NBER WORKING PAPER SERIES

WHO BENEFITS FROM STATE CORPORATE TAX CUTS? A LOCAL LABOR MARKETS APPROACH WITH HETEROGENEOUS FIRMS

Juan Carlos Suárez Serrato
Owen Zidar

Working Paper 20289
http://www.nber.org/papers/w20289

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2014

We are very grateful for guidance and support from our advisors: Alan Auerbach, Yuriy Gorodnichenko, Patrick Kline, and Emmanuel Saez. We are also indebted to Dominick Bartelme, Alex Bartik, Pat Bayer, Michael Boskin, David Card, Jeffrey Clemens, Robert Chirinko, Rebecca Diamond, Pascaline Dupas, Matt Gentzkow, Gopi Goda, Marc Hafstead, Caroline Hoxby, Koichiro Ito, Matt Leister, Attila Lindner, Neale Mahoney, John McClelland, David Molitor, Enrico Moretti, Pascal Noel, Matt Notowidigdo, Alexandre Poirier, Jim Poterba, Andr es Rodr guez-Clare, Jesse Rothstein, Greg Rosston, Florian Scheuer, John Shoven, Orie Shelef, Reed Walker, Dan Wilson, Danny Yagan, Shuang Zhang, and Eric Zwick for helpful comments and suggestions. We are especially thankful to Nathan Seegert, Dan Wilson and Robert Chirinko, and Jamie Bernthal, Dana Gavrila, Katie Schumacher, Shane Spencer, and Katherine Sydor for generously providing us with tax data. Tim Anderson and Anastasia Bogdanova provided excellent research assistance. All errors remain our own. This work is supported by the Kathryn and Grant Swick Faculty Research Fund at the University of Chicago Booth School of Business. The latest version of this paper can always be found at http://www.jcsuarez.com/ and http://faculty.chicagobooth.edu/owen.zidar/. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms
Juan Carlos Suárez Serrato and Owen Zidar
NBER Working Paper No. 20289
July 2014, Revised November 2014
JEL No. F22,F23,H2,H22,H25,H32,H71,J23,J3,R23,R30,R58

ABSTRACT

This paper estimates the incidence of state corporate taxes on the welfare of workers, landowners, and firm owners using variation in state corporate tax rates and apportionment rules. We develop a spatial equilibrium model with imperfectly mobile firms and workers. Firm owners may earn profits and be inframarginal in their location choices due to differences in location-specific productivities. We use the reduced-form effects of tax changes to identify and estimate incidence as well as the structural parameters governing these impacts. In contrast to standard open economy models, firm owners bear roughly 40% of the incidence, while workers and landowners bear 30-35% and 25-30%, respectively.

Juan Carlos Suárez Serrato
Department of Economics
Duke University
213 Social Sciences Building
Box 90097
Durham, NC 27708
and NBER
jc@jcsuarez.com

Owen Zidar
University of Chicago
Booth School of Business
5807 South Woodlawn Avenue
Chicago, IL 60637
and NBER
owen.zidar@chicagobooth.edu

> If you're a business owner in Illinois, I want to express my admiration for your ability to survive in an environment that, intentionally or not, is designed for you to fail. [...] There is an escape route to economic freedom... a route to Texas.
>
> —Texas Governor Rick Perry (6/1/2013)

This paper evaluates the welfare effects of corporate income taxes on business owners, workers, and landowners. The conventional wisdom among economists and policymakers is that corporate taxation in an open economy is unattractive on both efficiency and equity grounds: it distorts the location and scale of economic activity and falls on the shoulders of workers.[1] We revisit this conventional wisdom both empirically and theoretically.

We begin by developing a spatial equilibrium model where firm productivity and profitability can differ across locations.[2] Standard models have a difficult time explaining how California, with corporate tax rates of nearly 10%, is home to one out of nine establishments in the United States, especially when neighboring Nevada has no corporate tax. Our modeling approach acknowledges that if California were to increase corporate tax rates modestly, many new and existing technology firms would continue to find Silicon Valley to be the most profitable location in the world. The presence of such inframarginal firms changes the nature of the equity and efficiency tradeoff by allowing firms (and their shareholders) to bear some of the incidence associated with corporate taxes.[3]

We provide a new assessment of the welfare effects of local corporate tax cuts by implementing this model empirically. The welfare effects are point identified by the reduced-form impacts of changes in business taxes on four outcomes: wages, rental costs, the location decisions of establishments, and the location decisions of workers. We estimate these impacts using variation in state corporate tax rates and rules and establish their validity through a number of tests. Neither concomitant policy or productivity changes, nor trends in local economic conditions confound the relationship between changes in business taxes and these outcomes. In addition, using external tax variation from nearby states yields similar results. These reduced-form impacts enable us to estimate the welfare effects of state corporate tax cuts as well as the structural parameters that rationalize these effects. The structural elasticities are similar to existing estimates from the literature, to the extent these estimates exist.

Our main finding is that, over a ten-year period, firm owners bear a substantial portion of the incidence of a corporate tax change, while landowners and workers split the remaining burden. Our estimates place approximately 40% of the burden on firm owners, 25-30% on landowners and 30-35% on workers; the finding that firms bear a substantial portion of the burden is robust across a variety of specifications and estimating assumptions. The result that firm owners may bear the incidence of

[1] See for instance, Gordon and Hines (2002). Gravelle and Smetters (2006) show how imperfect product substitution can alter this conclusion. For the Perry quote, see "Perry Ad Campaign Targets Illinois Businesses," *The Texas Tribune* 4/15/2013.

[2] While many recent papers have documented large and persistent productivity differences across countries (Hall and Jones, 1999), sectors (Levchenko and Zhang, 2012), businesses (Syverson, 2011), and local labor markets (Moretti, 2011), the corporate tax literature has not accounted for the role that heterogeneous productivities may have in determining equilibrium incidence. Some research on the incidence of local corporate tax cuts exists, but to our knowledge, there are no empirical analyses that incorporate local equilibrium effects of these tax changes. See McLure Jr. (1977) for an early analysis. Fuest, Peichl and Siegloch (2013) use employer-firm linked data to assess the effects of corporate taxes on wages in Germany and Desai, Foley and Hines Jr. (2007) analyze international variation in corporate tax rates using data from American multi-nationals.

[3] Existing and new firms can be inframarginal due to heterogeneous productivities. This idea is conceptually distinct from the taxation of "old" capital as discussed by Auerbach (2006). See Liu and Altshuler (2013) and Cronin et al. (2013) for incidence papers that allow for imperfect competition and supernormal economic profits, respectively.

local policies starkly contrasts with existing results in the corporate tax literature (e.g., Fullerton and Metcalf (2002)) and is a novel result in the local labor markets literature (e.g., Moretti (2011)).

We establish this result in three steps. In the first part of the paper, we construct the model to allow for the possibility that firm owners, workers, and landowners can bear incidence. The incidence on these three groups depends on the equilibrium impacts on profits, real wages, and housing costs, respectively. A tax cut mechanically reduces the tax liability and the cost of capital of local establishments, attracts establishments, and increases local labor demand. This increase in labor demand leads firms to offer higher wages, encourages migration of workers, and increases the cost of housing. Our model characterizes the new spatial equilibrium following a business tax cut and relates the changes in wages, rents, and profits to a few key parameters governing labor, housing, and product markets. In particular, the incidence on wages depends on the degree to which establishment location decisions respond to tax changes, an effective labor supply elasticity that is dependent on housing market conditions, and a macro labor demand elasticity that depends on location and scale decisions of establishments. Having determined the incidence on wages, the incidence on profits is straightforward; it combines the mechanical effects of lower corporate taxes and the impact of higher wages on production costs. Finally, we show that the equilibrium incidence formulae on worker welfare, firm profits, and landowners' rents are identified by reduced-form effects of corporate taxes as well as by structural parameters of the model.

The variation in our empirical analysis comes from changes to state corporate tax rates and apportionment rules, which are state-specific rules that govern how national profits of multi-state firms are allocated for tax purposes.[4] We implement these state corporate tax system rules using matched firm-establishment data and construct a measure of the average tax rate that businesses pay in a local area. This approach not only closely approximates actual taxes paid by businesses, but it also provides multiple sources of identifying variation from changes in state tax rates, apportionment formulae, and the rate and rule changes of other states.

In the second part of the paper, the empirical analysis quantifies the responsiveness of local economic activity to local business tax changes. We find that a 1% cut in local business taxes increases the number of local establishments by 3 to 4% over a ten-year period. This estimate is unrelated to other changes in policy that would otherwise bias our results, including changes in per-capita government spending and changes in the corporate tax base such as investment tax credits. To rule out the possibility that business tax changes occur in response to abnormal economic conditions, we analyze the typical dynamics of establishment growth in the years before and after business tax cuts. We also directly control for a common measure of changes in local labor demand from Bartik (1991). Finally, we estimate the effects of external tax changes of *other locations* on local establishment growth and find symmetric effects of business tax changes on establishment growth. These symmetric effects corroborate the robustness of our reduced-form results of business tax changes. We also provide estimates of the effects of corporate tax cuts on local population, wages, and rental costs.

In the third part of the paper, we use these reduced-form results to estimate the incidence of business tax changes. We first apply the incidence expressions that transparently map four reduced-form effects – on business and worker location, wages, and rental costs – to the welfare effects on workers, landowners, and firm owners. We then estimate the structural parameters governing incidence by

[4] Previous studies have focused on the theoretical distortions that apportionment formulae have on the geographical location of capital and labor (see, e.g., McLure Jr. (1982) and Gordon and Wilson (1986)). Empirically, several studies have used variation in apportionment rules (e.g., Goolsbee and Maydew (2000)). Hines (2009) and Devereux and Loretz (2007) have analyzed how these tax distortions affect the location of economic activity internationally.

minimizing the distance between these four reduced-form effects and their theoretical counterparts. We test over-identifying restrictions of the model and find that they are satisfied. The structural elasticities are precisely estimated. These parameters help reinforce the validity of our overall estimates for two reasons. First, our estimated parameters align with existing estimates from the literature. Second, they enable us to use estimates from Suárez Serrato and Wingender (2011) to show that our results are robust and, if anything, modestly strengthened when accounting for the welfare effects of changes in government spending that result from changes in tax revenue. Government service reductions disproportionately hurt workers and infrastructure reductions hurt both firms and workers; lower infrastructure reduces productivity and thus wages. The magnitudes of these adjustments depend on the magnitude of tax revenue changes, which can be limited due to low revenue shares from corporate taxes and fiscal externalities on sales and individual income tax bases.

In the last section of the paper, we analyze the efficiency costs of state corporate income taxes and discuss the implications of our results for tax revenues and the revenue-maximizing tax rate. Although business mobility is an often-cited justification in proposals to lower states' corporate tax rates, we find that business location distortions per se do not lead to a low revenue-maximizing rate. Based solely on the responsiveness of establishment location to tax changes, corporate tax revenue-maximizing rates would be nearly 40%. This rate greatly exceeds average state corporate tax rates, which were 7% on average in 2010. However, corporate tax cuts have large fiscal externalities by distorting the location of individuals. This additional consideration implies substantially lower revenue-maximizing state corporate tax rates than the 40% rate based only on establishment mobility. The revenue-maximizing tax rate also depends on state apportionment rules. By apportioning on the basis of sales activity, policymakers can decrease the importance of firms' location decisions in the determination of their tax liabilities and thus lower the distortionary effects of corporate taxes. Overall, accounting for fiscal externalities and apportionment results in revenue-maximizing rates that are close to actual statutory rates on average.

This paper contributes a new assessment of the incidence of corporate taxation. The existing corporate tax literature provides a wide range of conclusions about the corporate tax burden. In the seminal paper of this literature, Harberger (1962) finds that under reasonable parameter values, capital bears the burden of a tax in a closed economy model in which all the adjustment has to be through factor prices. However, different capital mobility assumptions can completely reverse Harberger's conclusion (Kotlikoff and Summers, 1987). Gravelle (2010) shows how conclusions from various studies hinge on their modeling assumptions, while Fullerton and Metcalf (2002) note that "few of the standard assumptions about tax incidence have been tested and confirmed." Gravelle (2011) and Clausing (2013) critically review some of the existing empirical work on corporate tax incidence. We contribute to both the theoretical and empirical corporate tax literature by developing a new theoretical approach and connecting this theory directly to the data. Doing so not only allows the data to govern the relative mobility of firms and workers, but also enables us to conduct inference on the resulting incidence calculations.

This paper also contributes to the recent labor labor markets literature, which has focused on the importance of linking workers and locations (Kline, 2010; Moretti, 2011; Suárez Serrato and Wingender, 2011; Diamond, 2012; Busso, Gregory and Kline, 2013; Notowidigdo, 2013; Kline and Moretti, 2013). This literature and benchmark models (Rosen, 1979; Roback, 1982; Glaeser, 2008) have representative and perfectly competitive firms with no link between firms and location. Our work links firms and locations by incorporating features popular in the trade literature (Krugman, 1979;

Hopenhayn, 1992; Melitz, 2003). Developing the demand side of local labor markets is important because it allows for the possibility that firm owners can bear some of the incidence of local economic development policies or local productivity shocks—a feature that was previously absent in models of local labor markets.[5] In addition, estimating labor demand functions in models of local labor markets has been limited by the lack of plausibly exogenous labor supply shocks that may trace the slope of the demand function.[6] Our framework exploits firm location decisions and the empirical tradeoff firms make among productivity, corporate taxes, and factor prices to provide a novel link between firm location choices and labor demand that can be used to recover the parameters governing labor demand (and the incidence on firm profits). Finally, this paper relates to the literature on local public finance and business location literatures.[7] We contribute by providing a framework to interpret existing estimates and by implementing the state corporate tax system, which provides novel variation in local business taxes.

We make a number of simplifying assumptions that may limit some of our analysis. First, we abstract from issues of endogenous agglomerations that may result from changes in corporate taxes.[8] Second, we do not allow firms to bear the cost of rising real estate costs. This feature could be added in a model with a real estate market that integrates the residential and commercial sectors. However, given that firms' cost shares on real estate are small, this addition would likely not change our main result and would come at the cost of additional complexity. Third, our model abstracts from the entrepreneurship margin (Gentry and Hubbard, 2000; Scheuer, 2012). Abstracting from this margin is unlikely to affect our incidence calculations to the extent that the entrepreneurship margin is small relative to the number of firms and aggregate employment. In particular, the magnitude of this margin depends on the effect of one state's tax changes on the total number of businesses in the United States. Fourth, many of the factors in our incidence formulae are likely to be geographically heterogeneous. A more general model that accounts for differences in housing markets, sectoral compositions, and skill-group compositions may result in a better approximation to the incidence in specific locations.

We proceed as follows. We develop the model in Section 1, derive simple expressions for the incidence of state corporate tax changes in Section 2, and show how these formulae can be estimated in Section 3. Section 4 describes the data and U.S. state corporate tax apportionment rules. Our reduced-form and structural results are discussed in Sections 5 and 6, respectively. Section 7 discusses additional policy implications and Section 8 concludes.

[5] One finding from the set of papers linking workers to locations that differentiates them from previous work is the possibility that workers may be inframarginal in their location decisions. This feature allows workers to bear the benefit or cost of local policies. Analogously, our paper allows firms to be inframarginal in their location decisions and thus they may also bear the cost or benefit of local policies. More generally, this renewed focus on the firm coincides with recent work on the important role of firms in determining labor market outcomes (see, e.g., Card (2011) and Card, Heining and Kline (2013)). In terms of productivity shocks, the possibility that firms can bear incidence implies that wage and property value responses alone are not sufficient for evaluating incidence. This possibility may also alter the interpretation of existing work that relies exclusively on wage and property value responses to evaluate the welfare impacts of business location subsidies (e.g., Greenstone and Moretti (2004)).

[6] Recent papers have used structural approaches to ensure a downward-sloping labor demand curve (e.g., Notowidigdo (2013)) or have emphasized the role of local amenities in driving relative demand for skilled and unskilled workers (e.g., Suárez Serrato and Wingender (2011) and Diamond (2012)).

[7] Important contributions include Gyourko and Tracy (1989); Bartik (1991); Haughwout and Inman (2001); Feldstein and Vaillant (1998); Duranton, Gobillon and Overman (2011); Glaeser (2012); Hines (1997); Newman (1983); Bartik (1985); Helms (1985); Papke (1987, 1991); Wasylenko (1997); Bradbury, Kodrzycki and Tannenwald (1997); Goolsbee and Maydew (2000); Holmes (1998); Rothenberg (2012); Rathelot and Sillard (2008); Chirinko and Wilson (2008); Devereux and Griffith (1998).

[8] Incorporating agglomeration and heterogeneous firms is an interesting area for future work. See Kline and Moretti (2014) for a model of agglomeration with a representative firm and Diamond (2012) for amenity-related agglomerations.

1 A Spatial Equilibrium Model with Heterogeneous Firms

> You have to start this conversation with the philosophy that businesses have more choices than they ever have before. And if you don't believe that, you say taxes don't matter. But if you do believe that, which I do, it's one of those things, along with quality of life, quality of education, quality of infrastructure, cost of labor, it's one of those things that matter.
>
> —Delaware Governor Jack Markell (11/3/2013)

The model characterizes the incidence on wages, rents, and profits as functions of estimable parameters governing the supply and demand sides of the housing, labor, and product markets.[9] In particular, the main incidence results will be functions of three key objects: the effective elasticity of labor supply ε^{LS}, the macro elasticity of labor demand ε^{LD}, and the increase in labor demand following a business tax change $\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}$.

We consider a small location c in an open economy with many other locations. There are three types of agents: households, establishment owners, and landowners. Households choose their location to maximize utility, establishments choose location and scale to maximize after-tax profits, and landowners supply housing units to maximize rental profits. In terms of market structure, capital and goods markets are global and labor and housing markets are local. The equilibrium in location c is characterized by N_c households earning wage w_c and paying housing costs r_c, E_c establishments earning after-tax profits π_c, and a representative landowner earning rents r_c. We compare outcomes in spatial equilibrium before and after a corporate tax cut and do not model the transition between pre-tax and post-tax equilibria.[10]

1.1 Household Problem

In a given location c with amenities A, households maximize Cobb-Douglas utility over housing h and a composite X of non-housing goods x_j while facing a wage w, rent r, and non-housing good prices p_j as follows:

$$\max_{h,X} \ \ln A + \alpha \ln h + (1-\alpha)\ln X \ \ s.t. \ \ rh + \int_{j\in J} p_j x_j dj = w, \ \ \text{where } X = \left(\int_{j\in J} x_j^{\frac{\varepsilon^{PD}+1}{\varepsilon^{PD}}} dj \right)^{\frac{\varepsilon^{PD}}{\varepsilon^{PD}+1}},$$

$\varepsilon^{PD} < -1$ is the product demand elasticity, and P is an elasticity of substitution (CES) price index that is normalized to 1.[11] Workers inelastically provide one unit of labor.[12]

---

[9] For Markell quote, see "'Low wages aren't what it's about anymore': Delaware's governor on bringing jobs home," *The Washington Post* 11/3/2013.

[10] We abstract from transition dynamics, which can have important incidence implications (Auerbach, 2006). Interestingly, the benefits to firm owners are likely front-loaded as the mechanical effects of tax cuts occur immediately while the increases in wages and rental costs follow a gradual adjustment as establishments relocate.

[11] One could incorporate personal income taxes into this framework by replacing w with after tax income $w(1-\tau^i)$. One could also incorporate local property taxes by replacing r analogously. The intuition for having a product demand elasticity $\varepsilon^{PD} < -1$ reflects the idea that the demand elasticity for a broad category of goods, such as food or transportation, is typically thought to be closer to -1. Since there are many varieties, this representation is a simplified way of capturing the idea that price changes result in substitution within and across categories of goods. In addition, note that this price index is $P = \left(\int_{j\in J} (p_j)^{1+\varepsilon^{PD}} dj \right)^{\frac{1}{1+\varepsilon^{PD}}} = 1$. Demand from each household for variety j, $x_j = (1-\alpha) w p_j^{\varepsilon^{PD}}$, depends on the non-housing expenditure, the price of variety j, and the product demand elasticity.

[12] Inelastically supplied labor is a common assumption in local labor markets models such as Rosen (1979); Roback (1982); Moretti (2011) and is consistent with modestly-sized estimates of individual labor supply elasticities in Saez,

1.1.1 Household Location Choice

Wages, rental costs, and amenities vary across locations. The indirect utility of household n from their choice of location c is then

$$V_{nc}^W = a_0 + \ln w_c - \alpha \ln r_c + \ln A_{nc},$$

where a_0 is a constant. Households maximize their indirect utility across locations, accounting for the value of location-specific amenities $\ln A_{nc}$, which are comprised of a common location-specific term $\bar{A}_c$ and location-specific idiosyncratic preference ξ_{nc}:[13]

$$\max_c \underbrace{a_0 + \ln w_c - \alpha \ln r_c + \bar{A}_c}_{\equiv u_c} + \xi_{nc}.$$

The presence of the household-specific-component allows for workers to be inframarginal in their location choices and, in turn, allows for workers to bear part of the incidence of local shocks (Kline and Moretti, 2013). Households will locate in location c if their indirect utility there is higher than in any other location c'. Assuming $\xi_{nc}'s$ are i.i.d. type I extreme value, the share of households for whom that is true determines local population N_c:

$$N_c = P\left(V_{nc}^W = \max_{c'}\{V_{nc'}^W\}\right) = \frac{\exp \frac{u_c}{\sigma^W}}{\sum_{c'} \exp \frac{u_{c'}}{\sigma^W}}, \tag{1}$$

where σ^W is the dispersion of the location-specific idiosyncratic preference ξ_{nc}. This equation defines the local labor supply as a function that is increasing in wages w_c, decreasing in rents r_c, and increasing in log amenities $\bar{A}_c$. If workers have similar tastes for cities, then σ^W will be low and local labor supply will be fairly responsive to real wage and amenity changes.

1.2 Housing Market

Local housing demand follows from the household problem and is given by: $H_c^D = \frac{N_c \alpha w_c}{r_c}$. The local supply of housing, $H_c^S = G(r_c; B_c^H)$, is upward-sloping in both the rental price r_c, which allows landowners to benefit from higher rental prices, and exogenous local housing productivity B_c^H. The marginal landowner supplies housing at cost $r_c = G^{-1}(H_c^S; B_c^H)$. For tractability, we assume $G(r_c; B_c^H) \equiv (B_c^H r_c)^{\eta_c}$, where the local housing supply elasticity $\eta_c > 0$ governs the strength of the price response to changes in demand and productivity.[14] The housing market clearing condition, $H_c^S = H_c^D$, determines the rents r_c in location c and is given in log-form by the following expression:

$$\ln r_c = \frac{1}{1+\eta_c} \ln N_c + \frac{1}{1+\eta_c} \ln w_c - \frac{\eta_c}{1+\eta_c} B_c^H + a_1, \tag{2}$$

where a_1 is a constant. Substituting this expression into Equation 1 yields an expression for labor supply that does not depend on r_c but that incorporates the housing market feedback into the effective

Slemrod and Giertz (2012).

[13] Note that location preferences and heterogenous mobility costs, which some prior work (e.g., Topel (1986)) has included, are observationally equivalent here. We assume fixed amenities for simplicity. See Diamond (2012) for an analysis with endogenous amenities and Suárez Serrato and Wingender (2011) for an analysis where government services responds to local population. We use estimates from Suárez Serrato and Wingender (2011) to quantify how our results change if government amenities are affected in Appendix Section F.

[14] Notowidigdo (2013) discusses the incidence implications of non-linear housing supply functions as in Glaeser and Gyourko (2005).

labor supply. From this substitution we obtain the first key object of interest – the effective elasticity of labor supply.

$$\frac{\partial \ln L_c^S}{\partial \ln w_c} = \left(\frac{1+\eta_c-\alpha}{\sigma^W(1+\eta_c)+\alpha} \right) \equiv \varepsilon^{LS}$$

1.3 Establishment Problem

The standard local labor markets and corporate tax models do not incorporate individual establishment location decisions. We add establishment location decisions for two main reasons. Firms' location decisions enable us to identify the effects of local tax changes on the prices and after-tax profits of firm owners. They also provide a micro-foundation for the local labor demand elasticity based on firms' location and scale decisions.

