What determines the level of business property taxes?

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Abstract: Economists have long lacked a well-articulated theory to explain why a large fraction of state and local taxes are remitted by business. Conventional economic wisdom holds that optimal business taxes exactly recover the cost of business public services. I present an alternative model and derive conditions under which a self-interested decision-maker picks tax rates to exploit a city's market power and maximize an objective function that depends on both business tax revenues and workers' labor earnings. I show that, in this model, optimal business tax revenues may be either greater or less than the cost of business public services.

Data from approximately 70 large U.S. cities over a 16 year period reveals that the mean ratio of commercial-to-home effective property tax rates (the "ETR ratio") is about 1.6. In many cities, this ratio changes little over time. Conventional wisdom suggests that ETR ratios should rise with the share of spending on business services while the alternative theory suggests the ETR ratio should rise with a city's desirability as a business location. Standard urban theory suggests cities with larger populations are more desirable business locations.

I report results from a large variety of regressions of empirical proxies for cities' share of spending on business services, population and an assortment of control variables on the ETR ratio. These regressions provide no support for the conventional wisdom—ETR ratios are inversely related to the share of spending on business public—services once I include city fixed effects. ETR ratios rise with population—consistent with the alternative model—as long as city fixed effects are included but controls for pay per employee or pay per establishment are not. ETR ratios also rise with cities' unemployment rates and median home values.

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I. Introduction: Lack of theory of state and local business taxes

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

> there has developed in this country a fairly elaborate structure of …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…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.622)

Despite efforts by Studenski and others the situation has not changed much. In 2007 Testa and Mattoon (p.838) wrote "States continue to struggle with finding a sound conceptual basis in their approach to business taxation."

This could be, at least in part, because as Kopczuk and Slemrod (2006) wrote "Firms are, for the most part, absent from the modern theory of optimal taxation…[despite the fact that]…firms play a central role in all modern tax systems" (p. 130). With modest exceptions, some of which are discussed below, economists lack an empirically-grounded positive theory to explain geographic and over-time variation in state and local taxation of business and a normative theory that is tangible enough to be applied in public policy debates. Many economists may believe that general theories to explain business taxation are unnecessary since, as we teach undergraduates, business don't pay taxes, people do (Worstall 2011).

The lack of conceptual grounding for business taxation has not prevented economists from writing 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 (see for example, 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 induce economic activity (see Bartik 1991, Weiner 2009, Kenyon et. al. 2012**).** These studies may be methodologically sound and informative but, in general, they do not address the relative benefits of state and local taxes on households versus business.

II. What are business taxes and how big are they?

Because the ultimate burden of all taxes must fall on some individual there is 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 revenues to government and focus on explaining the potential informational advantages of this arrangement. In practice, even this definition of business taxes leaves room for ambiguity since in some cases (e.g. the pass-through of withheld wages) tax revenues remitted by firms generally are not considered business taxes and in others (e.g. sales taxes on business-to-business transactions) taxes are not remitted by the firms that bare the impact incidence of the tax. In practice, in the discussion of business taxes analysts have measured what can easily be observed or estimated.

The Advisory Commission on Intergovernmental Relations (ACIR 1981) appears to have been the first to attempt a systematic quantification of state and local taxes with an impact incidence on business. The ACIR report used US Census and other data to measure such taxes in all 50 states at four points in time between 1957 and 1977. The ACIR found that roughly one-third of state and local taxes had an initial impact directly on business and that the most important business taxes were property taxes, sales and gross receipts taxes and the corporation income tax. ACIR (1981) found that the share of state and local taxes with an initial impact on business was generally highest in the Midwest region and lowest in the Plains region. Business' share of state and local taxes declined somewhat over the time period studied.

Tannenwald (1993) and Oakland and Testa (1996) later refined ACIR's (1981) methodology and provided updated estimates. Oakland and Testa (1996) found a continued decline in business' share of taxes through 1992. Property taxes continued to be the largest tax with a direct impact on business and accounted for about 43 percent of such taxes. Retail sales taxes and the corporation income tax each accounted for about 14 percent of business taxes.

Since about 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 are about 45 percent of all state and local taxes and equal 4.7 percent of gross state product (GSP). The report finds that the most important tax on business entities 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 and accounted for 21 percent of business taxes and the corporation income tax accounted for less than eight percent of business taxes. The report found considerable variation across states with some (Alaska, N. Dakota, Wyoming and Vermont) having high business taxes as a share of GSP while others (N. Carolina, Connecticut and Oregon) collect a small share of GSP in business taxes.

III. Conventional wisdom about state and local business taxes and an alternative

a. The conventional wisdom

Oakland and Testa (1996, p.2) express what is probably most economists' conventional wisdom about state and local business taxes. They

> advance the proposition that general business taxation should be structured so as to recover the costs of public services rendered to the business community… Business benefit taxes…promote appropriate choices between private and public goods. Without recovery of the costs of business services, voters may not support worthy public services provided to business. Alternatively, [if business taxes are too high] the voting public…may believe business taxes can…subsidize…households.

Perhaps because many economists find this intuition compelling there seems to have been only limited effort to rigorously develop this argument. One of the few formal treatments of the question is Oates and Schwab (1991) (O&S). Their 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 $[F[\cdot]]$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 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 non-labor 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.

In O&S'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]

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

s.t.

$$Q = Lf[k,x] \tag{1.1}$$
$$h + kt = p_g g + p_x x \tag{1.2}$$
$$y + w = c + h \tag{1.3}$$
$$w = f - kf_k - xf_x \tag{1.4}$$
$$r = f_k + \left(\frac{x}{k}\right) f_x - t \tag{1.5}$$

Where lower case symbols are equal to the per-unit-of-labor counterpart of the upper case symbol. 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 adjusts to satisfy equation (1.5).

[2] In my notation 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.

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

$$\frac{U_g}{U_c} = p_g \quad (2)$$

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

$$p_x = f_x \quad (4)$$

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 the household 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 O&S'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 not collectively consumed (i.e. it is subject to crowding). Equation (3) assures that the fee paid by the firm when bringing a unit of capital into the community will be equal to the additional amount of X 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 is a fee paid by the firm to compensate the community for the loss of production as a result of the use of X when it enters. Note that O&S's result in equation (3) depends on the ideas that X is a publicly-provided private good and that the share of X a firm consumes is just equal to its share of capital in the community.

Equation (4) simply 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

$$tk = xp_x \quad (5)$$

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

b. Alternative conceptualization—business property taxes capture economic profits

O&S's model provides a baseline result showing the most efficient government choice under a given set of conditions[3]. While O&S's model provides a useful baseline Oakland and Testa's (1996) quantitative results and empirical evidence to be presented later in this paper, cast doubt on its accuracy as a positive model to explain cross-geography and over-time variation in business taxation. Moreover, the tensions in O&S's model do not seem to mirror the political/public policy debate with regard to business taxation. O&S'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 O&S'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 business taxation and job creation.

I present a related but alternative model which shows that, in contrast to O&S, non-zero business taxes could be optimal even when the government provides no business services. In this model decision-makers, who are potentially agents of residents, use business taxes to transfer some business profits to households.

[3] After presenting their basic model O&S expand their analyses to allow for amenities and dis-amenities and limitations on household taxes. In these models the result in equation (5) does not always hold. Garcia-Mila and McGuire (2002) extend O&S 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.

However, the decision-maker must balance possible job losses against gains from extraction of business profits. Potential job gains give decision-makers a motivation to subsidize business and in this model net taxes could be either positive of negative (subsidies) even in a world with no publicly provided business services.

