Tax Effects on Investment Location: Evidence from Foreign Direct Investment in the U.S. States

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Abstract

This paper examines the effects of state corporate income taxes on the location of foreign direct investment, taking into account the state governments' behavior when setting taxes.

Ignoring the tax setting behavior of states may bias the estimate of the tax effects on foreign direct investment. States have a set of characteristics that influence investors' decisions, some of them are not observable by a researcher but states take them into account when they set taxes. States can also act strategically with respect to other states when setting taxes. The former behavior bias the estimated tax effects because it creates correlation between the error term and the tax rate. The latter behavior directly implies an endogenous tax rate.

We adapt a discrete choice model of differentiated products to estimate the tax effects. This approach allows us at the same time to control for the outside options of investors and to use instrumental variables to solve the problem of tax endogeneity. We find the tax elasticity to be consistently around -1.

JEL: F23, H25, H71, H73, H87.
Keywords: Foreign Direct Investment, State Corporate Taxes, Tax Endogeneity.

1 Introduction

Although corporate income taxes should theoretically influence investors' decisions about where to locate their investments, empirical studies of the tax effects show mixed results. Several articles in the literature have found that taxes have no influence on investment location at all[1]; some few

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[1] In this paper we will argue that tax endogeneity may dampen the overall estimated tax effects; consequently neglecting tax setting behavior may lead to insignificant estimates of the tax effects (even if the true effect is negative).

articles have found a consistent and robust negative effect, and a few others have found a positive impact (see Carlton (1983), Coughlin, Terza, and Arrondee (1991), Luger and Shetty (1985), Hines (1996), and Papke (1991)).[2]

The empirical work has mainly focused on the demand side of this story estimating then a reduced form model. Our view and the main motivation for this paper are that we can obtain an important insight by also considering the supply side of the problem. By demand and supply sides, we mean foreign firms as demanders for U.S. locations and U.S. states as suppliers of the locations for investment.

Foreign investors, on the one hand, compare different characteristics (including the state corporate income tax rate) of each location before deciding where to invest, considering for this purpose also locations outside of the U.S.. States, on the other hand, want to attract investment perhaps because of its positive effects on income growth and employment. There are some characteristics that each state supplies to investors, some of them are inherent to the state, such as natural resources and geography, while some others are set by the states themselves, corporate income tax rate and the level of public goods for example. This is the supply side of the story that opens the possibility of strategic interaction among states.

There is one strand of the public finance literature that has looked at the influence of neighboring states' (countries') decisions (Besley and Case(1995); Case, Hines, and Rosen (1993); Rork(2000)). Case, Hines, and Rosen (1993) test the notion that state governments' expenditures depend on the spending of similar states. They estimate that a dollar increase in a state's neighbors expenditures per capita increases its own expenditure by over 70 cents. This illustrates how decisions among states interrelate and how important is to take this interrelation into account. For example, if Florida were to lower its tax rate in order to attract FDI, Alabama may respond by cutting its tax

[2] Wasylenko (1997) reviews recent research on the effects state taxes have on economic development and reports a summary of econometric results of tax effects on business location. There are 6 studies that estimate an overall tax elasticity for investment in manufacturing, in 3 of them the tax elasticity is statistically significant, ranging from -1.2 to 0.54, and the median elasticity is either -0.6 or 0. There are 7 studies that estimate a business tax elasticity (corporate income tax or property tax) for investment in manufacturing; in 6 of them the elasticity is statistically significant and ranges from -0.36 to -0.1, the median elasticity being -0.2.

rate; consequently, the increase in FDI into Florida may not be as large. By ignoring tax competition in the analysis, the estimated tax effects may be biased since it also embeds the interaction among states. As we will explain when we present the model, even in the case where there is no strategic interaction at all, there may be a bias due to the correlation between the error term of the demand for investment location and the tax setting equation. For example, the discovery of an oil well in Alaska results in FDI inflow into Alaska for two different reasons. First, Alaska is now more attractive to foreign investors (at least to investors in the oil industry). Second, Alaska may lower its tax rate as the revenue from the oil well may relieve some pressure of the Alaskan government to raise revenue from FDI. In this example, the tax elasticity would be biased upward (towards zero).

This paper, then, examines the effects of corporate income taxes on the location of FDI in the U.S. states, considering the endogeneity of the tax rates and the fact that foreign investors have outside options (investment locations outside U.S. states). We focus on FDI in the U.S. mainly for three reasons. First, FDI has become increasingly important in the United States. Outlays by foreign direct investors to establish businesses in the United States have increased from \$15,333 millions in 1992 to \$282,946 millions in 1999. U.S. businesses established by foreign direct investors in 1999 had total assets of \$454.4 billion and employed 648,000 people. Second, for foreign investors, the corporate tax rate is the most relevant tax in their investment decision. Based on that and to make the analysis simpler, we omit other tax rates[3], the apportionment system[4], and tax incentives[5]. Third, we have access to surveys on foreign direct investment in the U.S. by state and by source country for 5 years in a span of 23 years; this provides time variation in tax rates and state characteristics.

In this paper, we use a structural model to estimate the effects of taxes on investment location

[3]This omission can cause biased estimation of the tax effect due to the potential correlation between the corporate tax rate and the error term (which includes the omitted tax rates); this provides another reason to use instrumental variables.

[4]Hines (1996) estimates the effects of corporate income tax with and without correction for apportionment system. He finds no difference in the results

[5]Papke (1995) examines the impact that tax incentives (investment tax credits and property tax abatements) have on the after-tax rate of return. He finds that tax incentives have very modest effects on the net returns to new investment.

taking into account the tax setting behavior of state governments and the potential strategic interaction among states. The rest of the paper is divided as follows. Section 2 presents a model of investors' decisions for location of investment (demand side). Adapting techniques from the discrete-choice literature, we present a general model of aggregated investment demand that can be used to estimate "unbiased" and consistent tax effects on investment location. We present then a special case of the general model, a very tractable Logit Model of demand that is used in the empirical part of the paper. Section 3 presents the tax setting process (supply side). Section 4 describes the data. Section 5 shows the empirical results, and Section 6 concludes.

2 Demand Side

In this section, we present a model of demand for location of investment. Then we extend the model into an estimable econometric framework using techniques developed in the discrete-choice literature. Finally, we discuss the instrumental variables technique that will be used to estimate tax effects on FDI.

2.1 A Model of Demand for Investment Location

A foreign investor can choose among 50 different U.S. states and an outside location to locate his investment. The presence of the outside location is extremely important. Without an outside investment alternative, a uniform increase in tax rates by all states does not change the amount of investment in each state.[6]

For the purpose of deciding where to invest, an investor will compare several different character-

[6] Furthermore, without an outside investment alternative a uniform increase in tax rates by all states would improve the states' welfare. With the outside investment alternative, states cannot uniformly increase their tax rates without losing some of the investment elsewhere; consequently, a uniform increase in tax rates may not increase welfare. Huber (1999) shows that if the wealth distribution is egalitarian, a coordinated increase in capital taxes does not affect welfare. For non-egalitarian wealth distributions, welfare can increase or decrease depending on the redistributive impact of a higher capital tax.

