9) provide some suggestive and perhaps surprising information about business and residential ETRs. Manchester, NH has the lowest ETR ratio of any of the cities in the dataset in six of the 13 years for which data is available, and Wilmington, DE has the lowest ETR ratio in three of the other years. Both of these cities are located in small states with a pro-business reputation. New Hampshire, in particular, has a reputation for low taxes, although its property taxes are not low. In 2004, Portland, OR had the lowest ETR ratio which is perhaps surprising for a city with a reputation of being quite intrusive when regulating businesses.

At the other extreme, New York City had the highest ETR ratio in 11 of the 13 survey years shown in table 2, a fact that is perhaps consistent with the idea that cities with significant market power can extract some of the profits that businesses earn by locating there. However, in the years in which New York City did not have the top ETR ratio, New Orleans and Charleston, SC did. While both of these cities have unique attributes that attract tourists, neither seems

[10] Twenty-eight states and the District of Columbia provide separate sales ratio data for homestead and business properties. In addition Hawaii provides this data for Honolulu and Illinois provides the data for Chicago.

[11] More complete details about the calculations are contained in the appendix to each year's report—see Minnesota Center for Fiscal Excellence (various years). Bell and Kirschner (2008) discuss alternative sources of data on effective property tax rates.

particularly well-positioned to negotiate with businesses and both are located in politically conservative states that might be expected to favor pro-business policies.

The persistence of certain cities at the top and bottom of the distribution of the ETR ratios suggests that there may not be much over-time variation in this ratio. Table 3 displays the raw mean of each city's ETR ratio and the within-city standard deviation of this ratio as well as the number of years in which I observe it. In many cases the within-city standard deviation of this measure is quite small relative to its mean. For example, Milwaukee, WI has an ETR ratio of 1.03 and a standard deviation of just 0.01, indicating that I observe almost no variation over time in Milwaukee. Similarly, I observe almost no variation in Las Vegas, Charlotte, and Raleigh.

Table 3 also suggests that state-level rules may be important determinants of ETR ratios. More than one city is observed in 18 states—Alaska (2), Arizona (3), California (8), Colorado (2), Connecticut (2), Florida (2), Illinois (3), Indiana (2), Kentucky (2), Louisiana (2), Missouri (2), New York (2), North Carolina (2), Oklahoma (2), South Carolina (2), Tennessee (2), Texas (7), and Virginia (2). Except for Connecticut, Illinois, Louisiana, New York, and possibly Indiana, cities within the same state have very similar ETR ratios.

The lack of within-city over-time variation in ETR ratios suggests that the variation in commercial ETRS can largely be explained by the variation in home ETRs and effectively reduces the information provided by the panel dataset. The effective sample size may be even more limited because within-state variation among cities is truncated. To the extent that state policies limit the variation in ETR ratios, city-level variables will be unable to explain variation in commercial ETRs conditional on the home ETRs. In order to account for the panel nature of this dataset, I include city and year fixed effects and cluster standard errors when estimating the variance of parameter estimates. This procedure accounts for the potential lack of independent information from multiple observations on the same city (Angrist and Pischke 2009, p.308–315). As a result, the standard errors are (appropriately) inflated and it may be impossible to reject hypotheses about some parameters with a high level of confidence.

V. Testing the Theories

a. Empirical Implications

The empirical implications of the theoretical analyses are embodied in equation (5), equation (11), and table 1. Equation (5) suggests that business tax revenues should increase with a city's/municipality's expenditures on business services. Data about government expenditures do not separate the spending directed toward businesses versus the expenditures that primarily benefit households. However, there is reason to believe that households are the primary direct beneficiaries of one major expenditure: K–12 education. Although businesses certainly benefit directly from having well-educated workers (and arguably consumers), firms are not limited to hiring employees educated in a particular city. Within the catchment area from which a firm hires its workers, there generally will be a number of school districts so increased services in one district benefit the firm only to the extent that it hires workers educated in this district.[12] Even in this case, the relationship between educational spending and the eventual employee is quite distant so that firms are unlikely to have much direct economic stake in spending for K–12 education. In contrast, households, at least those with school-aged children, usually care a great deal about this public service. Thus, at least as a first approximation, it seems reasonable to attribute a large share of K–12 spending to household services.[13]

The alternative theory embodied in equation (11)/table 1, suggests that business taxes rise with net value-added $\left((L^{\#})^{\alpha} - wL^{\#} + \theta\right)$ and should vary with λ_1 and λ_2, the weights local decisionmakers attach to locally generated labor earnings and profits, respectively. It is possible to obtain empirical proxies in the spirit of this theory.

b. Empirical Proxies for Key Explanatory Variables

Table 4 provides basic descriptive statistics about the dependent variable and key explanatory variables at 1998, the beginning of the observation period (except for net value-added and

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[12] More precisely, employers benefit from improved education only if they both hire those who received the better education and if wages increase less than productivity as a result of the improved education.

[13] Consistent with this assumption, Oakland and Testa (1996) attribute all education expenditures to households. Phillips et. al. (2014) present figures attributing zero, 25, and 50 percent of educational expenditures as services directed toward business.

compensation per worker) and 2012, the end of the observation period. The rationales for each of the explanatory variables are discussed below.

All monetary variables enter the regression analyses as logarithms and all the regressions include year dummies. Because inflation corrections are multiplicative, the combination of using logarithms and year dummies effectively controls for inflation.[14]

Because I do not directly observe spending on business public services, I indirectly test the implications of the conventional wisdom—that business taxes should rise with expenditures on business public services. A greater share of local public spending on households implies a smaller share of spending on business public services. Since education spending is by far the most important item of local public spending, I investigate the hypothesis that an increase in the share of spending on K–12 education results in a decline in commercial ETRs.