This model is, in some senses simpler but in others more complex than O&S's. The model is simpler in that the basic story can be told without any reference to publicly provided goods for either residents or businesses. However, the model is more complex in the sense that, intrinsic to the story, is an assumption that businesses are heterogeneous, with some more productive and others less so. I assume there is a "decision-maker" that picks the business tax rate to maximize some objective function. The model takes no position on the identity of the decision-maker who could be the median voter, an elected official or some other entity.

Let $U[C]=$ objective function of decision-maker,

The decision-maker's problem is to pick t (tax rate) to maximize an objective function that depends on a weighted sum of wages earned by workers, tax revenue and profits accruing to business, constrained by businesses behavior

$$U[C] \tag{6}$$

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

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 decision-makers attach 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 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[4]. This treatment implies that the per-firm tax discussed here is equivalent to the per-unit-of-capital tax studied in O&S.

I assume that decision-makers 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 there is 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 t. 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[5]. 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 $\theta_i = \theta - \psi i$. The firm stays in business if

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

Define

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

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

[4] This assumption is common in the literature. See Burbidge et. al. 2006 and Baldwin and Okubo 2014.

[5] Although developed independently this profit function is similar in spirit to that used in Burbridge et al. (2006).

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

Recall that

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

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

The decision-maker'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:

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

Consider three special cases of equation (11)

Special case 1. $\lambda_1 = \lambda_2 = 0$

$$2\mathrm{t} = \left(\left(L^{\#}\right)^{\alpha} - wL^{\#} + \theta\right)$$

Special case 2. $\lambda_1 = 1$ and $\lambda_2 = 0$
$2t = \left(L^{\#}\right)^{\alpha} + \theta - \left(2wL^{\#}\right)$

Special case 3. $\lambda_1 = \lambda_2 = 1$
$t = \left(\frac{1}{2}\psi\right) - \left(wL^{\#}\right)$

In special case 1 with $\lambda_1 = \lambda_2 = 0$ the decision-maker is analogous to an ordinary monopolist selling access to the city at a price (t) and facing a linear downward sloping demand curve and a zero marginal cost. The monopolist sets price equal to marginal revenue in this case. The profit maximizing price turns out to be one-half of the vertical intercept of the demand curve. In the example considered here the vertical intercept of the demand curve is profit of the most productive firm (i.e. the firm with the largest θ). The optimal tax will be unambiguously positive.

Notice that this is in sharp contrast with O&S. Since the government is supplying no business public services O&S's model implies that the optimal solution is for firms to pay no taxes. That results would come about in this model only if firms are indifferent about locating in the city (as implicitly assumed in O&S).

In special case 2 with $\lambda_1 = 1$ and $\lambda_2 = 0$ the decision-maker (still a monopolist) cares about workers' earnings as well as tax revenue. This concern about worker earnings constrains the decision-maker from extracting the maximum possible profit from firms in the form of tax revenues. In this case, the marginal firm brings two sorts of marginal benefits to the decision-maker—additions to tax revenue and additions to wages. In the standard monopolist framework, the additional wages resulting from an additional firm can be conceived of as a kind of negative marginal cost to the decision-maker. That is, it is as if, the additional firm entering the city is lowering the decision-maker's costs. This is depicted in the figure 1 below.

Figure 1 about here

The decision-maker 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.

In special case 3 with $\lambda_1 = \lambda_2 = 1$ the decision-maker cares about profits accruing to businesses as well as wages accruing to workers and tax revenue. We can think of the profits earned by the marginal firm as a kind of negative marginal cost from the perspective of the decision-maker. Then the decision-maker 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 decision-maker cares about profit as well as wages earned by workers the optimal tax will be somewhat lower (than in the case when the decision-maker does not care about profit) but could still be either negative (a subsidy) or positive. Comparing the solutions in special case two and three above the tax rate in case two is greater than the tax rate in case three as long as $((L^{\#})^{\alpha} + \theta) \geq \psi$. Thus, $\theta > \psi$ assures the tax rate is greater in case two. Note that $\theta_i = \theta - \psi i$ so $\theta \leq \psi$ implies that $\theta_i \leq 0$ for all i. This means that if tax rates were zero or positive there would be no firms.

Figure 2 about here

It might seem surprising that, in case 3, even though the decision-maker cares equally about earnings, tax revenues, and firm profits it may be optimal to set a non-zero tax rate, despite the fact that taxes may alter firms' profit-calculus and decision about where to locate. This result comes about because, in this model, there is a misalignment of private firm benefits—which depend only on profit—and social benefits which depend on profit, worker earnings and tax revenues. It may well be optimal for decision-makers to tax or subsidize firms in order to alter their location decisions.

The alternative model presented here is primarily intended to counter-balance the conventional wisdom that business tax revenues equal to the cost of 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 non-zero 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 decision-makers who care about tax revenue and/or household earnings may find it optimal to set business tax rates that are not equal to the cost of business public services. In the next sections of this paper I empirically explore of the determinants of the largest state and local business tax—the business property tax.

IV. Data about Business Property Taxes

As discussed above the general consensus among analysts is that the most important state and local taxes with a direct impact on business are the property tax and the sales tax with the corporation income tax a distant third. It is often difficult to study business property and sales taxes because these taxes are administered through the same system as similar taxes on households. So, for example, states typically do not track and the US 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 rough estimates of the non-household share of sales tax revenues. This methodology continues to be used in modified form in most studies of state and local business taxation (Phillips et. al. 2014).

Analysts 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. Few however report complete information about the myriad tax incentives, deferments and other devices businesses (see Kenyon et. al. 2012) and households use to reduce their property tax payments.

In the absence of well-organized, comparable administrative data about business property taxes analysts must assemble the data independently. Fortunately, since 1995[6] the Minnesota Center for Fiscal Excellence (henceforth "the Center") has compiled and published[7] a 50-State Property Tax Comparison Study of effective property tax rates for several classes of property. Since 2005 the study has included

[6] Studies were published in 1995, 1998, 2000, 2002, and each year since 2004.

[7] 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 been a partner in the reports' publication.

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[8]. Data for the report is collected from state and local websites where available. When 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 effective property tax rates (ETRs) for representative parcels of particular types. The simulated net property tax on each parcel is calculated taking into account the local sales ratio for that class of property, the classification rate and applicable property tax credits. Special property tax provisions that apply to less than half of taxpayers of a given class are omitted from the calculations. The ETR is calculated as the simulated tax payment divided by the assumed market value[9].

V. Descriptive information about business property taxes

Some descriptive information about the data is given in Table 1. 1995 data is not reported because the study did not include values for the median-priced home in that year. Table 1 shows that in each year mean ETRs on owner-occupied homes were between 1.3 and 1.5 percent of market value while mean ETRs on commercial parcels were between 1.8 and 2.2 percent. 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

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[8] Tables on the 50 largest US cities were added beginning in 2005.

[9] 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.

residential ETRs.   Manchester, NH has the lowest ETR ratio of any of the cities in the data set 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 and NH 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 a surprise for a city that has a reputation as having quite intrusive regulation of business.

At the other extreme NYC had the highest ETR ratio in 11 of the 13 years, 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 NYC did not have the top ETR ratio New Orleans and Charleston, S.C. did. While both of these cities have unique attributes that attract tourists, neither seems particularly well-positioned to to negotiate with businesses and both are located in politically conservative states that might be expected to favor pro-business policies.

Table 1 about here

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 2 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, Wisconsin 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 2 about here

Table 2 also suggests that state level rules may be important determinants of ETR ratios. Multiple cities within the same state are 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), NY (2), N. Carolina (2), Oklahoma (2), S. 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.