Previous empirical studies of the tax effects ignore the issue of outside investment alternatives in their estimation strategy. This may result in a biased estimate of the tax effects.

istics among states, one of which is the corporate tax rate. The tax rate is the price in the demand for investment function[7], but given that different states have different characteristics, we have to think about different locations as differentiated products (think about each state as a different brand of the same product).

If the investor decides to invest in state j, he maximizes his profits by choosing the level of investment as well as the quantity of labor hired in state j.

The investor's problem, conditional on investing in state j, can be written as follows:

$$\max_{L_{ij},FDI_{ij}} \pi_{ij} = (PQ_{ij} - w_j L_{ij} - r_i FDI_{ij} - F_j)(1 - t_j) \tag{1}$$

$$\text{s.t.} \quad Q_{ij} = f(FDI_{ij}, L_{ij})$$

where:

π_{ij} = profits of investor from country i if he invests in state j

P = price of the product produced by the investor

Q_{ij} = quantity of the product sold

w_j = wage rate in state j

L_{ij} = quantity of labor hired by the investor in state j

r_i = opportunity cost of capital for investor i[8]

FDI_{ij} = quantity of capital invested by the investor in state j

t_j = corporate tax rate in state j

F_j = fixed costs of production

The production function $f(FDI_{ij}, L_{ij})$ is assumed to be constant returns to scale. The first-order

[7] Depending on how it is specified, the tax rate is a price per unit of profits or per unit of capital invested in a specific state.

[8] This is the return on capital that the investor would receive if he invests in his outside option.

conditions of this maximization problem are:[9]

$$L_{ij}: \quad P\frac{\partial f}{\partial L_{ij}} - w_j = 0 \tag{2}$$

$$FDI_{ij}: \quad P\frac{\partial f}{\partial FDI_{ij}} - r_i = 0 \tag{3}$$

Using the first-order conditions, we can write the conditional profit function for the investor from country i who invests in state j as follows:

$$\pi^*_{ij}(P, r_i, w_j, t_j) \tag{4}$$

For given values of P, r_i, w_j and t_j the profit function will determine the actual profits an investor from country i will get if he invests in state j. Therefore, using the conditional profit functions, a foreign investor can compare the profits he would get from investing in various locations. Hence, the investor from country i will choose to invest in state j if and only if the investment yields the greatest profit among all investment alternatives.[10] [11] That is,

[9] Alternatively, we could have speficied the investor's problem as:
$\max_{L_{ij}, FDI_{ij}} \pi_{ij} = P_{ij}Q_{ij} - w_j L_{ij} - r_i FDI_{ij}(1 + t_j) - F_j$
Under this specification, the corporate tax rate have an impact on the optimal amount of capital and labor used. For our purposes, it will still affect the level of profits obtained, and therefore, the place where the investor invests.

[10] We have assumed that each investor solves 51 different maximization problems (one for each state and one for the outside option), compares the 51 profit levels that result from each maximization and then decides to invest in one and only one location. We explain the reasons to use this approach in the next section.

[11] It is a fact that several foreign investors have investments in more than one state. The discreteness of choice assumption has been defended saying that investors invest, in this case, in plant and equipment in one state at a time. Therefore, over time, they have investments in several states but when they decide about a particular project, they choose only one state for it. We will just claim that this model is a good approximation for the true decison process of investors.

$$\pi_i^* = \max\{\pi_{in}^*; n = 0, \ldots, 50\} \quad (5)$$

Where $n = 0$ represents the outside option (an alternative investment location outside the 50 U.S. states).

Adding investment choices by all investors yields the aggregated demand function.[12]

2.2 Discrete-Choice Approach

The estimation of a demand function for differentiated products is a complex task, mainly because of the large number of parameters that need to be estimated. In the case of N different products (50 states in our case), we have to estimate N own price elasticities and $N(N-1)$ cross-price elasticities.[13] This implies an over-parameterization of the econometric model, which makes it impossible to estimate in most cases. There are three ways to deal with this problem. First, we could estimate only a few functions of the parameters of interest. Second, we could aggregate similar products until there are only a few left in the system. For example, we could aggregate states by regions (East, Midwest, South, and West). This would reduce the number of parameters to be estimated from $2,500$ to 16. The drawback of this treatment is that we lose many parameters of interest. Third, we could model product choice explicitly in our estimation of the demand system. This latter approach is based on McFadden's (1974) work, which develops models of discrete choice to individual's choice of products.[14] This is the approach we will take.

[12] We are aware that this is just an approximation to the real aggregated demand function. This approximation might not be necessarily a smooth continuous function, but the alternatives are either to use a homogeneous product approach or, as we will discuss in the next section, to have a huge dataset that allows estimation of all the parameters involved. We think that the former approach introduces a bias that is worse than this approximation; the latter, on the other hand, is not possible with the data available.

[13] Thus, there are $50 \times 50 = 2500$ elasticities to be estimated in our case. If we impose symmetry in our elasticity matrix, the number of elasticities we would need to estimate would be reduced to: $50 + \frac{50(50-1)}{2} = 1275$.

[14] The following are good examples of the use of the discrete-choice framework. McFadden (1974) uses his discrete-choice model to examine individual choice of products. Berry, Levinsohn, and Pakes (1995, 1998) study strategic interactions in price setting among U.S. automakers. Nevo (2001) estimates demand and market power in the ready-to-eat cereal industry.

A second issue in the estimation of a demand function under product differentiation is the heterogeneity of consumers (investors in this case); unless investors have different preferences or production functions, all of them would invest in the same location.[15] There are different approaches to model heterogeneity depending on the assumptions regarding the distribution of individual attributes. The Logit, Nested Logit, and Generalized Extreme Value models assume that heterogeneity enters the model only through a random shock, and they also assume a distribution of these shocks and a different degree of correlation among them. Even though this approach places some restrictions on the elasticities of demand, which will be explained in the next section, it is more tractable and easier to estimate and, therefore, is the one we will use.[16]

In this section, we closely follow Nevo's (2000) approach to derive the aggregated demand for investment by explicitly aggregating discrete investment decisions of foreign investors. For this purpose, we first define the profit function of investor i for investing in state j in year t as:

$$\pi^*_{ijt}(X_{jt}, \xi_{jt}, t_{jt}, \tau_i, \theta) \tag{6}$$

where X are observed state characteristics, ξ are unobserved state characteristics, t is the state corporate tax rate, τ are investor's individual characteristics, and θ are unknown parameters. Here we are assuming that all investors face the same state characteristics, particularly the same tax rate.[17]

In this model, we assume the following specification for the profit function:[18]

[15]In this context, "heterogeneity of investors" basically means that investors have different profit functions. This can be due to different tastes (with respect to state characteristics), different production functions, or production in different economic sectors.

[16]The alternative is to use a Random Coefficients Model that allows for more general substitution patterns. That not only would require additional information about the distribution of investors heterogeneity but also would require the use of simulation methods to be solved.

[17]If different investors face different tax rates when they are investing in the same state, then the statutory tax rates we are using will be correlated with the error term (due to measurement error). This can be corrected using IV.