Establishments j are monopolistically competitive and have productivity B_{jc} that varies across locations.[15] Establishments combine labor l_{jc}, capital k_{jc}, and a bundle of intermediate goods M_{jc} to produce output y_{jc} with the following technology:

$$y_{jc} = B_{jc} l_{jc}^{\gamma} k_{jc}^{\delta} M_{jc}^{1-\gamma-\delta}, \tag{3}$$

where $M_{jc} \equiv \left(\int\limits_{v \in J} (x_{v,jc})^{\frac{\varepsilon^{PD}+1}{\varepsilon^{PD}}} dv \right)^{\frac{\varepsilon^{PD}}{\varepsilon^{PD}+1}}$ is establishment j's bundle of goods of varieties v. Goods of all varieties can serve as either final goods for household consumption or as intermediate inputs for establishment production.[16] We incorporate intermediate inputs since they represent a considerable portion of gross output and are important to consider when evaluating production technology parameter values empirically.[17]

In a given location c, establishments maximize profits over inputs and prices p_{jc} while facing a local wage w_c, national rental rates ρ, national prices p_v of each variety v, and local business taxes τ_c^b subject to the production technology in Equation 3:

$$\pi_{jc} = \max_{l_{jc}, k_{jc}, x_{v,jc}, p_{jc}} \; (1-\tau_c^b) \left(p_{jc} y_{jc} - w_c l_{jc} - \int\limits_{v \in J} p_v x_{v,jc} dv \right) - \rho k_{jc}, \tag{4}$$

[15] To simplify exposition, we describe the case in which firms are single-plant establishments in the main text, but fully characterize the more general firm problem and its complex interaction with apportionment rules in Appendix B.

[16] The bundle of intermediate goods M_{jc} is defined identically the consumption bundle X in the household problem so that demand for the establishment's variety j has CES demand as in Basu (1995). We use the same elasticity of substitution ε^{PD} for establishments and consumers to maintain CES demand overall. This characterization is not an essential aspect of the model. An alternative characterization is that intermediate inputs are imported at global prices from a location outside the United States. In addition, note that the production technology simplifies to the standard production technology when $\gamma + \delta = 1$.

[17] Accounting for intermediate goods also makes assumptions about trade costs important. We assume zero trade costs to simplify the model. To evaluate this assumption and its importance for our incidence results, consider the opposite extreme in which there is no trade and suppose that locations that have heterogeneous incomes. In this case, locating in a high-income location will be very attractive and may make establishments inframarginal in their location decisions. For instance, many firms would not want to leave New York if wages or taxes increased modestly. An intermediate case of non-zero but finite trade costs is operative in practice. Due to the possibility that these market access concerns can also make establishments inframarginal in their location decisions, we believe that the incidence implications in models with non-zero trade costs will be consistent with those in this paper. See Fajgelbaum et al. (2014) for a closely related model that incorporates trade costs.

where the local business tax is the effective tax from locating in location c.[18] An important feature of the establishment problem is the tax treatment of the returns to equity holders. Since returns to equity holders are not tax deductible, the corporate tax affects the cost of capital (Auerbach, 2002).[19] After solving this establishment problem (see Appendix B.1 and Appendix B.2), we can express economic profits in terms of local taxes, factor prices, and local productivity:

$$\pi_{jc} = (1-\tau_c^b) w_c^{\gamma(\varepsilon^{PD}+1)} \rho_c^{\delta(\varepsilon^{PD}+1)} B_c^{-(\varepsilon^{PD}+1)} \kappa, \tag{5}$$

where the local tax rate is τ_c^b, local factor prices are w_c and $\rho_c = \frac{\rho}{1-\tau_c^b}$, the establishment's local productivity is B_c, and κ is a constant term across locations.[20]

1.3.1 Establishment Location Choice

When choosing location, firm owners maximize after tax profits π_{jc}. The log of establishment j's productivity B_{jc} in location c equals $\bar{B}_c + \zeta_{jc}$ where $\bar{B}_c$ is a common location-specific level of productivity and ζ_{jc} is an idiosyncratic establishment and location-specific term that is i.i.d. type I extreme value. Establishments may be idiosyncratically more productive for a variety of reasons, including match-quality, sensitivity to transportation costs, factor or input market requirements, sector-specific concentration, and agglomeration.[21]

Define an establishment j's value function V_{jc}^F in location c:[22]

$$V_{jc}^F = \underbrace{\frac{\ln(1-\tau_s^b)}{-(\varepsilon^{PD}+1)} + \bar{B}_c - \gamma \ln w_c - \delta \ln \rho_c + \frac{\ln \kappa_1}{-(\varepsilon^{PD}+1)}}_{\equiv v_c} + \zeta_{jc}. \tag{6}$$

This value function is a positive monotonic transformation of log profits.[23] Similar to the household location problem, establishments will locate in location c if their value function there is higher there than in any other location c'. The share of establishments for which that is true determines local establishment share E_c:

$$E_c = P\left(V_{jc} = \max_{c'}\{V_{jc'}\}\right) = \frac{\exp \frac{v_c}{\sigma^F}}{\sum_{c'} \exp \frac{v_{c'}}{\sigma^F}} \tag{7}$$

where σ^F is the dispersion of the location-specific idiosyncratic establishment productivity ζ_{jc}.

[18] See Appendix B.1 for the establishment problem in the more general case with apportionment. In Section 4, we describe our implementation of the business tax rate τ_c^b as a combination of personal income taxes paid by partnerships and sole-proprietors and the relevant corporate income taxes for single-state and multi-state firms.

[19] Establishments are equity financed in the model. We view this as a reasonable characterization given non-tax costs of debt and firm optimization. See Heider and Ljungqvist (2014) for an analysis of the effects of state taxes on capital structure.

[20] See Appendix B.2 for a derivation. Note that equation 28 is the more general version of equation 5.

[21] Allowing for endogenous agglomeration, i.e., making B_{jc} a function of local population, is beyond the scope of this paper. See Kline and Moretti (2014) for a related model of agglomeration with a representative firm and Diamond (2012) for amenity-related agglomerations. We use estimates from Suárez Serrato and Wingender (2011) to quantify how our results change if government infrastructure (and thus productivity) is affected in Appendix Section F.

[22] In practice, establishment j is owned by firm i, which determines j's tax rate and thus pays a firm location-specific rate τ_{is}^b rather than τ_s^b due to apportionment rules. See Apprendix B.1 for the firm problem under apportionment.

[23] The transformation divides log profits by $-(\varepsilon^{PD}+1) \geq 1$, where log profits are the non-tax shifting portion of log profits, i.e., $\ln \pi_{jc} = \ln(1-\tau_i^A) + \gamma(\varepsilon^{PD}+1)\ln w_c + \delta(\varepsilon^{PD}+1)\ln \rho_c - (\varepsilon^{PD}+1)\ln \bar{B}_c + \ln \kappa_1$, which closely approximates the exact expression for log profits as shown in Appendix B.2.2. Note that $-(\epsilon^{PD}+1)^{-1} = \mu - 1$, which is the net-markup.

1.3.2 Local Labor Demand

Local labor demand depends on the share of establishments that choose to locate in c as well as the average employment of local firms and is given by the following expression:[24]

$$
\begin{aligned}
L_c^D &= E_c \times \mathbb{E}_\zeta \left[l_{jc}^*(\zeta_{jc}) | c = \underset{c'}{\text{argmax}}\{V_{jc'}\} \right] \\
&= \underbrace{\left(\frac{1}{C\bar{\pi}} \exp\left(\frac{v_c}{\sigma^F}\right)\right)}_{\text{Extensive margin}} \times \underbrace{w_c^{(\gamma\varepsilon^{PD}+\gamma-1)} \rho_c^{(1+\varepsilon^{PD})\delta} \kappa_0 \left(e^{\bar{B}_c(-\varepsilon^{PD}-1)}\right) z_c}_{\text{Intensive margin}},
\end{aligned} \tag{8}
$$

where C is the number of cities, $\bar{\pi} \equiv \frac{1}{C}\sum_{c'} \exp(\frac{v_{c'}}{\sigma^F})$ is closely related to average profits in all other locations, κ_0 is a common term across locations, and z_c is a term increasing in the idiosyncratic productivity draw ζ_{jc}. From this equation we obtain a key object of interest for incidence – the macro elasticity of local labor demand:

$$
\frac{\partial \ln L_c^D}{\partial \ln w_c} = \underbrace{\gamma - 1}_{\text{Substitution}} + \underbrace{\gamma\varepsilon^{PD}}_{\text{Scale}} - \underbrace{\frac{\gamma}{\sigma^F}}_{\text{Firm-Location}} \equiv \varepsilon^{LD}, \tag{9}
$$

where γ is the output elasticity of labor, ϵ^{PD} is the product demand elasticity, and σ^F is the dispersion of idiosyncratic productivity.[25] This expression is labeled the macro elasticity of labor demand because it combines the average firm's elasticity plus the effect of firm entry on labor demand. In addition, this equation also yields our last key object of interest: the effect of a business tax change on local labor demand, which is given by:

$$
\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)} = \frac{\partial \ln E_c}{\partial \ln(1-\tau_c^b)} = \frac{1}{-(\epsilon^{PD}+1)\sigma^F} = \frac{\mu - 1}{\sigma^F},
$$

where the last equation uses the definition of the net-markup: $\mu - 1$.

2 The Incidence of Local Corporate Tax Cuts

We characterize the incidence of corporate taxes on wages, rents, and profits and relate these effects to the welfare of workers, landowners, and firms. We focus on the welfare of local residents as the policies we study are determined by policymakers with the objective of maximizing local welfare.[26]

2.1 Local Incidence on Prices and Profits

Assuming full labor force participation, i.e., $L_c^S = N_c$, clearing in the housing, labor, capital, and goods markets gives the following labor market equilibrium:

$$
N_c(w_c, r_c; \bar{A}_c, \eta_c) = L_c^D(w_c, \bar{\pi}; \rho_c, \tau_c^b, \bar{B}_c, z_c).
$$

[24] Given a large number of cities C, we can follow Hopenhayn (1992) and use the law of large numbers to simplify the denominator of E_c and express the share $E_c = \left(\frac{\exp\frac{v_c}{\sigma^F}}{C\bar{\pi}}\right)$ as a function of average location-specific profits in all other locations $\bar{\pi} \equiv \frac{1}{C}\sum_{c'} \exp(\frac{v_{c'}}{\sigma^F})$.

[25] Note that the full expression for (log) labor demand is Equation 29 in Appendix B.3.

[26] We also discuss how decisions based on local objectives affect outcomes in other locations in Appendix C.1.

This expression implicitly defines equilibrium wages w_c.[27] Let $\dot{w}_c = \frac{d \ln w_c}{d \ln(1-\tau_c^b)}$ and define $\dot{r}_c$ analogously. The effect of a local corporate tax cut on local wages and rents are given by the following expressions:

$$\dot{w}_c = \frac{\left(\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}\right)}{\varepsilon^{LS} - \varepsilon^{LD}} = \frac{\frac{(\mu-1)}{\sigma^F}}{\left(\frac{1+\eta_c-\alpha}{\sigma^W(1+\eta_c)+\alpha}\right) - \gamma\left(\varepsilon^{PD} + 1 - \frac{1}{\sigma^F}\right) + 1}, \text{ and} \tag{10}$$

$$\dot{r}_c = \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right)\dot{w}_c. \tag{11}$$

Similarly, the effect of a corporate tax cut on establishment profits when apportionment effects are suppressed is given by the following expression:[28]

$$\dot{\pi}_c = 1 \quad \underbrace{-\delta(\varepsilon^{PD}+1)}_{\text{Reducing Capital Wedge}} \quad + \underbrace{\gamma(\varepsilon^{PD}+1)\dot{w}_c}_{\text{Higher Labor Costs}}, \tag{12}$$

where $\dot{\pi}_c$ is the percentage change in after-tax profits, δ is the output elasticity of capital, ε^{PD} is the product demand elasticity, γ is the output elasticity of labor, and $\dot{w}_c$ is the percentage change in wages following a corporate tax cut.

2.1.1 Discussion

The expression for wage growth in Equation 10 has an intuitive economic interpretation that translates the forces in our spatial equilibrium model to those in a basic supply and demand diagram, as in Figure 1. The numerator captures the shift in labor demand following the tax cut: $\frac{(\mu-1)}{\sigma^F}$. Since this shift in demand is due to establishment entry, the numerator is a function of the location decisions of establishments. Profit taxes matter more for location decisions when markups (and thus profits) are large, but matter less when productivity is more heterogeneous across locations. The denominator is the difference between an effective labor supply elasticity and a macro labor demand elasticity. The effective elasticity of labor supply $\varepsilon^{LS} = \left(\frac{1+\eta_c-\alpha}{\sigma^W(1+\eta_c)+\alpha}\right)$ incorporates indirect housing market impacts. As $\frac{\partial \varepsilon^{LS}}{\partial \eta_c} > 0$, the effect of corporate taxes on wages will be smaller, the larger the elasticity of housing supply. A simple intuition for this is that if η is large, workers do not need to be compensated as much to be willing to live there. As shown in Equation 9, the elasticity of labor demand depends on both location and scale decisions of firms.

In the expression for rental costs in Equation 11, the quantity $1+\varepsilon^{LS}$ captures the effects of higher wages on housing consumption through both a direct effect of higher income and an indirect effect on the location of workers. The magnitude of the rent increase depends on the elasticity of housing supply η_c and the strength of the inflow of establishments through its effect on $\dot{w}_c$ as in Equation 10.[29]

Equation 12 shows that establishment profits mechanically increase by one percent following a corporate tax cut of one percent. They are also affected by effects on factor prices. The middle term reflects increased profitability due to a reduction in the effective cost of capital and the last term diminishes profits due to increases in local wages.

[27] See Busso, Gregory and Kline (2013) for a generalization that allows for non-participation in the labor market. Appendix B.4 derives the expressions for equilibrium wages, rents, and population.

[28] Without suppressing apportionment effects, $\dot{\pi}_c = 1 + \gamma(\varepsilon^{PD}+1)(\dot{w}_c + \dot{\omega}_w) + \delta(\varepsilon^{PD}+1)\dot{\omega}_\rho + \dot{\tilde{\mu}}_c$.

[29] Note that the change in local population is given by $\dot{N}_c = \varepsilon^{LS}\dot{w}$ and the change in real wages is $\sigma^W\varepsilon^{LS}\dot{w}$.

2.2 Local Incidence on Welfare

Having derived the incidence of corporate taxes on local prices and profits, we now explore how these price changes affect the welfare of workers, landowners, and firm owners.[30] We define the welfare of workers as $\mathcal{V}^W \equiv \mathbb{E}[\max_c\{u_c + \xi_{nc}\}]$. Since the distribution of idiosyncratic preferences is type I extreme value, the welfare of workers can be written as:

$$\mathcal{V}^W = \sigma^W \log\left(\sum_c \exp\left(\frac{u_c}{\sigma^W}\right)\right),$$

as in McFadden (1978) and Kline and Moretti (2013).[31] It then follows that the effect of a tax cut in location c on the welfare of workers is given by:

$$\frac{d\mathcal{V}^W}{d\ln(1-\tau_c^c)} = N_c(\dot{w}_c - \alpha\dot{r}_c). \tag{13}$$

That is, the effect of a tax cut on welfare is simply a transfer to workers in location c equivalent to a percentage change in the real wage given by $(\dot{w}_c - \alpha\dot{r}_c)$. One very useful aspect of this formula is that it does not depend on the effect of tax changes on the location decisions of workers in the sense that there are no $\dot{N}_c$ terms in this expression (Busso, Gregory and Kline, 2013).[32] This expression assumes $\frac{d\mathcal{V}^W}{d\ln(1-\tau_c^b)} = \frac{d\mathcal{V}_c^W}{d\ln(1-\tau_c^b)}$, that is, tax changes in location c have no effect on wages and rental costs in other locations, consistent with the perspective of a local official.[33]

Similarly, defining the welfare of firm owners as:[34]

$$\mathcal{V}^F \equiv \mathbb{E}[\max_c\{v_c + \zeta_{jc}\}] \times -(\varepsilon^{PD}+1)$$

yields an analogous expression for the effect of corporate taxes on domestic firm owner welfare, which is given by:

$$\frac{d\mathcal{V}^F}{d\ln(1-\tau_c^c)} = E_c\dot{\pi}_c. \tag{14}$$

Finally, consider the effect on landowner welfare in location c. Landowner welfare in each location is the difference between housing expenditures and the costs associated with supplying that level of housing. This difference can be expressed as follows:[35]

$$\mathcal{V}^L = N_c\alpha w_c - \int_0^{N_c\alpha w_c/r_c} G^{-1}(q; Z_c^h)dq = \frac{1}{1+\eta_c}N_c\alpha w_c,$$

[30] A potential problem in assessing the effects of price changes on welfare is that agents might change their behavior in response to price changes. However, envelope-theorem logic implies that, to a first-order approximation, the effect of price changes on agents' welfare does not depend on their behavioral response.

[31] Euler's constant, which is $\approx .577$, is suppressed relative to the expression in McFadden (1978). In other words, $\mathcal{V}^W$ defined here less Euler's constant is the correct value for $\mathcal{V}^W$. This constant does not affect the welfare change calculations below.

[32] This result follows Busso, Gregory and Kline (2013), who additionally show that this logic holds for an arbitrary distribution of idiosyncratic preferences. Note that this expression differs from that in Busso, Gregory and Kline (2013) by including the percentage changes in prices as opposed to the price changes in levels. This deviation is a result of having Cobb-Douglas preferences and normalizing by the marginal utility of income as in Suárez Serrato and Wingender (2011).

[33] In Appendix C.1, we relax this assumption and consider the effects on global welfare.

[34] The firm owner term is multiplied by $-(\varepsilon^{PD}+1) > 0$ to undo the monotonic transformation that was applied when defining the establishment value function V_{jc}^F. In addition, this formulation treats firm owners and landlords as distinct from workers for conceptual clarity.

[35] Note that, in contrast to workers and firm owners, this formulation of the utility of the representative landlord assumes constant marginal utility of income.

and is proportional to housing expenditures. The effect of a corporate tax cut on the welfare of domestic landowners is then given by:

$$\frac{d\mathcal{V}^L}{d\ln(1-\tau_c^c)} = \frac{\dot{N}_c + \dot{w}_c}{1+\eta_c}. \tag{15}$$

3 Empirical Implementation and Identification

This section describes how we connect the theory to the data to implement the incidence formulae from the previous section. We write the key equations of the spatial equilibrium model from Section 1 as a simultaneous equations model and show that there is an associated exact reduced-form that relates equilibrium changes in the number of households, firms, wages, and rental prices to the structural parameters of the model. We then show that the incidence formulae are identified by simple combinations of these equilibrium responses, which can also be used to recover the key structural parameters of the model.

3.1 Exact Reduced-Form Effects of Business Tax Changes

The simultaneous equation model is given by the log-labor supply equation (Equation 1), the log-value of equilibrium rents (Equation 2), the log of the establishment location equation (Equation 7), and the log-labor demand equation (Equation 8).[36] Stacking these equations yields the structural form of the model:

$$\mathbb{A}\mathbf{Y}_{c,t} = \mathbb{B}\mathbf{Z}_{c,t} + \mathbf{e}_{c,t}, \tag{16}$$

where $\mathbf{Y}_{c,t}$ is a vector of the four endogenous variables (wage growth, population growth, rental cost growth, and establishment growth), $\mathbf{Z}_{c,t} = \left[\Delta\ln(1-\tau_{c,t}^b)\right]$ is a vector of tax shocks, $\mathbb{A}$ is a matrix that characterizes the inter-dependence among the endogenous variables, $\mathbb{B}$ is a matrix that measures the direct effects of the tax shocks on each endogenous variable, and $\mathbf{e}_{c,t}$ is a structural error term. Explicitly, these elements are given by:

$$\mathbf{Y}_{c,t} = \begin{bmatrix} \Delta\ln w_{c,t} \\ \Delta\ln N_{c,t} \\ \Delta\ln r_{c,t} \\ \Delta\ln E_{c,t} \end{bmatrix}, \mathbb{A} = \begin{bmatrix} -\frac{1}{\sigma^W} & 1 & \frac{\alpha}{\sigma^W} & 0 \\ 1 & -\frac{1}{\varepsilon^{LD}} & 0 & 0 \\ -\frac{1}{1+\eta} & -\frac{1}{1+\eta} & 1 & 0 \\ \frac{\gamma}{\sigma^F} & 0 & 0 & 1 \end{bmatrix}, \mathbb{B} = \begin{bmatrix} 0 \\ \frac{1}{\varepsilon^{LD}\sigma^F(\varepsilon^{PD}+1)} \\ 0 \\ \frac{1}{-\sigma^F(\varepsilon^{PD}+1)} \end{bmatrix}.$$

Pre-multiplying by the inverse of the matrix of structural coefficients $\mathbb{A}$ gives the reduced form:

$$\mathbf{Y}_{c,t} = \underbrace{\mathbb{A}^{-1}\mathbb{B}}_{\equiv\boldsymbol{\beta}^{\text{Business Tax}}} \mathbf{Z}_{c,t} + \mathbb{A}^{-1}\mathbf{e}_{c,t} \tag{17}$$

where $\boldsymbol{\beta}^{\text{Business Tax}}$ is a vector of reduced-form effects of business tax changes:

$$\boldsymbol{\beta}^{\text{Business Tax}} = \begin{bmatrix} \beta^W \\ \beta^N \\ \beta^R \\ \beta^E \end{bmatrix} = \begin{bmatrix} \dot{w} \\ \dot{w}\varepsilon^{LS} \\ \frac{1+\varepsilon^{LS}}{1+\eta}\dot{w} \\ \frac{\mu-1}{\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w} \end{bmatrix}.$$

[36] To economize on the number of parameters, we set $\eta_c = \eta\ \forall c$.

The expressions in the exact reduced form have insightful intuitive economic interpretations. The observed equilibrium change in wages and rents, β^W and β^R, are given by the incidence Equations 10 and 11. The equilibrium change in employment, β^N, is given by the change in wage multiplied by the effective elasticity of labor supply. The change in the number of establishments, β^E, is determined by two forces. The first, $\frac{\mu-1}{\sigma^F}$, is the increase in the number of establishments that would occur if wages did not change. The second component accounts for the equilibrium change in wages. Higher wages decrease the number of establishments by $-\frac{\gamma}{\sigma^F}\dot{w}$.

3.2 Identification of Parameters and Incidence Formulae

This section shows that these four reduced-form moments, $\boldsymbol{\beta}^{\text{Business Tax}} = \left[\beta^W, \beta^N, \beta^R, \beta^E\right]'$, are sufficient to identify the formulae describing the incidence on the welfare of each of our agents. Table 1 reproduces the incidence formulae for the welfare of each of our agents. The direct effects of taxes on disposable income ($\beta^W - \alpha\beta^R$) and on rents β^R identify the impacts on workers and landowners, respectively. The expression for firm owners depends on the equilibrium effect on profits, which are not directly observed empirically.

Table 1 shows that the formula for the incidence on after-tax profits includes the term $\gamma(\varepsilon^{PD} + 1)$. This term measures the decrease in profits from a one-percent increase in wages normalized by the firm's net-markup.[37] Intuitively, the amount firms care about wage changes depends on how much wage changes impact their costs, which is governed γ, and how much firms have to scale back production when costs are higher, which is governed by the product demand elasticity. We identify $\gamma(\varepsilon^{PD}+1)$ by inverting the wage incidence equation.[38] We recover the elasticity of labor supply, which is identified by the ratio of the first two rows of Equation 17 so that $\varepsilon^{LS} = \beta^N/\beta^W$. Similarly, the shift in labor demand is given by rearranging the establishment location in the last row of Equation 17:

$$\frac{\mu - 1}{\sigma^F} = \beta^E + \frac{\gamma}{\sigma^F}\beta^W.$$

This equation states that the shift in labor demand is given by the observed change in the number of establishments, β^E, plus the number of establishments that would have entered had wages not risen, as given by $\frac{\gamma}{\sigma^F}\beta^W$. Expressing the wage incidence formula as a function of reduced-form parameters yields:

$$\beta^W = \frac{\beta^E + \frac{\gamma}{\sigma^F}\beta^W}{\frac{\beta^N}{\beta^W} \underbrace{- \gamma\left(\epsilon^{PD} + 1 - \frac{1}{\sigma^F}\right) + 1}_{\varepsilon^{\text{LD}}}}. \tag{18}$$

Solving equation 18 for $\gamma(\epsilon^{PD}+1)$ shows that it is identified by the following combination of reduced-form moments:[39]

$$\gamma(\varepsilon^{PD} + 1) = \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right).$$

The intuition behind this derivation is that, given estimates of the equilibrium change in wages, employment, and the slope of labor supply, we can decompose the elasticity of labor demand into the

[37] Recall that $(\varepsilon^{PD} + 1) = \frac{-1}{\mu-1}$, where μ is the markup.

[38] Recall the wage incidence equation 10 and use the first line of Equation 17 to obtain its empirical counterpart β^W.

[39] The terms involving $\frac{\gamma}{\sigma^F}$ cancel out as the number of establishments that would have entered had wages not risen (in the numerator) exactly equals the establishment-location component of the macro elasticity of labor demand (in the denominator) multiplied by the observed wage change.