Because the responsibility for educational spending may differ among cities and over time, the share of educational spending is measured as the sum of educational spending by all overlying local governments (municipal and school district) divided by the sum of total spending by all overlying governments. I use data drawn from the Lincoln Institute of Land Policy's Fiscally Standardized Cities (FiSC) database (Lincoln Institute of Land Policy 2015). According to this source:

> The construction of FiSCs involves adding together revenues and expenditures for the city government plus an appropriate share from overlying counties, school districts, and special districts. The allocations are based on a city's share of county population, the percentage of students in each school district that live in the central city, and the city's share of the estimated population served by each special district. FiSCs provide a full picture of revenues raised from city residents and business and spending on their behalf, whether done by the city government or a separate overlying government.

This is an appropriate measure of educational spending since the ETRs that serve as dependent variables are the aggregated tax rates from all overlying levels of government. Unfortunately, the sample of 112 cities in the FiSC dataset does not perfectly coincide with the sample of

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[14] Let X_{it} be the nominal dollar value of a X in city i in year t and $\mathrm{CPI}_t * X_{it}$ be the inflation-adjusted dollar value of the variable in year t. Then $ln(CPI_t * X_{it}) = lnX_{it} + lnCPI_t$. Note that $lnCPI_t$ is constant across the sample in any year and can be absorbed into the year fixed effect.

cities in the property tax data from the Minnesota Center for Fiscal Excellence. Over the period from 1998 to 2012, this discrepancy reduces the potential sample size from 871 to 619 city-years.

Net value-added is a key explanatory variable for the alternative theory.[15] Data on value-added by city are not available but the Regional Economic Accounts maintained by the U.S. Department of Commerce's Bureau of Economic Analysis contain data series on gross metropolitan product (gmt), compensation of employees, and total full and part-time employment by industry for 381 metropolitan areas. I have matched each city in the dataset with its metropolitan area's per employee net value-added ((gmt-compensation)/employment). These data are only available after 2001 and are not available for Honolulu. Thus, the potential number of observations in the dataset is reduced from 871 to 757 city-years or to 545 city-years when I also control for the share of spending on K–12 education.

c. Basic Tests of the Theory

I first discuss basic tests of the theory using only the variables that play key roles in the theory. Refinements, including other controls for other independent variables and corrections for potential endogeneity, are discussed later.

In table 5, model 1 provides a stripped-down test of the conventional wisdom. I control only for city fixed effects, year fixed effects, and the key explanatory variable measuring the share of spending going to K–12 education. Conventional wisdom suggests a negative coefficient—all else equal, as cities devote a higher share of spending to K–12 education, the property tax rate on commercial parcels should fall. Instead, as shown in model 1, I find a positive and statistically significant coefficient at a 5 percent level of confidence. The estimated coefficient in model 1 suggests that a one-standard deviation increase in the share of spending on schools from roughly 27 to 35 percent would result in an increase in the commercial ETR from its mean of about 20 mills to approximately 21 mills, a 5 percent increase in the commercial ETR.

Model 2 provides a rudimentary test of the alternative theory. This theory suggests that increases in net value-added are associated with increases in business tax revenues. The

[15] The literal counterpart of the theoretical construct is actually the value-added minus the wage bill of the most profitable firm $(L^{\#})^{\alpha} - wL^{\#}$. My empirical implementation assumes that average net value-added in the relevant industry is correlated with net value-added of the most profitable firm.

theory's baseline result is that a revenue-maximizing government's per firm tax revenue would rise by the same percentage as net value-added. This prediction can be compared with the empirical result in table 5's model 2. The estimated parameter says that a 10 percent increase in net value-added is associated with a one-half mill increase in the commercial ETR rate. Since the mean commercial ETR is about 20 mills, this result implies that a 10 percent increase in net value-added is predicted to increase commercial ETRs (and presumably tax revenue from commercial parcels) about 2.5 percent. This increase is roughly one-fourth of the amount expected if decisionmakers were strict revenue maximizers.

In Table 5, model 3 combines key coefficients from both the conventional and alternative models. The coefficient on the share of spending going to K–12 education becomes statistically insignificant but remains positive, while the coefficient on net value-added changes only slightly and remains significant. The next three models shown in table 5 simply repeat each of the first three models but add an additional variable to control for the tax rate on homes (home ETR), since a reasonable interpretation of the alternative theory might be that it is about relative, rather than absolute, commercial and home/residential ETRs. The home ETR is statistically significant at a high level of confidence in models 4 to 6 but the substantive results do not change. The share of spending on education is either positively or neutrally related to commercial ETRs, while net value-added is positively and significantly related to the dependent variable.

In addition to net-value-added, the alternative theory suggests that the decisionmaker's ideology (embodied in the parameters λ_1 and λ_2) may be an important determinant of the commercial ETR. In addition, as shown in table 1, as long as $\lambda_1 \neq 0$, per worker compensation may be an important determinant of the commercial ETR independent of net value-added. The U.S. Department of Commerce provides a measure of compensation per worker but only at the metropolitan-area level. I matched metropolitan-area data to the relevant city for the empirical analyses.

Local political ideology is hard to measure but, to the extent that this ideology is relatively constant over time, I control for it with the city fixed effects included in models 1 to 6. An alternative and more direct measure of ideology is the city's share of the presidential vote in a highly contested election. Fortunately, Tausanovitch and Warshaw (2013) provide data about Barack Obama's share of the 2008 presidential vote in 62 of the cities with data about commercial ETRs. Unfortunately, data for other cities and other presidential elections is not available at the city level.

Table 6 displays the results from two regressions. Model 7 adds a variable that measures log of per worker compensation. The theoretical model predicts the observed negative coefficient on this variable. Based on the estimated coefficient, a 10 percent increase in compensation per worker raises the predicted commercial ETR by 0.57 mills—implying a tax rate elasticity of about 0.28 at the mean commercial ETR of 20 mills. However, the coefficient is estimated imprecisely and I cannot rule out other, even positive values, for this coefficient with much confidence.