[18]The model is relatively general and with minor adjustments can be used with different specifications. The linear and loglinear cases basically require the absence of wealth effects. That is the case when we consider maximization of profits, but it is not always true for utility maximization.

$$\pi^*_{ijt} = -\alpha_i t_{jt} + X_{jt}\beta_i + \xi_{jt} + \varepsilon_{ijt} \tag{7}$$

In a general model we would also need to specify how the profit function varies depending on investor individual characteristics τ.[19] This has been usually modeled[20] assuming that individual characteristics have two components: D_i (observed demographic characteristics) and v_i (unobserved characteristics),

$$\begin{pmatrix} \alpha_i \\ \beta_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \end{pmatrix} + \Lambda D_i + \Sigma v_i \tag{8}$$

where it is assumed that demographics affect the distribution of the coefficients in a linear way and that D_i and v_i are independent. Λ is a (k+1)*d vector of coefficients that measures how investors' taste characteristics vary with demographics. Σ is just a scaling matrix, and it is assumed that $v_i \sim N(0, I_{k+1})$.

Finally, we also need to consider the possibility that the investor may decide not to invest in any of the 50 states at all. The outside option in this case is to invest in any other country of the world; the profit function from this option is:

$$\pi^*_{iot}(X_{ot}, \xi_{ot}, t_{ot}, \tau_i, \theta) \tag{9}$$

The functional form for the profit function of the outside option is:

[19] In our data set we do not have information on investor characteristics, but we know the source country of the FDI in each state. Therefore, at most we could use demographic information by country to know something about the distribution of investor characteristics.

[20] See Nevo (2001), Berry (1994), and Berry et al. (1995,1998).

$$\pi^*_{iot} = \xi_{ot} + \gamma_o D_i + \sigma_o v_{io} + \varepsilon_{ijt} \tag{10}$$

The mean profit of the outside option is not identified without either making more assumptions or normalizing one of the U.S. states. We normalize ξ_{ot} to zero. Notice also that γ_o and σ_o are not identified separately from a set of state constants (one for each state). Defining $\theta_1 = (\alpha, \beta)$ and $\theta_2 = (\Lambda, \Sigma, \gamma_o, \sigma_o)$, we can combine (7) and (8) to express the profit function as:

$$\pi^*_{ijt} = \delta_{jt}\left(X_{jt}, t_{jt}, \xi_{jt}; \theta_1\right) + \mu_{ijt}\left(X_{jt}, t_{jt}, v_i, D_i; \theta_2\right) + \varepsilon_{ijt} \tag{11}$$

where

$$\delta_{jt} = -\alpha t_{jt} + X_{jt}\beta + \xi_{jt}$$

$$\mu_{ijt} = [-t_{jt}, X_{jt}] * (\Pi D_i + \Sigma v_i)$$

In this model, investors are assumed to invest in one state, the one that gives them the highest profits (return). [21] One investor is defined as a vector of demographics and state specific shocks, $(D_i, v_i, \varepsilon_{iot}, \varepsilon_{i1t}, ..., \varepsilon_{i50t})$. We can define the set of individual characteristics that lead to the choice of state j as:

$$A_{jt}(X_{.t}, t_{.t}, \delta_{.t}; \theta_2) = \{(D_i, v_i, \varepsilon_{it}) \mid \pi_{ijt} \geq \pi_{ilt} \ \forall \ _{l=\ 0...50}\} \tag{12}$$

[21] This assumption is needed; otherwise, we would have to compare every single combination of different states, and that makes the model not tractable (the number of parameters increases dramatically). Hendel (1999) has relaxed this assumption in some way, but it is not applicable in the context of our problem and our data.

Then, for a given set of parameters, we can predict the FDI share of each state in each year, as a function of state characteristics, tax rates, and unknown parameters. If ties occur with zero probability, the FDI share of the state j as a function of the mean profit levels of all the 51 locations given the parameters is:

$$s_{ijt}\left(X_{.t}, t_{.t}, \delta_{.t}; \theta_2\right) = \int_{A_{jt}} dP\left(D, v, \varepsilon\right) = \int_{A_{jt}} dP(D)dP(v)dP(\varepsilon) \tag{13}$$

where P(·) represents population distribution functions. The second equality is the result of the independence assumption of D, v, and ε.

The estimation strategy is to choose parameters that minimize the distance between the FDI shares predicted by the model and the observed ones[22], which implies to solve the implicit system of equations:

$$s_{.t}\left(X_{.t}, t_{.t}, \delta_{.t}; \theta_2\right) = S_{.t} \tag{14}$$

where $s_{.t}(\cdot)$ are the predicted FDI shares define by equation (13), and $S_{.t}$ are the observed FDI shares.

This strategy gives estimates of the parameters that determine the distribution of investors' attributes, but it does not solve the correlation between tax rates and unobserved state characteristics.

2.2.1 A Special Case: Logit

The model we have presented in the previous section, is very general and no more restrictive than other models used in the literature. In this section we are going to impose some restrictions that will

[22] By making assumptions on the distribution of investors' characteristics, we can analytically compute the integral of equation (13).

simplify the model and, make it more tractable econometrically and computationally. Of course, these assumptions have a cost and in this case, they will affect the substitution pattern among states (cross-elasticities).

Using the Logit demand model developed by McFadden we can solve the problem of over-parameterization projecting the states into a space of characteristics. Investors' heterogeneity is assumed to enter only through a separable additive random shock ε_{ijt}. In this model, that assumption implies that either $\theta_2 = 0$ or $\alpha_i = \alpha$ and $\beta_i = \beta$ for all i. Using only this assumption our model is still as general as the one specified in equation (11). The second assumption of the Logit model is that ε_{ijt} is i.i.d. and is distributed according to a Type I extreme value distribution. These latter restrictions, which are made in order to compute the integral in equation (13), have implications for the tax elasticities of the demand equation.

The FDI share of state j in year t for investment from country i under this restrictions is:

$$s_{ijt} = \frac{\exp\left(-\alpha t_{jt} + X_{jt}\beta + \xi_{jt}\right)}{1 + \sum_{k=0}^{50} \exp\left(-\alpha t_{kt} + X_{kt}\beta + \xi_{kt}\right)} \tag{15}$$

Now, we can solve equation (14) analytically to get:

$$\delta_{jt} = \ln\left(S_{ijt}\right) - \ln\left(S_{iot}\right) \tag{16}$$

where S_{ijt} and S_{iot} are the observed FDI shares in state j and in outside investment option respectively.

Thus, the demand equation to be estimated becomes:

$$\ln(S_{ijt}) - \ln(S_{iot}) = -\alpha t_{jt} + X_{jt}\beta + \xi_{jt} + \varepsilon_{ijt} \tag{17}$$

The tax elasticities of the FDI shares s_{ijt} defined by equation (15) are:

$$\eta_{ijt} = \frac{\partial s_{ijt}}{\partial t_{jt}} \frac{t_{jt}}{s_{ijt}} = \begin{cases} -\alpha t_{jt}(1 - s_{ijt}) & \text{if } \quad j = k \\ \alpha t_{kt} s_{ikt} & \text{otherwise} \end{cases}$$

The main problem of the Logit assumption is related with the cross-states tax elasticities. The Logit model restricts investors to substitute investment from one state towards other states in proportion to FDI shares, regardless of characteristics. This does not constitute a big problem for us because we are interested in the own elasticity for each state and the mean elasticity for the whole sample.