Table 3 reports a more formal analysis of variance of the ETR ratio across cities and over time. The R-squared indicates that 91% of the variation in the ETR ratio is explained by city-fixed effects. Both the estimated intra-class correlation and the estimated reliability of a city mean confirm that a very large share of the variation in the ETR ratio is between, rather than within, cities.

Table 3 about here

VI. Explaining the variation in business property taxes

The lack of within-city over-time variation in ETR ratios effectively reduces the information provided by the panel data set. The effective sample size may be even more limited because within-state variation among cities is truncated. To the extent that state policies limit variation in ETR ratios, city-level variables will be unable to explain this variation. In order to account for the panel nature of this data set it may be appropriate to cluster standard errors when estimating the statistical significance of parameter estimates (Angrist and Pischke 2009 p.308-315). Keeping in mind the data limitations discussed above, I begin with a series of simple bivariate analyses designed to shed light on major hypotheses that may explain variation in business property taxes.

a. Business property taxes and city population rank

The alternative model presented above suggests that business property taxes may be a device to capture economic profits generated by locating in the city. Empirical analogs to the components of equation (11) are difficult to identify. However, a long literature in urban economic systems suggests that the largest cities in an 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. An intuitive test of the theory that business property taxes capture economic profits is that larger cities should have higher business property taxes, or at least higher ETR ratios, than smaller cities.

In Figure 3 (below) ETR ratio is plotted against the population rank for the 50 biggest US cities for the years 2012 (most recent available), 2010, 2004 and 1998 (oldest available). The nation's largest city, NYC has the highest ETR ratio of any city in each of the four years. However, Los Angeles, the nation's second largest city has one of the lowest ETR ratios in the nation and Chicago, the 3rd largest city has an ETR ratio in-between. The data show cities to be largely bi-model; with one group's ETR ratios cluster around one (the solid horizontal line) and another smaller group (including Boston, Denver and Colorado Springs in 2012 and 2010) has much higher ratios. The regression (dotted) line shows a slight downward slope.

Figure 3 about here

An analogous figure showing <u>levels</u> of commercial ETRs against population rank is displayed in the appendix and illustrates broadly similar themes. Commercial ETRs are somewhat higher in larger cities but there is a lot of variation around the trend line.

VII. Bivariate regressions

Conventional wisdom as manifest in O&S's formal model suggests that business taxes rise with the level of business services. Statistics on government service provision do not break out those directed toward business versus services that primarily benefit households. However, there is reason to believe that the primary direct beneficiaries of one major service—K to 12 education—are households. Although businesses certainly benefit (directly) from well-educated workers (and arguably consumers) businesses are not constrained to hire students educated in a particular city. Within the catchment area from which a business hires there generally will be a number of school districts so increased services in one district benefit the business only to the extent that the employer hires (former) students from this district[10]. Even in this case, the relationship between educational spending and the eventual employee is quite

[10] More precisely, employers benefit from improved education only if they both hire students/graduates receiving the improved education and if wages increase less than productivity as a result of the improved education.

distant so that businesses are unlikely to have much direct economic stake in the quality of K to 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 to 12 spending to household services[11].

In Table 4 I present results from a number of bivariate regressions with ETR ratio as the dependent variable. The regression results in the first row are relevant to the conventional wisdom (formally described in O&S) that business taxes pay for business services. This theory suggests that cities with a higher share of spending on K-12 education[12] should have a lower ETR ratio, i.e. a negative coefficient on the independent variable. The estimated coefficients (all negative) are consistent with this theory although the individual year coefficients are estimated too imprecisely to reject the null hypothesis of no effect. When all available years are pooled the estimated coefficient is statistically significant but this is only mildly reassuring since I have not controlled for city or time fixed effects or for any other possibly correlated variables. The coefficient in row 1 of column 5 suggests that a one standard deviation (0.09) increase in the share of expenditures on education is correlated with a 0.13 decline in the dependent variable which has a mean of about 1.6.

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

[12] 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.

Table 4 about here

Rows 2 and 2b of Table 4 analyze the relationship between population (measured in natural logs) and ETR ratios and can be viewed as simply another way of looking at the data in Figure 3. All of the estimated coefficients in row 2 are positive although none except column 5 are statistically significant. The coefficient in column 5 of row 2 (0.1985) means that a ten percent increase in population is associated with a 0.2 point increase in the ETR ratio. However, this result depends heavily on a single observation. NYC has both, by far, the highest population in the data set and also the highest ETR ratio. I report the estimated coefficients I obtain when I drop NYC from the analyses in row 2b. In this case, the estimated coefficient on log population is negative in two of the four years and statistically insignificant in all 5 columns.

The evidence does not present strong prima facie evidence for either the conventional wisdom or an alternative theory of extraction of business profit. I also analyzed the relationship between ETR ratio and a number of other plausibly relevant independent variables. Rows 3 and 4 report results from regressions on the natural log of pay per employee and pay per establishment which equation (11) (above) suggests are relevant. All else equal, according to equation (11) business tax rates should fall with increases in pay per establishment (i.e. $wL^{\#}$). However, it is likely that higher wages per establishment are correlated with higher productivity per establishment ($(L^{\#})^{\alpha}$) so, without controls for productivity, the hypothesized sign on wage is ambiguous and could potentially be zero. All of the estimated coefficients in rows 3 and

4 are positive and the estimates in columns 2 (2004) and column 5 (all years) are statistically significant. The significant coefficients suggest a ten percent increase in wages per employee is associated with an increase in the ETR ratio of between 0.07 and 0.20 from its mean of about 1.6. A ten percent increase in wages per establishment is associated with a slightly smaller increase in the ETR ratio of between 0.04 and 0.12.

More impressionistically one might think that the economic or fiscal condition of the city would influence its choice of business tax rate. To examine this hypothesis, row 5 reports regression coefficients from a bivariate regression of ETR on the unemployment rate. The coefficient is positive twice and negative three times but never statistically significant.

Consistent with main theme of the alternative model one might expect cities in fiscal distress to lower their business tax rate in an attempt to retain or increase their tax base. Row 6 reports results of a regression of one measure of fiscal distress—the ratio of debt outstanding to direct expenditures[13]—against the ETR ratio. The estimated coefficient is positive and (barely) statistically significant with the 1998 data and negative and statistically significant when all available data is included but statistically insignificant (though negative) in the other three cases. The coefficient in column 5 suggests that a one standard deviation increase in the ratio of debt outstanding would be associated with a fall in the ETR ratio of about .055.

Row 7 reports results from regressions of median home value on the ETR ratio. The expected sign is unclear. High median home values might signal affluence and a

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

reduced desire to extract tax revenue from business. On the other hand, high median home values might mean high property taxes (at a given rate) and an increased desire to shift the burden to business. The latter effect predominates in the data—all of the estimated coefficients are positive though only the column 5 coefficient is statistically significant. This coefficient suggests that a ten percent increase in median house value is associated with an increase of .02 in the ETR ratio.

Finally, row 8 reports results from a regression of the share of the vote for the democratic candidate for president in 2008 (Barack Obama) on the ETR ratio[14]. These cities voted overwhelmingly democratic with Obama getting a mean share of 69 percent of the vote. This vote share variable might be thought of as an empirical proxy for the inverse of λ_2—the weight decision-makers give to profit in the objective function—in equation 11. We might expect the business tax rate to be somewhat lower as λ_2 increases and so might expect that a higher democratic vote share would be associated with a higher ETR ratio. All estimated coefficients are positive but only the column 5 coefficient is statistically significant and its magnitude does not seem particularly large. A one standard deviation increase in the 2008 democratic vote share (0.15) would increase the ETR ratio by .06.