Model 8 adds a variable measuring Obama's share of the 2008 presidential vote in cities where it is available but drops city fixed effects since these would be perfectly colinear with this variable. These changes result in a coefficient on log of net value-added that is barely statistically insignificant at the 10 percent level of confidence and results in a 25 percent decline in the magnitude of the coefficient but does not change the sign or statistical significance of the other control variables. The coefficient on Obama's share of the 2008 presidential vote is statistically significant and positive, and suggests that a one standard deviation increase in his vote share (from about 0.7 to about 0.85) would be predicted to increase the commercial ETR by about 1.6 mills or 8 percent.

d. Concerns about the Endogeneity of Net Value-Added

The theoretical model assumes that decisionmakers pick the commercial ETR conditional on an exogenously determined distribution of θ_is. This distribution determines the net value-added. Empirically one might be concerned that the commercial ETR influenced the net value-added as well as vice-versa. If, for example, net value-added was in part determined by agglomeration economies, a high tax rate could shrink the commercial sector and result in smaller net value-added. Since agglomeration economies probably change little over time within a city, concerns about this potential source of endogeneity might be somewhat alleviated by the inclusion of city fixed effects. Despite this, it seems worthwhile to investigate the hypothesis of endogeneity more directly and to consider other potential empirical proxies for net value-added.

When confronted with potential endogeneity of an independent variable, the standard econometric practice is to collect data about an instrument that is correlated with the independent variable but which it can be argued has no a priori influence on the dependent variable except indirectly through the potentially endogenous independent variable. This does not seem like a promising strategy in this case since any variable that might affect net value-added (e.g. the phase of the business cycle) could reasonably also be linked directly to the commercial ETR.

The alternative strategy I pursue here is to investigate two variables—land values and the population—that could plausibly be proxies for net value-added and can arguably be corrected for potential endogeneity as I describe below.

A theory dating back almost 200 years to David Ricardo and Henry George argues that land values capture rents accruing from exceptional productivity (England 2010). This suggests that land values are an indicator of net value-added. Davis and Palumbo (2007) developed a dataset on land prices in 46 metropolitan areas and have updated it through 2012. I linked these metropolitan areas to 28 cities on which the Minnesota Center for Fiscal Excellence provides data on commercial ETRs. This smaller sample size will lower the power to test hypotheses relative to the empirical results presented in tables 5 and 6. As with the net value-added data, land price value data are only available at the metropolitan statistical area.[16]

Despite these weaknesses, a strength when using the land value data is that there is clear theoretical guidance about how to purge the data of potential endogeneity with the tax rate. In competitive markets, land values (*V*) are determined by the formula $= \frac{rent}{(i+t)}$, where *rent* is the productivity of the land, *i* is the discount rate, and *t* is the ETR. Clearly, *V* is endogenous since it depends on *t*. However, if I observe *V*, *i*, and *t* I can calculate *rent*, or as I actually do, a tax

[16] An additional weakness of this data for our purposes is that the land price index refers to residential rather than commercial land values. Although we might assume that land value changes would be strongly correlated across organizational forms there is some evidence to the contrary. See Davis (2009).

rate "adjusted" land value that is independent of the observed tax rate and therefore is exogenous. I use data on mortgage rates from Freddie Mac as a proxy for *i*. [17]

Given the disadvantages of taking land values as a proxy of net value-added, I also explored alternative approaches. A long literature in urban economic systems suggests that the largest cities in a national economy offer the most unique economic opportunities (Alperovich 1984). As city size falls, cities become more substitutable. Therefore, it seems likely that the largest cities offer the most profitable opportunities—the highest net value-added (see Glaeser 2011 or Moretti 2012). An intuitive test of the theory that business property taxes capture net value-added is that larger (more populous) cities should have higher business property taxes than smaller cities.

However, one might doubt that a city's population is exogenously determined. Perhaps high commercial ETRs drive jobs away which, in turn, drives residents away. Then tax rates might cause population as well as vice-versa.

To empirically examine this hypothesis, I ran an instrumental variables regression using the log of state population as an instrument for city population. The exclusion restriction—the commercial ETR in a particular city does not influence state population growth—is justified if people first choose to locate in a state t and then pick among cities within a state. Regressions using land values and population in place of net value-added are reported in table 7.

Model 9 simply repeats model 5 but replacies net value-added with the log of land value. The number of observations (441) is much fewer than in model 2 (757). The result is that the coefficient on the log of land value has a negative sign—counter to the theory that tax rates should increase with value-added—and the estimated coefficient is not significantly different from zero. Model 10 substitutes adjusted land values for the observed value but this makes little difference in the estimated coefficients. Adding the share of spending going to schools in model 11 also matters little. In model 12 I add the log compensation per worker and the sign on adjusted land values then becomes positive but it is still not significantly different from zero at a high confidence level. Log per worker compensation has the expected negative sign but also is not significantly different from zero.

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[17] See http://www.freddiemac.com/pmms/pmms15.htm.