The Logit model allows us to solve the over-parameterization of our model but does not solve the endogeneity of the tax rate. In this model a state is defined by a set of characteristics and some of those characteristics are not observed, though they influence investors' decisions (demand); therefore, they will be captured in the error term. States know those characteristics, and they take them into account when setting taxes.[23] This implies that the tax rate is endogenous, and we need to instrument for it in the demand equation.[24]

3 Supply Side

In this section, we present a model of the states' tax setting process.

[23]These state characteristics are not observed by the researcher, but they are observed by investors and by state governments. Examples of these characteristics are: reputation of the state (honesty, bureaucracy, quality of services, quality of workers) and effects of advertisement (promotion of the state).

[24]Using a set of Montecarlo results, Berry (1994) has shown that estimation methods that ignore the endogeneity of prices (taxes) in the presence of unobserved product (state) characteristics can be severely misleading.

3.1 A Model of Tax Setting

Consider a state where there are not income distribution concerns, allowing us to use a representative-agent model to describe the behavior and welfare of the state's residents. The state's government supplies the resident with a public good and levies corporate income taxes to finance it. The utility function of the resident is strictly-concave and depends on the consumption of a private good C, a public good G, and labor supply L. For simplicity, we assume that the capital is owned only by foreign investors and we normalize the price of the private good to one.[25]

The representative resident's maximization problem is:

$$\max_{C,L} U(C,L,G) \qquad \text{such that} \qquad C \leq wL \tag{18}$$

where w is the wage rate.

The solution of this maximization problem defines the indirect utility of the individual $V(w,G)$, which is a function of the wage rate and the level of public good provided by the state government. The state government's problem is then to choose the corporate tax rate and the level of public good that maximize the indirect utility of the resident[26], such that the tax revenue collected is enough to finance the provision of the public good:

$$\max_{t,G} V(w,G) \quad \text{s.t.} \quad t\Pi \geq G \tag{19}$$

$$\Pi = f\left(FDI, \overline{L}\right) - w\overline{L} - rFDI \tag{20}$$

[25] In this model, states compete for FDI because more FDI would lead to higher labor wage and greater public good provision.

[26] The corporate income tax is the only tax in this model. When other taxes are available, such as personal income or lump sum taxes, a small state with fixed labor supply should set the corporate tax rate equal to zero (Diamond and Mirrlees (1971a, 1971b)). The goal of this section is to show why the estimated tax elasticity of foreign investment migth be biased if the tax setting process is not taken into account. We could have used a different model to explain why the corporate tax rate in most of the sates is different from zero (Gordon (1992), Gordon and Mackie-Mason (1994), Boadway, Marchand and Pestieau (1994)), but that would complicate the analysis without providing more insight on the potential bias in the tax elasticity.

where t : corporate tax rate

FDI : amount of foreign direct investment in the state

r : opportunity cost of the capital

$f(\cdot)$: state production function

Π : profits before taxes of the foreign firms in the state

The first-order conditions for this maximization problem are:

$$\frac{\partial V}{\partial w}\frac{\partial w}{\partial FDI}\frac{\partial FDI}{\partial t}+$$
$$\lambda\left[f\left(FDI,\overline{L}\right)-w\overline{L}-rFDI+t\left(\frac{\partial f\left(FDI,\overline{L}\right)}{\partial FDI}\frac{\partial FDI}{\partial t}-L\frac{\partial w}{\partial FDI}\frac{\partial FDI}{\partial t}-r\frac{\partial FDI}{\partial t}\right)\right]=0 \quad (21)$$

$$\frac{\partial V}{\partial G}-\lambda=0 \quad (22)$$

The first-order condition for the tax rate, shows that the state must equate the marginal effect of changing the corporate tax rate on wages, due to the resulting change in FDI influx (the first term of equation (21)), and the marginal effect on the level of public good provided, due to the change in tax revenue (the second term in equation (21)). On the one hand, an increase in the tax rate, for example, would reduce the wages in the state because of the reduction in the amount of FDI the state receives. On the other hand, it would increase the amount of public good provided by the state government because of the increase in tax revenue.

The first-order condition for G implies, as usual, that the optimal level of public good is chosen such that its marginal benefit $\frac{\partial V}{\partial G}$ equal to its marginal cost λ (the shadow value of government funds).

The first-order conditions (21) and (22) define an implicit function of t and G. Using the implicit function theorem we can derive an expression for the derivative of the optimal corporate tax rate with respect to the unobserved characteristics. The sign of $\frac{d\xi}{dt}$ depends on the sign of $\frac{\partial FOC_t}{\partial \xi}$[27], and, therefore, it will depend on the signs of $\frac{\partial FDI}{\partial \xi}$ (the direct effect of the unobserved characteristics on FDI) and, $\frac{\partial^2 FDI}{\partial t \partial \xi}$ (the effect of the unobserved characteristics on the effect of the state's corporate tax rate on FDI) [28]. In general, the sign of $\frac{d\xi}{dt}$ is indeterminate and it will depend on the type of unobservables, among other factors.

The total tax effect on FDI can be decomposed in two effects: the direct effect and, the indirect effect through observed (X) and unobserved (ξ) characteristics[29]:

$$\frac{dFDI}{dt} = \frac{\partial FDI}{\partial t} + \frac{\partial FDI}{\partial \xi}\frac{d\xi}{dt} + \frac{\partial FDI}{\partial X}\frac{dX}{dt} \tag{23}$$

Since in estimating the tax effects, we controlled for observed characteristics on the right-hand-side of the estimating equation (17), the bias would only come from the unobserved factors. If $\frac{d\xi}{dt}$ is different from zero, then estimating the tax effects on FDI without considering the unobservables will bias the estimated tax elasticity. The direction of the bias will depend on the signs of $\frac{\partial FDI}{\partial \xi}$,

[27] Totally differentiating the first-order conditions (equations (21) and (22)) with respect to the corporate tax rate (t), the level of public good (G) and, the unobservables (ξ), we obtain the following expression:

$$\begin{pmatrix} SOC_t & \frac{\partial FOC_t}{\partial G} \\ \frac{\partial FOC_G}{\partial t} & SOC_G \end{pmatrix}\begin{pmatrix} dt \\ dG \end{pmatrix} + \begin{pmatrix} \frac{\partial FOC_t}{\partial \xi} \\ \frac{\partial FOC_G}{\partial \xi} \end{pmatrix} d\xi = 0$$

where FOC_i and SOC_i are the first and second-order conditions with respect to i respectively.
If the marginal utility of the public good does not depend on the unobservables, we can rearrange the terms as:

$$\begin{pmatrix} \frac{dt}{d\xi} \\ \frac{dG}{d\xi} \end{pmatrix} = -\begin{pmatrix} SOC_t & \frac{\partial FOC_t}{\partial G} \\ \frac{\partial FOC_G}{\partial t} & SOC_G \end{pmatrix}^{-1}\begin{pmatrix} \frac{\partial FOC_t}{\partial \xi} \\ 0 \end{pmatrix}$$

If the second-order conditions for the maximization problem are satisfied (the hessian is negative semidefinite), the sign of $\frac{dt}{d\xi}$ is determined by the sign of $\frac{\partial FOC_t}{\partial \xi}$.