Table 1: Identification of Local Incidence on Welfare

Stakeholder (Benefit)	Incidence	Identified By
Workers (Disposable Income)	$\dot{w} - \alpha\dot{r}$	$\beta^W - \alpha\beta^R$
Landowners (Housing Costs)	$\dot{r}$	β^R
Firm Owners (After-tax Profit)	$1 + \gamma(\varepsilon^{PD} + 1)(\dot{w}_c - \frac{\delta}{\gamma})$	$1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right)(\beta^W - \frac{\delta}{\gamma})$

Notes: This table shows how reduced-form estimates $\boldsymbol{\beta}^{\text{Business Tax}} = \left[\beta^W, \beta^N, \beta^R, \beta^E\right]'$ map to the incidence on welfare of workers, landowners, and firm-owners at the local level. Note that we calibrate the housing expenditure share (α) and the ratio of the capita to labor output elasticities (δ/γ).

extensive component, using the equilibrium change in establishments, and the remaining intensive margin $\gamma(\epsilon^{PD}+1)-1$. This micro-elasticity of labor demand also reveals the effect of a wage increase on profits, which determines the incidence on firm owners.

A few remarks are worth highlighting about this identification argument. First, the welfare effects are point identified even though we cannot identify all of the parameters of the model independently. In particular, even though we cannot separately identify γ and ε^{PD}, identifying the product $\gamma(\varepsilon^{PD}+1)$ is sufficient to characterize the effect of a corporate tax cut on profits. Second, we can further identify additional primitives of the model including σ^W and η_c by manipulating the identification of the elasticity of labor supply and the incidence on rents. Finally, this identification argument highlights the relationship between our theory and reduced-form estimates, providing a transparent way to evaluate how sensitive our ultimate incidence estimates are to changes in the four reduced-form estimates.

4 Data and Institutional Details of State Corporate Taxes

We use annual county-level data from 1980-2012 for over 3,000 counties and decadal individual-level data to create a panel of outcome and tax changes for 490 county-groups. Ruggles et al. (2010) developed and named these country-groups "consistent public-use micro-data areas (PUMAs)." This level of aggregation is the smallest geographical level that can be consistently identified in Census and American Community Survey (ACS) datasets and has a number of advantages for our purposes.[40]

[40] First, this geographical definition depends on county boundaries that are geographically consistent since 1980. This fact allows us to generate data series at a yearly frequency using data for individual counties. Moreover, it allows us to use micro-data from the U.S. census to create wage, rental cost, and home value indexes for geographically consistent areas across censuses. Second, the level of aggregation does not straddle state lines, in contrast to other definitions of local economies. This feature is beneficial since some of the policies we analyze, namely changes in statutory corporate tax rates, vary at the state level. Since local areas vary in industrial composition, apportionment rules create within state variation in the taxes businesses pay. To our knowledge, this paper is the first to use apportionment rules to compute the average tax rates businesses pay across different locations in the United States.[41] Finally, this level of

4.1 Data on Economic Outcomes

We aggregate the number of establishments in a given county to the PUMA county-groups using data from the Census Bureau's County Business Patterns (CBP). We analogously calculate population changes using Bureau of Economic Analysis (BEA) data.

Data on local wages and housing costs are available less frequently. We use individual-level data from the 1980, 1990, and 2000 U.S. censuses and the 2009 ACS to create a balanced panel of 490 county groups with indices of wages, rental costs, and housing values, following Suárez Serrato and Wingender (2011).

When comparing wages and housing values, it is important that our comparisons refer to workers and housing units with similar characteristics. As is standard in the literature on local labor markets, we create indices of changes in wage rates and rental rates that are adjusted to eliminate the effects of changes in the compositions of workers and housing units in any given area.[42] We create these composition-adjusted values as follows. First, we limit our sample to the non-farm, non-institutional population of adults between the ages of 18 and 64. Second, we partial out the observable characteristics of workers and housing units from wages and rental costs to create a constant reference group across locations and years. We do this adjustment to ensure that changes in the prices we analyze are not driven by changes in the composition of observable characteristics of workers and housing units. Additional details regarding our sample selection and the creation of composition-adjusted outcomes are available in Appendix A.1. Finally, we construct a "Bartik" local labor demand shock that we use to supplement our tax change measure and enhance the precision of labor supply parameters.[43]

4.2 Tax Data

Businesses pay two types of income taxes. C-corporations pay state corporate taxes and many other types of businesses, such as S-corporations and partnerships, pay individual income taxes. We combine these measures to calculate an average business tax rate for every local area in the U.S. from 1980 to 2010.

4.2.1 State Corporate Tax Data and Institutional Details

The tax rate we aim to obtain in this subsection is the effective average tax rate paid by establishments of C-corporations in a given location from 1980 to 2010.

Firms can generate earnings from activity in many states. State authorities have to determine how much activity occurred in state s for every firm i. They often use a weighted average of payroll,

aggregation enables us to maximize statistical power and to exploit and measure variation in prices in local labor and housing markets, which vary considerably within states.

[42] See, e.g., Albouy (2009); Busso, Gregory and Kline (2013); Kline (2010); Notowidigdo (2013); Suárez Serrato and Wingender (2011).

[43] Many other papers in the local labor markets literature use Bartik shocks, e.g., Bartik (1991), Notowidigdo (2013), Suárez Serrato and Wingender (2011), and Diamond (2012). This approach weights national industry-level employment shocks by the initial industrial composition of each local area to construct a measure of local labor demand shocks:

$$Bartik_{c,t} \equiv \sum_{Ind} \text{EmpShare}_{Ind,t-10,c} \times \Delta\text{Emp}_{Ind,t,\text{National}},$$

where $\text{EmpShare}_{Ind,t-10,c}$ is the share of employment in a given industry at the start of the decade and $\Delta\text{Emp}_{Ind,t,\text{National}}$ is the national percentage change in employment in that industry. Following Suárez Serrato and Wingender (2011), we calculate national employment changes as well as employment shares for each county group using micro-data from the 1980, 1990, and 2000 Censuses and the 2009 ACS. We use a consistent industry variable based on the 1990 Census that is updated to account for changes in industry definitions as well as new industries.

property, and sales activity. The weights $\boldsymbol{\theta}_s$, called apportionment weights, determine the relative importance tax authorities place on these three measures of in-state activity.[44] From the perspective of the firm i, the firm-specific "apportioned" tax rate is a weighted average of state corporate tax rates:

$$\tau_i^A = \sum_s \tau_s^c \omega_{is}, \tag{19}$$

where τ_s^c is the corporate tax rate in state s and the firm-specific weights ω_{is} are themselves weighted averages $\omega_{is} = \underbrace{\left(\theta_s^w \frac{W_{is}}{W}\right)}_{payroll} + \underbrace{\left(\theta_s^\rho \frac{R_{is}}{R}\right)}_{property} + \underbrace{\left(\theta_s^x \frac{X_{is}}{X}\right)}_{sales}$ of in-state activity shares.[45] Equation 19 shows that the tax rate corporations pay depends on home-state and other states' tax rates and rules. We use the latter to construct an external rate τ_i^E, which represents an index of the importance of changes in every other state's tax and yields a source of variation that is likely exogenous to local economic conditions.[46]

To implement the activity shares for each firm i, we use the Reference USA dataset from Infogroup to compute the geographic distribution of payroll at the firm level. Due to the lack of information on the geographic distribution of property in the Reference USA dataset, we make the simplifying assumption that capital activity weights equal the payroll weights. Finally, since the apportionment of sales is destination-based, we use state GDP data for ten broad industry groups from the BEA to apportion sales to states based on their share of national GDP.[47]

Empirically, we use the spatial distribution of establishment-firm ownership and payroll activity in 1997, the first year in which micro establishment-firm linked data are available. We hold the spatial distribution of establishment-firm ownership and payroll activity weights constant at these initial values to avoid endogenous changes in effective tax rates. Consequently, variation in our tax measure τ_i^A comes from variation in state apportionment rules, variation in state corporate tax rules, and initial conditions, which determine the sensitivity of each firm's tax rate τ_i^A to changes in corporate rates and apportionment weights. We combine our empirical activity measures with state corporate tax rates and apportionment rules from Book of the States, Significant Features of Fiscal Federalism and Statistical Abstracts of the United States.[48] We then use these components to compute an average tax rate $\bar{\tau}_c^A$ for all establishments in each location and decompose it into average local "domestic" and external rates, $\bar{\tau}_c^D$ and $\bar{\tau}_c^E$.

Figure 2 shows that apart from a few states that have never taxed corporate income, most states have changed their rates at least three times since 1979.[49] States in the South made fewer changes while states in the Midwest and Rust Belt changed rates more frequently. This figure shows that changes in state corporate tax rates did not come form a particular region of the U.S. The top rate is 12% in Iowa, and 75% of the states have rates above 6%.

[44] Goolsbee and Maydew (2000) use variation in apportionment weights on payroll activity to show that reducing the payroll apportionment weight from 33% to 25% leads to an increase in manufacturing employment of roughly one percent on average.

[45] In particular, $a_{is}^w \equiv \frac{W_{is}}{W}$ is the payroll activity share. Payroll and sales shares are defined analogously. See Appendix A.2.1 for more detail on apportionment rules.

[46] This index is defined explicitly in Appendix A.2.1.

[47] This assumption corresponds to the case where all goods are perfectly traded, as in our model. We use broad industry groups in order to link SIC and NAICS codes when calculating GDP by state-industry-year.

[48] See Appendix A.2.2 for supplemental tax data sources.

[49] Appendix Figure A3 shows how large these rate changes have been over a 30 year period from 1980-2010.

States also vary in the apportionment rates that they use. Table 2 provides summary statistics of apportionment weights. Since the late 1970s, apportionment weights generally placed equal weight on payroll, property, and sales activity, setting $\theta_s^w = \theta_s^\rho = \theta_s^x = \frac{1}{3}$. For instance, 80% of states used an equal-weighting scheme in 1980. However, many states have increased their sales weights over the past few decades as shown in Figure 3. In 2010, the average sales weight is two-thirds and less than 25% of states still maintain sales apportionment weights of 33%.

4.2.2 Local Business Tax Rate Data

We combine measures of state personal income tax rates from Zidar (2014) (see Appendix A.2.3 for details) and local effective corporate tax rates that account for apportionment to construct a measure of the change in average taxes that local businesses pay:

$$\begin{aligned}\Delta \ln(1-\tau^b)_{c,t,t-h} \equiv & \underbrace{f^{SC}_{c,t-h}\Delta \ln(1-\tau^c)_{c,t,t-h} + f^{MC}_{c,t-h}\Delta \ln(1-\bar{\tau}^D)_{c,t,t-h}}_{\text{Corporate}} \\ & + \underbrace{(1 - f^{SC}_{c,t-h} - f^{MC}_{c,t,t-h})\Delta \ln(1-\tau^i)_{c,t,t-h}}_{\text{Personal}}, \end{aligned} \tag{20}$$

where $h \in \{1, 10\}$ is the number of years over which the difference is measured, $f^{SC}_{c,t}$ is the fraction of local establishments that are single-state C-corporations, and $f^{MC}_{c,t}$ is the fraction of local establishments that are multi-state C-corporations.[50] Overall, changes in corporate tax rates, apportionment weights, and personal income tax rates generate considerable variation in effective tax rates across time and space. The bottom of Table 2 provides summary statistics of a few different measures of corporate tax changes over 10 year periods. The average log change over 10 years in corporate taxes due only to statutory corporate rates $\Delta \ln(1-\tau^c)_{c,t,t-10}$ is near zero and varies less than measures based on business taxes that incorporate the complexities of apportionment changes. Business tax changes $\Delta \ln(1-\tau^b)_{c,t,t-10}$ are slightly more negative on average over a ten-year period. The minimum and maximum values are less disperse than the measure based on statuary rates since sales apportionment reduces location-specific changes in effective corporate tax rates.

5 Reduced-Form Results and Incidence Estimates

We use changes in state tax rates and apportionment formulas to estimate the reduced-form effects of local business tax changes on population, the number of establishments, wages, and rents. We estimate Equation 17 for a given outcome Y as the first-difference over a 10-year period:

$$\ln Y_{c,t} - \ln Y_{c,t-10} = \beta^Y [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})] + \mathbf{D}'_{s,t}\boldsymbol{\Psi}^{LD}_{s,t} + u_{c,t}, \tag{21}$$

where $\ln Y_{c,t} - \ln Y_{c,t-10}$ is approximately outcome growth over ten years, $[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})]$ is the change in the net-of-business-tax-rate over ten years, and $\mathbf{D}_{s,t}$ is a vector with year dummies as well as state dummies for states in the industrial Midwest in the 1980s, and where a county-group fixed effect is absorbed in the long-difference.[51] This regression measures the degree to which larger tax cuts

[50] We use the County Business Patterns and RefUSA to obtain these fractions. In 2010, C-corporations accounted for roughly half of employment and one-third of establishments in the U.S. Yagan (2013) notes that switching between corporate types is rare empirically.

[51] There were more changes in the industrial midwest as shown in Figure 2, so we include these dummies to avoid the concern that this regional variation is driving our results. Robustness with different fixed-effects is shown for the main estimates in Appendix Table A9.

are associated with greater economic activity. The validity of the reduced-form estimate β^Y depends on the assumption that tax shocks conditional on fixed effects are uncorrelated with the residual term, i.e., $\mathbb{E}\left(u_{c,t}|[\ln(1-\tau^b_{c,t})-\ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0$. This assumption would be violated by potentially confounding elements such as concomitant changes in the tax base, government spending, and productivity shocks. From a dynamic perspective, a violation would also occur if tax changes are the result of adverse local economic conditions that also determine the long-difference in a given outcome Y. We provide evidence that this identifying assumption is valid by showing that the main reduced-form effects of local business taxes on our outcomes are not affected by changes in a number of potential confounders and by showing that the tax changes are not related to prior economic conditions.

Table 3 provides results of long-differences specifications that account for these potential concerns for the establishment location equation. Column (1) shows that a 1% cut in business taxes causes a 4.07% increase in establishment growth increase over a ten-year period. To the extent that cuts in corporate taxes are not fully self-financing, states may have to adjust other policies when they cut corporate taxes.[52] Column (2) controls for changes in state investment tax credits and Column (3) controls for changes in per capita government spending. There is no evidence that either confounds the reduced form estimate $\hat{\beta}^E$.[53] Column (4) controls for other measures of labor demand shocks. The point estimate declines slightly, but χ^2 tests indicate that $\hat{\beta}^E$ estimates are not statistically different than the estimate in Column (1). Column (5) uses variation in the external tax rates from changes in other states' tax rates and rules, $[\ln(1-\tau^E_{c,t})-\ln(1-\tau^E_{c,t-10})]$. This specification has three interesting results. First, the point estimate of changes in business taxes is 3.9%, which is close to the estimate of $\hat{\beta}^E$ without controls in Column (1). Second, the point estimate from external tax changes is roughly equal and opposite to the estimates of $\hat{\beta}^E$. This symmetry in effects indicates that external tax shocks based on state apportionment rules have comparable effects to domestic business tax changes.[54] Third, one potential concern for our main result is that firms do not appear responsive to tax changes because they expect other states to match tax cuts as might be expected in tax competition models. By holding other state changes constant, we find no evidence that expectations of future tax cuts lower establishment mobility. Column (6) controls for all of these potentially confounding elements simultaneously. The point estimate of β^E is robust to including all of these controls.

Figure 4 shows that the long-difference estimate is similar to the cumulative effects of a one-percent cut in local business taxes over a ten-year period. This relationship holds even when adjusting for the years of prior economic activity (as shown in Figure 5).[55] This evidence, based on annual changes in establishment growth and business taxes, suggests that (1) business tax cuts tend to increase establishment growth over a five-to-ten-year period and (2) business tax changes do not occur in response to abnormally good or bad local economic conditions. These dynamic patterns establishing the validity of local business tax variation also hold for population (see Appendix Figure A7).[56] For brevity, the ten-year results for the other three outcomes – population, wages, and rental cost – are provided in Appendix Tables A3, A4, and A5. Non-parametric graphs showing the relationship between outcome changes and business tax changes over a 10 year period are shown for each outcome

[52] We explore the tax revenue implications of corporate tax changes in Section 7.

[53] See Appendix E.2 for additional evidence on concomitant tax base changes.

[54] χ^2 tests indicate that the effect from domestic and external business tax changes are statistically indistinguishable (in absolute value).

[55] See Appendix E.1 for more detail.

[56] Wage and rental cost data are only available every ten years, so making comparable graphs is not possible.

in Appendix Figures A8, A9, A10, and A11, respectively.

5.1 Incidence Estimates

Armed with plausible reduced-form estimates, we can now implement the incidence formulae in Table 1; the estimates for incidence and shares of incidence are presented in Table 4.[57] Column (1) shows results using the baseline reduced-form specification, Equation 21. Panel A shows that a 1% cut in business taxes increases real wages by 1.1% over a ten-year period. Rental costs and profits also increase. In contrast to the conventional view that 100% of the burden of corporate taxation falls on workers in an open economy, the estimated share of the burden for workers is only 28% as shown in Panel B. This estimate is precise enough to reject the conventional view. Firm owners bear 42% of the incidence and landowners bear 30%. The landowner estimate is less precise, perhaps reflecting in part regional housing supply heterogeneity. Specifications (2) -(4) show that these incidence results are robust to controlling for state fixed effects, changes in government spending, and Bartik labor demand shocks. Firm owners bear roughly 40% of the incidence of state corporate taxes in each of these specifications. In the Appendix Table A7, we show that these findings are robust to including a wide-variety of political controls, changes in other state tax rates, and changes in fiscal and economic conditions. Moreover, Appendix Table A8 shows that using statutory state corporate tax rates in Equation 21 (instead of business tax rates τ^b) results in similar and significant estimates, indicating that our measure of business tax rates is not crucial for the results. In addition, the incidence expressions in Table 1 transparently show how sensitive our incidence estimates are in general and that using estimates from other sources of variation, such as the absolute value of the external tax change estimate from Table 3 Column (5), delivers similar incidence results. Overall, these results provide broad evidence that firm owners bear a substantial portion of the incidence of state corporate tax changes.

6 Estimation of Structural Parameters

To understand and evaluate these results, we now estimate the parameters and structural elasticities that rationalize the treatment effects from the previous two sections. We use a classical minimum distance (CMD) estimator to find the parameters that best match the moments $\mathbf{m}(\boldsymbol{\theta}) = \boldsymbol{\beta}^{\text{Business Tax}}$ to the vector of reduced form effects $\hat{\boldsymbol{\beta}}$:

$$\hat{\boldsymbol{\theta}} = \arg\min_{\boldsymbol{\theta}\in\boldsymbol{\Theta}} \; [\hat{\boldsymbol{\beta}} - \mathbf{m}(\boldsymbol{\theta})]'\hat{\mathbf{V}}^{-1}[\hat{\boldsymbol{\beta}} - \mathbf{m}(\boldsymbol{\theta})], \tag{22}$$

where $\hat{\mathbf{V}}$ is the inverse variance of the OLS estimate, and $\mathbf{m}(\boldsymbol{\theta})$ is the moment predicted by our model.[58] We initially use only variation from tax changes, which provides the four moments from Equation 17, and then supplement this approach with four additional moments from a Bartik local

[57] To implement Table 1, we have to calibrate the housing expenditure share (α) and the ratio of the capita to labor output elasticities (δ/γ). We use $\alpha = .3$ using data from the Consumer Expenditure Survey. Note that a higher value of α further strengthens the conclusion that firm owners accrue the largest share of incidence by decreasing the benefits to workers. We use .9 for the ratio of output elasticities based on data from the Bureau of Economic Analysis. BEA's 2012 data on shares of gross output by industry indicate that for private industries, compensation and intermediate inputs account for 28.5% and 45.6% respectively; the ratio $\frac{1-.285-.456}{.285} \approx .9$.

[58] The parameters are the dispersion of firm productivity across locations σ^F, the dispersion of worker preferences across locations σ^W, the elasticity of substitution across varieties ε^{PD}, the elasticity of housing supply η, and the output elasticity of labor γ.

labor demand shock, increasing the precision of our estimates. The supplemental variation from labor demand shocks provides over-identifying restrictions that enable us to test the goodness-of-fit and evaluate the predictions of our model.[59] We calibrate some of the parameters that can be approximated based on external data and estimates from other literatures.[60]

Panel (a) of Table 5 shows parameter estimates for different values of the calibrated parameters: the output elasticity of labor γ and the product demand elasticity ε^{PD}. Our baseline specification in Column (1) finds an estimate for the productivity dispersion $\hat{\sigma}^F = 0.11(SE = 0.069)$.[61] The estimate for preference dispersion $\hat{\sigma}^W = 0.469(SE = 0.36)$ is larger and implies a labor mobility elasticity of 2.13. The elasticity of housing supply is $\hat{\eta} = 2.244(SE = 3.16)$ is statistically insignificant. However, recall that the effect of an increase in wages or an increase in population on rents is given by $\frac{1}{1+\eta} \approx 0.31$, which is statistically significant. Columns (2)-(7) explore the effect of different calibrated values of γ and ε^{PD} on the parameter estimates. The results using variation from the Bartik local labor demand shock are presented in Panel (b) of Table 5.[62] Adding variation from labor demand shocks helps pin down σ^W, freeing up variation and enhancing the precision of σ^F. Standard good-of-fit tests confirm that, overall, the model fits the data well even with additional moments from the Bartik shock.[63]

6.1 Parameter-based Incidence Estimates and Structural Elasticities

The corresponding incidence results are provided in Table 6. Incidence calculations based on estimated parameter values are similar to those in Table 4, but provide more statistical precision for worker effects. Figure 8 plots these results and shows that our baseline values of $\gamma = 0.15$ and $\varepsilon^{PD} = -2.5$ give a conservative share of the incidence to firm owners. It shows that using calibrations with more elastic product demand elasticities, while holding the output elasticity of labor constant at $\gamma = 0.15$, does not change the result that the share to firm owners is roughly 40%. Increasing the calibrated output elasticity of labor generally increases the share accruing to firm owners. When we estimate rather than calibrate ε^{PD} in Column (6) of Table 6, we find that firm owners bear roughly 40% and landowners bear 23% of the burden, leaving workers with substantially less than 100% of the burden.

The effective labor supply and labor demand curves are crucial determinants of the incidence. Panel (b) of Table 6 shows the estimated supply and demand elasticities corresponding to the three CMD estimators. On the supply side, Column (1) shows that the labor supply elasticity without

[59] See Appendix E.3.1 for estimation details. See Appendix E.3.3 for more detail on goodness-of-fit and over-identification tests. We control for changes in personal income taxes in the population growth regression to account for the fact that personal income taxes directly affect both worker and firm location. We provide evidence that alternative approaches yield similar parameter estimates in Appendix E.

[60] In particular, we calibrate the output elasticity of labor γ and the product demand elasticity ε^{PD}. We present results for calibrations for wide ranges of γ and choose a baseline that is close to other values used in the local labor markets literature (e.g., Kline and Moretti (2014)) and close to data from the BEA and IRS. The IRS data are from the most recent year available (2003) and can be downloaded at `http://www.irs.gov/uac/SOI-Tax-Stats-Integrated-Business-Data`. These data show that costs of goods sold are substantially larger than labor costs. Results based on revenue and cost shares from earlier years available are similar. BEA data on gross output for private industries show similar patterns. For our baseline product demand elasticity, we use values that are slightly lower that in the macro and trade literatures (e.g., Coibion, Gorodnichenko and Wieland (2012); Arkolakis et al. (2013)) in order to obtain local labor demand elasticities that are similar to those used in the labor literature (Hamermesh, 1993). However, we also provide results for a wide range of product demand elasticities and estimate this elasticity directly in Section E.3.

[61] This estimate has a similar magnitude to the value from the single-equation approach in Appendix Figure A13.

[62] See Appendix E.3.1 for estimation details.

[63] See Appendix E.3.3 for more detail on goodness of fit and over-identification tests.

housing market effects is roughly two percent. Incorporating housing market interactions lowers the effective elasticity of labor supply. This estimate of a labor supply is close to other estimates in the literature. Based in a calibrated model of population flows, Albouy and Stuart (2013) estimate that the labor supply elasticity is 1.98. Empirical estimates are comparable if not modestly larger. The ranges cited by Bartik (1991) and Notowidigdo (2013) are roughly 2 to 4. Importantly, these comparisons show that our estimates are conservative with respect to our bottom line results – larger labor supply elasticities imply lower incidence on wages and, consequently, more incidence on firm owners.