The next four columns in table 7 substitute log estimated coefficient for land value as a proxy for the net value-added. In model 13 population is treated as exogenous. The estimated coefficient is positive and implies that a 10 percent increase in population is associated with a one-tenth of a mill increase in the predicted tax rate, but the estimated coefficient is not significantly different from zero. In models 14, 15, and 16 the log population is instrumented by the log of state population. The instrument strongly predicts log population (i.e. state population growth predicts city population growth) but an endogeneity test does not reject the hypothesis that city population is exogenously determined, so the simple panel regressions may be preferable to the IV estimates. The IV estimates yield a negative but not a statistically significant estimate of the coefficient on the log of population. The coefficient on the share of spending on K-12 remains positive counter to the conventional wisdom, but statistically insignificant.

e. Additional Explanatory Variables

There are a number of additional potentially important explanatory variables that are not naturally incorporated in the theories presented in section III. Perhaps most obviously, one might be concerned that city business tax rates are influenced by competition with other jurisdictions. To the extent that the very large cities in this analysis compete among themselves and that competition is not greatly weighted toward neighboring regional cities, the empirical framework used above is adequate. If, however, cities compete with their suburbs and other areas of their states, it might also be necessary to take regional tax competition into account.[18]

The dataset from the Minnesota Center for Fiscal Excellence that provides the big city commercial and home ETRs used in the regressions reported in tables 5 to 7 also provides commercial ETRs for one rural city in each state. As shown in table 4, rural commercial ETRs tend to be lower than those in the big cities that appear in the sample—averaging about 17 mills compared to 20 or 21 mills in the sample cities. To the extent that there is competition between big cities and smaller cities located in their state's hinterland, the rural cities' tax rates will be simultaneously determined with the commercial ETRs in large cities. While the coefficient on

[18] See Janeba and Osterloh (2013) for a model incorporating both competition between large cities across regions and between large and small cities within a region.

rural commercial ETRs should not be interpreted as causal, including rural ETRs in the regression may reduce the omitted variable bias of other coefficients.

One might also believe that the commercial ETRs are influenced by the economic and fiscal situation of the given city. Economic conditions have an uncertain effect on decisionmakers' choices. Difficult economic conditions might result in higher business tax rates if there is both a higher demand for services to households and less perceived capacity by the households to pay for these services. On the other hand, difficult economic conditions could result in an increased desire to attract and retain employment in the city and therefore could result in lower comercial ETRs. I include the unemployment rate as an independent variable without offering a strong hypothesis about what may be the sign of the coefficient.

I consider two additional independent variables: the ratio of a city's debt outstanding to annual expenditures[19]—a measure of fiscal distress—and the log of the median home value—a measure of the residential average home tax base.[20] Consistent with the alternative model's main theme, one might expect cities in fiscal distress to lower their business tax rate in an attempt to retain or increase their tax base so I expect to find a negative coefficient on debt outstanding. It is unclear what the expected sign of the coefficient on the median home value may be. High median home values might signal affluence and a reduced desire to extract tax revenue from business. On the other hand, high median home values might mean high property taxes payments (at a given rate) and an increased desire to shift the city's tax burden to businesses.

Table 8 reports some representative regressions using these variables. Models 17 and 18 simply add the commercial ETR in the city representing the rural area in each state to models 4 and 6 that appear in table 5. Although the coefficient on the rural commercial ETR is statistically significant at a 97 percent level of confidence in both models, the substantive results change little. The share of spending on K-12 education has a positive sign—counter to the conventional wisdom—but is statistically insignificant when log net value- added is included.

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[19] Again the data is drawn from Lincoln Institute of Land Policy's FISC database and accounts for the debt and expenditures of all overlying governments.

[20] Median home values are also in nominal dollars. The data for this value is drawn the Minnesota Center For Fiscal Excellence (various years).

With a coefficient around 0.004, the log net value-added is positive and statistically significant at high level of confidence.

Model 19 adds the log of compensation per worker and the results are very similar to those shown in table 6, model 7: increases in net value-added are associated with increased commercial ETRs. Models 19 through 20 add the three additional independent variables discussed above along with various combinations of the home and rural commercial ETRs. Using these additional variables and combinations does not substantially change theresults . The coefficient on the spending share for K-12 education is always positive and statistically insignificant, while the coefficient on log net value-added is always positive and statistically significant. Neither the city's unemployment rate nor its debt ratio are statistically significant. The coefficient on the log median home value is positive and statistically significant at a high level of confidence in models 21 and 22. The estimated coefficients in those models suggest that a 10 percent increase in the median home value is associated with an increase in the commercial ETR of approximately two mills—about a 10 percent increase at the mean commercial ETR. This finding is consistent with the hypothesis that cities' with high housing values shift some of their overall tax burden onto commercial real estate.

VI. Conclusion

The fact that cities place a relatively high reliance on business taxes is somewhat puzzling in light of the conventional economic theories that suggest these taxes are detrimental to the residents the government represents. Property taxes, accounting for more than one-third of state and local taxes directly remitted by business firms, by far have consistently been the most important state and local business taxes. Despite this reliance, the relative property taxation of firms has not been studied as extensively as some other forms of business taxes, such as the corporate income tax.

I use a model that allows for heterogeneous businesses, some of which are more profitable than others in certain locations, to illustrate why business property taxes that exceed the cost of providing business services may be an optimal policy choice for decisionmakers who care about residents' well-being. My analyses show that optimal business property taxes also could be less than the cost of providing businesses with public services (i.e. subsidies). Thus, the analysis provides clues about how to rationalize the seemingly incongruent facts of cities imposing high business property taxes while also offering an extensive array of business property tax incentives.

I use data compiled by the Minnesota Center for Fiscal Excellence to empirically study variation in cross-city, over-time levels of commercial and home ETRs. Although the empirical analyses are hindered by lack of variation in some cities' ETR ratios, the preponderance of the evidence is inconsistent with the conventional wisdom that business property tax rates are driven by spending on public services for business. There is mixed empirical support for the alternative theory that commercial ETRs rise with a city's competitive position. Commercial ETRs also rise with a city's median home value.

What determines the level of business property taxes? Surely the answer to this question is complex and varies with the local economic, fiscal, political and historical conditions present in an individual city. However, there are important cross-city over-time regularities that can assist our understanding of this policy choice. There are logical reasons to believe and empirical evidence to support the idea that a city will exploit its competitive advantage and use property taxes to extract some of the economic profits businesses gain by locating within its boundaries.