[28]

$$\begin{aligned}\frac{\partial FOC_t}{\partial \xi} \quad = \quad & \frac{\partial V}{\partial w}\left(\frac{\partial w}{\partial FDI}\frac{\partial^2 FDI}{\partial t \partial \xi} + \frac{\partial^2 w}{\partial FDI^2}\frac{\partial FDI}{\partial t}\frac{\partial FDI}{\partial \xi}\right) \\ & +\lambda\left[\left(\frac{\partial f}{\partial FDI} - \frac{\partial w}{\partial FDI}L - r\right)\left(\frac{\partial FDI}{\partial \xi} + t\frac{\partial^2 FDI}{\partial t \partial \xi}\right)\right] \\ & +\lambda\left[t\left(\frac{\partial^2 f}{\partial FDI^2} - \frac{\partial^2 w}{\partial FDI^2}L\right)\frac{\partial FDI}{\partial t}\frac{\partial FDI}{\partial \xi}\right]\end{aligned}$$

[29] Recall that from (13), foreign direct investment (FDI) is a function of the corporate tax rate t, the observable state characteristics X (public good provision, population, miles of road per area, real price of energy, etc.) and other unobserved characteristics ξ (state reputation, non-tax investment incentives, other states' tax abatement programs, crime level, etc.): $FDI = f(t, X, \xi)$.

and $\frac{d\xi}{dt}$.

If ξ is the tax abatements offered by other states, and there is tax competition, we would expect $\frac{d\xi}{dt}$ to be negative[30]. In this example, $\frac{\partial FDI}{\partial \xi}$ will also be negative.[31] Consequently, ignoring tax competition would bias the estimated tax elasticity upward.

If ξ is the bad reputation for doing business in the state (e.g. corruption), we would expect $\frac{d\xi}{dt}$ to be negative. To compensate for the bad reputation, the state may want to reduce its corporate tax rate to attract investment. In this case, $\frac{\partial FDI}{\partial \xi}$ will be negative. States with bad reputation will receive less foreign direct investment, ceteris paribus. Consequently, ignoring the unobserved bad reputation would bias the estimated tax elasticity upward.

In the two previous examples, the estimated tax elasticity would be biased upward. In general, the bias could be either upward or downward.

3.2 Instrumental Variables

As we mentioned before, if we ignore state governments' behavior in tax setting, the estimate of the tax effects on FDI (α in equation (17)) might be biased. To avoid this bias, we need to instrument for the tax rate in the demand equation. Natural candidates to be used for this purpose are the exogenous variables in the tax setting equation that do not appear in the demand equation. Then, the natural instruments are other state tax rates (individual, sales), total government expenditures and, some other determinants of the state budget process. However, we have to consider how exogenous these potential instruments are with respect to investors' decisions.[32]

In the case of state personal tax rates, we can think that states that want to have higher taxes will have higher tax rates for both corporate and personal incomes. In addition, if states set their corporate tax rate much lower than the personal tax rate, some individuals may avoid high personal

[30] If a state reduce its corporate tax rate, other states may respond by increasing their tax abatement offers to foreign investors.

[31] If other states increase their tax abatement offers, the amount of FDI in the state would decrease.

[32] As well as whether the potential instruments are highly correlated with the tax rate.

taxes by incorporating themselves. For these two reasons we should expect corporate and personal tax rates to be positively correlated. If personal taxes do not influence foreign investors' decisions, for example, because they do not have to pay personal taxes in any of the states where they may invest, then this variable might be a good instrument. In our view, we still have to consider that personal and corporate tax rates are set simultaneously and therefore personal tax rates are not truly exogenous.

In the case of total state government expenditures, we can think that states with higher levels of government expenditures should set higher taxes to finance those expenditures (ceteris paribus). Therefore, we should expect a positive sign in the first stage regression. However, some of the expenditures might be considered by investors when they decide where to invest, what would make this variable not a suitable instrument.

The results of estimating equation (17) using these two variables as instruments are shown in the appendix, and we will briefly discuss them in the next section. However, because of the potential problems we focus on alternatives that we believe are more valid.

If we look at budget practices across states, we can observe a good variation among them. On the one hand, there are different revenues or expenditures limitations. These limits constrain the annual growth of revenues or expenditures either to a fixed rate or to one based on one or more of the following variables: inflation rate, population growth, growth of personal income, and ratio of revenue to personal income. On the other hand, states have a statutory or constitutional requirement to balance the budget. The two most common requirements are that the governor must submit a balanced budget and that the legislature must pass a balanced budget.

We think that these budget practices are good instruments for the tax rate. The main concern is that the observed correlation between budget rules and fiscal outcomes reflects just a correlation of these two variables with an omitted third one, specifically citizens (voters) preferences for fiscal outcomes. We have two arguments against this concern. First, the empirical literature on state budgeting and fiscal policy supports the hypothesis that budget rules matter and many of these studies have controlled for some measure of state voter preferences (Alt and Lowry (1994), Crain and Miller (1990), Bohn and Inman (1996), Elder (1992), Poterba (1994), Poterba (1995) and Rueben (1997)). The second one is that most of the constitutional balanced budget requirements were enacted a long time ago, some of them even in the nineteenth century. We do not think rules enacted many years ago reflect the preferences of current state residents. Therefore, we will use as instruments a set of dummy variables that reflect these different budget limits: Expenditure Limit, Revenue Limit, and Legislature. Each dummy is equal to one if the state has a limit, and zero otherwise. Legislature is equal to one if the state legislature must pass a balanced budget, and zero otherwise.

4 Data

The Bureau of Economic Analysis (BEA) publishes a benchmark survey of foreign direct investment in the U.S. roughly every five years. The data report FDI by state and by source country for major investing countries in the United States. These countries are Australia, Canada, France, Germany, Japan, the Netherlands, Switzerland, and the United Kingdom.[33] The survey provides information on the value of property, plant, and equipment (PPE) owned by foreign U.S. affiliates in the manufacturing industry.[34] [35]

In the empirical work, we use the PPE data by state and source country for the years 1974, 1980, 1987, 1992 and 1997. As the outside option for investors, we use the total amount of investment in fixed capital (GFX) in their own countries.[36] [37]

The benchmark survey of 1974 has information only for four countries (Canada, Japan, Switzerland, and the United Kingdom) and the 1980 survey is missing Australia (it has data for 7 countries).

[33] Investment outlays from these 8 countries accounted for 75.7% of the total foreign investment outlays in 1999.
[34] Foreign direct investment in manufacturing represented 41.6% of the total FDI in the U.S. in 1999.
[35] An affiliate is defined to be foreign-owned if one or more foreign investors own at least 10% percent each.
[36] That means $S_{ijt} = \frac{PPE_{ijt}}{\sum_j PPE_{ijt} + GFX_{it}}$ and $S_{oit} = \frac{GFX_{it}}{\sum_j PPE_{ijt} + GFX_{it}}$ in equation (17).
[37] We would have preferred to use FDI in the rest of the world as the outside option for each country, but the data are not available for some of the years in our sample.