On the demand side, Panel (b) also provides estimates of the micro elasticity of labor demand, which measures the intensive margin responses of establishments' labor demand to wage changes, and the macro elasticity, which also incorporates extensive margin effects of establishment entry and exit from the local labor market. The first two CMD estimators in Columns (1) and (2) show micro elasticities of labor demand of -1.2 and macro elasticities of roughly -2. While there are few estimates of the average slope of local labor demand, perhaps as a consequence of common assumptions of a representative firm (Card, 2011) and its implied infinite labor demand elasticity (Kline, 2010), our result is consistent with values cited in the literature. In particular, based on estimates from Hamermesh (1993), Kline and Moretti (2014) use a macro elasticity of local labor demand of -1.5. Column (3) shows estimates for the CMD estimator that estimates product demand elasticities ε^{PD}. Column (3) shows a much larger macro labor demand elasticity of -24.5 that is remarkably close to the estimate from Albouy and Stuart (2013), who obtain a calibration-based elasticity of -22.79 when using quality-of-life changes and -24.7 when using housing-productivity changes. However, this macro labor demand elasticity is estimated very imprecisely. Importantly, the incidence results with this elastic labor demand did not imply a small share of the burden on firm owners. The intuition for this result is that the parameters consistent with a highly elastic labor demand curve also imply large shifts in labor demand. The similarity of our structural elasticities to those in the literature reinforce the validity of our incidence results.

Overall, these results in Table 6 show that workers do not bear 100% of state corporate taxes. Landowners often bear some of the increase in wages, which many empirical analyses of corporate tax incidence attribute as gains to workers. The incidence on firm owners in Columns (1) through (3) as well as for a wide variety of reasonable calibration values is statistically significant and economically important. The bottom line of these results is that firm owners bear a substantial burden of the incidence of U.S. state corporate taxes.

6.2 Discussion of Additional Considerations

It is important to note that we document average effects, but there is likely heterogeneity in the effects of corporate tax cuts across regions.[64] For instance, housing markets vary considerably, which affects the incidence of local corporate tax cuts. Our results should be interpreted as national averages, but

[64]For example, places like Houston, Texas, which have real estate markets that can accommodate large inflows of people without large housing costs increases, have more elastic effective labor supply curves ε^{LS}. Corporate tax cuts in these places will tend to result in more adjustment in population than in prices. Consequently, location decision distortions, and thus efficiency costs, are likely to be larger in these areas. This statement applies in the absence of other market failures affecting these areas. In terms of equity, lower adjustment in prices means less incidence on workers. Lower adjustments in prices, however, benefit firm owners since labor costs will not increase by as much as they would in places like San Francisco, California, where housing markets are less elastic. Based on this reasoning, the efficiency and equity consequences of corporate tax cuts will be bigger in places like Houston. In locations like San Francisco, the efficiency costs are likely less stark and corporate tax cuts will result in more non-firm incidence on landowners.

location-specific considerations can alter local incidence and the structure of optimal local corporate tax policy.

These results have also not accounted for government spending changes which can affect incidence to the extent that corporate tax changes result in large government spending changes. In Appendix F, we provide a detailed, quantitative assessment of incidence that accounts for changes in government spending. We adjust the model to allow workers and firms to benefit from government spending and use estimates from Suárez Serrato and Wingender (2011) to quantify how much incorporating these effects changes our incidence results. We evaluate three cases for how government spending declines: cutting services only, infrastructure only, or both in proportion to state finance spending. Since governments spend more on services than they do on infrastructure, workers' government amenities decline disproportionately more. Accounting for these worker impacts increases the share of benefits firm owners enjoy overall. In the infrastructure-only case, spending cuts hurt firm owners, but they also hurt workers because lower infrastructure reduces productivity and negative productivity shocks hurt workers. Consequently, accounting for government spending changes reinforces the conclusion that firm owners enjoy a substantial portion of the benefit of business tax cuts. Finally, it is important to note that changes in our main results due to this consideration are limited because the revenue effects of a business tax cut (and resulting spending declines) can be limited due to low revenue shares from state corporate taxes as well as fiscal externalities from impacts on larger sales and personal income tax bases.

7 Tax Revenue and Policy Implications

This section analyzes expected changes in tax revenue following a state corporate tax cut and characterizes the revenue-maximizing tax rate.

7.1 Tax Revenue Elasticities and Revenue-Maximizing Tax Rates

Firm mobility is an often-cited justification in proposals to lower states' corporate tax rates. In this section, we explore whether firm mobility is a compelling reason to lower or eliminate state corporate taxes. Additionally, we consider how interactions with other state tax revenues, such as personal income taxes, and with features of apportionment rules affect this conclusion.

Consider first the effect of a corporate tax cut solely on the corporate tax income revenues of a given state. In Appendix D, we show that the corporate-tax-revenue-maximizing corporate tax rate equals the following expression.

$$\tau_c^* = \frac{1}{\dot{\bar{\pi}}_c + \dot{E}_c}.$$

This expression shows that the revenue-maximizing corporate tax rate is inversely related to the effects of corporate tax changes on average establishment profitability and on establishment mobility. Recall that $\dot{\bar{\pi}}_c$ denotes average percentage change in after-tax profit and $\dot{E}_c$ is the percentage change in establishments in location c. Based on our estimates of average national parameters, we find that establishment mobility on its own does not justify a low maximal tax rate. In particular, using estimates from Table 6, Panel (a), Column (3), we calculate the maximal tax rate and report the results in Table 7 for selected states. This rate is roughly 40%, substantially above current state corporate tax rates.[65]

However, this calculation does not account for fiscal externalities on other aspects of local public finance that are quantitatively important. For instance, one can show that the *total state tax revenue* maximizing corporate rate equals the following expression:

$$\tau_c^{**} = \frac{1}{\dot{\bar{\pi}}_c + \dot{E}_c + (\text{revshare}_c^{\text{pers}}/\text{revshare}_c^{C})(\dot{w}_c + \dot{N}_c)},$$

where $\text{revshare}_c^{\text{pers}}/\text{revshare}_c^{C}$ is the relative share of personal tax revenues and corporate tax revenues.[66] This additional term in the denominator reflects revenue externalities from reduced personal income and sales tax revenue due to worker mobility. Since state personal income and state sales tax revenue comprise a larger share of total tax revenue for almost all states, including this extra term in the denominator lowers the revenue-maximizing corporate tax rate all else equal.[67] We present these revenue shares for a few selected states in Table 7 and provide these statistics for all states in Appendix D. In California, for example, the personal to corporate revenue share in 2010 was 9. Based on national averages of the percentage change in wages $\dot{\hat{w}}_c$ and the percentage change in population $\dot{\hat{N}}_c$, the revenue-maximizing rate absent fiscal externalities $\tau_{CA}^{*} = 39\%$ exceed the revenue-maximizing rate with fiscal externalities $\tau_{CA}^{**} = 3.9\%$ by a factor of 10. This difference in revenue-maximizing rates is smaller in states that raise a relatively smaller share of their revenue from personal income taxes and sales taxes.

In addition to fiscal externalities, there are also important and interesting complexities in determining the revenue-maximizing rate due to apportionment. The relevant rate that incorporates apportionment is $\frac{\tau_c^{**}}{1-\theta_s^x}$. This rate scales up τ_c^{**} since only a portion of state corporate taxes, namely the payroll and property components, distort location decisions.[68] Since sales apportionment is destination-based, it does not distort location decisions (absent trade costs) and allows for higher revenue-maximizing tax rates. Reducing the location dependence of corporate taxes increases the revenue-maximizing rate since it alleviates the costs of fiscal externalities mentioned above.[69] We present calculations of $\frac{\tau_c^{**}}{1-\theta_s^x}$ for a few selected states in the last Column of Table 7. A comparison of New Mexico and Arizona illustrates the importance of apportionment considerations. As shown in Table 7, New Mexico's statutory corporate tax rate τ_{NM}^c was 7.6% in 2010 and Arizona's rate τ_{AZ}^c was 7.0%. New Mexico used an equal-weighted apportionment formula with $\theta_{NM}^w = \theta_{NM}^\rho = \theta_{NM}^x = 33\%$ in 2010. Arizona, however, put much more weight on sales as $\theta_{AZ}^x = 80\%$. As a result, New Mexico's revenue-maximizing rate was roughly four times smaller than that of Arizona despite only a 0.6 percentage point difference in their statutory corporate rates. In particular, $\frac{\tau_{NM}^{**}}{1-\theta_{NM}^x} = 2.2\%$ and

[65] Note that this measure varies slightly across states due to differences in state size. A corporate tax cut in large states like California affects more local areas simultaneously, which slightly diminishes the effect of a tax cut to an extent that depends on the state's establishment share (as shown in Appendix D). We adjust our estimates of the percent change in local establishments $\dot{E}_c$ by state to account for this simultaneous impact based on state size. The first corporate-revenue-maximizing tax rate, $\tau_s^* = \frac{1}{\dot{E}_s + \dot{\pi}_c}$, is a function of this state-size-adjusted establishment response $\dot{E}_s$ and the estimate of national average change in profits $\dot{\pi}_c$ from Table 6, Panel (a), Column (3).

[66] While these shares are also set by local officials and are thus decision variables, modeling these choices is beyond the scope of this paper.

[67] In addition, this calculation abstracts from the welfare, productivity, and amenity effects of prudent government spending.

[68] This statement applies in models without trade costs. See Fajgelbaum et al. (2014) for a closely-related model that incorporates trade costs.

[69] In addition, this policy usually does not require transition relief, which has limited the attractiveness of comparable corporate tax reforms at the national level (e.g. Altig et al. (2001); Auerbach (2010)).

$\frac{\tau^{**}_{AZ}}{1-\theta^{x}_{AZ}} = 8.6\%$. Perhaps for this reason, we have seen more states shift more weight towards the sales factor θ^x_s as shown in Figure 3. Overall, other tax factors, including apportionment formulae and differences in the reliance on other sources of tax revenue, account for the large geographic variation in the total revenue-maximizing state corporate tax rates that range from 0.7% to 42%.

8 Conclusion

This paper evaluates the welfare effects of cutting corporate income taxes on business owners, workers, and landowners. This question is important for three reasons. First, the conventional view among many economists and policy makers – that workers fully bear the incidence of corporate taxes in an open economy – is based on fairly abstract arguments and less than fully convincing evidence. Second, evaluating the welfare effect of corporate taxes also highlights efficiency consequences of corporate taxation and has direct implications for revenue-maximizing rates. Third, the welfare impacts of corporate tax cuts closely relate to the welfare impacts of a broad class of local economic development policies that aim to entice businesses to locate in their jurisdictions.

We estimate the incidence of corporate taxes in four steps. First, we develop a novel local labor markets framework with heterogeneously productive and monopolistically competitive firms. This framework not only enables us to characterize the incidence on workers, firms, and landowners in terms of a few parameters, but it can also be used to answer other important questions, such as the welfare impacts of business location subsidies for individual companies, optimal local tax policy, and the incidence of technological change. Second, we use state corporate tax apportionment rules and matched establishment-firm data to construct a new measure of the effective tax rate that businesses pay at the local level. Third, we relate changes in these effective rates to local outcomes and show that a 1% cut in business taxes increases establishment growth by 3 to 4% over a ten-year period. Fourth, and most importantly, we combine these three components – a new framework, a new measure of business taxes, and new reduced form effects of business taxes – to estimate the incidence of corporate taxes on firm owners, workers, and landowners.

Our main result is that firm owners bear a substantial portion of the incidence of corporate taxes in an open economy. The intuition for this result is that non-tax considerations, namely heterogeneous productivity, can limit the mobility of businesses. If a business is especially productive in a given location, small changes in taxes won't have large enough impacts on profitability to make changing locations attractive. For instance, technology firms may still find it optimal to locate in Silicon Valley, even if corporate tax rates were increased modestly. Consequently, firm owners bear a substantial portion of the incidence of corporate tax changes, a result that starkly contrasts with the conventional wisdom.

References

Albouy, David. 2009. "The Unequal Geographic Burden of Federal Taxation." *Journal of Political Economy*, 117(4): 635–667.

Albouy, David, and Bryan Stuart. 2013. "Urban Population and Amenities." University of Michigan Working Paper.

Altig, David, Alan J. Auerbach, Laurence J. Kotlikoff, Kent A. Smetters, and Jan Walliser. 2001. "Simulating Fundamental Tax Reform in the United States." *American Economic Review*, 91(3): 574–595.

Arkolakis, Costas, Natalia Ramondo, Andres Rodriguez-Clare, and Stephen Yeaple. 2013. "Innovation and Production in the Global Economy." U.C. Berkeley Working Paper.

Auerbach, Alan J. 2002. "Taxation and Corporate Financial Policy." In *Handbook of Public Economics*. Vol. 3. 1 ed., , ed. Alan J. Auerbach and Martin Feldstein, Chapter 19. Elsevier.

Auerbach, Alan J. 2006. "Who Bears the Corporate Tax? A Review of What We Know." In *Tax Policy and the Economy*. Vol. 20, , ed. James Poterba, 1–40. The MIT Press.

Auerbach, Alan J. 2010. "A Modern Corporate Tax." The Center for American Progress and The Hamilton Project.

Bartik, Timothy J. 1985. "Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States." *Journal of Business & Economic Statistics*, 3(1): 14–22.

Bartik, Timothy J. 1991. *Who Benefits from State and Local Economic Development Policies?* W.E. Upjohn Institute for Employment Research.

Basu, Susanto. 1995. "Intermediate Goods and Business Cycles: Implications for Productivity and Welfare." *The American Economic Review*, 85(3): pp. 512–531.

Bernthal, Jamie, Dana Gavrila, Katie Schumacher, Shane Spencer, and Katherine Sydor. 2012. "Single Sales-Factor Corporate Income Tax Apportionment: Evaluating the Impact in Wisconsin."

Bradbury, Katharine L., Yolanda K. Kodrzycki, and Robert Tannenwald. 1997. "The Effects of State and Local Policies on Economic Development: An Overview." *New England Economic Review*.

Bradford, David F. 1978. "Factor Prices May Be Constant But Factor Returns Are Not." *Economics Letters*, 1(3): 199–203.

Busso, Matias, Jesse Gregory, and Patrick Kline. 2013. "Assessing the Incidence and Efficiency of a Prominent Place Based Policy." *American Economic Review*, 103(2): 897–947.

Card, David. 2011. "The Return of the Firm to Labor Economics."

Card, David, Jörg Heining, and Patrick Kline. 2013. "Workplace Heterogeneity and the Rise of West German Wage Inequality." *The Quarterly Journal of Economics*.

Chirinko, Robert S., and Daniel J. Wilson. 2008. "State Investment Tax Incentives: A Zero-Sum Game?" *Journal of Public Economics*, 92(12).

Clausing, Kimberly. 2013. "Who Pays The Corporate Tax In A Global Economy?" *National Tax Journal*, 66(1): 151–84.

Coibion, Olivier, Yuriy Gorodnichenko, and Johannes Wieland. 2012. "The Optimal Inflation Rate in New Keynesian Models: Should Central Banks Raise Their Inflation Targets in Light of the Zero Lower Bound?" *The Review of Economic Studies*, 79(4): 1371–1406.

Cronin, Julie Anne, Emily Y. Lin, Laura Power, and Michael Cooper. 2013. "Distributing The Corporate Income Tax: Revised U.S. Treasury Methodology." *National Tax Journal*, 66(1): 239–62.

Cullen, Zoe, Juan Carlos Suárez Serrato, and Owen Zidar. 2014. "State Corporate Taxes, Firm Mobility, and Innovation Productivity: Evidence from US patent data." Stanford and University of California - Berkeley Working Paper.

Desai, Mihir A., C. Fritz Foley, and James R. Hines Jr. 2007. "Labor and Capital Shares of the Corporate Tax Burden: International Evidence."

Devereux, Michael P., and Rachel Griffith. 1998. "Taxes and the location of production: evidence from a panel of US multinationals." *Journal of Public Economics*, 68(3): 335 – 367.

Devereux, Michael P, and Simon Loretz. 2007. "The Effects of EU Formula Apportionment on Corporate Tax Revenues." *Oxford University Centre for Business Taxation working paper.*

Diamond, Rebecca. 2012. "The Determinants and Welfare Implications of US Workers' Diverging Location Choices by Skill: 1980-2000." Harvard University Job Market Paper.

Duranton, Gilles, Laurent Gobillon, and Henry G. Overman. 2011. "Assessing the Effects of Local Taxation using Microgeographic Data." *The Economic Journal*, 121(555): 1017–1046.

Fajgelbaum, Pablo, Eduardo Morales, Juan Carlos Suarez Serrato, and Owen Zidar. 2014. "State Taxes and Spatial Misallocation." UCLA, Princeton, Stanford, and U.C. Berkeley Working Paper.

Feldstein, Martin, and Marian Vaillant. 1998. "Can State Taxes Redistribute Income?" *Journal of Public Economics*, 68(3): 369–396.

Fuest, Clemens, Andreas Peichl, and Sebastian Siegloch. 2013. "Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany." Institute for the Study of Labor Discussion Paper.

Fullerton, Don, and Gilbert E. Metcalf. 2002. "Tax Incidence." In *Handbook of Public Economics*. Vol. 4, , ed. Alan J. Auerbach and Martin Feldstein, Chapter 26. Elsevier.

Gentry, William M., and R. Glenn Hubbard. 2000. "Tax Policy and Entrepreneurial Entry." *American Economic Review*, 90(2): 283–287.

Glaeser, Edward L. 2008. *Cities, Agglomeration, and Spatial Equilibrium.* Oxford University Press.

Glaeser, Edward L. 2012. "Urban Public Finance." National Bureau of Economic Research Working Paper 18244.

Glaeser, Edward L., and Joseph Gyourko. 2005. "Urban Decline and Durable Housing." *Journal of Political Economy*, 113(2): pp. 345–000.

Goolsbee, Austan, and Edward L. Maydew. 2000. "Coveting thy neighbor's manufacturing: the dilemma of state income apportionment." *Journal of Public Economics*, 75(1): 125 – 143.

Gordon, Roger H., and James R. Hines. 2002. "International taxation." In *Handbook of Public Economics*. Vol. 4, , ed. Alan J. Auerbach and Martin Feldstein, 1935 – 1995. Elsevier.

Gordon, Roger H., and John Douglas Wilson. 1986. "An Examination of Multijurisdictional Corporate Income Taxation under Formula Apportionment." *Econometrica*, 54(6): 1357–73.

Gravelle, Jane, and Kent Smetters. 2006. "Does the Open Economy Assumption Really Mean That Labor Bears the Burden of a Capital Income Tax?" *The B.E. Journal of Economic Analysis & Policy*, 6(1): 1–44.

Gravelle, Jennifer. 2011. "Corporate Tax Incidence: Corporate Tax Incidence: A Review of Empirical Estimates and Analysis." Congressional Budget Office.

Gravelle, Jennifer C. 2010. "Corporate Tax Incidence: Review of General Equilibrium Estimates and Analysis." Congressional Budget Office Working Paper 2010-03.

Greenstone, Michael, and Enrico Moretti. 2004. "Bidding for Industrial Plants: Does Winning a 'Million Dollar Plant' Increase Welfare?" MIT Department of Economics Working Paper 04-39.

Gyourko, Joseph, and Joseph Tracy. 1989. "The Importance of Local Fiscal Conditions in Analyzing Local Labor Markets." *Journal of Political Economy*, 97(5): 1208–31.

Hall, Robert E., and Charles I. Jones. 1999. "Why do Some Countries Produce So Much More Output Per Worker than Others?" *The Quarterly Journal of Economics*, 114(1): 83–116.

Hamermesh, Daniel. 1993. *Labor Demand.* Princeton University Press.

Harberger, Arnold C. 1962. "The Incidence of the Corporation Income Tax." *Journal of Political Economy*, 70(3): pp. 215–240.

Haughwout, Andrew F., and Robert P. Inman. 2001. "Fiscal policies in open cities with firms and households." *Regional Science and Urban Economics*, 31(2-3): 147 – 180.

Heider, Florian, and Alexander Ljungqvist. 2014. "As Certain as Debt and Taxes: Estimating the Tax Sensitivity of Leverage from Exogenous State Tax Changes." *Journal of Financial Economics.*

Helms, L. Jay. 1985. "The Effect of State and Local Taxes on Economic Growth: A Time Series–Cross Section Approach." *The Review of Economics and Statistics*, 67(4): pp. 574–582.

Hendren, Nathaniel. 2013. "The Policy Elasticity." Harvard University Working Paper.

Hines, James. 2009. "Income Misattribution under Formula Apportionment." *NBER working paper 15185.*

Hines, James R. 1997. "Altered States: Taxes and the Location of Foreign Direct Investment in America." National Bureau of Economic Research Working Paper 4397.

Holmes, Thomas J. 1998. "The Effect of State Policies on the Location of Manufacturing: Evidence from State Borders." *Journal of Political Economy*, 106(4): pp. 667–705.

Hopenhayn, Hugo A. 1992. "Entry, Exit, and Firm Dynamics in Long Run Equilibrium." *Econometrica*, 60(5): pp. 1127–1150.

Kline, Patrick. 2010. "Place Based Policies, Heterogeneity, and Agglomeration." *American Economic Review*, 100(2): 383–87.

Kline, Patrick, and Enrico Moretti. 2013. "People, Places, and Public Policy: Some Simple Welfare Economics of Local Economic Development Programs." U.C. Berkeley Working Paper.

Kline, Patrick, and Enrico Moretti. 2014. "Local Economic Development, Agglomeration Economies and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority." Quarterly Journal of Economics.

Kotlikoff, Laurence J., and Lawrence H. Summers. 1987. "Tax Incidence." In *Handbook of Public Economics*. Vol. 2, , ed. Alan J. Auerbach and Martin Feldstein, Chapter 16. Elsevier.

Krugman, Paul R. 1979. "Increasing returns, monopolistic competition, and international trade." *Journal of International Economics*, 9(4): 469 – 479.

Levchenko, Andrei A., and Jing Zhang. 2012. "Ricardian Productivity Differences and the Gains from Trade." Research Seminar in International Economics, University of Michigan Working Papers 633.

Liu, Li, and Rosanne Altshuler. 2013. "Measuring the Burden of the Corporate Income Tax Under Imperfect Competition." *National Tax Journal*, 66(1): 215–238.

McFadden, Daniel. 1978. "Modeling the Choice of Residential Location." In *Spatial Interaction Theory and Planning Models*. , ed. Karlqvist, Lundqvist, Snickars and Weibull. Amsterdam: North Holland.

McLure Jr., Charles E. 1977. "State Corporate Income Tax: Lambs in Wolves' Clothing?" Office of Tax Analysis Paper 25.

McLure Jr., Charles E. 1982. "The Elusive Incidence of the Corporate Income Tax: The State Case." National Bureau of Economic Research Working Paper 616.

Melitz, Marc J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica*, 71(6): pp. 1695–1725.

Moretti, Enrico. 2010. "Local Multipliers." *American Economic Review*, 100(2): 373–77.

Moretti, Enrico. 2011. "Local Labor Markets." In *Handbook of Labor Economics*. Vol. 4, , ed. O. Ashenfelter and D. Card, Chapter 14, 1237–1313. Elsevier.

Newman, Robert J. 1983. "Industry Migration and Growth in the South." *The Review of Economics and Statistics*, 65(1): pp. 76–86.

Notowidigdo, Matthew J. 2013. "The Incidence of Local Labor Demand Shocks." University of Chicago Booth School of Business.

Papke, Leslie E. 1987. "Subnational Taxation and Capital Mobility: Estimates of Tax-Price Elasticities." *National Tax Journal*, 40(2).

Papke, Leslie E. 1991. "Interstate Business Tax Differentials and New Firm Location: Evidence from Panel Data." *Journal of Public Economics*, 45(1): 47 – 68.

Rathelot, Roland, and Patrick Sillard. 2008. "The Importance of Local Corporate Taxes in Business Location Decisions: Evidence from French Micro Data." *The Economic Journal*, 118.

Roback, Jennifer. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy*, 90(6): 1257–78.

Rosen, Sherwin. 1979. “Wage-Based Indexes of Urban Quality of Life.” In *Current Issues in Urban Economics.* , ed. Mahlon R. Straszheim Peter M. Mieszkowski. Johns Hopkins University Press.

Rothenberg, Alexander D. 2012. “Transport Infrastructure and Firm Location Choice in Equilibrium: Evidence from Indonesia’s Highways.” The RAND Corporation Working Paper.

Ruggles, Steven, et al. 2010. “Integrated Public Use Microdata Series: Version 5.0.” Minneapolis: University of Minnesota [Machine-readable database].

Saez, Emmanuel, and Stefanie Stantcheva. 2013. “Generalized Social Marginal Welfare Weights for Optimal Tax Theory.” National Bureau of Economic Research Working Paper 18835.

Saez, Emmanuel, Joel Slemrod, and Seth H. Giertz. 2012. “The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review.” *Journal of Economic Literature*, 50(1): 3–50.

Scheuer, Florian. 2012. “Entrepreneurial Taxation with Endogenous Entry.” Stanford University and NBER Working Paper.

Seegert, Nathan. 2012. “Optimal Taxation with Volatility: A Theoretical and Empirical Decomposition.” University of Michigan Job Market Paper.

Suárez Serrato, Juan Carlos, and Philippe Wingender. 2011. “Estimating the Incidence of Government Spending.” U.C. Berkeley and International Monetary Fund Working Paper.

Syverson, Chad. 2011. “What Determines Productivity?” *Journal of Economic Literature*, 49(2): 326–65.