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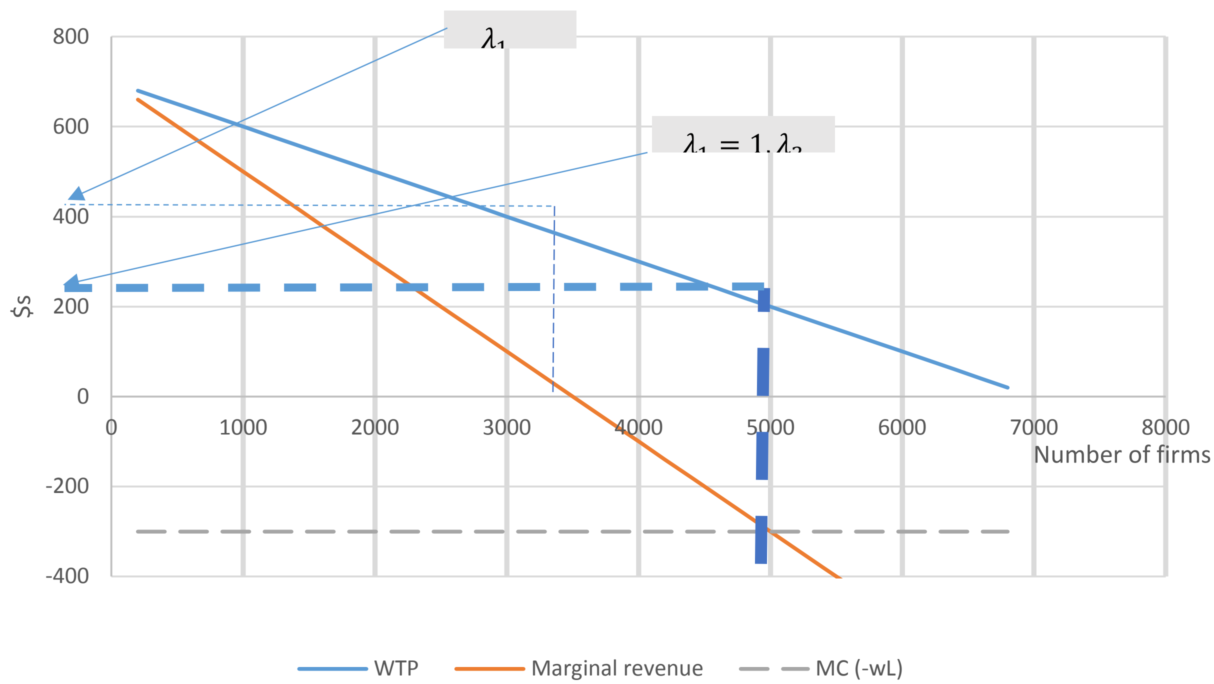
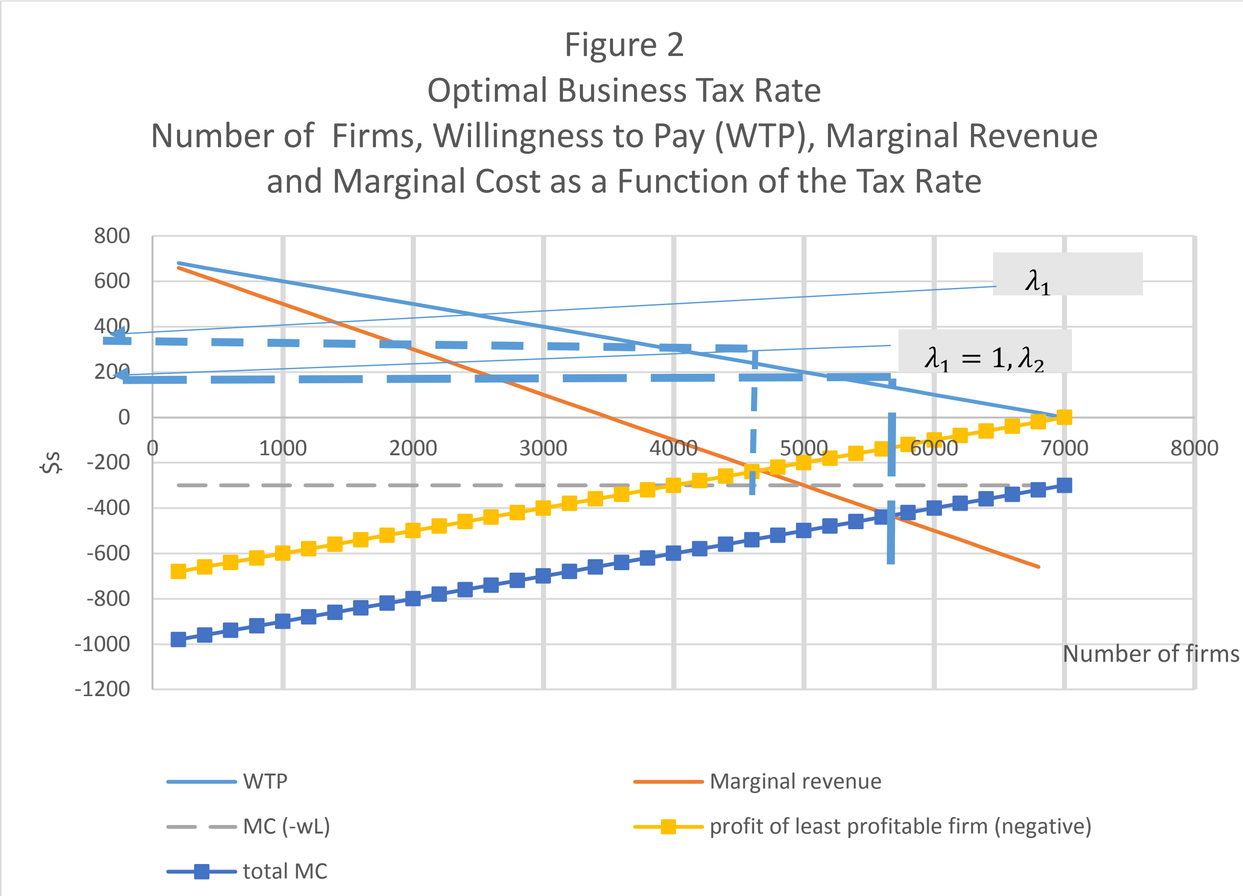
Tables and Figures