Therefore, we have 1750 ($50 \times 3 \times 8 + 50 \times 7 + 50 \times 4$) observations. Among these 1750 observations, 195 (11.1%) are suppressed by the BEA for confidentiality reasons[38], and 30 (1.7%) are reported as being less than $500,000 but no specific amount is provided.[39] We deal with these data problems in three ways: first, the two types of observations are excluded from the sample; second, we estimate an interval regression using the 30 observations that we know represent a PPE of less than $500,000; and third, we assume that all missing observations represent PPE of less than $500,000. The results are very similar across the three cases.[40]

There has been a long discussion in the literature about how to measure tax variables. The most common approaches are either to use the nominal tax rate for each tax or the ratio of revenues collected to income or population. The latter approach has the advantage that it captures aspects of both the nominal rate and the tax base, and in that sense it is a better measure of the tax burden. In our case, we decided to use the top marginal rate of the state corporate income tax. The main reason for this is that for newly locating firms or expanding businesses we think that the effect of taxes on the rate of return is better measured by the marginal rate of taxation on the investment or the user's cost.

Table 1 shows summary statistics of the data. The mean corporate tax rate is 6.6% with a range between 0% and 12.7%, which provides enough tax variation across states to estimate tax effects. Still, we have to take into account the fact that some states allow corporations to deduct their federal tax liabilities. In those cases we multiply the state corporate tax rate by (1− federal top corporate tax rate).[41] This variable is called Etaxrate in Table 1 and is the one we use for the empirical work.

Table 2 shows summary statistics for the corporate tax rate by year.[42] As we can see the

[38]The states with the highest number of missing observations are: Alaska (with 16), Idaho (with 13), and Montana (with 11). In terms of source countries they are: Switzerland (with 40) and Netherlands (with 39). 1980 is the year with most missing observations (with 61).

[39]The source countries with the highest number of observations of this type are: Japan (with 10) and Switzerland (with 13). In terms of states they are: Delaware and South Dakota (both with 4). 1974 is the year with most of this type of observations (with 19).

[40]We also estimated the same regressions dropping either the 5 states or the 3 source countries with most missing observations. The results were again very similar, but still we had around 8% of missing observations in both cases (instead of the 11% we have for the full sample).

[41]Eight states in 1974, six in 1980, seven in 1987, five in 1992, and three in 1997.

[42]Table 9 in the appendix shows summary statistics for the tax rate by state. There are four states that have had

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Real PPE ($ millions)	1555	1119.38	2170.19	0	35419.8
State Corporate Tax Rate	1750	0.0663	0.0287	0	0.1265
Etaxrate	1750	0.06314	0.0281	0	0.1265
Population (in thousands)	1750	4874.42	5254.14	344	32182.12
Real Wage ($ per hour)	1750	13.476	1.81	9.96	21.81
Road per Area (mile^{-1})	1750	1.609	1.16	0.09	6.12
Real Price of Energy	1750	7.40	2.50	2.83	16.70
Revenue Limit	1750	0.089	0.285	0	1
Expenditure Limit	1750	0.334	0.472	0	1
Legislature	1750	0.489	0.50	0	1
Real Gov. Exp. Per Capita	1750	2515.52	1111.8	1297.33	10581.3
State Personal Tax Rate	1750	0.059	0.0382	0	0.198
Domestic Fixed Capital Investment	1750	260920	315710	24357	1296402

mean and the median tax rate have been increasing over time, and the standard deviation has been decreasing since 1987. This might be a symptom of some degree of collusion rather than one of competition, but this is an empirical question we will try to answer in a different paper.

Table 2: States Corporate Tax Rate by Year

Year	Mean	Std. Dev.	Median	Min.	Max.
1974	0.0594	0.0284	0.06	0	0.12
1980	0.0622	0.0295	0.06	0	0.12
1987	0.0676	0.0303	0.07	0	0.12
1992	0.0710	0.0293	0.0781	0	0.1265
1997	0.0705	0.0271	0.076	0	0.12

Table 3 shows the changes in the state corporate tax rates over time. If we look at the whole period 1974-1997, we have that 29 states had a higher corporate tax rate in 1997 compared to the one they had in 1974, 7 have a lower one, and 14 states have exactly the same one. If we split the period in two, we can see that more states increased their tax rates between 1974 and 1987 than between 1987 and 1997 (27 compared to 15). The opposite is true in terms of decreases in the tax rate (11 states compared to only 5). This table may suggest that the degree of collusion was higher between 1974 and 1987 and that the degree of competition has increased after 1987 (at least compared to the previous period).

a zero tax rate over the whole period (Nevada, South Dakota, Washington and Wyoming) and seven states that have never changed their tax rate during this period.

Table 3: Tax Rates Variation

	1974-97	1974-87	1987-97
Increases	29	27	15
Mean Increased	0.0225	0.0213	0.01163
Reductions	7	5	11
Mean Reduction	0.0155	0.0236	0.00732
No Change	14	18	24

The characteristics of each country we use to control for investors' characteristics are: population, interest rate, real wages, and GDP per capita.[43]

The characteristics of each state we use are: statutory top tax rates (personal and corporate), revenue limits, expenditure limits, balanced budget requirements, total government expenditures per capita, miles of road per area (squared miles), real wages, real price of energy, education level, and population.[44]

5 Results and Discussion

Table 4 shows the Tobit[45] regressions of equation (17). The first regression uses the statutory corporate tax rate as a variable to capture tax effects, and the IV regression uses instrumental variables to control for the endogeneity of the tax rate.[46] The first regression shows a negative relationship between FDI share and state's corporate tax rate, but the coefficient is not significant, and the elasticities implied are quite low. Given the mean of s_{ijt} of 0.005054 and the mean of states' effective tax rates of 0.0634, the coefficient -3.020 implies a tax elasticity of -0.208. Calculated at the median values of 0.002067 for the s_{ijt} and 0.066 for the effective tax rate, the elasticity is

[43] The source for these characteristics is the IMF International Monetary Statistics Yearbook.
[44] The sources of the data for states are the following:
-Tax Rates, Total Expenditures, and Miles of Roads per Area: The Book of the States.
-Wages: Bureau of Labor Statistics.
-Population: Census Bureau.
-Revenue Limits, Expenditure Limits, Balanced Budget Requirements: Advisory Commission on Intergovernmental Relations.
[45] We actually use interval regression which is just a generalization of a Tobit model.
[46] For the first regression standard errors were calculated using the Huber-White estimator. For the regression in which we use instrumental variables, we calculated the standard errors for the second stage using bootstrapping with 1000 repetitions.

−0.218.

Correcting for possible tax endogeneity and/or omitted variables, the coefficient of the state's tax rates is −16.911, which implies a tax elasticity of −1.053 at the mean values and −1. 101 at the median values (the tax elasticities at mean and median values for each state are reported in table 12 in the appendix[47]). This result shows a upward bias that occurs when the tax effects on investment location are estimated without taking tax endogeneity into account. This is consistent with the results in the literature that have shown very small or zero tax effects.

Table 4: FDI Equations

$\ln(s_{ijt}) - \ln(s_{iot})$	TOBIT	TOBIT-IV
Corporate Tax Rate	-3.020	-16.911
	(4.708)	(4.627)
Population	0.000175	0.000183
	(0.00002)	(0.000008)
Real Wage	-0.0260	-0.0287
	(0.0510)	(0.0292)
Real Energy Price	-0.1166	-0.1067
	(0.0342)	(0.0215)
Road per Area	0.3261	0.458
	(0.1516)	(0.0720)
Constant	-6.329	-5.753
	(0.8326)	(0.4631)
Wald Chi^2	106.91	117.16
Log Likelihood	-3131.11	-3121.01
Observations	1555	1555

Numbers in parenthesis are standard errors.