Topel, Robert H. 1986. “Local Labor Markets.” *Journal of Political Economy*, 94(3): S111–43.

Train, Kenneth. 2009. *Discrete Choice Methods with Simulation.* . 2 ed., Cambridge University Press.

Wasylenko, Michael. 1997. “Taxation and economic development: the state of the economic literature.” *New England Economic Review*, 37–52.

Yagan, Danny. 2013. “Capital Tax Reform and the Real Economy: The Effects of the Dividend Tax Cut.” Harvard University Working Paper.

Zidar, Owen M. 2014. “Tax Cuts for Whom? Heterogeneous Effects of Income Tax Changes on Growth and Employment.” University of Chicago Booth School of Business.

Table 2: Summary Statistics

Variable	Mean	S.D.	Min	Max	N
Annual Outcome Data from BEA and CBP					
Year	1995	8.9	1980	2010	15190
Log Population: $\ln N_{c,t}$	13.8	1.1	10.9	16.1	15190
Log Employment: $\ln L_{c,t}$	13.2	1.2	9.4	15.6	15190
Log Establishments: $\ln E_{c,t}$	10.0	1.2	6.5	12.4	15190
Annual Data on Apportionment Rules and Corporate, Personal, and Business Tax Rates					
State Corporate Tax Apportionment Parameters					
Payroll Apportionment Weight: $\theta^w_{s,t}$	22.7	11.6	0.0	33.3	15190
Property Apportionment Weight: $\theta^\rho_{s,t}$	22.8	11.6	0.0	33.3	15190
Sales Apportionment Weight: $\theta^x_{s,t}$	54.5	23.2	25	100	15190
Corporate Income					
Rate: $\tau^c_{s,t}$	6.6	3.0	0.0	12.3	15190
% Change in Net-of-Rate: $\Delta \ln (1-\tau^c)_{s,t,t-1}$	-0.01	0.4	-5.4	3.8	15190
Personal Income					
Effective Rate: $\tau^i_{s,t}$	2.6	1.7	0.0	7.4	15190
% Change in Net-of-Rate: $\Delta \ln (1-\tau^i)_{s,t,t-1}$	0.03	0.2	-3.3	2.5	15190
Business Income					
Rate: $\tau^b_{c,t}$	3.1	1.1	0.3	5.4	15190
% Change in Net-of-Rate: $\Delta \ln (1-\tau^b)_{c,t,t-1}$	-0.01	0.2	-1.8	1.2	15190
Decadal Data					
Year	2000	8.2	1990	2010	1470
% Change in Population: $\Delta \ln N_{c,t,t-10}$	11.2	10.4	-16.6	76.1	1470
% Change in Establishments: $\Delta \ln E_{c,t,t-10}$	15.2	16.5	-23	126.2	1470
% Change in Adjusted Wages: $\Delta \ln w_{c,t,t-10}$	-2.8	7.2	-31.2	14.9	1470
% Change in Adjusted Rents: $\Delta \ln r_{c,t,t-10}$	8.5	12.0	-41.4	43.4	1470
% Change in Net-of-Corp.-Rate: $\Delta \ln (1-\tau^c)_{s,t,t-10}$	-0.1	1.1	-5.4	4.5	1470
% Change in Net-of-Pers.-Rate: $\Delta \ln (1-\tau^i)_{s,t,t-10}$	-1.3	1.1	-5.3	1.3	1470
% Change in Net-of-Bus.-Rate: $\Delta \ln (1-\tau^b)_{c,t,t-10}$	-0.8	0.6	-2.8	1.3	1470
% Change in Gov. Expend./Capita: $\Delta \ln G_{c,t,t-10}$	0.0	0.6	-13.3	11.6	1470
Bartik Shock: $\text{Bartik}_{c,t,t-10}$	7.8	4.8	-15.2	26.0	1470

SOURCES: BEA, CBP, Zidar (2014), Suárez Serrato and Wingender (2011). Corporate tax sources in Section 4.

Table 3: Effects of Business Tax Cuts on Establishment Growth over 10 Years

Establishment Growth	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln$ Net-of-Business-Tax Rate	4.07**	4.14**	4.06**	3.35**	3.91**	3.24**
	(1.82)	(1.80)	(1.83)	(1.43)	(1.78)	(1.41)
Δ State ITC		-0.46				-0.17
		(0.32)				(0.30)
$\Delta \ln$ Gov. Expend./Capita			-0.01			-0.01
			(0.01)			(0.01)
Bartik				0.59***		0.57***
				(0.19)		(0.18)
Change in Other States' Taxes					-4.66***	-4.18***
					(1.60)	(1.43)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.472	0.475	0.472	0.491	0.481	0.500

NOTES: This table shows the effects of local business tax changes over ten years on local establishment growth. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources. Col (2)-(6) show that the effect of business taxes is robust to controlling for state investment tax credit changes in Col (2), per capita government spending changes in Col (3), Bartik shocks in Col (4), external tax shocks due to changes in tax rules of other states in Col (5), and all of these controls in Col (6). χ^2 tests indicate that the coefficients in Col (1) and Col (4) are not statistically different. Similarly, the negative effect from tax cuts in other states is not statistically different than the positive effect of tax cuts. Regressions use population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Estimates of Economic Incidence Using Reduced-Form Effects

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	1.10*	1.38**	1.10*	0.68	0.28***	0.31***	0.28***	0.37
	(0.59)	(0.59)	(0.59)	(0.52)	(0.09)	(0.10)	(0.09)	(0.43)
Landowners	1.17	1.27	1.17	0.32	0.30	0.29	0.30	0.18
	(1.43)	(1.42)	(1.43)	(1.36)	(0.19)	(0.18)	(0.19)	(0.48)
Firm Owners	1.63*	1.79**	1.63*	0.81	0.42***	0.40***	0.42***	0.45***
	(0.90)	(0.80)	(0.90)	(1.40)	(0.12)	(0.11)	(0.12)	(0.13)
Controls								
State FX	N	Y	N	N	N	Y	N	N
Δ ln Gov./Capita	N	N	Y	N	N	N	Y	N
Bartik	N	N	N	Y	N	N	N	Y

NOTES: This table shows the estimates of economic incidence expressions from Table 1. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources. Results were produced by implementing Equation 21 and including the listed control variable in each reduced-form regression. Column (2) estimates include state fixed effects. Column (3) controls for changes in per capita government spending, and Column (4) controls for Bartik shocks. Several other robustness specifications are available in Appendix Table A7. Results using statutory state corporate tax rates are in Appendix Table A8. Regressions use population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Minimum Distance Estimates of Structural Parameters

Panel (a) Tax Shock Only

Calibrated Parameters	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output Elasticity γ	0.15	0.1	0.2	0.3	0.1	0.2	0.3
Elasticity of Product Demand ε^{PD}	-2.5	-2.5	-2.5	-2.5	-3.5	-3.5	-3.5
Estimated Parameters							
Idiosyncratic Location	0.110	0.128*	0.094	0.067	0.063	0.035	0.016
Productivity Dispersion σ^F	(0.069)	(0.069)	(0.070)	(0.074)	(0.042)	(0.045)	(0.051)
Idiosyncratic Location	0.469	0.476	0.462	0.444	0.467	0.437	0.405
Preference Dispersion σ^W	(0.360)	(0.362)	(0.358)	(0.352)	(0.360)	(0.350)	(0.334)
Elasticity of Housing	2.244	2.194	2.313	2.511	2.265	2.595	3.163
Supply η	(3.163)	(3.033)	(3.338)	(3.834)	(3.216)	(4.049)	(5.610)

Panel (b) Bartik and Tax Shock

Calibrated Parameters	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output Elasticity γ	0.15	0.1	0.2	0.3	0.1	0.2	0.3
Elasticity of Product Demand ε^{PD}	-2.5	-2.5	-2.5	-2.5	Estimated below		
Estimated Parameters							
Idiosyncratic Location	0.174*	0.200*	0.151	0.110	0.004	0.009	0.013
Productivity Dispersion σ^F	(0.103)	(0.106)	(0.102)	(0.100)	(0.052)	(0.106)	(0.155)
Idiosyncratic Location	0.765**	0.770**	0.759**	0.749**	0.725**	0.726**	0.725**
Preference Dispersion σ^W	(0.313)	(0.317)	(0.310)	(0.304)	(0.304)	(0.304)	(0.304)
Elasticity of Housing	2.467	2.483	2.473	2.544	3.154	3.145	3.155
Supply η	(5.099)	(5.127)	(5.148)	(5.456)	(8.813)	(8.763)	(8.816)
Elasticity of Product					-9.778	-5.344	-3.926
Demand ε^{PD}					(15.506)	(7.715)	(5.169)

NOTES: This table shows the estimated parameters of our model. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources. Panel (a) presents estimates from models with only the tax shock relying on 4 moments to estimate 3 parameters for a variety of assumed values of γ and ε^{PD}. Panel (b) presents estimates from models with both the Bartik shock and the tax shock. The first four columns calibrate the parameters γ and ε^{PD} while the last three columns calibrate only γ and present estimates of ε^{PD}. Section 6 for more details on estimation. Regressions use initial population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Estimates of Economic Incidence Using Estimated Structural Parameters

Panel (a) Incidence

	Incidence			Shares of Incidence		
	(1)	(2)	(3)	(4)	(5)	(6)
	Tax Only	Tax & Bartik		Tax Only	Tax & Bartik	
Output Elasticity γ	0.15	0.15	0.15	0.15	0.15	0.15
Elasticity of Product	-2.500	-2.500	-6.852	-2.500	-2.500	-6.852
Demand ε^{PD}			(10.337)			(10.337)
Wages $\dot{w}$	1.438*	1.211**	1.004			
	(0.798)	(0.592)	(0.708)			
Landowners $\dot{r}$	1.159	0.724	0.523	0.371	0.273	0.230
	(1.329)	(1.241)	(1.298)	(0.251)	(0.338)	(0.463)
Workers $\dot{w} - \alpha\dot{r}$	1.090**	0.994***	0.847**	0.348***	0.375***	0.372**
	(0.476)	(0.316)	(0.419)	(0.105)	(0.145)	(0.152)
Firm Owners $\dot{\pi}$	0.879***	0.930***	0.908*	0.281	0.351	0.399
	(0.180)	(0.133)	(0.512)	(0.191)	(0.220)	(0.405)

Panel (b) Demand and Supply Elasticities

	(1)	(2)	(3)
	Tax Only	Tax & Bartik	
Output Elasticity γ	0.150	0.15	0.15
Elasticity of Product	-2.500	-2.500	-6.852
Demand ε^{PD}			(10.337)
Labor Mobility	2.130	1.308**	1.379**
$\frac{1}{\sigma^W}$	(1.636)	(0.535)	(0.578)
Elasticity of	1.615	1.073**	1.163*
Labor Supply	(1.305)	(0.541)	(0.659)
Micro Elasticity	-1.225	-1.225	-1.878
of Labor Demand			(1.551)
Macro Elasticity	-2.584***	-2.086***	-24.509
of Labor Demand	(0.850)	(0.510)	(266.914)

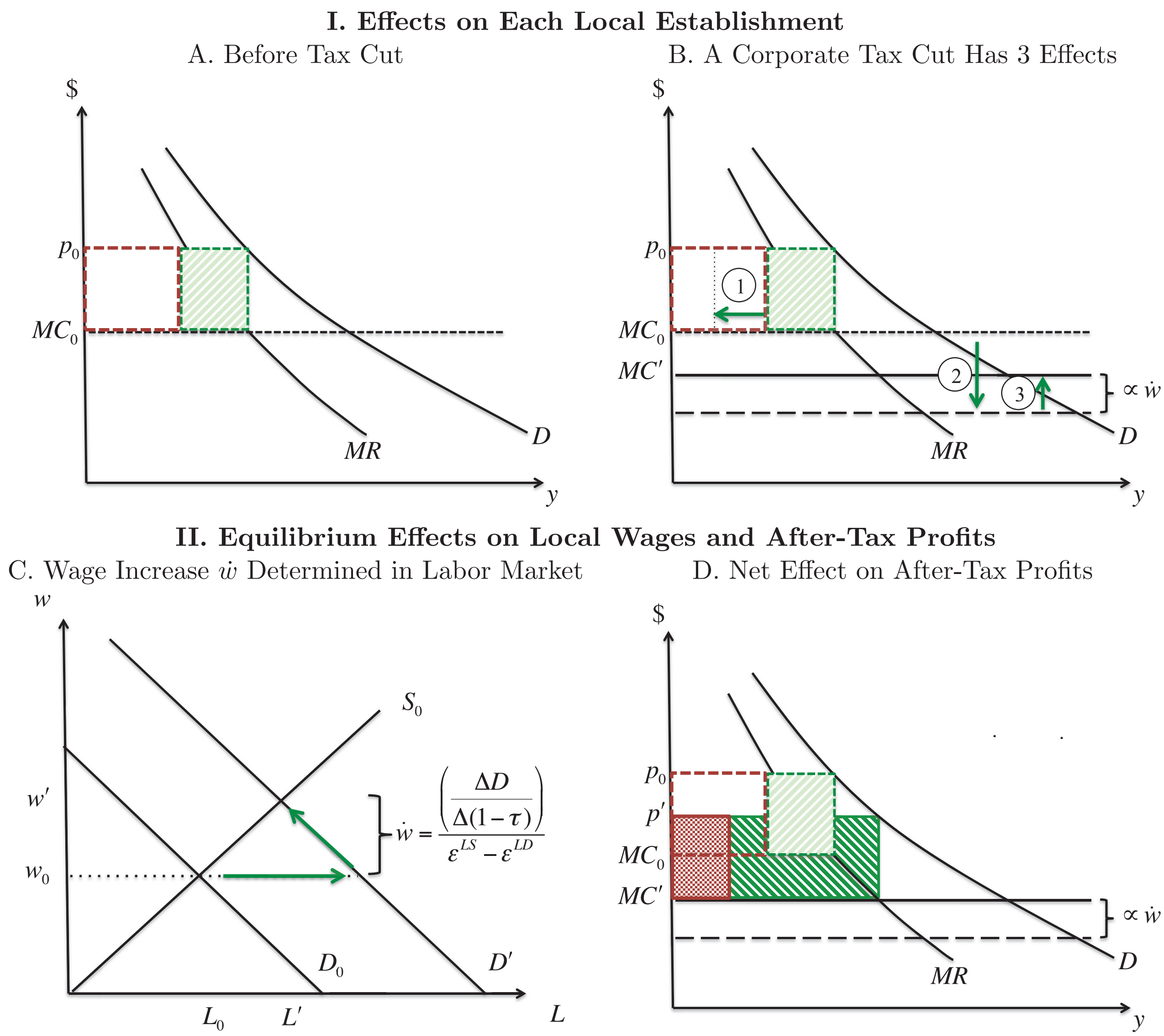
NOTES: This table shows estimates of economic incidence from our model. Col (1)-(3) of Panel (a) show the estimates of tax changes from our three minimum distance specifications: using only taxes, using both taxes and Bartik, and using both shocks and estimating ε^{PD}. See Table 5 for details about the estimation of the related structural models. Col (4)-(6) of Panel (a) present the shares of total economic gains to each agent. Panel (b) presents the associated structural elasticities. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Revenue-Maximizing Corporate Tax Rates for Selected States

State	Establishment Share E_s	Revenue Ratio $\text{rev}_s^{\text{pers}}/\text{rev}_s^C$	Sales Apport. Weight θ_s^x	Corporate Tax Rate τ_s	Revenue Max. Corp. Rate τ_s^*	τ_s^{**}	$\tau_s^{**}/(1-\theta_s^x)$
Kansas	1.0	16	33	7.1	36.9	2.3	3.5
New Mexico	0.6	26	33	7.6	39.1	1.5	2.2
California	11.7	9	50	8.8	39.0	3.9	7.8
Virginia	1.5	18	50	6.0	36.0	2.0	4.1
Arizona	1.8	22	80	7.0	36.0	1.7	8.6
Indiana	2.0	21	90	8.5	40.3	1.8	18.4
Texas	7.2		100	0.0	36.4		
U.S. State Average	2.0	21.7	66.1	6.7	38.8	3.0	7.5
U.S. State Median	1.4	17.1	50.0	7.1	38.3	2.2	4.6
U.S. State Min	0.3	0.4	33.3	0.0	33.8	0.3	0.7
U.S. State Max	11.7	141.5	100.0	12.0	46.6	28.1	42.1

NOTES: This table shows the corporate tax revenue-maximizing corporate tax rate τ_s^* and the total tax revenue-maximizing corporate tax rate τ_s^{**}, which accounts for fiscal externalities on personal income sources, for a few selected states (see Appendix Table A13 for the full list of states). These calculations are based on 2010 data and **average national parameter estimates** and do not incorporate heterogeneous housing markets. We use three state statistics to calculate state revenue-maximizing rates discussed in Section 7 and presented in the last columns of the table. These three statistics are the state's share of establishments, the state's ratio of revenue that comes from personal income, i.e. sales and personal income taxes, to their state corporate tax revenue, and their sales apportionment weight. The second column shows each state's share of national establishments in 2010. A corporate tax cut in large states like California affects more local areas simultaneously, which slightly diminishes the effect of a tax cut to an extent that depends on the state's establishment share (as shown in Appendix D). We adjust our estimates of the percent change in local establishments $\dot{E}_c$ by state to account for this simultaneous impact based on state size. The first corporate revenue-maximizing tax rate, $\tau_s^* = \frac{1}{\dot{E}_s + \dot{\pi}_c}$, is a function of this state-size adjusted establishment response $\dot{E}_s$ and the estimate of national average change in pre-tax profits $\dot{\pi}_c$ from Table 6, panel (a), column (3). This rate is much higher than τ_s^{**} which accounts for fiscal externalities. The size of fiscal externalities from corporate tax changes vary based on the importance of other revenue sources. We measure the state-specific importance of population dependent revenue sources $\text{rev}_s^{\text{pers}}/\text{rev}_s^C$ with the ratio of (1) total state tax revenue from sales and personal income taxes to (2) total state revenue from corporate income taxes. The product of this state-specific revenue share term and national average responsiveness of wages and population is added to the denominator following the formula presented in Section 7 and Section D. These rates are much lower on average. However, in models without trade costs, location distortions result from payroll and property apportionment but not from sales apportionment. The right-most column divides the total state tax revenue-maximizing state corporate tax rate τ_s^{**} by the apportionment factors that distort establishment location, i.e. $(1 - \theta_s^s)$. Since sales is destination based, it does not distort location decisions (absent trade costs) and allows for higher revenue-maximizing tax rates. See Section 7 and Section D in the appendix for more details. Sources: U.S. Census Annual Survey of Governments and the other sources listed in Section 4.

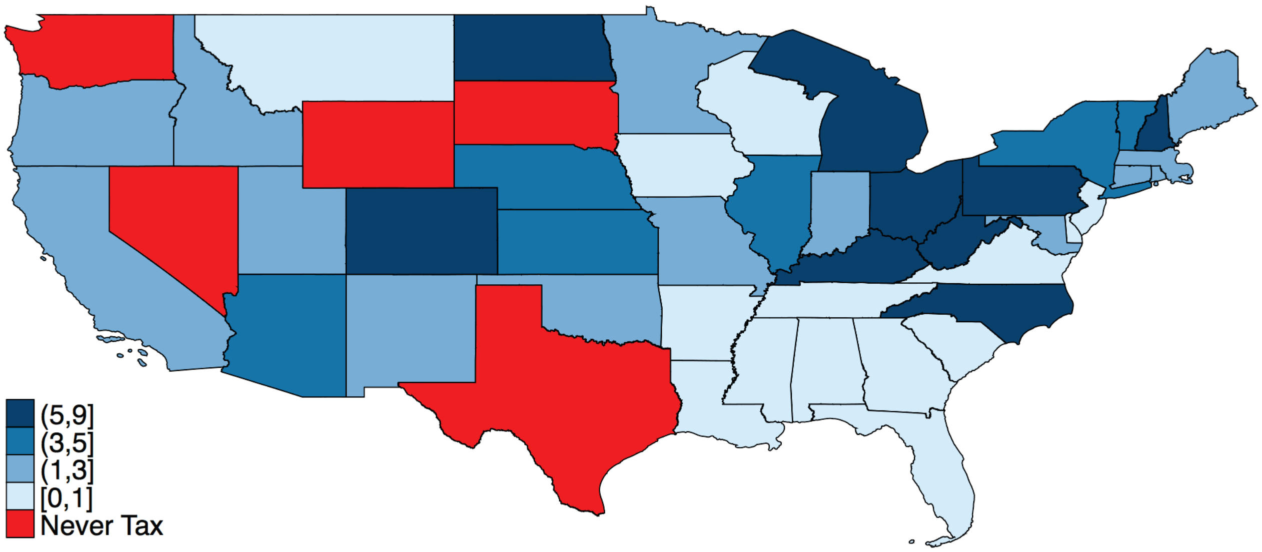
Figure 1: The Impact of a Corporate Tax Cut on Workers and Firm Owners



Notes: **A**. Monopolistically competitive establishments earn profits, which are divided into taxes and after-tax profits. **B**. Cutting corporate taxes has three effects on local establishments: a corporate tax cut reduces the establishment's (1) tax liability and (2) capital wedge mechanically. (3) Establishments enter the local area and bid up wages by $\dot{w}$ percent. **C**. Wage increases are determined in the local labor market as workers move in, house prices increase, each establishment hires fewer workers, and some marginal establishments leave. **D**. The cumulative percentage increase on profits $\dot{\pi}$ depends on the magnitude of wage increases. We derive the change in local labor demand, ε^{LS}, and ε^{LD} from microfoundations and express them in terms of a few estimable parameters in Section 1. Empirical estimates of these parameters, which govern the three effects above are provided in Tables A11 and 5 and discussed in Section 6. Note that these effects are enumerated to help provide intuition, but the formal model does not include dynamics. The model shows how the spatial equilibrium changes when states cut corporate taxes.