VIII. Multivariate regressions

a. Relationship between the share expenditures on K-12 education, population and ETR ratio

The bivariate analyses in Table 4 yields mixed results that suggest a complex relationship between business property taxes and municipal characteristics. To help

[14] Unfortunately vote shares for city geographies were not available for other years.

untangle this I proceed to multivariate analysis that allows for simultaneous controls for multiple influences. I first focus on explaining the ETR ratio using the two key independent variables; share schools (which proxies for the share of public expenditures on business) and the log of population (which indicates the extent to which the city offers business extraordinary profit opportunities). Table 5 reports coefficients, conventional p values and p values when standard errors are clustered by city. I report results from 48 multivariate regressions with a variety of control variables and assumptions about fixed effects.

Table 5 about here

Table 5 is arranged in six panels. Each column (in each panel) presents estimated coefficients and p values from a separate regression. The other independent variables (besides share school and log pop) included in the regression differ by column as explained in a footnote to the table. Set 1 contains OLS regressions while set 2 contains regressions with city fixed effects.   In case A I include no control for payment per employee or per establishment because, as discussed above, inclusion of these variables limits the sample size because it necessitates dropping observations prior to 2004. Case B includes a measure of payment per employee in all regressions and Case C includes a measure of payment per establishment in all regressions.

Because NYC is something of an outlier with respect to both population and the ETR ratio I ran analogous regressions with a sample that excluded observations from

NYC. Coefficients and p values for share school and log pop from these regressions are reported in appendix table 5B.

Table 6 summarizes results from Tables 5 and 5B. It contains an entry for share school and log pop summarizing the results in each of the six panels in Tables 5 and 5B.

Table 6 about here

Each entry indicates the sign of the coefficient on the variable (positive or negative) and information about the precision with which the coefficient is estimated when I do, and do not, cluster the standard errors[15]. As shown in the top panel, when data from NYC is included and standard errors are clustered I get low precision (high p values) for estimated coefficients except in a regression when I used fixed effects and have no controls for payment per employee or payment per establishment. In that regression, log pop has a positive coefficient estimated with relatively high precision. This is consistent with the alternative theory (presented earlier) that relative business taxes increase with cities' competitive position. The coefficient on share school in that regression is also positive and estimated relatively precisely. This directly contradicts the conventional wisdom (O&S theory) that business taxes rise with government services to business.

[15] My designation for "high" precision is a p value of 0.30 or below which is somewhat less than the conventional standard of 0.10. The goal here is to use the limited available data to identify the most likely explanations for variation in the level of business property taxes rather than adhering to conventional but arbitrary definitions of statistical significance. See Ziliak and McCloskey (2008).

Readers might wonder whether the relatively strong link between business taxes and population is mainly the result of data from NYC which, as we saw above, is an outlier in both categories. The second panel of table 6 reports results when NYC observations are dropped from the analysis. Conventional wisdom is nevertheless refuted (when fixed effects are included) and the positive estimated coefficient on log pop is consistent with the alternative theory. Moreover, when the NYC observations are dropped and city fixed effect are included we get the same substantive results as when NYC observations are included—the ETR ratio rises with both the share of spending on schools and the cities' population. However, when I drop the NYC observations but do not control for fixed effects both share school and population have negative coefficients estimated with a relatively high degree of precision.

The fact that, when NYC data is excluded, fixed effects change the algebraic sign of key coefficients means that there are important, relatively fixed, city-specific characteristics beyond those included in the empirical analyses that influence the ETR ratio. Those variables could include state regulations, historical agreements, as well as other factors. Without additional data it is not possible to provide much additional empirical evidence. However, even without this information the fixed effects results summarized in Table 6 provide evidence against the conventional theory that business taxes increase with spending on business services and provide evidence in support of the alternative theory that relative business taxes are largely driven by a city's competitive position.

b. Relationship between other independent variables and ETR ratio

The bivariate regressions results reported in Table 4 suggest a set of variables, in addition to those highlighted by the theoretical analyses in section III, which may influence the ETR ratio. In Table 7 I report estimated coefficients, conventional p values and p values when standard errors are clustered by city for the independent variables in eight representative regressions on ETR ratio. Entries with clustered p values of 0.10 or less—the conventional limit for “statistically significant” coefficients—are shaded. As the table makes clear, using this criteria, only the unemployment rate and the median home value are statistically significant determinants of the ETR ratio.

Table 7 about here

The estimated coefficient on the unemployment rate of between .04 and .06 implies that a one standard deviation (three percentage point) increase in the unemployment rate would increase the ETR ratio between 0.12 and 0.18 or about nine percent of the ETR mean of about 1.6. A one standard deviation ($129,158) increase in median home value would increase the mean median home value by about 60 percent. The estimated coefficient on the natural log of the median home value is between 0.19 and 0.23. Thus, a one-standard deviation increase in median home value is associated with a 0.11 to a .0.14 increase in the ETR ratio. This is about eight percent of the ETR mean of 1.6.

None of the other estimated coefficients on the independent variables is statistically significant in the representative regressions shown in Table 7, although, as shown in tables 5 and 6 the estimated coefficients on the share of direct expenditures on K-12 education and the natural log of population are estimated relatively precisely (p values of less than 0.3) when city fixed effects are included, standard errors are clustered and controls for payment per employee or per establishment are omitted.

IX. Conclusion

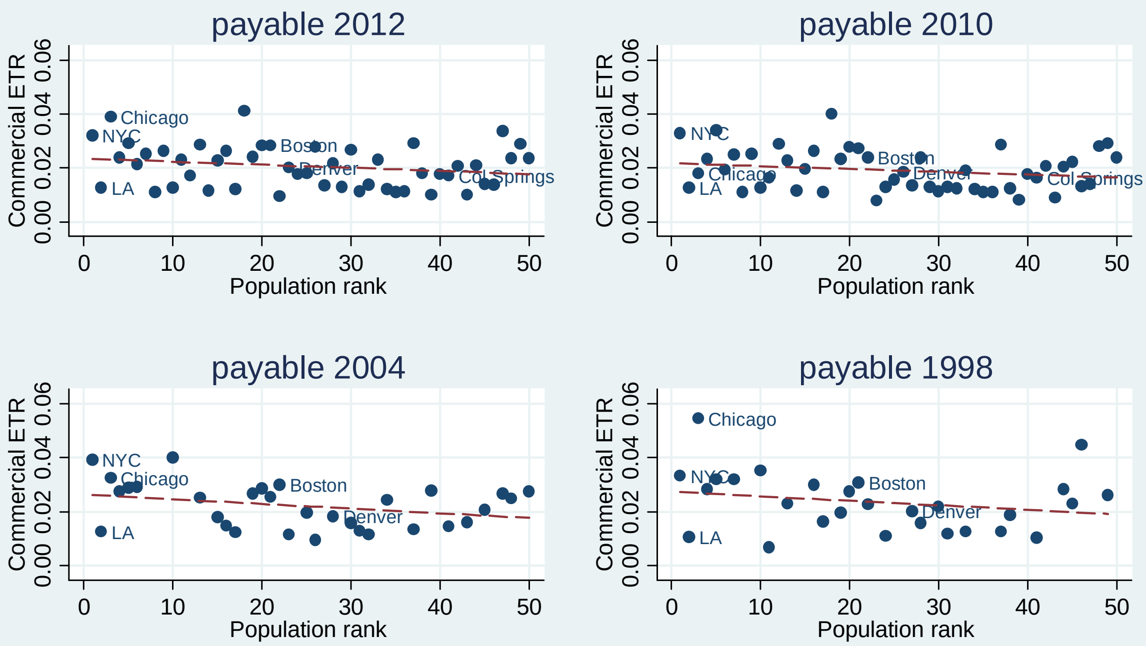
Cities' relatively high reliance on business taxes is somewhat puzzling in light of conventional economic theories that suggest these taxes are detrimental to the residents the government represents. Property taxes account for more than one-third of state and local taxes directly remitted by business and have consistently been by far the most important state and local business taxes. Despite this, the relative property taxation of business has not been studied as extensively as some other 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 business services may be an optimal policy choice for decision-makers who care about residents' well-being. My analyses shows that optimal business property taxes also could be less than the cost of business public services (i.e. subsidies) and thus the analysis provides clues about how to rationalize the seemingly incongruent facts of high business property taxes together with 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 ratios of commercial and home effective property tax rates. 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 the ETR ratio rises with cities' competitive position as proxied by their population. ETR ratios also rise with cities' unemployment rates and median home values.