The coefficients for the population and road per area variables are both positive, significant, and with the expected sign. Total population in one state captures in some way the level of business activity; therefore, it should have a positive impact on the amount of FDI the state receives.[48] The elasticity at the mean is 0.912, which means that a 1% increase in the population of a state would increase its FDI share on average by 0.9%, ceteris paribus. The number of miles of roads per area measures the level of a public good provided by the state that helps business activity; thus it should

[47] We also calculated the cross-tax elasticities (the effect of an increase in the tax rate of one state on the s_{jt} of the other 49 states). They are not reported here, but they are available upon request to the authors.

[48] We also tried real retail sales by state instead of population, and the results were very similar.

also have a positive impact on FDI. The implied elasticity evaluated at the mean is 0.733 which implies that a 1% increase in the miles of roads per area would increase, on average, the share of FDI by 0.73%, ceteris paribus. The real price of energy captures the cost of some of the non-labor inputs of production; therefore, the negative and significant coefficient for that variable in the regressions is the expected one. The elasticity at the mean is -0.786, what implies that an increase in the real price of energy of 1% would decrease the share of FDI by 0.78% on average.

The coefficient for the wage variable is negative but not significant. A negative sign would be expected if higher wages increase the costs of a firm and, therefore, decrease its profits. One possible explanation for the non-significance finding is that the real wage variable we use is also capturing higher productivity of the labor force. Therefore, we decided to include a variable for education in the regression, and, for this purpose, we used the number of high school graduates per capita. The coefficient on the education variable is positive and not significant in the regression, and the size of the coefficient for wages is reduced to half and is still not significant.[49] If we use education instead of wages in the regression, the coefficient on education is positive and not significant, and the other coefficients and standard errors are almost identical. We decided, then, to use the regression with wages instead of education because it should reflect labor costs better. The elasticity with respect to wages, even though it is not significant, is -0.385, what implies that a 1% increase in the real wage in a state would decrease its FDI share by 0.38%.

Table 5 shows the results of the first-stage regression corresponding to the set of instrumental variables we used. [50] [51] The coefficients on the variables Revenue Limit and Expenditure Limit are both negative, as expected, and statistically significant. The coefficient on the Legislature variable is positive and significant, which shows that states whose legislatures must enact a balanced budget will have higher taxes. The F-test of joint significance of the three variables we used as instruments

[49]The correlation between the education and wage variables is -0.6339.

[50]The first-stage regression includes all the exogenous variables of the model but the coefficients and standard errors for the variables real wages, real price of energy, population and roads per area are not reported in the table.

[51]We estimated the first stage equation using every instrument alone and every combination of two of them and then we performed likelihood ratio and Hausman tests among the different specifications, and the unrestricted model was always prefered.

is 97.18 which strongly rejects the hypothesis of non-significance.

Table 5: IV First-Stage Regression

Corporate Tax Rate	OLS
Revenue Limit	-0.0271
	(0.0018)
Expenditure Limit	-0.0037
	(0.0013)
Legislature	0.0046
	(0.0015)
Constant	0.0290
	(0.0051)
Adjusted R^2	0.3735
F(all)	121.72
F(IVs)	97.18
Observations	1555

Numbers in parenthesis are standard errors

As a comparison with our results we also estimated equation (17) using as instruments the personal state tax rates and the real state government expenditures per capita. The results are shown in tables 10 and 11 in the appendix. The two variables are significant and have the expected sign. The implied elasticities are negative and significant, but smaller (-0.75 at mean values and -0.79 at median values) than the ones obtained using budget limits as instruments.

Finally, we also estimated equation (17) using some characteristics from the source countries as a way of controlling for investors' characteristics. For this purpose, we use real GDP per capita, real interest rate, and real wages of the source countries. We run regressions with all possible combinations of these three variables. The variable real wages was never significant and the real interest rate was negative and significant only if included together with GDP per capita. Table 6 shows the results of adding GDP per capita as a source country characteristic to the IV regression.

The coefficient of real GDP per capita is negative and significant, which shows a negative relationship between the economic size of the investors' country and the share of their investment in the U.S. states. The results of including source country characteristics show good news and bad news. The bad news is that some characteristics are relevant, therefore, one of the assumptions of the Logit model ($\theta_2 = 0$) is not right, so it would be better to use a Full Random Coefficients Model.

Table 6: FDI Equation Including Source Country GDP Per Capita

$\ln(s_{ijt}) - \ln(s_{iot})$	IV
Tax Rate	-17.211
	(6.189)
Population	0.00018
	(0.00002)
Real Wage	-0.0516
	(0.0503)
Real Energy Price	-0.1338
	(0.0384)
Road per Area	0.5390
	(0.1817)
Real GDP p.c.	-0.0537
	(0.0044)
Constant	-3.981
	(0.7507)
Log Likelihood	-3058.6
Observations	1555

The good news is that the tax effects estimated with and without source country characteristics are almost identical. This implies that even if different investors might have different tax elasticities, the average tax elasticity is still consistently estimated when investors' characteristics are not taken into account. This is not surprising given the structure of the demand equation where δ_{jt} captures the mean effects and μ_{ijt} captures deviations with respect to the mean based on investors' characteristics. The implied tax elasticities from this regression are -1.175 at the mean and -1.195 at the median.

It is also important to consider the role of the outside option in these results. For this purpose we estimated equation (17) again without including the outside option.[52] Table 7 compares the estimated elasticities evaluated at the means with and without considering the outside option.

Our results show a robust, negative, and statistically significant tax elasticity for foreign direct investment when tax endogeneity and investors' outside options are considered. The estimated elasticity is bigger in absolute value compared to what other studies have found. Table 8 compares this result with the estimates of other studies for foreign direct investment in the U.S..

[52] We used the same procedure and the same instrumental variables, but s_{ijt} was calculated over the total investment of each country in the US (instead of total investment in the US plus total investment in their own countries). The

Table 7: Tax Elasticities at Mean Values

	Outside Option	No Outside Option
OLS	-0.208 (*)	-0.174 (*)
	(0.2918)	(0.1331)
IV	-1.053	-0.866
	(0.2970)	(0.1972)

(*) Not statistically significant. Standard errors are in parenthesis.

Table 8: Tax Elasticities for Foreign Investment and Plant Locations in the US

Study	Analysis	Data Years	Tax Elasticity
Hines (1996)	State Share of Foreign Manufacturing Investment	1987	Corporate Income Tax Rate -0.65
Ondrich and Wasylenko (1993)	Manufacturing Plant Births	1978-1987	Corporate Taxes -0.567
Woodward (1992)	Number of Japanese Branch Plants	1980-1989	Not Statistically Significant
Coughlin, Terza and Arrondee (1991)	Foreign Direct Investment by State	1981-1983	Not Statistically Significant
Moore, Steece and Swenson (1987)	Net Foreign Investment in Manufacturing Assets by State	1977-1981	Tax Burdens are Not Statistically Significant
Luger and Shetty (1985)	Number of New Foreign Start-Ups in Three Industries	1979,1981-1983	Negative for Drug Manufac. Positive for Ind. Machinery

Source : Reproduced from Wasylenko (1997)

6 Conclusion

In this paper, we have used a Logit Model of demand adapted from the discrete-choice literature to investigate the effects of corporate taxes on investment location[53]. Theoretically taxes should have a negative impact on investment location, unless they represent a fiscal package that includes greater amounts of public goods and services that benefit investment, in which case the total package might have a positive impact. The empirical literature shows mixed results; most of the studies find no tax effects; some of them, a negative effect, and some others show a positive effect. The question, then, is whether the theoretical models are not capturing very well how investors take decisions or whether the empirical work is missing something, or both. We do not pretend to give a final answer

dependent variable in the equation was $\ln(s_{ijt})$ instead of $\ln(s_{ijt}) - \ln(s_{ot})$.