Figure 2: State Corporate Tax Rates

A. Number of Corporate Tax Changes by State since 1979



B. Corporate Tax Rates by State in 2012

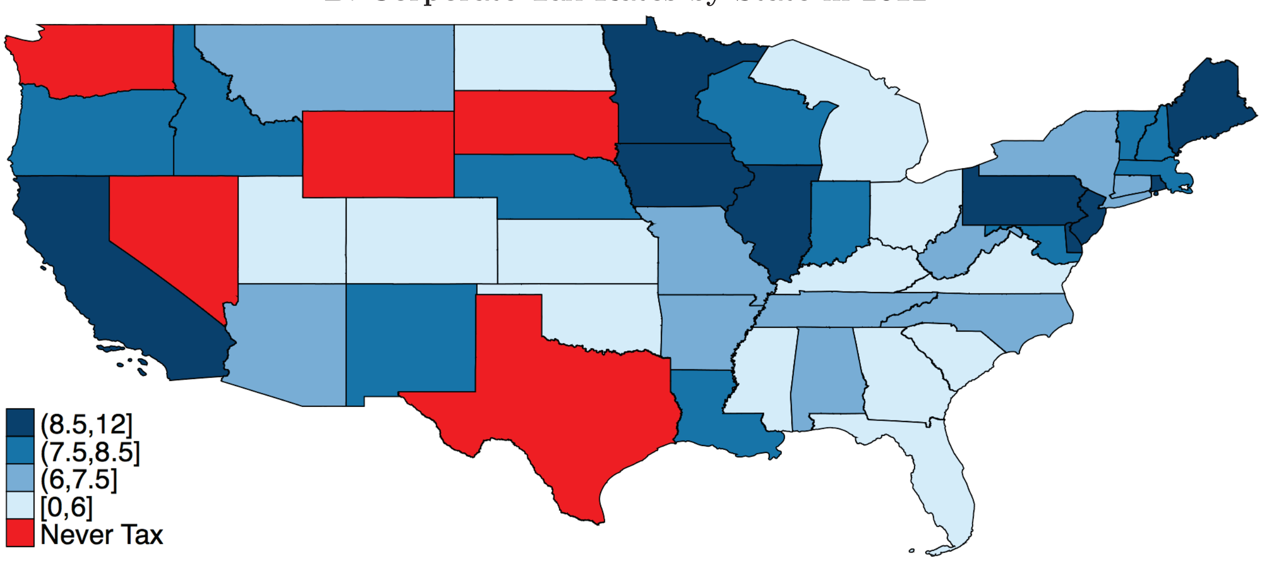
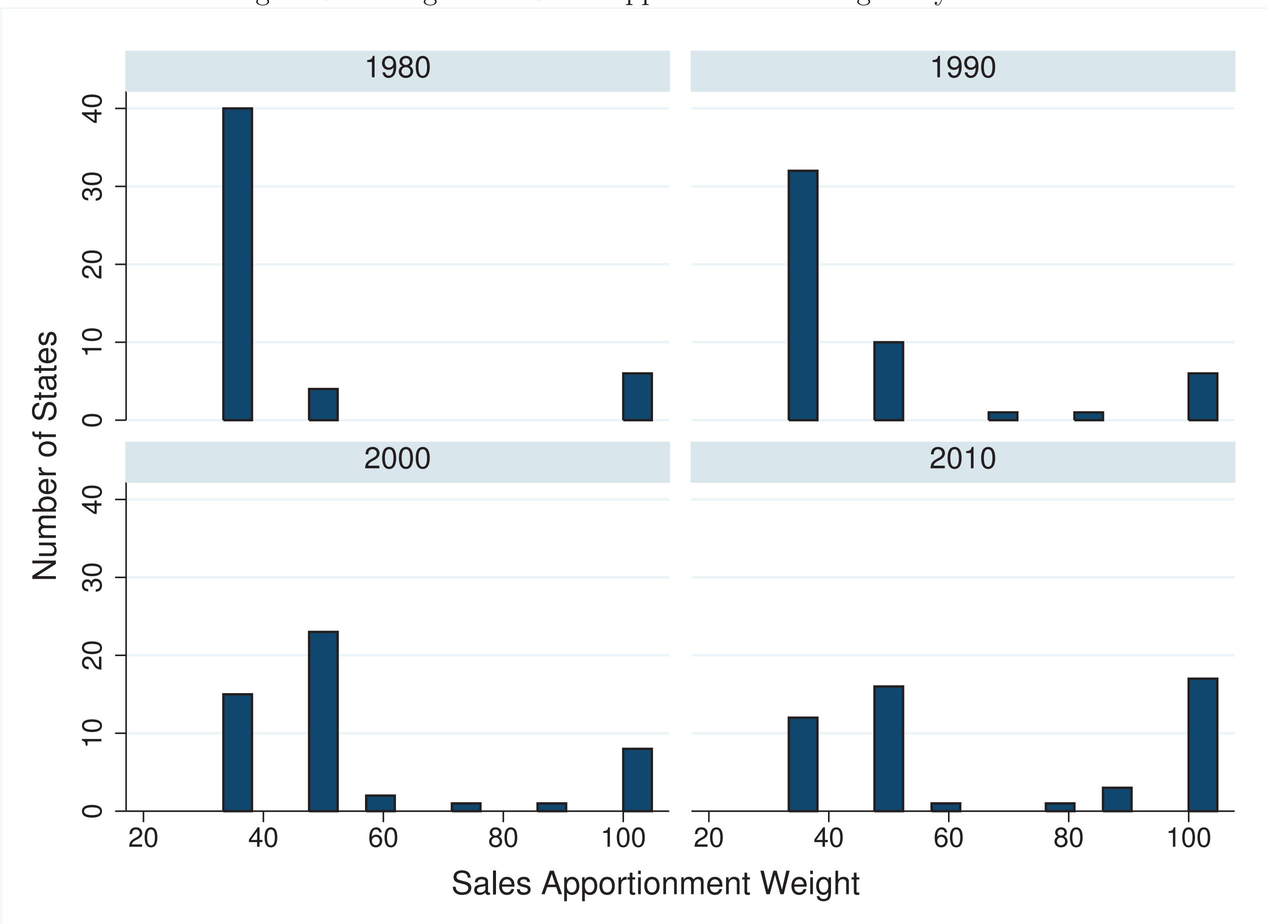
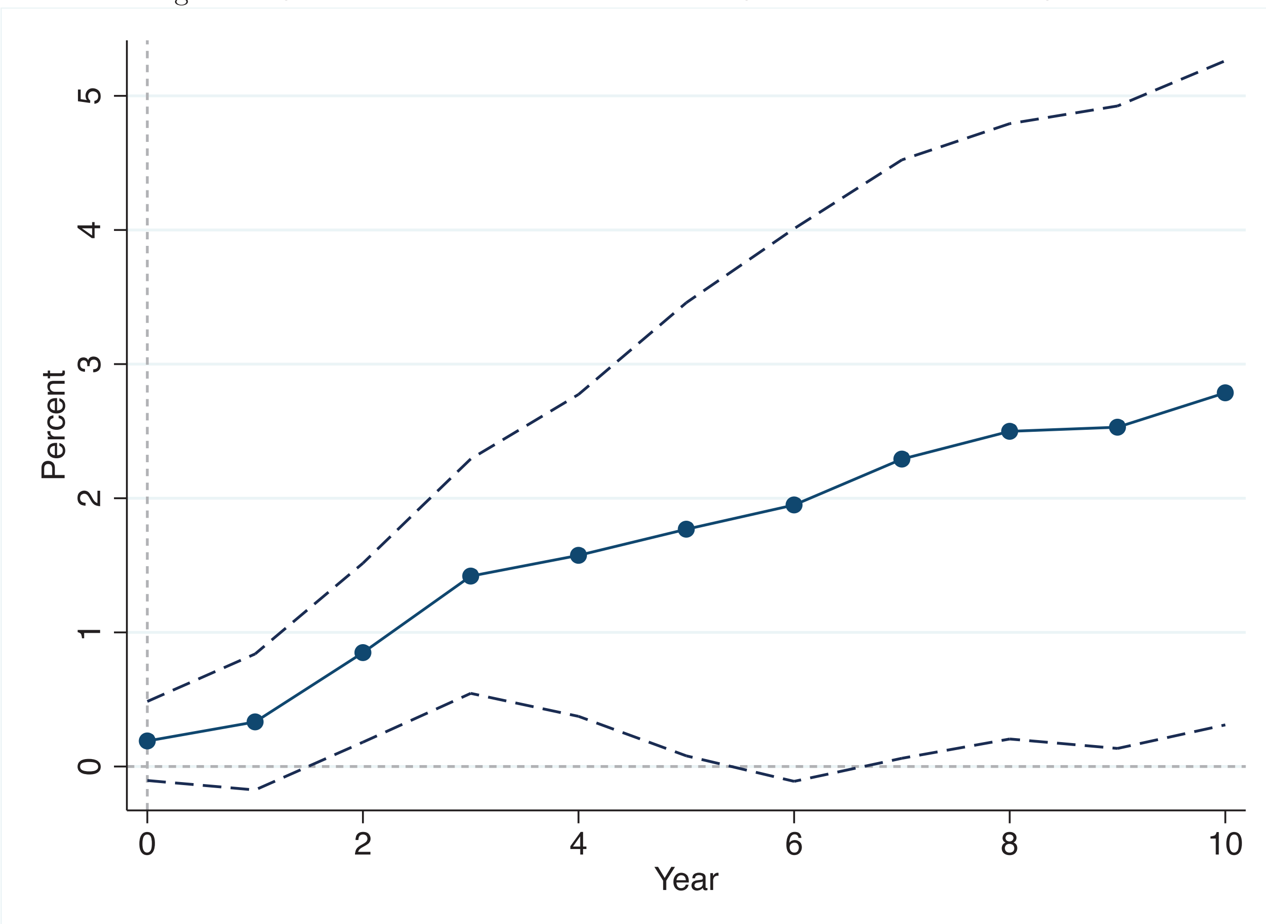


Figure 3: Histogram of Sales Apportionment Weights by Decade



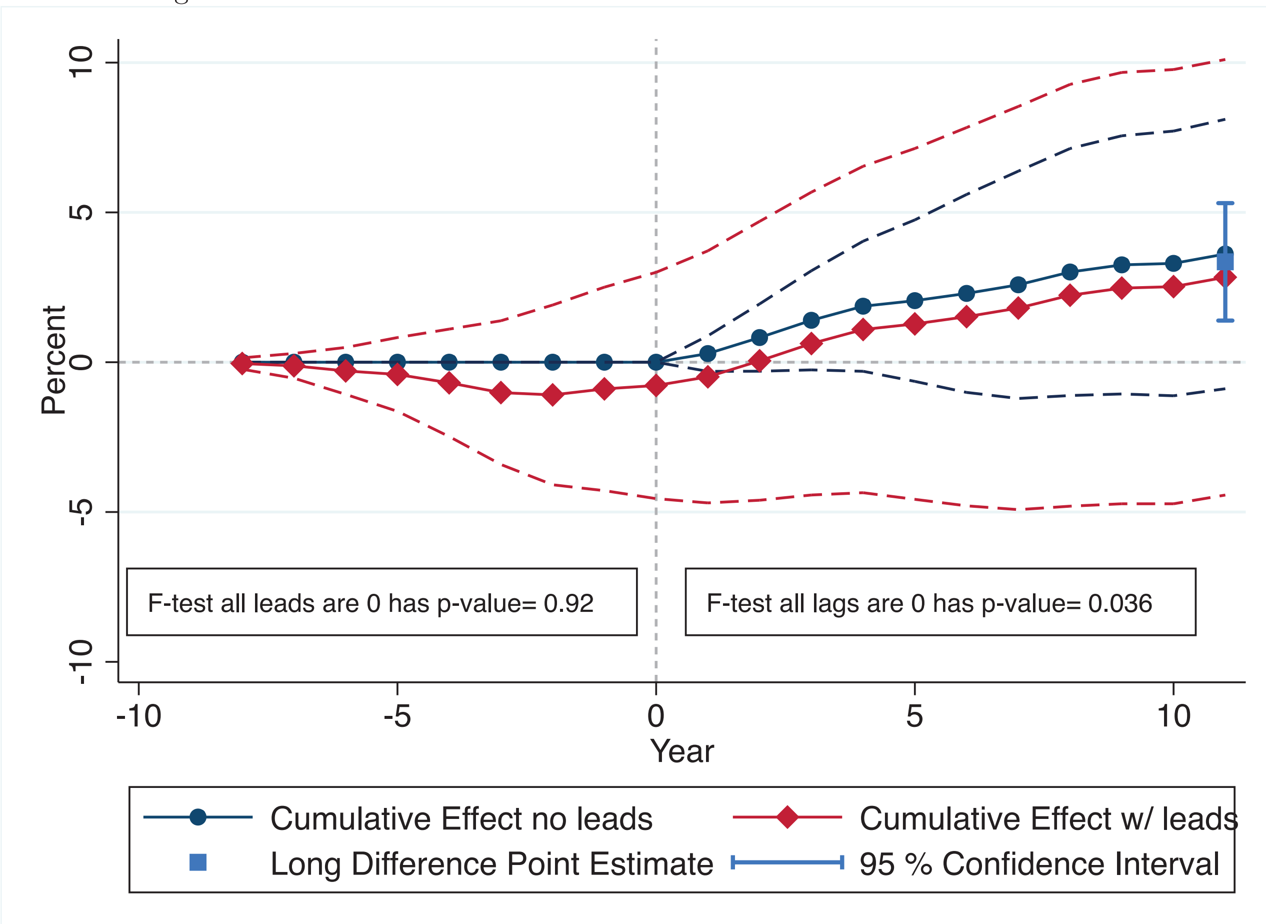
Notes: This figure shows a histogram of the weight on sales activity that states use to apportion the national profits of multi-state firms for tax purposes. Many states have increased their sales apportionment weights in recent decades. Forty states used a one-third weight in 1980. As of 2010, more states put half or full 100% weight on sales activity than the number that still uses the traditional one-third weight. See Section 4.2.1 for a description of state corporate tax apportionment rules.

Figure 4: Cumulative Effects of Business Tax Cuts on Establishment Growth



NOTES: This figure shows the cumulative annual effects of local business tax cuts on local establishment growth over different time horizons. It plots the sum of the point estimates in Col (4) of Table A2 and 90% confidence interval for each time horizon. For example, the cumulative effect for year 4 corresponds to the following sum of point estimates: $\hat{\beta}_0 + \hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3 + \hat{\beta}_4$. See Section 4 for data sources, Section 5 for estimation details, Figure 5 for a version of this figure that shows the cumulative effects including pre-trends.

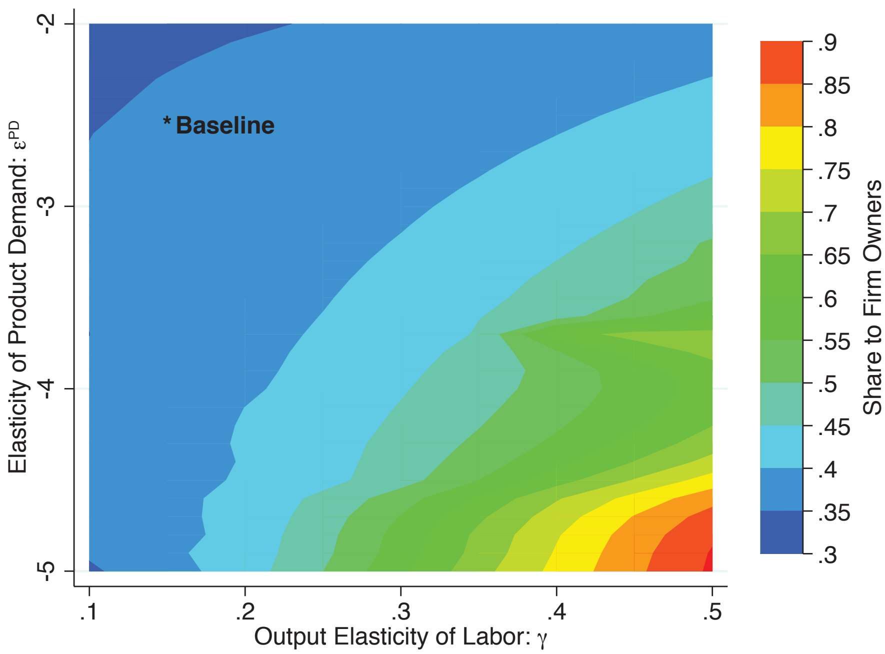
Figure 5: Cumulative Effects of Business Tax Cuts on Establishment Growth



Notes: This figure shows the cumulative annual effects of local business tax cuts on local establishment growth over different time horizons with pre-trends. It plots the sum of the point estimates in Col (7) of Table A2 and 90% confidence interval for each time horizon starting with the greatest lead. In addition, it reports the p-values for the F-test that all leads and lags are jointly equal to zero, which is also reported in Col 7 of Table A2. The square shows the point estimate and 95% confidence interval for the long-run effect of a one percent businesses tax cut on establishment growth, which corresponds to the estimate reported in Col 4 of Table 3. See Section 4 for data sources and Section 5 for estimation details.

Figure 6: Robustness of Economic Incidence

Firm Owner's Share of Incidence for Calibrated Values of γ and ε^{PD}



Notes: This figure shows that our baseline empirical result – that firm owners bear a substantial share of incidence – is robust to using a wide range of calibrated parameter values. The figure plots firm owner incidence shares for a variety of parameter values and illustrates that our baseline parameters values of $\gamma = 0.15$ and $\varepsilon^{PD} = -2.5$ give a conservative share of the incidence to firm owners. Using calibrations with more elastic product demand elasticities, while holding the output elasticity of labor constant at $\gamma = 0.15$, does not change the result that the share to firm owners ranges between 35 and 40%. Increasing the calibrated output elasticity of labor generally increases the share accruing to firm owners. Overall, larger product demand elasticities ε^{PD} and/or larger output elasticities of labor γ result in larger burdens on firm owners. See Section 3 for more detail.

Appendices for Online Publication

A Data

A.1 Composition-Adjusted Outcomes

This appendix describes in detail the construction of the skill-specific, county group outcomes using micro-data from the IPUMS samples of the 1980, 1990, and 2000 Censuses and the 2009 American Community Survey (Ruggles et al. (2010)). The data created using this process was first used in Suárez Serrato and Wingender (2011) and this data appendix is a reproduction of an identical appendix in that paper. Our sample is restricted to adults between the ages of 18 and 64 that are not institutionalized and that are not in the farm sector. We define an individual as skilled if they have a college degree.[70]

A number of observations in the data have imputed values. We remove these values from the following variables: employment status, weeks worked, hours worked, earnings, income, employment status, rent, home value, number of rooms, number of bedrooms, and building age. Top-coded values for earnings, total income, rents, and home values are multiplied by 1.5. Since the 2009 ACS does not include a variable with continuous weeks worked, we recode the binned variable for 2009 with the middle of each bin's range.

Our measure of individual wages is computed by dividing earnings income by the estimate of total hours worked in a year given by multiplying of average hours worked and average weeks worked. Aggregate levels of income, earnings, employment, and population at the county group level are computed using person survey weights. Average values of log-wages are also computed using person survey weights while log-rents and log-housing values are computed using housing unit survey weights and restricting to the head of the household to avoid double-counting. We create composition-adjusted values of mean wages, rents, and housing values in order to adjust for changes in the characteristics of the population of a given county group. First, we de-mean the outcomes and the personal and household characteristics relative to the whole sample to create a constant reference group across states and years. We then estimate the coefficients of the following linear regression model

$$\dot{y}_{ctsi} = \dot{X}_{ctsi}\Gamma^{s,\tau} + \nu_c + \mu_{c,\tau} + \varepsilon_{ctsi},$$

where $\dot{y}_{ctsi}$ is observations i's de-meaned log-price in county group c, year t and state group s. $\dot{X}_{ctsi}$ is observations i's de-meaned characteristics, ν_c is a county group fixed effect, and $\mu_{c,\tau}$ is a county group-year fixed effect. Allowing $\Gamma^{s,\tau}$ to vary by state and year allows for heterogeneous impacts of individual characteristics on outcomes.

We run this regression for every state group and for years $\tau = 1990, 2000$, and 2010.[71] For each regression we include observations for years $t = \tau, \tau - 10$ so that the county group-year fixed effect corresponds to the average change in the price of interest for the reference population. Our analysis of adjusted prices uses the set of fixed effects $\{\mu_{c,t}\}$ as outcome variables.

The regressions on wage outcomes use individual survey weights while the regressions on housing outcomes use housing survey weights and restrict to the head of the household. The wage regressions

[70] For the 1980 Census there is no college degree code. We code those with less than 4 years of college education as not having a college degree. This corresponds to detailed education codes less than 100.

[71] As a technical note, before every regression was computed, an algorithm checked that no variables would be automatically excluded by the software program in order to avoid problems with cross-equation comparisons.

include the following covariates: a quartic in age and dummies for hispanic, black, other race, female, married, veteran, currently in school, some college, college graduate, and graduate degree status. The housing regressions included the following covariates: a quadratic in number of rooms, a quadratic in the number of bedrooms, an interaction between number of rooms and number of bedroom, a dummy for building age (every 10 years), interactions of the number of room with building age dummies, and interactions of the number of bedroom with building age dummies.

A.2 Tax Data

A.2.1 Apportionment Details

The tax liability for unitary businesses[72] in state s of firm i is comprised of three parts: taxes due on apportioned national profit based on sales activity, payroll activity, and property activity in state s:

$$\text{State Tax Liability}_{is} = \underbrace{(\tau_s^c \theta_s^x a_{is}^x)\Pi_i^p}_{\text{Tax from Sales Activity}} + \underbrace{(\tau_s^c \theta_s^w a_{is}^w)\Pi_i^p}_{\text{Tax from Payroll Activity}} + \underbrace{(\tau_s^c \theta_s^\rho a_{is}^\rho)\Pi_i^p}_{\text{Tax from Property Activity}}.$$

where τ_s^c is the corporate tax rate in state s, $0 \leq \theta_s^x \leq 1$ is the sales apportionment weight in state s, $a_{is}^x \equiv \frac{S_{is}}{S_i}$ is the share of the firm's total sales activity that occurs in state s, and Π^p is total pretax profits for the entire firm across all of it's establishments in the U.S. Payroll and property activity in state s are defined similarly and the weights sum to one for each state, i.e., $\theta_s^x + \theta_s^p + \theta_s^\rho = 1 \ \forall s$. Summing tax liabilities across states results in the following firm-specific "apportioned" tax rate:

$$\tau_i^A = \sum_s \left((\tau_s^c \theta_s^x a_{is}^x) + (\tau_s^c \theta_s^w a_{is}^w) + (\tau_s^c \theta_s^\rho a_{is}^\rho)\right) \tag{23}$$

where τ_i^A is the firm-specific tax rate for all of it's establishments across the U.S. This expression shows that the effective tax rate of a given establishment depends on (1) apportionment weights θ_s in every state, (2) the corporate rate τ_s^c in every state, and (3) the distribution of it's payroll, property, and sales activity across states: a_{is}^w,a_{is}^ρ and a_{is}^x, respectively, for all s. Finally, note that while the activity weights of payroll and capital are source-based (i.e. where goods are produced), the activity weights of revenue are destination-based (i.e., where goods are consumed). This distinction has important efficiency implications, which we discuss in Section 7.

To ensure that a decrease in tax rates can be interpreted as an in increase in the attractiveness of any given location, we decompose τ_i^A into three components: one that depends on own-state "domestic" tax rates and rules, an "external" component that depends on the statutory rates and rules in other states, and a sales component.

$$\underbrace{\tau_i^A}_{\text{Apportioned Rate}} = \underbrace{(\tau_s^c \theta_s^w a_{is}^w) + (\tau_s^c \theta_s^\rho a_{is}^\rho)}_{\text{Domestic Component}} + \underbrace{\sum_{s' \neq s} (\tau_{s'}^c \theta_{s'}^w a_{is'}^w) + (\tau_{s'}^c \theta_{s'}^\rho a_{is'}^\rho)}_{\text{External Component}} + \underbrace{\sum_s (\tau_s^c \theta_s^x a_{is}^x)}_{\text{Sales Component}}$$

We then define the domestic tax rate that excludes the external component of tax changes, i.e. $\tau_i^D \equiv (\tau_s^c \theta_s^w a_{is}^w) + (\tau_s^c \theta_s^\rho a_{is}^\rho) + \sum_s (\tau_s^c \theta_s^x a_{is}^x)$, and the external rate as the difference between the apportionment rate and the domestic rate: $\tau_i^E \equiv \tau_i^A - \tau_i^D$.

[72] Unitary businesses are businesses with close connections between units in separate states. If an orange grove in Florida and steel plant in Pennsylvania were owned by the same firm, these businesses would be considered separate and profits would be taxed separately.

A.2.2 Additional Tax Data Sources

In addition to the sources listed in the main text, we also rely on data collected by the authors of the following papers: Seegert (2012) , Bernthal et al. (2012), and Chirinko and Wilson (2008). In particular, Seegert (2012) generously shared data on corporate tax rates and Bernthal et al. (2012) provided data on apportionment formulae. In both cases we cross-checked our newly digitized data with those used by these authors. Chirinko and Wilson (2008) provided us with data on investment tax credits to analyze the concomitance of changes in corporate tax rates and the corporate tax base.

A.2.3 Personal Income Tax Rate Data

To calculate state personal income tax changes, we use the NBER Tax Simulator TAXSIM, which calculates individual tax liabilities for every annual tax schedule and stores a large sample of actual tax returns. Similar to Zidar (2014), we construct a measure of synthetic tax changes by comparing each individual's income tax liabilities in the year preceding a tax change to what their tax liabilities would have been if the new tax schedule had been applied, while holding other tax-relevant factors such as income and deductions constant. For example, suppose there was a state tax change in 1993. This measure subtracts how much a taxpayer paid in 1992 from how much she would have paid in 1992 if the 1993 tax schedule had been in place. We then use these measures to calculate effective state personal income tax changes. This process has the benefit that it mechanically ignores the effects of taxes on economic behavior, which might be related to unobservable factors driving our outcomes of interest. Before using these data in our empirical work in Section 5, we first crosscheck these simulated changes with actual statutory changes to top and bottom marginal rates for each state to ensure that the variation we observe is actually driven by statutory changes. Note that when calculating tax liabilities, TAXSIM takes into account each individual's deductions and credits and their specific implications for state personal income tax liabilities. See Zidar (2014) for more detail on the construction of this measure of income tax changes.

An important limitation of this approach relates to our inability to assign personal tax rate of non C-corps to the residence of owners, which could be different than the state in which the firm operates. For instance, if investors from Florida own all of the non C-corps in New York, we will mistakenly use the personal tax rate in New York rather than Florida for these firms. To address this concern, we provide a wide range of results using different tax measures for our main incidence table.

A.2.4 Other Data Sources for Appendix Tables

In addition to the sources referenced in the notes of Table 4, we also use a few other data sources for control variables for Appendix Table A7, Appendix Table A8, and Appendix Table A9. Data on the political party of state Governors and sales tax rates was hand collected from annual editions of the Book of the States. The tax rule specification includes dummies for states with combined reporting rules as well as dummies for states with so called throwback rules based on the panel provided by Bernthal et al. (2012). Corporate tax revenue measures are from the U.S. Census Bureau's Government Division: Database on Historical State Tax Collections.