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 in each 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 cities' exploit their competitive advantage and use property taxes to extract some of the economic profits businesses gain by locating within their boundaries.

Figure 3A
Commercial ETR versus population rank



Source of tax rates is Minnesota Center for Fiscal Excellence,
population ranks based on US Census data

Table 5B:
Coefficients on share school and ln Population from 48 multivariate regressions on ETR ratio
(P value with and w/o clustering is reported)
(data excludes observations from NYC)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
SET 1: OLS										
share_school	-1.53***	-1.47***	-2.12***	-1.21**	-1.15*	-2.11***	-1.84***	-1.84***	estimated coefficient	A: no control for payments
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.19]	[0.22]	[0.07]	[0.32]	[0.36]	[0.07]	[0.14]	[0.15]	p value cluster	
lnpop	-0.19***	-0.19***	-0.17***	-0.21***	-0.20***	-0.15**	-0.18***	-0.17***	estimated coefficient	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.19]	[0.21]	[0.24]	[0.15]	[0.16]	[0.28]	[0.21]	[0.25]	p value cluster	
share_school	-2.63***	-2.58***	-2.88***	-2.46***	-2.42***	-2.89***	-2.76***	-2.77***	estimated coefficient	B: ln of payment per employee
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.04]	[0.05]	[0.02]	[0.06]	[0.07]	[0.02]	[0.04]	[0.04]	p value cluster	
lnpop	-0.20***	-0.19***	-0.19***	-0.21***	-0.20***	-0.18***	-0.20***	-0.18***	estimated coefficient	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.16]	[0.18]	[0.16]	[0.13]	[0.15]	[0.20]	[0.15]	[0.19]	p value cluster	
share_school	-1.93***	-1.88***	-2.54***	-1.77***	-1.72***	-2.56***	-2.47***	-2.50***	estimated coefficient	C: ln of payment per establishment
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.13]	[0.14]	[0.04]	[0.17]	[0.19]	[0.04]	[0.06]	[0.06]	p value cluster	
lnpop	-0.24***	-0.23***	-0.21***	-0.25***	-0.24***	-0.19***	-0.21***	-0.20***	estimated coefficient	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.08]	[0.09]	[0.11]	[0.07]	[0.07]	[0.14]	[0.11]	[0.14]	p value cluster	
SET 2: Fixed effects										
share_school	1.66***	1.61***	1.65***	1.62***	1.58***	1.57***	1.62***	1.55**	estimated coefficient	A: no control for payments
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.23]	[0.18]	[0.23]	[0.24]	[0.20]	[0.20]	[0.24]	[0.21]	p value cluster	
lnpop	0.42**	0.52***	0.42**	0.42**	0.52***	0.48**	0.42**	0.48**	estimated coefficient	
	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	p value no cluster	
	[0.16]	[0.17]	[0.16]	[0.14]	[0.16]	[0.19]	[0.15]	[0.18]	p value cluster	
share_school	-0.04	0.03	-0.21	-0.04	0.03	-0.05	-0.22	-0.05	estimated coefficient	B: ln of payment per employee
	(0.93)	(0.94)	(0.61)	(0.92)	(0.94)	(0.90)	(0.61)	(0.91)	p value no cluster	
	[0.94]	[0.94]	[0.71]	[0.94]	[0.95]	[0.92]	[0.70]	[0.93]	p value cluster	
lnpop	0.09	0.21	0.03	0.09	0.21	0.12	0.04	0.12	estimated coefficient	
	(0.56)	(0.20)	(0.82)	(0.55)	(0.21)	(0.46)	(0.82)	(0.46)	p value no cluster	
	[0.70]	[0.43]	[0.88]	[0.70]	[0.43]	[0.65]	[0.88]	[0.66]	p value cluster	
share_school	-0.02	0.03	-0.14	-0.03	0.03	-0.04	-0.15	-0.04	estimated coefficient	C: ln of payment per establishment
	(0.95)	(0.95)	(0.73)	(0.95)	(0.94)	(0.92)	(0.72)	(0.93)	p value no cluster	
	[0.96]	[0.95]	[0.79]	[0.96]	[0.95]	[0.93]	[0.79]	[0.94]	p value cluster	
lnpop	0.09	0.20	0.05	0.09	0.19	0.12	0.05	0.11	estimated coefficient	
	(0.56)	(0.24)	(0.76)	(0.56)	(0.24)	(0.48)	(0.75)	(0.49)	p value no cluster	
	[0.71]	[0.48]	[0.84]	[0.71]	[0.49]	[0.68]	[0.84]	[0.69]	p value cluster	

Notes: p statistic in parens below estimated coefficient. * for p<.05, ** for p<.01, and *** for p<.001

All specifications include time dummies. In additon to share school and ln pop independent variables are as follows. Specification 1. none, 2. unemployment rate, 3. ln median home value 4. ratio debt outstanding 5. unemployment rate, ratio debt outstanding 6. unemployment rate, ln median home value 7. ratio debt outstanding, ln median home value 8. unemployment rate, ln median home value, ratio debt outstanding .