Figures

Figure 1
Optimal Business Tax Rate
Number of Firms, Willingness to pay (WTP), Marginal Revenue
and Marginal Cost as a Function of the Tax Rate



Source: Author's calculations based on hypothetical example.



Source: Author's calculations based on hypothetical example

Tables

Table 1
Four Special Cases of Equation (11)

		λ_1: 0	λ_1: 1
λ_2	0	$t = \left(\frac{1}{2}\right)\left((L^{\#})^{\alpha} - wL^{\#} + \theta\right)$	$t = \left(\frac{1}{2}\right)\left((L^{\#})^{\alpha} - wL^{\#} + \theta\right) - \left(\frac{1}{2}\right)wL^{\#}$
	1	$t = \left(\frac{1}{2}\right)(\psi) = \left(\frac{1}{2}\right)(\theta - \theta_1)$	$t = \left(\frac{1}{2}\psi\right) - \left(wL^{\#}\right)$

Table 2:
Effective Tax Rates (ETR) on Property by Year in Large US Cities

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
year	Number of cities	Home ETR (mean)	Commercial ETR (mean)	Ratio commercial to home (mean)	Ratio commercial to home (minimum)	City at the minimum	Ratio commercial to home (maximum)	City at the maximum
1998	51	0.015	0.022	1.76	0.83	Wilmington, DE	6.43	New Orleans
2000	51	0.014	0.022	1.70	0.83	Newark, NJ	4.10	New York City
2002	51	0.014	0.021	1.63	0.83	Manchester, NH	4.14	New York City
2004	55	0.014	0.021	1.62	0.71	Portland, OR	5.04	New York City
2005	73	0.015	0.020	1.57	0.83	Manchester, NH	6.05	New York City
2006	73	0.014	0.020	1.59	0.82	Cheyenne,WY	5.83	New York City
2007	73	0.013	0.019	1.63	0.83	Manchester, NH	7.14	New York City
2008	74	0.013	0.018	1.64	0.83	Manchester, NH	7.36	New York City
2009	74	0.014	0.019	1.61	0.83	Manchester, NH	5.41	New York City
2010	74	0.014	0.019	1.57	0.71	Wilmington, DE	5.01	New York City
2011	74	0.014	0.019	1.55	0.79	Wilmington, DE	5.03	New York City
2012	74	0.015	0.020	1.62	0.83	Newark, NJ	4.97	New York City
2013	74	0.015	0.021	1.56	0.83	Manchester, NH	4.50	Columbia, SC

Source: Minnesota Center for Fiscal Excellence (various years) and author's calculations.
Home ETRs are for the Median-Valued Owner-Occupied House in each city in each year. Commercial ETRs are for a parcel with a nominal market value of $1 million and $200,000 worth of fixtures