B Model Details

B.1 Establishment Problem with Apportionment

In a given location c, establishments maximize profits over inputs and prices p_{ijc} while facing a local wage w_c, national rental rates ρ, national prices p_v of each variety v, local corporate taxes τ_s^c, and local apportionment weights θ_s subject to the production technology in Equation 3:

$$\pi_{ijc} = \max_{l_{ijc}, k_{ijk}, x_{v,ijc}, p_{ijc}} (1-\tau_i^A)\left(p_{ijc}y_{ijc} - w_c l_{ijc} - \int\limits_{v\in J} p_v x_{v,ijc} dv\right) - \rho k_{ijc} - (\tau_i^A - \tau_{i/j}^A)\Pi_{i/j}^p \quad (24)$$

where $\tau_i^A = \left(\sum_{s'}\left((\tau_{s'}^c\theta_{s'}^x a_{is'}^x) + (\tau_{s'}^c\theta_{s'}^w a_{is'}^w) + (\tau_{s'}^c\theta_{s'}^\rho a_{is'}^\rho)\right)\right)$ is the effective "apportioned" corporate tax rate with activity weights for sales a_{is}^x, payroll a_{is}^w, and property a_{is}^ρ, where $a_{is}^w \equiv \frac{w_c l_{ijc}}{W_i}$ is the local share of national payroll, W_i, for firm i.[73] Sales and property activity weights are defined similarly.[74] In addition, $\tau_{i/j}^A$ and $\Pi_{i/j}^p$ are the effective apportioned corporate tax rate and pre-tax profit respectively for firm i without any production from establishment j.

State tax laws, which apportion *firm* profits based on *firm* activity to determine tax liabilities, have two important effects on establishments. First, the effective apportioned corporate tax rate τ^A of an establishment operating in location c can be quite different than τ_c^c, the statutory state corporate rate, due to apportionment and activity weights. Second, increasing production at a given establishment affects the *firm*'s tax liability by the product of the change in the firm's effective apportioned tax rate (due to establishment production) and the firm's pretax profits: $(\tau_i^A - \tau_{i/j}^A)\Pi_{i/j}^p$. Thus, including this additional term incorporates the ultimate effects on firm i's profitability due to the location and production decisions at establishment j.

One can show that demand takes the following form:[75]

$$y_{ijc} = I\left(\frac{p_{ijc}}{P}\right)^{\varepsilon^{PD}}$$

where I is the sum of national real income not spent on housing and intermediate good demand from establishments and P is the price level, which was normalized to 1 in the prior section.Using this demand expression to substitute for price gives the following expression for establishment j's economic profits.

$$\pi_{ijc} = (1-\tau_i^A)\left(y_{ijc}^{\frac{1}{\mu}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} - w_c l_{ijc} - \int\limits_{v\in J} p_v x_{v,ijc} dv\right) - \rho k_{ijc} - (\tau_i^A - \tau_{i/j}^A)\Pi_{i/j}^p$$

where the markup $\mu \equiv \left[\frac{1}{\varepsilon^{PD}} + 1\right]^{-1}$ is constant due to CES demand.

Firms maximize this establishment profit function and set the optimal choices of labor, capital, and intermediate inputs. These, in turn, determine the scale in production in each establishment. However, as first noted McLure Jr. (1977), the effective tax rate faced by a given firm is affected by

[73] Given the typical structure of state corporate tax schedules, one can think of τ_i^A as both the marginal and average tax rate of establishments owned by firm i.

[74] For apportionment purposes, property is measured as the sum of land and capital expenditures.

[75] See the appendix of Basu (1995) for a derivation where I is analogous to the sum of intermediate goods and final goods in Equation (A6) of his paper.

changes in the geographical distribution of payroll and capital.[76] Thus, when firms optimize this profit function, they take this effect into consideration thus creating a wedge between the marginal product of factors and their respective marginal costs. These wedges are evident in the firm's first-order conditions for labor and capital: [77]

$$\frac{y_{ijc}^{\frac{1}{\mu}}}{\mu}\frac{\gamma}{l_{ijc}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} = \underbrace{w_c \left(\frac{1 - \tau_i^A + \frac{\Pi_i^p}{W_i}\left[\tau_s^c \theta_{is}^w - \sum_{s'} a_{is'}^w \tau_{s'}^c \theta_{is'}^w\right]}{1 - \tau_i^A} \right)}_{\equiv \tilde{w}_c} \tag{25}$$

$$\frac{y_{ijc}^{\frac{1}{\mu}}}{\mu}\frac{\delta}{k_{ijc}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} = \underbrace{\rho \left(\frac{1 + \frac{\Pi_i^p}{R_i}\left[\tau_s^c \theta_{is}^\rho - \sum_{s'} a_{is'}^\rho \tau_{s'}^c \theta_{is'}^\rho\right]}{1 - \tau_i^A} \right)}_{\equiv \tilde{\rho}_c} \tag{26}$$

We denote the effective wage and capital rental rates $\tilde{w}_c$ and $\tilde{\rho}_c$ respectively. Note that capital owners supply capital perfectly elastically at the national rate, so local capital wedges result in lower levels of local capital.[78] These conditions and the input demand for the bundle of intermediate goods yield an expression for firm revenues and costs that takes the form:[79]

$$y_{ijc}^{\frac{1}{\mu}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} = y_{ijc}\mu \underbrace{\frac{1}{B_{ijc}}\left[\tilde{w}^\gamma \tilde{\rho}^\delta \gamma^{-\gamma}\delta^{-\delta}(1-\gamma-\delta)^{-(1-\gamma-\delta)}\right]}_{\equiv c_{ijc}} \tag{27}$$

This equation shows that revenues are a markup μ over costs, i.e. $p_{ijc}y_{ijc} = \mu y_{ijc}c_{ijc}$, indicating that prices are a markup over marginal costs c_{ijc}.

B.2 Deriving the Profit Expression

Taking a ratios of the first order conditions (Equation 25 and 26) and the analogous expression for the intermediate good bundle yields an expression for the capital to labor and intermediate good to labor ratios:

$$\frac{k_{ijc}}{l_{ijc}} = \frac{\tilde{w}_c}{\tilde{\rho}_c}\frac{\delta}{\gamma} \qquad \frac{M_{ijc}}{l_{ijc}} = \frac{\tilde{w}_c}{1}\frac{1-\gamma-\delta}{\gamma}$$

[76] McLure Jr. (1977) assumed that the corporate rate of all other states was zero, so the term in brackets simplifies to a simpler factor wedge, e.g. $\tau_s^c \theta_{is}^w(1 - a_{is}^w)$.

[77] Note the following auxiliary derivative $\frac{\partial \tau_i^A}{\partial l_{ijc}} = \frac{\tau_s^c \theta_{is}^w}{W_i} w_c - \sum_{s'} \frac{\tau_{s'}^c \theta_{is'}^w W_{is'}}{W_i^2} w_c = \frac{w_c}{W_i}\left[\tau_s^c \theta_{is}^w - \sum_{s'} a_{is'}^w \tau_{s'}^c \theta_{is'}^w\right]$ where the second equality exploits the assumption that all of a firms activity in a given state is done by one establishment.

[78] Given the setup of the establishment problem, we effectively abstract from consequences of state corporate tax changes on capital structure choices. See Heider and Ljungqvist (2014) for such an analysis.

[79] See Appendix B.2 for the derivation. Note that the price of the intermediate good bundle is 1.

Plugging these expressions into the production function yields expressions for input demand:

$$y_{ijc} = B_{ijc} l_{ijc}^{\gamma} k_{ijc}^{\delta} \left(\frac{\tilde{w}_c}{1} \frac{1-\gamma-\delta}{\gamma} l_{ijc} \right)^{1-\gamma-\delta} \Rightarrow l_{ijc} = \frac{y_{ijc}}{B_{ijc}} \left[\tilde{w}_c^{\gamma-1} (\tilde{\rho}_c)^{\delta} \gamma^{1-\gamma} \delta^{-\delta} (1-\gamma-\delta)^{-(1-\gamma-\delta)} \right]$$

$$\Rightarrow k_{ijc} = \frac{y_{ijc}}{B_{ijc}} \left[\tilde{w}_c^{\gamma} (\tilde{\rho}_c)^{\delta-1} \gamma^{-\gamma} \delta^{1-\delta} (1-\gamma-\delta)^{-(1-\gamma-\delta)} \right]$$

$$\Rightarrow M_{ijc} = \frac{y_{ijc}}{B_{ijc}} \left[\tilde{w}^{\gamma} (\tilde{\rho}_c)^{\delta} \gamma^{-\gamma} \delta^{-\delta} (1-\gamma-\delta)^{(\gamma+\delta)} \right]$$

Substituting the expression for labor into Equation 25 and rearranging terms yields the markup expression in Equation 27. With these expressions for establishment factor demand, we can now derive the expression for profits in Equation 5.

B.2.1 Profits

Begin with the following expression for profits in terms of factors:

$$\pi_{ijc} = (1-\tau_i^A) \left(p_{ijc} y_{ijc} - w_c l_{ijc} - \int_{v \in J} p_v x_{v,ijc} dv \right) - \rho k_{ijc} - (\tau_i^A - \tau_{i/j}^A) \Pi_{i/j}^p$$

In terms of after wedge wages and interest rates, we can use the capital to labor ratio, the intermediate good to labor ratio, and the implication of Equation 27 that price is a markup over marginal costs to express profits as follows:

$$\pi_{ijc} = (1-\tau_i^A) \tilde{w}_c l_{ijc} \left[\frac{\mu}{\gamma} - \frac{1}{\omega_w} - \frac{1-\gamma-\delta}{\gamma} - \frac{(1-\tau_i^A)}{\omega_\rho} \frac{\delta}{\gamma} \right] - (\tau_i^A - \tau_{i/j}^A) \Pi_{i/j}^p$$

where $\omega_w \equiv \left(\frac{1-\tau_i^e + \frac{\Pi_i^p}{W_i} \left[\tau_s^c \theta_{is}^w - \sum_{s'} a_{is'}^w \tau_{s'}^c \theta_{is'}^w \right]}{1-\tau_i^A} \right)$, and $\omega_\rho \equiv \left(\frac{1 + \frac{\Pi_i^p}{R_i} \left[\tau_s^c \theta_{is}^r - \sum_{s'} a_{is'}^\rho \tau_{s'}^c \theta_{is'}^\rho \right]}{1-\tau_i^e} \right)$. Substituting for labor and using the definition of product demand yields:

$$\pi_{ijc} = (1-\tau_i^A) I \mu^{\varepsilon^{PD}} c_{ijc}^{\varepsilon^{PD}+1} \left[\mu - \frac{\gamma}{\omega_w} - \frac{1-\gamma-\delta}{1} - \frac{(1-\tau_i^A)\delta}{\omega_\rho} \right] - (\tau_i^A - \tau_{i/j}^A) \Pi_{i/j}^p$$

Notice that in the standard case in which there are no apportionment wedges, the term in brackets would be $\mu - 1$, indicating that profits are a mark up over costs where $\mu \geq 1$. Substituting for c_{ijc}, we can express profits as a function of local factor prices, local productivity, and taxes.

$$\pi_{ijc} = (1-\tau_i^A) \tilde{w}_c^{\gamma(\varepsilon^{PD}+1)} \tilde{\rho}_c^{\delta(\varepsilon^{PD}+1)} B_c^{-(\varepsilon^{PD}+1)} \tilde{\mu}_{ic} \kappa - (\tau_i^A - \tau_{i/j}^A) \Pi_{i/j}^p \tag{28}$$

where $\tilde{\mu}_{ic}$ is an apportionment adjusted mark-up term and κ is a constant term across locations.[80]

Equation 28 shows that apportionment creates an externality between the after-tax profits within multi-state firms. In practice, this tax shifting term is empirically small relative to the other components of establishment profitability. The intuition for this result is that the potential change in the firm's apportionment tax rates $(\tau_i^A - \tau_{i/j}^A)$ is small and declines at a rate faster than the impact of increasing establishment on profits. Appendix B.2.2 quantifies this argument explicitly.

[80] $\kappa \equiv I \mu^{\varepsilon^{PD}} \left(\gamma^{-\gamma} \delta^{-\delta} (1-\gamma-\delta)^{-(1-\gamma-\delta)} \right)^{\varepsilon^{PD}+1}$ and $\tilde{\mu}_{ic} \equiv \left[\mu - \frac{\gamma}{\omega_w} - \frac{1-\gamma-\delta}{1} - \frac{(1-\tau_i^A)\delta}{\omega_\rho} \right]$.

B.2.2 Quantifying the Tax Shifting Term

In this section, we show that log profits can be closely approximated by $\ln \pi_{ijc} = \ln(1-\tau_i^A) + \gamma(\varepsilon^{PD}+1)\ln\tilde{w} + (1-\gamma)(\varepsilon^{PD}+1)\ln\tilde{\rho} - (\varepsilon^{PD}+1)\ln B + \tilde{\mu}_{ic} + \ln\kappa$. To illustrate this point, let $\bar{\pi}$ be the average profit of the existing N establishments and assume that the establishments in all states are of the same size. In this case, we can write the change in firm profits from opening the new establishment as:

$$\pi = (1-\tau^A)\bar{\pi} - \phi N\bar{\pi}(\tau^A - \tau_0^A)$$

where ϕ is a factor of relative profitability of the old establishments and τ_0^A is the pre-existing effective corporate tax rate. It then follows that the share of new establishment profits as a fraction of the total change in profit is given by:

$$\frac{1-\tau^A}{1-\tau^A-\phi N(\tau^A-\tau_0^A)}$$

From this equation we observe that the fraction is close to 1 when the change in taxes is small, i.e., $(\tau^A - \tau_0^A) \approx 0$ and is decreasing in the size of the firm N. Note that $(\tau^A - \tau_0^A) \approx (\frac{1}{N+1} - \frac{1}{N})$. Related to a point raised by Bradford (1978), one may be concerned that small activity weight changes are associated with large profits, i.e. $N\bar{\pi}$, so the product of activity weight changes and profits may still be large. However, the product is small in this setting. To see this, note that the product of the change in activity weights and profits is roughly:

$$\underbrace{(\frac{1}{N+1} - \frac{1}{N})}_{\text{Activity weight change}} \underbrace{\phi N\bar{\pi}}_{\text{profits}}$$

As $N \to \infty$, this product goes to zero regardless of the size of $\phi\bar{\pi}$. Since most employment in the U.S. happens at firms that are located in more that 10 states, we believe that ignoring the tax shifting part of the firm's decision problem does not significantly bias our estimates.

B.3 Local Labor Demand

$$L_c^D(w_c; Z_c, \tau_s^b) = \mathbb{E}_\zeta[n^*(\zeta_{ijc})|c = \underset{c'}{\operatorname{argmax}}\{V_{ijc'}\}]E_c$$

To determine local labor demand, we first solve for the intensive labor demand term.

B.3.1 Intensive Margin

$$l_{ijc} = \frac{y_{ijc}}{B_{ijc}}\left[\tilde{w}_c^{\gamma-1}(\tilde{\rho}_c)^\delta \gamma^{1-\gamma}\delta^{-\delta}(1-\gamma-\delta)^{-(1-\gamma-\delta)}\right]$$
$$l_{ijc} = B_{ijc}^{-(\epsilon^{PD}+1)}\tilde{w}_c^{(\gamma\epsilon^{PD}+\gamma-1)}\tilde{\rho}_c^{(1+\epsilon^{PD})\delta}\kappa_0$$

where $\kappa_0 = I\mu^{\epsilon^{PD}}\gamma^{-\gamma(\epsilon^{PD}+2)+1}\delta^{-\delta(\epsilon^{PD}+2)}(1-\gamma-\delta)^{-(1-\gamma-\delta)(\epsilon^{PD}+2)}$. Thus, we can express $\mathbb{E}_\zeta[l_{ijc}^*(\zeta_{ijc})|c = \underset{c'}{\operatorname{argmax}}\{V_{ijc'}\}]$ as follows:

$$\mathbb{E}_\zeta[n^*(\zeta_c^j)|c] = \tilde{w}_c^{(\gamma\epsilon^{PD}+\gamma-1)}\tilde{\rho}_c^{(1+\epsilon^{PD})\delta}\kappa_0\mathbb{E}_\zeta[B_{ijc}^{-(\epsilon^{PD}+1)}]$$

where $\mathbb{E}_\zeta[B_{ijc}^{-(\epsilon^{PD}+1)}] = \exp\left((-\epsilon^{PD}-1)\bar{B}_c\right)\underbrace{\mathbb{E}_\zeta[\exp\left((-\epsilon^{PD}-1)\zeta_{ijc}\right)|c]}_{\equiv z_c}$.

B.3.2 Growth in Local Labor Demand

We can now combine this intensive labor demand expression with the expression for aggregate location decisions to determine local labor demand.

$$L_c^D = \mathbb{E}_\zeta[l^*_{ijc}(\zeta_{ijc})|c = \underset{c'}{\text{argmax}}\{V_{ijc'}\}]E_c$$

Taking logs yields (log) labor demand:

$$\begin{aligned}\ln L_c^D = &\ln\left(\tilde{w}_c^{(\gamma\epsilon^{PD}+\gamma-1)}\tilde{\rho}_c^{(1+\epsilon^{PD})\delta}\kappa_0\text{exp}\left(\bar{B}_c(-\epsilon^{PD}-1)\right)z_c\right)+\\ &+\frac{\bar{B}_c}{\sigma^F}-\frac{\gamma}{\sigma^F}\ln\tilde{w}_c-\frac{\delta}{\sigma^F}\ln\tilde{\rho}_c-\frac{\ln\tilde{\mu}_{ic}}{(\varepsilon^{PD}+1)\sigma^F}-\frac{\ln(1-\bar{\tau}^A_{is})}{(\varepsilon^{PD}+1)\sigma^F}-\ln(C)-\ln(\bar{\pi})\end{aligned}$$

Simplifying this expression yields the (log) local labor demand curve.[81]

$$\begin{aligned}\ln L_c^D = &\kappa_2-\frac{\ln(1-\tau_c^b)}{(\varepsilon^{PD}+1)\sigma^F}-\ln\bar{\pi}+\left(\gamma(\epsilon^{PD}+1-\frac{1}{\sigma^F})-1\right)\ln\tilde{w}_c-\frac{\ln\tilde{\mu}_{ic}}{(\varepsilon^{PD}+1)\sigma^F}\\ &+\left(\delta(\epsilon^{PD}+1-\frac{1}{\sigma^F})\right)\ln\tilde{\rho}_c+\left(-(\epsilon^{PD}+1)+(\frac{1}{\sigma^F})\right)\bar{B}_c+z_c\end{aligned} \tag{29}$$

where κ_2 is a common term across locations and $\bar{\pi}$ is a sufficient statistic for tax, factor price, and productivity changes in all other cities.[82]

B.4 Equilibrium and Incidence Expressions

Spatial equilibrium c depends market clearing in factor markets, housing markets, and output markets and can be expressed in terms of the expressions for log labor supply (Equation 1), the log of housing market clearing condition from Section 1.2, and log labor demand (Equation 29) as follows:

$$\begin{bmatrix}-\frac{\bar{A}_c}{\sigma^W}\\ -B_c^H\\ -\left(\ln\kappa_2-\frac{\ln(1-\tau_c^b)}{(\varepsilon^{PD}+1)\sigma^F}-\ln\bar{\pi}+\left(-(\epsilon^{PD}+1)+(\frac{1}{\sigma^F})\right)\bar{B}_c-\frac{\ln\tilde{\mu}_{ic}}{(\varepsilon^{PD}+1)\sigma^F}+z_c\right)\end{bmatrix}$$
$$=\begin{bmatrix}-1 & \frac{1}{\sigma^W} & -\frac{\alpha}{\sigma^W}\\ -1 & -1 & 1+\eta_c\\ -1 & \varepsilon^{LD} & 0\end{bmatrix}\times\begin{bmatrix}\ln N_c\\ \ln w_c\\ \ln r_c\end{bmatrix}$$

[81] In the model, we treat all establishments as C-corporations but some labor is demanded by other types of firms. We assume that C-corporations and non C-corporations are the same in all other dimensions and, for analytical tractability, that corporate status is fixed. As a result, we can replace the apportioned rate with the corporate form weighted average business tax rate that was introduced in Section 4.

[82] Note that $\bar{\pi}$ is a actually a C-corporation and non C-Corporation share weighted average of profits in all other cities. In addition, note that $\kappa_2 \equiv \ln\kappa_0\frac{\ln\kappa}{(\varepsilon^{PD}+1)\sigma^F}$.

The expressions for log population, wages, and rents can be derived using Cramer's rule yielding the following local corporate tax elasticities:

$$
\begin{aligned}
\frac{\partial \ln N}{\partial \ln(1-\tau^c)} &= \varepsilon^{LS} \frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}} \\
\frac{\partial \ln w_c}{\partial \ln(1-\tau^c)} &= \frac{-\frac{f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\left(\frac{1+\eta_c-\alpha}{\sigma^W(1+\eta_c)+\alpha}\right)-\varepsilon^{LD}} \\
\frac{\partial \ln r_c}{\partial \ln(1-\tau^c)} &= \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right) \frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}} \\
\frac{\partial \ln w_c}{\partial \ln(1-\tau^c)} - \alpha \frac{\partial \ln r_c}{\partial \ln(1-\tau^c)} &= \sigma^W \varepsilon^{LS} \frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}}
\end{aligned}
$$

where $\left(\frac{1+\eta-\alpha}{\sigma^W(1+\eta)+\alpha}\right) \equiv \varepsilon^{LS}$ is the effective labor supply elasticity.

C Incidence and Efficiency of Corporate Taxes

C.1 Global Welfare

The welfare effects derived in section 2.2 would provide sufficient information for a state politician who is interested in maximizing local welfare. Nonetheless, maximizing local objectives can affect the welfare of agents in other locations. We now characterize the effects on both local "domestic" agents and "foreign" agents using the framework in Kline (2010) and Kline and Moretti (2013) by allowing wages and rental costs in other locations to be affected by tax changes in any given state. We extend their framework to incorporate firm owners and define aggregate social welfare $\mathcal{W}$ as the sum of the expected welfare of workers, firm owners, and landowners.[83]

$$\mathcal{W} = \mathcal{V}^W + \mathcal{V}^F + \sum_c \mathcal{V}_c^L. \tag{30}$$

The effect of a corporate tax cut in location c on aggregate worker welfare is now:

$$\frac{d\mathcal{V}^W}{d\ln(1-\tau_c^c)} = \underbrace{N_c(\dot{w}_c - \alpha \dot{r}_c)}_{\text{Domestic Workers}} + \sum_{c' \neq c} \underbrace{N_{c'}(\dot{w}_{c'} - \alpha \dot{r}_{c'})}_{\text{Foreign Workers}}.$$

Similar to the logic of Moretti (2010), who analyzes the effects of a labor demand shock in the two city case, a corporate tax cut not only benefits local workers by increasing wages, but it also helps foreign workers via housing cost relief. These gains, however, can be offset to the extent that domestic workers have to pay higher rents and foreign workers earn lower wages.

The effect of a cut in corporate taxes on aggregate firm owner welfare can be written as:

$$\frac{d\mathcal{V}^F}{d\ln(1-\tau_c^c)} = E_c \dot{\pi}_c + \sum_{c' \neq c} E_{c'} \gamma(\varepsilon^{PD}+1) \frac{dw_{c'}^c}{d\ln(1-\tau_c^c)} \tag{31}$$

[83] For simplicity, we assume that there is a continuum of workers, establishments, and landowners of measure one. We use a utilitarian social welfare function that adds up log consumption terms, but one could easily incorporate more general social welfare weights as in Saez and Stantcheva (2013).

where E_c is the share of establishments in location c, $\dot{\pi}_c$ is the percentage change in after-tax profits in location c, γ is the output elasticity of labor, and ε^{PD} is the product demand elasticity. As in Bradford (1978), factor price changes affect all firm owners foreign and domestic. In particular, owners of domestic firms benefit from the mechanical decrease in tax liabilities and capital costs, but have to pay higher wages. Owners of foreign firms do not get the mechanical or capital cost changes, but they do gain from lower wage costs since fewer establishments bid up wages in their local labor markets.

Finally, landowner welfare changes by $\frac{\dot{N}_c+\dot{w}_c}{1+\eta_c}$ in each location. The aggregate of these effects may be positive or negative depending on the net flows of workers and establishments. Empirically estimating global incidence is beyond the scope of this paper (see Fajgelbaum et al. (2014) for such an analysis), yet these calculations illustrate the effects of spatial equilibrium forces on aggregate welfare when policies are set by maximizing local objectives.