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Tables and Figures

Figures

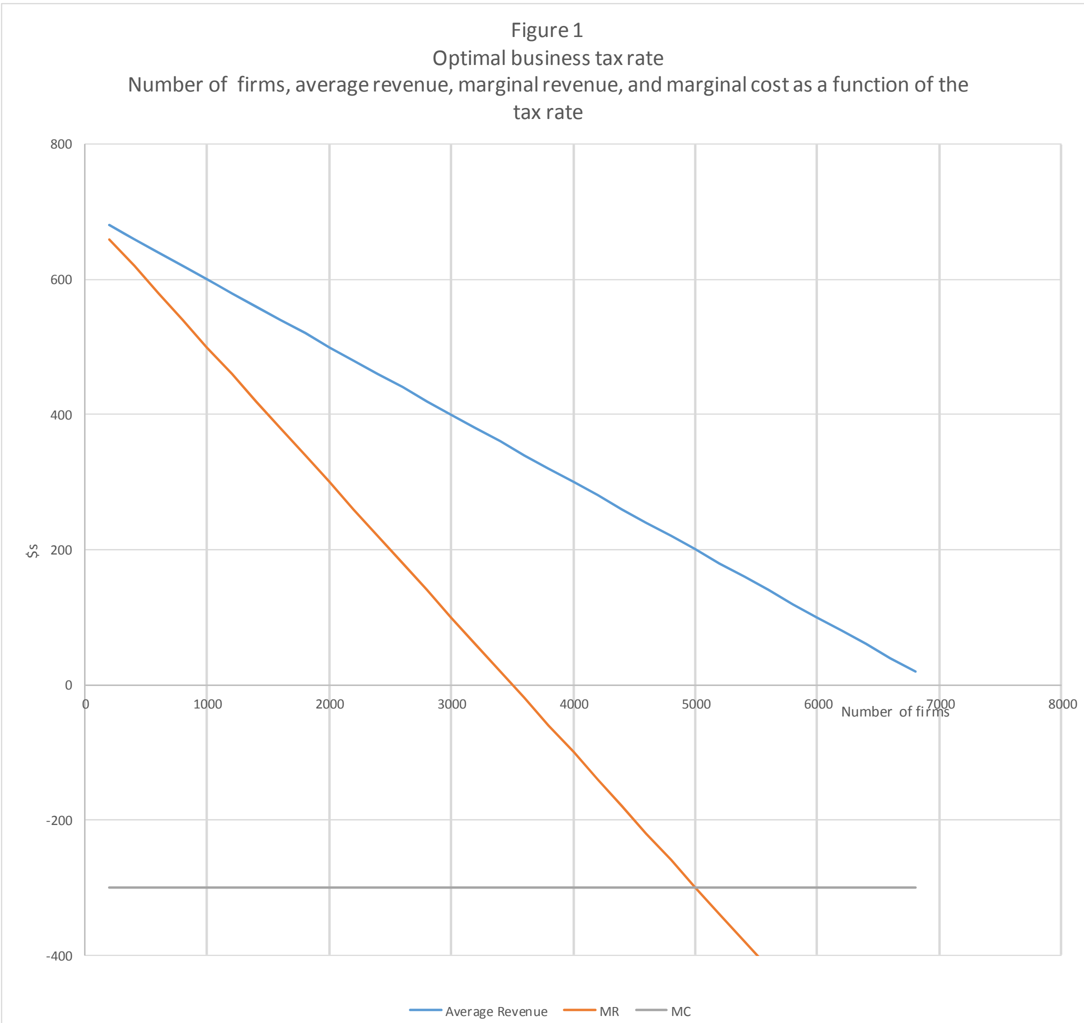
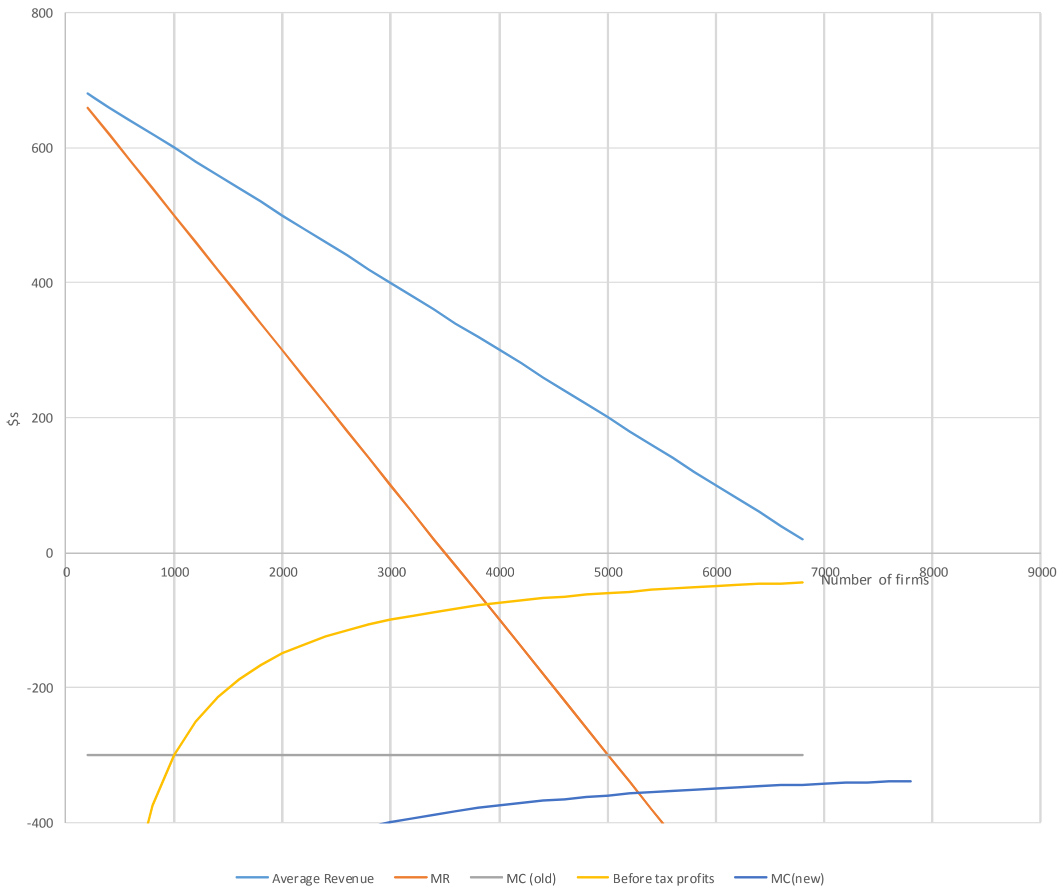
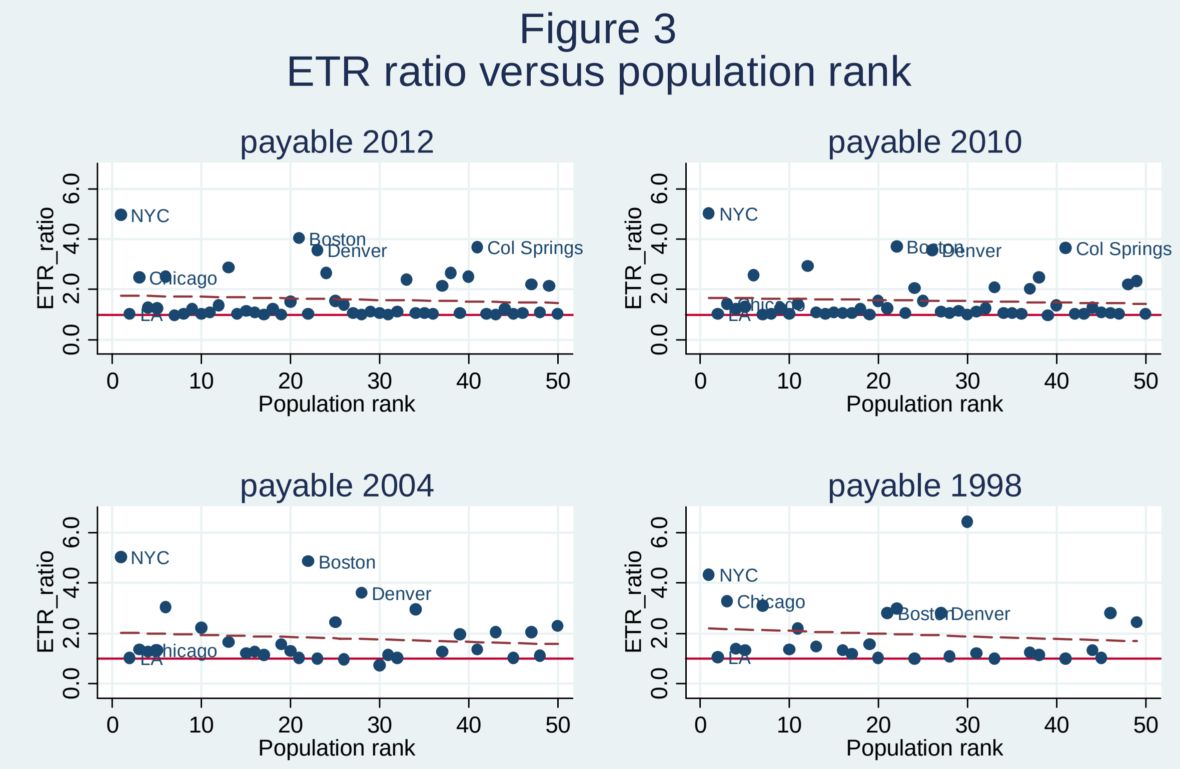