[53] A natural extension of this paper is to use a full Random Coefficients Model to estimate tax effects allowing not only for a more flexible substitution pattern but also to control for investor's characteristics in a nonlinear way.

to this question, but with this study we do want to highlight the importance of considering tax endogeneity and the existence of outside options for the empirical work in this matter.

In this paper, we show that ignoring the tax setting behavior of states may bias the estimate of the tax effects on FDI. Using instrumental variables and explicitly allowing an outside option for investors, we correct for this bias. We find the FDI to be quite sensitive to states' corporate tax rates. The estimated elasticity is roughly -1.

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8 APPENDIX

Table 9: Tax Rate Summary Statistics by State

State	Mean	Std. Dev.	Min.	Max.	State	Mean	Std. Dev.	Min.	Max.
Alabama	0.05	0	0.05	0.05	Montana	0.0675	0	0.0675	0.0675
Alaska	0.0814	0.0188	0.054	0.094	Nebraska	0.0649	0.0147	0.04125	0.0781
Arizona	0.0988	0.0069	0.09	0.105	Nevada	0	0	0	0
Arkansas	0.0622	0.0025	0.06	0.065	New Hampshire	0.0765	0.0048	0.07	0.08
California	0.0922	0.0026	0.0884	0.096	New Jersey	0.0852	0.0070	0.075	0.09
Colorado	0.0529	0.0040	0.05	0.06	New Mexico	0.0678	0.0122	0.05	0.076
Connecticut	0.1106	0.0103	0.1	0.1265	New York	0.0931	0.0047	0.09	0.1
Delaware	0.0852	0.0048	0.072	0.087	North Carolina	0.0702	0.0078	0.06	0.079825
Florida	0.0534	0.0023	0.05	0.055	North Dakota	0.0958	0.0153	0.06	0.105
Georgia	0.06	0	0.06	0.06	Ohio	0.0861	0.0042	0.08	0.089
Hawaii	0.0641	0.0001	0.064	0.06435	Oklahoma	0.0514	0.0087	0.04	0.06
Idaho	0.0752	0.0070	0.065	0.08	Oregon	0.0676	0.0037	0.065	0.075
Illinois	0.0665	0.0101	0.04	0.073	Pennsylvania	0.1022	0.0134	0.085	0.123
Indiana	0.0724	0.0099	0.055	0.079	Rhode Island	0.0868	0.0082	0.08	0.0999
Iowa	0.1137	0.0094	0.1	0.12	South Carolina	0.0554	0.0050	0.05	0.06
Kansas	0.0438	0.0021	0.04	0.045	South Dakota	0	0	0	0
Kentucky	0.0725	0.0107	0.058	0.0825	Tennessee	0.06	0	0.06	0.06
Louisiana	0.0754	0.0129	0.04	0.08	Texas	0.0133	0.0209	0	0.045
Maine	0.0874	0.0128	0.0693	0.093	Utah	0.0491	0.0056	0.04	0.06
Maryland	0.07	0	0.07	0.07	Vermont	0.0801	0.0035	0.075	0.0825
Massachusetts	0.0949	0.00001	0.094962	0.095	Virginia	0.06	0	0.06	0.06
Michigan	0.0068	0.0107	0	0.023	Washington	0	0	0	0
Minnesota	0.1042	0.0108	0.095	0.12	West Virginia	0.0829	0.0159	0.06	0.0975
Mississippi	0.0468	0.0047	0.04	0.05	Wisconsin	0.079	0	0.079	0.079
Missouri	0.0562	0.0070	0.05	0.065	Wyoming	0	0	0	0

Table 10: FDI Equation Using Alternative IV

$\ln(s_{ijt}) - \ln(s_{iot})$	Tobit-IV
Corporate Tax Rate	-12.011
	(4.035)
Population	0.0001801
	(0.00000872)
Real Wage	-0.0278
	(0.0293)
Real Energy Price	-0.1103
	(0.0221)
Road per Area	0.4113
	(0.0600)
Constant	-5.951
	(0.742)
Wald Chi^2	129.53
Log Likelihood	-3,126.16
Observations	1,555

Numbers in parenthesis are standard errors.

Table 11: Alternative IV First-Stage Regression

Corporate Tax Rate	OLS
Personal Tax Rate	0.3341
	(0.0179)
Government Expenditure Per Capita	0.00000671
	(0.00000061)
Constant	0.01369
	(0.00445)
Adjusted R^2	0.4424
F(all)	169.60
F(IVs)	253.76
Observations	1,555

Numbers in parenthesis are standard errors

Table 12: Tax Elasticities by State

State	Elasticity at Mean	Elasticity at Median	State	Elasticity at Mean	Elasticity at Median
Alabama	-0.439	-0.462	Montana	-0.962	-0.963
Alaska	-1.171	-1.341	Nebraska	-0.904	-0.949
Arizona	-1.050	-0.988	Nevada	0	0
Arkansas	-0.888	-0.856	New Hampshire	-1.091	-1.141
California	-1.298	-1.309	New Jersey	-1.167	-1.277
Colorado	-0.754	-0.713	New Mexico	-0.966	-1.084
Connecticut	-1.542	-1.495	New York	-1.293	-1.270
Delaware	-1.216	-1.241	North Carolina	-0.995	-0.994
Florida	-0.756	-0.780	North Dakota	-0.856	-0.974
Georgia	-0.849	-0.851	Ohio	-1.228	-1.262
Hawaii	-0.913	-0.913	Oklahoma	-0.732	-0.712
Idaho	-1.063	-1.099	Oregon	-0.957	-0.941
Illinois	-0.938	-0.969	Pennsylvania	-1.472	-1.490
Indiana	-0.992	-0.995	Rhode Island	-1.237	-1.141
Iowa	-1.181	-1.129	South Carolina	-0.787	-0.852
Kansas	-0.742	-0.656	South Dakota	0	0
Kentucky	-1.031	-1.032	Tennessee	-0.853	-0.854
Louisiana	-0.668	-0.739	Texas	-0.286	0
Maine	-1.246	-1.274	Utah	-0.654	-0.713
Maryland	-0.996	-0.997	Vermont	-1.141	-1.178
Massachusetts	-1.335	-1.353	Virginia	-0.852	-0.854
Michigan	-0.419	-0.334	Washington	0	0
Minnesota	-1.481	-1.396	West Virginia	-1.181	-1.283
Mississippi	-0.668	-0.713	Wisconsin	-1.062	-1.125
Missouri	-0.533	-0.469	Wyoming	0	0