Table 3:
City by City Results

State, City	Ratio commercial to home ETR: Mean	Std. Dev.	Number of years with data	State, City	Ratio commercial to home ETR: Mean	Std. Dev.	Number of years with data
Alabama,Birmingham	2.14	0.07	13	Mississippi,Jackson	1.86	0.12	13
Alaska,Anchorage	1.04	0.04	12	Missouri,Kansas City	1.98	0.11	11
Alaska,Juneau	1.01	0.00	1	Missouri,Saint Louis	2.02	0.04	2
Arizona,Mesa	2.80	0.39	9	Montana,Billings	1.35	0.11	13
Arizona,Phoenix	2.89	0.37	13	Nebraska,Omaha	1.01	0.01	13
Arizona,Tucson	2.52	0.35	9	Nevada,Las Vegas	1.00	0.01	13
Arkansas,Little Rock	1.20	0.11	13	New Hampshire,Manchester	0.84	0.03	13
California,Fresno	1.04	0.01	9	New Jersey,Newark	0.85	0.04	13
California,Long Beach	1.02	0.01	9	New Mexico,Albuquerque	1.23	0.05	13
California,Los Angeles	1.02	0.01	13	New York,Buffalo	1.44	0.07	9
California,Oakland	1.01	0.00	9	New York,New York City	5.27	1.07	13
California,Sacramento	1.03	0.01	9	North Carolina,Charlotte	1.01	0.01	13
California,San Diego	1.02	0.00	9	North Carolina,Raleigh	1.00	0.02	6
California,San Francisco	1.01	0.00	9	North Dakota,Fargo	0.92	0.03	13
California,San Jose	1.01	0.00	9	Ohio,Cleveland	1.14	0.13	9
Colorado,Colorado Springs	3.67	0.04	9	Ohio,Columbus	1.17	0.16	13
Colorado,Denver	3.42	0.28	13	Oklahoma,Oklahoma City	1.13	0.03	13
Connecticut,Bridgeport	1.06	0.14	11	Oklahoma,Tulsa	1.06	0.01	9
Connecticut,Hartford	2.07	0.25	2	Oregon,Portland	1.05	0.11	13
DC,Washington	2.39	0.37	13	Pennsylvania,Philadelphia	1.30	0.02	13
Delaware,Wilmington	0.86	0.13	13	Rhode Island,Providence	2.30	0.40	13
Florida,Jacksonville	1.27	0.10	10	South Carolina,Charleston	2.99	0.63	2
Florida,Miami	1.19	0.09	13	South Carolina,Columbia	3.57	0.97	11
Georgia,Atlanta	1.48	0.40	13	South Dakota,Sioux Falls	1.11	0.06	13
Hawaii,Honolulu	2.78	0.33	13	Tennessee,Memphis	1.54	0.01	13
Idaho,Boise	1.78	0.21	13	Tennessee,Nashville	1.54	0.01	9
Illinois,Aurora	0.90	0.02	9	Texas,Arlington	1.03	0.02	9
Illinois,Chicago	2.08	0.63	13	Texas,Austin	1.08	0.03	9
Illinois,Naperville	0.87	0.00	1	Texas,Dallas	1.20	0.03	9
Indiana,Fort Wayne	2.87	0.00	1	Texas,El Paso	1.01	0.05	9
Indiana,Indianapolis	2.10	0.59	12	Texas,Fort Worth	1.04	0.03	9
Iowa,Des Moines	1.84	0.17	13	Texas,Houston	1.22	0.08	13
Kansas,Wichita	2.25	0.08	13	Texas,San Antonio	1.01	0.05	9
Kentucky,Lexington	1.07	0.00	2	Utah,Salt Lake City	1.83	0.04	13
Kentucky,Louisville	1.05	0.04	12	Vermont,Burlington	1.11	0.09	13
Louisiana,Baton Rouge	2.28	0.00	1	Virginia,Richmond	1.31	0.10	3
Louisiana,New Orleans	3.09	1.15	12	Virginia,Virginia Beach	1.18	0.16	11
Maine,Portland	1.06	0.02	13	Washington,Seattle	1.01	0.02	13
Maryland,Baltimore	1.28	0.08	13	West Virginia,Charleston	2.18	0.16	13
Massachusetts,Boston	3.82	0.60	13	Wisconsin,Milwaukee	1.03	0.01	13
Michigan,Detroit	1.35	0.27	13	Wyoming,Cheyenne	0.99	0.05	13
Minnesota,Minneapolis	2.29	0.27	13				
Total					1.61	0.91	871

Source: Minnesota Center for Fiscal Excellence (various years) and author's calculations. Home ETRs are for the Median-Valued Owner-Occupied House in each city in each year. Commercial ETRs are for a parcel with a nominal marrket value of $1 million and $200,000 worth of fixtures

Table 4
Descriptive Statistics about Variables used in the Empirical Analyses

	First year (1998) except for value added and compensation which are for 2002)			Last year (2012)		
Variable	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
commercial ETR	51	0.0220	0.0100	74	0.0200	0.00800
home ETR	51	0.0150	0.00800	74	0.0150	0.00700
share of spending going to K-12 education	37	0.280	0.0700	59	0.270	0.0900
per worker value added net of compensation (000s of nominal $s)	50	45	9.700	73	40.50	10
per worker compensation (000s of nominal $s)	50	38.10	6.200	73	49.70	9.100
share of presidential vote for Barack Obama in 2008	40	0.710	0.150	62	0.684	0.151
value of land for typical home	28	69,638	41,535	37	114,063	151,252
tax-rate-adjusted value of land for typical home	28	68,638	39,519	37	108,804	141,432
population	47	692,005	1,197,585	73	711,644	1,087,953
rural commercial ETR	50	0.0170	0.00800	73	0.0170	0.00800
unemployment rate (%)	51	4.700	2	73	8.200	2.800
ratio of debt outstanding to annual expenditures	37	1.130	0.380	59	1.410	0.500
value of median home	51	121,213	39,983	74	213,845	117,978

Sources: commercial ETR and home ETR see Table 2. Share of spending going to K-12 education Lincoln Institute of Land Policy. Fiscally Standardized Cities database. Per worker value added and per worker compensation U.S. Department of Commerce. Bureau of Economic Analysis. Regional Economic Accounts. Share of presidential vote for Barack Obama in 2008 Tausanovitch and Warshaw, 2013 as posted at http://www.americanideologyproject.com, value of land for typical home Davis and Palumbo. 2007. tax-rate-adjusted value of land for for a typical home is value of land for typical home adjusted as described in section V.d of the text population U.S. Census Bureau, Population Division SUB-EST2013: Subcounty Resident Population Estimates https://www.census.gov/popest/data/datasets.html, rural commercial ETR Minnesota Center for Fiscal Excellence (various years), unemployment rate US Department of Labor, Bureau of Labor Statistics http://download.bls.gov/pub/time.series/la/, ratio of debt to outstanding annual expenditures Lincoln Institute of Land Policy. Fiscally Standardized Cities database and author's calculations, value of median home Minnesota Center for Fiscal Excellence (various years).

Table 5
Regressions to Explain Variation in Commercial ETR

	model1	model2	model3	model4	model5	model6
share of spending going to K-12 education	0.0101*		0.0036	0.0081**		0.0020
	(0.05)		(0.41)	(0.03)		(0.63)
log (per worker Value added net of compensation)		0.0054**	0.0060***		0.0031**	0.0038***
		(0.01)	(0.00)		(0.01)	(0.00)
home ETR				0.8365***	0.7526***	0.7407***
				(0.00)	(0.00)	(0.00)
r2_a	0.09	0.15	0.12	0.34	0.49	0.39
N	619	757	545	619	757	545

Notes: city level cluster robust p stats reported in parentheses * for p<.05 ** for p<.01 and *** for p<.001 All regressions have city-fixed effects and year dummies
r2_a is the within adjusted r-square.