Figure 2
Optimal business tax rate
Number of firms, average revenue, marginal revenue, before tax profits, and marginal cost as a function of the tax rate





Source of ETR ratio is Minnesota Center for Fiscal Excellence,
population ranks based on US Census data

Tables

Table 1: 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 marrket value of $1 million and $200,000 worth of fixtures

Table 2:
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 3 One-way Analysis of Variance for commercial to home ETR ratio						
					Number of obs	848
					R-squared	0.906
Source	SS	df	MS	F	Prob>F	
Between city	646.8	74	8.7	100.2	0.000	
Within city	67.5	773	0.1			
Total	714.26347	847	0.843286			
	Intra-class correlation	Standard Error	95% confidence interval			
	0.898	0.016	0.866	0.929		
Estimated SD of city effect	0.8750					
Estimated SD within city effect	0.2954					
Est. reliability of a city mean	0.9900					
(evaluated at n=11.30)						

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. Cities in which less than 6 years in which less than six years of data are observed are dropped from the analysis.

Table 4

Bi-variate regressions to explain ETR ratios

Number	Independent variable		Period (1) 1998	(2) 2004	(3) 2010	(4) 2012	(5) 1998, 2002, 2004-12	Source of Independent variable	Notes
1	Share direct expenditures on K-12 education (Mean=0.28 sd=0.09)	Coefficient	-1.7003	-2.5285	-1.1236	-1.4234	-1.5219	Lincoln Institute of Land Policy FiSC database.	
		Standard error	(2.0725)	(1.6911)	(0.9738)	(1.0827)	(0.3611)***		
		Number of observations	37	39	59	59	619		
2	Natural log of Population (Mean=713,723 sd=1,120,833)	Coefficient	0.3337	0.2711	0.1224	0.1472	0.1985	US Census	Units of mean and sd are number of people.
		Standard error	(0.1299)**	(0.1561)*	(0.1601)	(0.1572)	(0.0472)***		
		Number of observations	47	50	73	73	837		
2b	Natural log of Population (Mean=596,652 sd=625,818)	Coefficient	0.2297	0.1180	-0.0372	-0.0026	0.0333	US Census	Units of mean and sd are number of people. Excludes NYC observation in all years.
		Standard error	(0.1139)**	(0.0914)	(0.0884)	(0.0999)	(0.0255)		
		Number of observations	46	49	72	72	824		
3	Natural log pay per employee (Mean=45.0 sd=10.11)	Coefficient	no data	1.9813	0.3841	0.5049	0.6920	Estimated using Census Zip Code Business Patterns	Units of mean and sd are nominal 000s of $s. Column 5 includes data from 2004 to 2010 only. Year dummies are included in column 5 to account for inflation.
		Standard error		(1.0075)*	(0.6817)	(0.6908)	(0.2773)**		
		Number of observations		55	73	73	636		
4	Natural log pay per establishment (Mean=833 sd=273)	Coefficient	no data	1.1806	0.2726	0.3503	0.4498	Estimated using Census Zip Code Business Patterns	Units of mean and sd are nominal 000s of $s. Column 5 includes data from 2004 to 2010 only. Year dummies are included in column 5 to account for inflation.
		Standard error		(0.4466)**	(0.3899)	(0.4158)	(0.1459)***		
		Number of observations		55	73	73	636		
5	Unemployment rate (Mean=6.77 sd=3.00)	Coefficient	0.0845	0.0639	-0.0197	-0.0042	-0.0102	Bureau of Labor Statistics	Units are percent.
		Standard error	(0.0805)	(0.0450)	(0.0200)	(0.0281)	(0.0079)		
		Number of observations	51	55	73	73	860		
6	Ratio of debt outstanding to direct expenditures (Mean=1.27 sd=0.46)	Coefficient	0.5138	-0.1512	-0.1037	-0.0510	-0.1187	Lincoln Institute of Land Policy FiSC database.	
		Standard error	(0.2618)*	(0.3033)	(0.2225)	(0.2218)	(0.0682)*		
		Number of observations	37	39	59	59	619		
7	Natural log of median home value (Mean=213,553 sd=129,158)	Coefficient	0.5283	0.5909	0.0873	0.1479	0.2175	Minnesota Center for Fiscal Excellence	Units of mean and sd are nominal 000s of $s. Year dummies are included in column 5 to account for inflation.
		Standard error	(0.4585)	(0.4504)	(0.2061)	(0.2924)	(0.0806)***		
		Number of observations	51	55	74	74	871		
8	Democratic share of presidential vote in 2008 (Mean=0.69 sd=0.15)	Coefficient	1.1207	1.4106	0.0813	0.2830	0.4206	Tausanovitch and Warshaw (2013)	This independent variable available only for 2008. Same variable used in all years.
		Standard error	(1.0434)	(0.8990)	(0.7871)	(0.8050)	(0.2472)*		
		Number of observations	40	43	62	62	718		

Notes: Dependent variable is ratio of Commercial ETR to ETR for homes. Cells show a regression coefficient, robust standard error or number of observations. All regressions include a constant and the independent variable shown. Sample potentially includes 50 biggest cities (except in 1998 and 2002) and largest city in each state but is limited by availability of data on independent variables as shown. *p<0.10,**p<0.05, ***p<0.01

Table 5:
Coefficients on share school and ln Population from 48 multivariate regressions on ETR ratio
(P value with and w/o clustering is reported)
(data includes observations from NYC)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
	SET 1: OLS									
share_school	-0.84	-0.72	-1.11*	-0.69	-0.57	-1.13*	-0.99	-1.05	estimated coefficient	
	(0.09)	(0.15)	(0.03)	(0.20)	(0.30)	(0.03)	(0.09)	(0.07)	p value no cluster	
	[0.56]	[0.62]	[0.47]	[0.65]	[0.71]	[0.46]	[0.53]	[0.52]	p value cluster	
										A: no control for payments
lnpop	0.27*	0.28*	0.28**	0.26*	0.27*	0.30**	0.28*	0.30**	estimated coefficient	
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)	(0.01)	(0.01)	p value no cluster	
	[0.46]	[0.44]	[0.42]	[0.48]	[0.45]	[0.39]	[0.43]	[0.40]	p value cluster	
share_school	-1.33*	-1.31*	-1.48*	-1.34*	-1.30*	-1.54*	-1.58*	-1.66*	estimated coefficient	
	(0.04)	(0.04)	(0.02)	(0.04)	(0.05)	(0.02)	(0.02)	(0.01)	p value no cluster	
	[0.46]	[0.47]	[0.42]	[0.46]	[0.47]	[0.39]	[0.39]	[0.36]	p value cluster	
										B: ln of payment per employee
lnpop	0.28*	0.29*	0.29*	0.28*	0.29*	0.31*	0.29*	0.31*	estimated coefficient	
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)	(0.02)	(0.01)	p value no cluster	
	[0.45]	[0.43]	[0.44]	[0.46]	[0.44]	[0.41]	[0.44]	[0.41]	p value cluster	
share_school	-1.23*	-1.17*	-1.55**	-1.21*	-1.12	-1.67**	-1.62**	-1.75**	estimated coefficient	
	(0.02)	(0.04)	(0.01)	(0.03)	(0.05)	(0.00)	(0.01)	(0.00)	p value no cluster	
	[0.42]	[0.45]	[0.34]	[0.44]	[0.48]	[0.30]	[0.33]	[0.29]	p value cluster	
										C: ln of payment per establishment
lnpop	0.27*	0.28*	0.29*	0.27*	0.28*	0.31*	0.30*	0.32*	estimated coefficient	
	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)	(0.02)	(0.03)	(0.02)	p value no cluster	
	[0.50]	[0.47]	[0.45]	[0.50]	[0.48]	[0.42]	[0.45]	[0.42]	p value cluster	
	SET 2: Fixed effects									
share_school	1.77**	1.68**	1.74**	1.73**	1.65**	1.64**	1.71**	1.62**	estimated coefficient	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	p value no cluster	
	[0.20]	[0.18]	[0.22]	[0.22]	[0.19]	[0.20]	[0.23]	[0.21]	p value cluster	
										A: no control for payments
lnpop	0.41*	0.51**	0.40*	0.40*	0.50**	0.47**	0.40*	0.47**	estimated coefficient	
	(0.02)	(0.00)	(0.03)	(0.02)	(0.00)	(0.01)	(0.02)	(0.01)	p value no cluster	
	[0.20]	[0.21]	[0.21]	[0.19]	[0.20]	[0.23]	[0.20]	[0.22]	p value cluster	
share_school	0.10	0.12	-0.03	0.09	0.13	0.05	-0.03	0.06	estimated coefficient	
	(0.85)	(0.81)	(0.95)	(0.85)	(0.81)	(0.92)	(0.95)	(0.91)	p value no cluster	
	[0.87]	[0.82]	[0.96]	[0.87]	[0.82]	[0.93]	[0.96]	[0.92]	p value cluster	
										B: ln of payment per employee
lnpop	0.15	0.30	0.11	0.16	0.30	0.22	0.11	0.22	estimated coefficient	
	(0.41)	(0.14)	(0.55)	(0.41)	(0.14)	(0.28)	(0.55)	(0.28)	p value no cluster	
	[0.52]	[0.31]	[0.63]	[0.52]	[0.31]	[0.47]	[0.63]	[0.48]	p value cluster	
share_school	-0.07	0.02	-0.15	-0.07	0.03	-0.04	-0.15	-0.03	estimated coefficient	
	(0.89)	(0.97)	(0.77)	(0.89)	(0.96)	(0.94)	(0.77)	(0.95)	p value no cluster	
	[0.89]	[0.97]	[0.80]	[0.89]	[0.96]	[0.94]	[0.80]	[0.95]	p value cluster	
										C: ln of payment per establishment
lnpop	0.12	0.22	0.09	0.12	0.22	0.16	0.09	0.15	estimated coefficient	
	(0.54)	(0.27)	(0.64)	(0.54)	(0.27)	(0.44)	(0.64)	(0.45)	p value no cluster	
	[0.64]	[0.43]	[0.71]	[0.64]	[0.44]	[0.60]	[0.72]	[0.61]	p value cluster	

Notes: p statistic in parens below estimated coefficient. * for p<.05, ** for p<.01, and *** for p<.001

All specifications include time dummies. In additon to share school and ln pop independent variables are as follows. Specification 1. none, 2. unemployment rate, 3. ln median home value 4. ratio debt outstanding 5. unemployment rate, ratio debt outstanding 6. unemployment rate, ln median home value 7. ratio debt outstanding, ln median home value 8. unemployment rate, ln median home value, ratio debt outstanding .

Table 6:
Summary of estimated coefficients and p values from tables 5 and 5B

Summary Table 5
(data includes NYC)

		no controls for payment			pay per employee			pay per establishment		
			precision of estimated coefficient			precision of estimated coefficient			precision of estimated coefficient	
		sign	no cluster	cluster	sign	no cluster	cluster	sign	no cluster	cluster
OLS	share school	neg	high	low	neg	high	low	neg	high	low
	ln pop	pos	high	low	pos	high	low	pos	high	low
Fixed effects	share school	pos	high	high	pos	low	low	neg	low	low
	ln pop	pos	high	high	pos	low	low	pos	low	low

Summary Table 5B
(data excludes NYC)

		no controls for payment			pay per employee			pay per establishment		
			precision of estimated coefficient			precision of estimated coefficient			precision of estimated coefficient	
		sign	no cluster	cluster	sign	no cluster	cluster	sign	no cluster	cluster
OLS	share school	neg	high	high	neg	high	high	neg	high	high
	ln pop	neg	high	high	neg	high	high	neg	high	high
Fixed effects	share school	pos	high	high	neg	low	low	neg	low	low
	ln pop	pos	high	high	pos	varies	low	pos	low	low

Note: Potential values for sign are pos (>0), neg (<0), varies (has opposite sign in more than two regressions).
Potential values for precision are high (p<.30), low (p>.30), varies (has opposite values in more than two regressios)

Table 7
Coefficients from selected multivariate regression
(Deptendent variable is ETR ratio in all regressions)

		(NYC is included in sample)				(NYC is excluded from sample)			
		OLS	FE	FE	FE	OLS	FE	FE	FE
		b/p	b/p	b/p	b/p	b/p	b/p	b/p	b/p
Share direct expenditures on K-12 education	Coefficient	-1.05	1.62	0.06	-0.03	-1.84	1.55	-0.05	-0.04
	P value	(0.07)	(0.00)	(0.91)	(0.95)	(0.00)	(0.00)	(0.91)	(0.93)
	P value with clustering	[0.52]	[0.21]	[0.92]	[0.95]	[0.15]	[0.21]	[0.93]	[0.94]
Natural log of population	Coefficient	0.30	0.47	0.22	0.15	-0.17	0.48	0.12	0.11
	P value	(0.01)	(0.01)	(0.28)	(0.45)	(0.00)	(0.00)	(0.46)	(0.49)
	P value with clustering	[0.40]	[0.22]	[0.48]	[0.61]	[0.25]	[0.18]	[0.66]	[0.69]
Unemployment rate	Coefficient	-0.06	0.05	0.04	0.04	-0.03	0.06	0.04	0.04
	P value	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
	P value with clustering	[0.15]	[0.06]	[0.01]	[0.00]	[0.34]	[0.01]	[0.01]	[0.01]
Natural lof of median home value	Coefficient	-0.20	0.21	0.20	0.19	-0.29	0.21	0.23	0.22
	P value	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
	P value with clustering	[0.23]	[0.02]	[0.03]	[0.03]	[0.03]	[0.02]	[0.01]	[0.01]
Ratio of debt outstanding to direct expenditures	Coefficient	0.04	-0.08	0.02	0.03	0.12	-0.08	0.01	0.02
	P value	(0.67)	(0.27)	(0.71)	(0.65)	(0.08)	(0.18)	(0.80)	(0.71)
	P value with clustering	[0.88]	[0.31]	[0.72]	[0.65]	[0.54]	[0.32]	[0.83]	[0.76]
Democratic share of presidential vote in 2008	Coefficient	0.57				-0.09			
	P value	(0.18)				(0.81)			
	P value with clustering	[0.64]				[0.93]			
Natural log of pay per employee	Coefficient			1.01				0.03	
	P value			(0.02)				(0.92)	
	P value with clustering			[0.34]				[0.94]	
Natural log of pay per establishment	Coefficient				0.70				0.18
	P value				(0.02)				(0.47)
	P value with clustering				[0.22]				[0.46]
adjusted R-squared		0.06	-0.04	-0.09	-0.09	0.06	0.00	-0.09	-0.09
N		522	605	500	500	510	593	491	491

Note: All regressions include year fixed effects. P values with clustering that are less than .10 are highlighted. OLS=ordinary least squares, FE=(city) fixed effects