Table 6

Regressions to Explain Variation in Commercial ETR

	model7	model8
share of spending going to K-12 education	0.0019	0.0042
	(0.63)	(0.29)
log (per worker Value added net of compensation)	0.0042***	0.0032
	(0.00)	(0.10)
log(per worker compensation)	-0.0057	-0.0073
	(0.40)	(0.18)
home ETR	0.7370***	0.7194***
	(0.00)	(0.00)
share of presidential vote for Barack Obama in 2008		0.0109*
		(0.06)
r2_a	0.39	
r2_w	0.41	0.38
N	545	474

Notes: City level cluster robust p statistic in parens below estimated coefficient. * for p<.05 ** for p<.01 and *** for p<.001

All regressions include year dummies. Model 7 is estimated with city fixed effects. presdem_2008 is Barack Obama's share of the presidential vote in 2008. since this does not vary over time within a city, fixed effects must be omitted in model 8. r2_a is the within adjusted r-square r2_w is the within rsquared and is reported when r2_a is not available.

Table 7
Regressions to Explain Variation in Commercial ETR

	model9	model10	model11	model12	model13	model14	model15	model16
share of spending going to K-12 education			0.0027	-0.0011			0.0098	0.0054
			(0.62)	(0.87)			(0.33)	(0.39)
log value of land for typical home	-0.0003							
	(0.74)							
log tax rate adjusted value of land for typical home		-0.0003	-0.0003	0.0004				
		(0.74)	(0.78)	(0.69)				
log population					0.0011	-0.0029	-0.0012	-0.0047
					(0.35)	(0.40)	(0.89)	(0.53)
home ETR	0.7857***	0.7902***	0.7869***	0.7161***	0.8090***	0.8030***	0.8317***	0.7495***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
log per worker compensation				-0.0034				-0.0032
				(0.71)				(0.67)
r2_a	0.35	0.35	0.33	0.36	0.46	0.39	0.27	0.27
estatp						0.28	0.65	0.24
N	441	441	402	348	837	837	607	537

Notes: City level cluster robust p statistic in parens below estimated coefficient. * for p<.05 ** for p<.01 and *** for p<.001.

All regressions have city-fixed effects and year dummies.Log population is treated as endogenous and is instrumented by state population in models14, 15 and 16

estap is a statistic from an endogeneity test. The endogeneity test is implemented by creating a test statistic that is the difference of two Sargan-Hansen statistics: one where log population is assumed endogenous and and one where log population is treated as exogenous. Under the null hypothesis that log population can actually be treated as exogenous the test statistic is distributed chi-squared with degrees of freedom equalt to the number of regressors tested.

The estat statistic gives the level of confidence at which the null hypothesis of exogeneity can be rejected.

Table 8
Regressions to Explain Variation in Commercial ETR

	model17	model18	model19	model20	model21	model22
share of spending going to K-12 education	0.0086***	0.0026	0.0025	0.0049	0.0023	0.0029
	(0.01)	(0.52)	(0.52)	(0.29)	(0.59)	(0.50)
ln_VA_net_total		0.0041***	0.0042***	0.0064***	0.0040***	0.0041***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ln_comp_per_empl_total			-0.0024	-0.0088	-0.0077	-0.0041
			(0.69)	(0.30)	(0.27)	(0.52)
home ETR	0.7920***	0.7066***	0.7055***		0.7623***	0.7281***
	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)
rural commercial ETR	0.1947**	0.1481**	0.1469**			0.1384**
	(0.03)	(0.03)	(0.03)			(0.03)
unemployment rate				0.0001	0.0003	0.0003
				(0.64)	(0.11)	(0.15)
ratio of debt outstanding to annual expenditures				0.0003	-0.0001	0.0001
				(0.75)	(0.92)	(0.86)
median home value				0.0002	0.0018**	0.0016**
				(0.83)	(0.04)	(0.04)
r2_a	0.37	0.41	0.41	0.12	0.40	0.41
N	607	535	535	543	543	533

Notes: City level cluster robust p statistic in parens below estimated coefficient. * for p<.05 ** for p<.01 and *** for p<.001
All regressions have city-fixed effects and year dummies. r2_a is the within adjusted r-square.

Appendix A

A general model that encompasses both O&S and the alternative model

Objective function

General Case $U[c, g]$
O&S special case Same as general case
My special case $U_g = U_{cg} = U_{gc} = 0$

Output of ith firm

General Case $Q_i = (L_i^{\alpha} + \beta\theta_i)f(k, x)^{\gamma}$
O&S special case $\alpha = 1, \beta = 0, \gamma = 1$
My special case $\alpha > 0, \beta = 1, \gamma = 0$

Tax on ith firm

General Case $t_i = \kappa_1 L_i k t + k_2 t = \kappa_1 K_i t + k_2 t$
O&S special case $\kappa_1 = 1, k_2 = 0$
My special case $\kappa_1 = 0, k_2 = 1$

Budget constraint

General Case $\phi_1 \mathrm{w} \sum_{i=1}^{N}(L_i)^{\#} + \phi_2 \sum_{i=1}^{N} t_i + \phi_3 \sum_{i=1}^{N} \pi_i + \phi_4 wL - p_g gL - p_x xL + yL = cL$
O&S special case $\phi_1 = 0, \phi_2 = 1, \phi_3 = 0, \phi_4 = 1$
My special case $\phi_1 = \lambda_1, \phi_2 = 1, \phi_3 = \lambda_2, \phi_4 = 0, p_g = p_h = y = 0$

Wages

General Case $w = \nu(f - kf_k - xf_x) + \overline{w}$
O&S special case $\nu = 1, \overline{w} = 0$
My special case $\nu = 0$

Return per unit of capital

General Case $r = f_k + \left(\frac{x}{k}\right) f_x - t$
O&S special case Same as general case
My special case Does not matter