C.2 Efficiency

The previous section detailed the effects of corporate tax changes on the welfare of workers, firm owners, and landlords. In this section, we turn to efficiency considerations by analyzing how state corporate taxes affect a social planner's problem.[84] The social planner maximizes global welfare $\mathcal{W} = \mathcal{V}^W + \mathcal{V}^F + \mathcal{V}^L$ over $\{\tau_c^c\}$ subject to a revenue requirement. The lagrangian takes the following form:

$$\mathcal{L} = \mathcal{W} - \lambda \left(\underbrace{\tau_c^c E_c \bar{\pi}_c^p + \sum_{c' \neq c} \tau_{c'}^c E_{c'} \bar{\pi}_{c'}^p}_{\text{Tax Revenue}} - \text{RR} \right) \tag{32}$$

where $\bar{\pi}_c^p$ is the average pretax profit of establishments in location c and RR is the government's revenue requirement.[85]

A consistent message from the previous section is that the effect of a corporate tax change on $\mathcal{W}$ does not depend on behavioral responses. However, behavioral responses have important budgetary consequences that reveal the economic distortions of corporate taxes.[86] There are two key effects of establishment behavior on the government's budget. The first effect is due to marginal establishments that changed locations as in Busso, Gregory and Kline (2013). These establishments are roughly as profitable as they would have been in their original location without the tax cut yet tax revenues from these firms decrease. Since the tax revenue required to pay for these cuts depends on how many establishments move, establishment mobility has direct implications for efficiency costs. It follows from Equation 7 that establishment mobility is decreasing in the dispersion of productivity σ^F. As a result, greater productivity dispersion lowers efficiency costs. Intuitively, if establishments are inframarginal due to location-specific productivity advantages, small changes in taxes will not induce

[84] This accounting has abstracted away from welfare benefits of government spending which could improve amenities or local productivity. See Suárez Serrato and Wingender (2011) for an analysis of the welfare effects of government spending changes.

[85] We evaluate these costs starting from point of symmetric statutory rates of zero in all locations for simplicity. In general, the initial distribution of tax rates impacts conclusions. For instance, suppose all states except CA had a 5% rate. If CA has a 6% rate, cutting corporate taxes there by one percent would not only increase production but also reduce distortions. However, if CA started at 4% and lowered rates to 3%, then production would increase but the cut would also exacerbate distortions since some establishments that would more productive elsewhere would move to CA.

[86] See Hendren (2013) for a discussion of the generality of this calculation.

establishments to move and will not require excessive payments to new establishments. Measuring this effects empirically requires estimates of the parameters of model.

The second effect on the budget is due to spatial distortions created by local corporate tax changes. Lower taxes induce some establishments to leave the locations where they would be most productive. As a consequence, scale of production, business revenues, tax collections, and aggregate welfare decline. In addition, greater dispersion in (non-sales apportioned) state corporate rates exacerbate these effects. Measuring these effect is more complicated as it requires measures of changes in profitability due to establishment relocation and is an important topic for future research.[87]

Although characterizing global efficiency is beyond the scope of this project, in Section 7 we characterize the impacts of behavioral responses on local budgets from the perspective of state politicians. Additionally, we derive states' revenue-maximizing tax rates and relate them to the efficiency costs of state corporate taxes.

D Revenue-Maximizing Corporate Tax Rate

In the next two sections, we briefly derive the revenue-maximizing corporate tax rate under two scenarios about the underlying policy-maker's objective. First, we consider the case when the the policy-maker's objective is to maximize corporate tax revenue while ignoring other tax collections. The second case assumes the policy-maker's objective is to maximize all forms of tax revenue. We show that, while the revenue-maximizing tax rate is inversely related to firm mobility, firm mobility on its own does not justify a low maximal tax rate. This conclusion, however, is weakened when the policy-maker's objective considers the effects of corporate tax changes on other revenue sources.

D.1 Maximal Tax Rate with No Other State Taxes

Local (corporate) tax revenue is given by

$$TaxRev_c = E_c \bar{\pi}_c \frac{\tau_c^c}{1-\tau_c^c}$$

Taking logs and differentiating with respect to $\ln(1-\tau_c^c)$ we have

$$\frac{d\ln TaxRev_c}{d\ln(1-\tau_c^c)} = \frac{d\ln E_c}{d\ln(1-\tau_c^c)} + \dot{\bar{\pi}}_c - 1 - \frac{1-\tau_c^c}{\tau_c^c}$$

Setting the expression above equal to zero and rearranging we have:

$$\tau_c^* = \frac{1}{\dot{\bar{\pi}}_c + \dot{E}_c}.$$

D.1.1 Maximal Tax Rate with Other State Taxes

Consider now the maximum tax rate for corporate income when the state also collects personal income.[88] Local tax revenue is given by

$$TotalTaxRev_c = E_c \bar{\pi}_c \frac{\tau_c^c}{1-\tau_c^c} + N_c w_c \tau_c^i$$

[87] In Cullen, Suárez Serrato and Zidar (2014) we explore how establishment relocation affects productivity as measured by patent activity and in Fajgelbaum et al. (2014) we quantify aggregate misallocation in productivity due to corporate state taxes.

[88] In this derivation we lump sales revenue and personal income tax revenue together. We also ignore the effects of corporate taxes on property tax revenue since states do not collect property taxes. However, there are interesting fiscal externalities on localities that do collect property taxes.

Following a derivation similar to that in the previous section we find a revenue-maximizing tax rate given by:

$$\tau_c^{**} = \frac{1}{\dot{\bar{\pi}}_c + \dot{E}_c + (\text{revshare}_c^{\text{pers}}/\text{revshare}_c^{C})(\dot{w}_c + \dot{N}_c)},$$

where $\text{revshare}_c^{\text{pers}}/\text{revshare}_c^{C}$ is the relative share of personal tax revenues and corporate tax revenues.

D.1.2 Calculating the Tax Elasticity of Establishment Location for States

This section describes the calculation of the elasticity of establishment location with respect to **state** corporate tax rates and explores two forms of heterogeneity that may affect this elasticity: size of location (in terms of market share of establishments) and the effects of apportionment across locations in a given state.

State Tax Revenue

In the simple case without apportionment effects, state corporate tax revenue is given by

$$TaxRev_s = E_s \bar{\pi}_s \frac{\tau_s^c}{1 - \tau_s^c}$$

where E_s is the share of national establishments in state s and $\frac{\bar{\pi}_s}{1-\tau_s^c}$ is average pre-tax profits. Taking logs and differentiating with respect to $\ln(1 - \tau_s^c)$ we have

$$\frac{d \ln TaxRev_s}{d \ln(1 - \tau_s^c)} = \frac{d \ln E_s}{d \ln(1 - \tau_s^c)} + \tilde{\pi}_s - 1 - \frac{1 - \tau_s^c}{\tau_s^c}$$

To derive the key component of the expression above – the state level location elasticity $\frac{d \ln E_s}{d \ln(1-\tau_s^c)}$ – first consider the elasticity with respect to changes at the local conspuma level.

Local Elasticity

Let $t_{c'}$ be effective corporate rate paid in location c' . Suppose that a policy can be enacted that changes only $t_{c'}$ but not other corporate tax rates in the same state. From standard logit formulae (see Train (2009), Chapter 3.6), the elasticity of establishment location for a given location c is given by:

$$\frac{d \log E_c}{d \log(1 - t_{c'})} = \begin{cases} \frac{1}{-\sigma^F(\varepsilon^{PD}+1)}(1 - E_c) & \text{if } c' = c \\ -\frac{1}{-\sigma^F(\varepsilon^{PD}+1)} E_c & \text{otherwise.} \end{cases}$$

As we show below, this is not the same exercise as changing the state corporate tax rate. The reason is that the change in the state rate affects the rates of every location within a state and is thus described by a simultaneous change in every state rather than just a change in c'. The correct calculation needs to account for both within states changes in establishment location as well as across state changes in establishment location that occur from this joint change.

We now derive the elasticity at the state level under two different cases.

No Apportionment Taxation

Let τ_S^c be the state corporate tax rate in state S and assume that $t_c = \tau_S^c$ for every c in S. The experiment of changing τ_S^c corresponds to simultaneously changing the rate in every conspuma c in state S. The elasticity of the state tax on establishment location for a given location c is then given by:

$$\begin{aligned}\frac{d\log E_c}{d\log(1-t_S^{Corp})} &= \sum_{c'\in S}\frac{d\log E_c}{d\log(1-t_{c'})}\frac{d\log(1-t_{c'})}{d\log(1-\tau_s^c)}\\ &= \frac{1}{-\sigma^F(\varepsilon^{PD}+1)}\left(1-\sum_{c'\in S}E_c'\right),\end{aligned}$$

where we use the assumption that $\frac{d\log(1-t_{c'})}{d\log(1-\tau_s^c)} = 1$. Letting $E_S \equiv \sum\limits_{c'\in S} E_{c'}$ describe the share of establishments in the state, we find that this elasticity is smaller that the own-tax elasticity in a given location by the fraction:

$$\frac{1-E_S}{1-E_c} < 1.$$

This result shows that as taxes are simultaneously reduced in several places, fewer establishments will move into a given location with a tax cut. From this result we can log-linearize to arrive at the elasticity at the state level, which is given by:

$$\begin{aligned}\frac{d\log E_S}{d\log(1-\tau_s^c)} &= \sum_{c\in S}\left(\frac{E_c}{E_S}\right)\frac{d\log E_c}{d\log(1-\tau_s^c)}\\ &= \frac{1}{-\sigma^F(\varepsilon^{PD}+1)}(1-E_S)\,. \end{aligned} \tag{33}$$

Apportionment Taxation

The result in Equation 33 holds when $\frac{d\log(1-t_c)}{d\log(1-\tau_s^c)} = 1$. However, due to different rules across states and different activity weights across locations in a given state this derivative is not generally equal to one. Following the same logic as above, it can be shown that:

$$\frac{d\log E_S}{d\log(1-\tau_s^c)} = \frac{1}{-\sigma^F(\varepsilon^{PD}+1)}(1-E_S)\left(\sum_{c\in S}\left(\frac{E_c}{E_S}\right)\frac{d\log(1-t_c)}{d\log(1-\tau_s^c)}\right),$$

where the last term measures the size-weighted average effect of a change in the state corporate rate on the effective rate paid by firms in a given state.

This formula accounts for differences across states that are due to size of the state as well as to the formulae used to determine state taxes and the distribution of economic activity within each state. Note that

$$\frac{d\log(1-t_c)}{d\log(1-\tau_s^c)} = \frac{(1-\tau_s^c)}{(1-t_c)}\times\left[(\theta_s^x a_s^x + \theta_s^w a_s^w + \theta_s^\rho a_c^\rho) + \tau_s^c\left(\theta_s^w\frac{\partial a_s^w}{\partial t_s^{Corp}} + \theta_s^\rho\frac{\partial a_s^\rho}{\partial t_s^{Corp}}\right)\right], \tag{34}$$

where θ_S^j is the apportionment weight on factor j and a_s^j is the activity weight is for factor j and where $j = x, w, \rho$ correspond to sales, payroll, and property, respectively.

E Empirical Appendix

E.1 Annual Effects of Business Tax Cuts on Establishment Growth

One potential concern is tax changes may be related to local economic conditions and bias our main result. We measure the effects of local business tax cuts on the growth in the number of local establishments using the following specification:

$$\ln E_{c,t} - \ln E_{c,t-1} = \sum_{h=\underline{h}}^{\overline{h}} \beta_h [\ln(1-\tau^b_{c,t-h}) - \ln(1-\tau^b_{c,t-1-h})] + \mathbf{D}'_{s,t}\mathbf{\Psi}_{s,t} + e_{c,t} \tag{35}$$

where $\ln E_{c,t} - \ln E_{c,t-1}$ is the annual log change in local establishments, $\ln(1-\tau^b_{c,t-h}) - \ln(1-\tau^b_{c,t-1-h})$ is the annual log change in the net-of-business-tax rate for different time horizons indexed by h, $\mathbf{D}_{s,t}$ is a vector with year dummies as well as state dummies for states in the industrial midwest in the 1980s. The specification relates changes in establishment growth to leads and lags of annual changes in business taxes, differences out time invariant local characteristics and adjusts for average national establishment growth and abnormal conditions in rust belt states in the 1980s.

This specification allows for lags that can show the dynamic impacts of tax changes and leads that can detect pre-trends. The baseline specification includes five lags and no leads, i.e. $\overline{h} = 5$ and $\underline{h} = 0$. In this baseline, we relate business tax changes over the past five years to establishment growth. Summing up the coefficients for each lag provides an estimate of the cumulative effect of a change in business taxes. For example, a state tax change in 2000 has its initial impact β_0 in 2000, its first year impact β_1 in 2001, the second year impact in 2002, etc. The number of local establishments in 2005 reflects the impact of each of these lagged effects, which sum to the cumulative effect $\sum_{h=0}^{5} \beta_h$. We also include leads in some specifications. Including leads, i.e. $\underline{h} < 0$, enables the detection of abnormal average establishment growth preceding tax changes.

Table A2 shows results for different combinations of leads and lags. Column (1) shows that a one percent cut in business taxes increases establishment growth by roughly 1.5% over a five year period. This increase in average growth tends to occur two and three years after the cut. Columns (2) sets $\underline{h} = -2$ and Column (3) sets $\underline{h} = -5$. The estimates of each of the leads in Column (2) indicate that average establishment growth in the two years preceding a business tax cut are not statistically different from zero. The same applies for the specification with 5 leads in Column (3). In addition, the p-value of the joint test that all leads are zero is quite large for both cs. Columns (4) through (7) show similar results with 10 lags and up to 10 leads. Figure 4 and Figure 5 help visualize the resulting estimates from the ten leads and lags.

Figure 4 shows the cumulative effects of the estimates in Column (4). It shows that establishment growth increases following a one percent cut in business taxes, especially two to four years after a tax cut. The cumulative effect after ten years is roughly three percent, which amounts to roughly one fifth of a standard deviation in establishment growth over a ten-year period. Controlling for 10 lags makes the estimates less precise, but the cumulative effect after 10 years is statistically significant at the 90% level. Figure 5 shows the analogous information using the estimates in column (7), which come from a specification with 10 leads and lags. This figure with leads shows a modest dip in average establishment growth in the years before business tax changes occur. However, this decline is statistically indistinguishable from zero. The figure also shows the cumulative effects of the lags if the leads were set to zero. The two cumulative effects with and without leads are quite similar.

E.2 Tax Base Changes

One concern is that concomitant tax base changes might confound the effects of state corporate tax changes in ways that are not detectable in the long difference specification. To address this concern, we use data generously provided by Chirinko and Wilson (2008) and find that there is no relationship between long-run tax changes and investment tax credit changes. Figure A6 shows how the average tax rate change varies for different bins of investment credit changes. The best fit line is fairly flat, the estimated slope is 0.026 (se=.06), which is quite modest and not statistically different from zero.

E.3 CMD Estimation of the Simultaneous Equation Model

E.3.1 CMD Estimation with Moments from Bartik Shocks

We interpret the Bartik as a proxy for changes in local productivity and estimate auxiliary parameters that project this proxy onto the local productivity measures in our model as follows:

$$\begin{aligned}\Delta B_{c,t} &= \varphi Bartik_{c,t} + v_{c,t}\\ \Delta B^H_{c,t} &= \varphi^h Bartik_{c,t} + v^h_{c,t}\\ \Delta z_{c,t} &= \varphi^z Bartik_{c,t} + v^z_{c,t}.\end{aligned}$$

With these productivity measures, we define a new reduced form that relates the matrix of tax and Bartik shocks:

$$\mathbf{Z}_{c,t} = \begin{bmatrix}\Delta \ln(1-\tau^b_{c,t}) & Bartik_{c,t}\end{bmatrix},$$

to the same vector of outcomes $\mathbf{Y}_{c,t}$. The matrix $\mathbb{A}$ remains unchanged and the matrix $\mathbb{B}$ in Equation 17 is now given by:

$$\mathbb{B} = \begin{bmatrix} \frac{1}{\varepsilon^{LD}\sigma^F(\varepsilon^{PD}+1)} & \frac{\left(\varepsilon^{PD}+1-\frac{1}{\sigma^F}\right)\varphi-\varphi^z}{\varepsilon^{LD}} \\ 0 & 0 \\ 0 & \frac{-\eta_c\varphi^h}{1+\eta_c} \\ \frac{1}{-\sigma^F(\varepsilon^{PD}+1)} & \frac{\varphi}{\sigma^F} \end{bmatrix}.$$

The matrix of reduced form moments $\mathbb{C}$ now includes the effects of taxes and the effects of productivity shocks

$$\mathbb{C} = \begin{bmatrix}\boldsymbol{\beta}^{\text{Business Tax}} & \boldsymbol{\beta}^{\text{Bartik}}\end{bmatrix}.$$

This gives us a total of 8 reduced-form effects. The predicted moments from our model have similar intuitive interpretations as those above and are listed in Appendix E.3.2.

E.3.2 Equilibrium and Incidence Expressions

$$\Delta \ln w_{c,t} = \phi_t^2 + (\dot{w})\, \Delta \ln(1-\tau_{c,t}^b) + \frac{\lambda\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}} Bartik_{c,t} + u_{c,t}^2 \tag{36}$$

$$\Delta \ln N_{c,t} = \phi_t^1 + \left(\dot{w}\varepsilon^{LS}\right) \Delta \ln(1-\tau_{c,t}^b) + \varepsilon^{LS}\frac{\lambda\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}} Bartik_{c,t} + u_{c,t}^1 \tag{37}$$

$$\Delta \ln r_{c,t} = \phi_t^3 + \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\dot{w}\right) \Delta \ln(1-\tau_{c,t}^b) + \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right)\frac{\lambda\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}} Bartik_{c,t} + u_{c,t}^3 \tag{38}$$

$$\begin{aligned}\Delta \ln E_{c,t} = \phi_t^4 &+ \left(\frac{1}{-\sigma^F(\varepsilon^{PD}+1)} - \frac{\gamma}{\sigma^F}\dot{w}\right) \Delta \ln(1-\tau_{c,t}^b) \\ &+ \left(\frac{\lambda}{\sigma^F} - \frac{\gamma}{\sigma^F}\frac{\lambda\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\right) Bartik_{c,t} + u_{c,t}^4\end{aligned} \tag{39}$$

E.3.3 Model Fit

We evaluate the fit of our model by comparing the estimated reduced-form effects to the predictions of our model. Table A10 presents the estimated reduced-form effects along with the predicted moments based on the estimated parameters for three cases. Panel (a) shows the model for the case where only taxes are used in estimation and corresponds to Column (1) in Panel (a) of Table 5. In all four cases, the model matches the reduced-form estimates well. However, most of of the effects are not precisely estimated, with the exception of the effect of taxes on establishment growth. This estimation has three parameters and four moments, which allows us to conduct a test of over identifying restrictions. The last line of Panel (a) reports the results of this test and shows that this restriction is not rejected by the data. Panels (b) and (c) report similar results models corresponding to Columns (1) and (5) of Panel (b) of Table 5, respectively. In both cases the models fit the reduced-form estimates well and do not reject the over identification restriction. The benefit of using the additional variation in the Bartik shock is evident in these panels as the corresponding moments are more precisely estimated than those in Panel (a).

E.4 Single-Equation Estimates of Labor Supply, Housing Supply, and Establishment Location

In this appendix we present a complementary approach to our main estimation methodology by estimating the labor supply, housing supply, and establishment location equations separately. By isolating each equation, we clarify the potential estimation pitfalls, we show the sources of variation that we use to overcome these pitfalls, and we explore how the structural estimates relate to economic features in our model. By contrast, in our main strategy we estimate a simultaneous equation model that incorporates all of the spatial equilibrium forces of our model. This approach uses classical minimum distance methods to match the reduced-form effects of business tax changes on equilibrium outcomes with the prediction from our model. This strategy improves the precision of our estimates and allows for inference on the incidence to workers, landowners, and firm owners.

E.4.1 Labor Supply

The log of Equation 1 relates changes in labor supply $\Delta \ln N_{c,t}$ to changes in wages $\Delta \ln w_{c,t}$, rental costs $\Delta \ln r_{c,t}$, and amenities $\Delta \bar{A}_{c,t}$ in location c and year t:

$$\Delta \ln N_{c,t} = \frac{\Delta \ln w_{c,t} - \alpha \Delta \ln r_{c,t}}{\sigma^W} + \frac{\Delta \bar{A}_{c,t}}{\sigma^W}. \tag{40}$$

where σ^W is the dispersion of idiosyncratic worker location preferences. We define log real wage changes, $\Delta \ln \text{Real Wage}_{c,t} \equiv \Delta \ln w_{c,t} - \alpha \Delta \ln r_{c,t}$, where we calibrate $\alpha = 0.3$ using data form the Consumer Expenditure Survey. In order to implement this equation, consider estimating the following empirical analogue:

$$\Delta \ln N_{c,t} = \beta^{LS} \Delta \ln \text{Real Wage}_{c,t} + \mathbf{D}'_{s,t} \mathbf{\Psi}^{LS}_{s,t} + \nu^{LS}_{c,t} \tag{41}$$

where the changes are decadal changes in year $t \in 1990, 2000, 2010$ are relative to year $t-10$, β^{LS} is total effect of real wage changes, and $\mathbf{D}_{s,t} = \begin{bmatrix} \mathrm{I}(t=1990) & \ldots & \mathrm{I}(t=2010) & \mathrm{I}(Midwest1990)_{s,t} \end{bmatrix}'$ is a vector with year dummies as well as state dummies for states in the industrial midwest in the 1980s, and $\nu^{LS}_{c,t}$ is the error term. From Equation 40, it follows that the error term will be composed partly of aggregate amenity shocks to a given area. Since changes in real wages and changes in amenities are likely negatively correlated, an OLS estimate of β^{LS} will be biased downwards. Intuitively, rightward shifts in supply due to amenity improvements result in apparently flatter local labor supply curves. Since σ^W is related to the inverse of β^{LS}, attenuation in β^{LS} results in overestimates of σ^W. In order to deal with this endogeneity concern, we instrument for real wage changes using the Bartik instrument for local labor demand as well as changes in taxes $\Delta \ln(1-\tau^c_{c,t})$. The exclusion restriction is that workers only value changes in labor demand and corporate taxes only through their effects on the real wage.[89]

Table A11 provides estimates for the preference dispersion parameter σ^W using both OLS and IV approaches. In both cases, we estimate $\hat{\sigma}^W$ as a non-linear function of the estimated $\hat{\beta}^{LS}$ using the delta method. Comparing Columns (1) and (2), we find that OLS indeed overestimates the parameter σ^W relative to the IV estimate. Our IV estimate yields a point estimate of $\hat{\sigma}^W = 0.72$ that is significantly different than zero at the 1% level with a standard error of 0.28. Figure A12 depicts the relationship of these estimates to worker mobility. Figure A12 plots the mean log change in population for several bins of log change in real wages as well as the fitted values of a first stage regression of changes in log real wages on the Bartik shock and the tax shock. The fitted lines plot the associated estimates from OLS and IV regressions and show that the IV estimates imply that workers are indeed three times more mobile than the OLS estimates would imply. The IV estimate implies that a \$1 increase in the real wages leads to an increase in population of 1.64. In Section 3.1 we discuss how this estimate relates to others in the literature.

E.4.2 Housing Market

The log of housing market clearing condition from Section 1.2, provides the following estimable equation for housing costs:

$$\Delta \ln r_{c,t} = \beta^{HM} (\Delta \ln N_{c,t} + \Delta \ln w_{c,t}) + \mathbf{D}'_{s,t} \mathbf{\Psi}^{HM}_{s,t} + \nu^{HM}_{c,t} \tag{42}$$

[89] In order to ensure that this is the case, we control for changes in state personal income taxes that might drive both the location of establishments and workers.

where the changes are decadal changes in year $t \in 1990, 2000, 2010$ relative to year $t-10$, $\mathbf{D}_{s,t}$ is a vector with year dummies as well as state dummies for states in the industrial midwest in the 1980s, and $\nu_{c,t}^{HM}$ is the error term. The structural model implies that $\beta^{HM} = \frac{1}{1+\eta}$, the average elasticity of housing supply.

As discussed in the previous section, the error term in this equation is partly composed of productivity shocks to the housing sector. To the extent that these shocks are positively correlated with changes in population, we would expect that OLS estimates of the coefficient β^{HM} might be biased. We avoid this potential issue by estimating this equation via IV, where we instrument for changes in population and wages using corporate tax changes and Bartik productivity shocks. As before, we report estimates of the parameter η from a delta method calculation.

Table A11 provides estimates for η. Column (3) provides the OLS estimate and Column (4) provides the IV estimate, which gives a similar, though slightly smaller estimate of the elasticity of housing supply of $0.834 (SE = 0.432)$. The parameter implies that a 1% increase in population or wages would raise rental costs by $0.55\% (SE = 0.12)$, which is a statistically significant effect at the 99% level. While not perfectly comparable to previous estimates, this estimate is within the range of parameters from previous studies including those in Notowidigdo (2013) and Suárez Serrato and Wingender (2011).[90]

E.4.3 Establishment Location and Labor Demand

Log differencing Equation 7 we obtain the following equation:

$$\Delta \ln E_{c,t} = \underbrace{\left(\frac{\mu-1}{\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w}\right)}_{\beta^{ES}} \Delta \ln(1-\tau_{c,t}^b) + \mathbf{D}_{s,t}' \mathbf{\Psi}_{s,t}^{ES} + \nu_{c,t}^{ES}.$$

To observe the interpretation of the coefficient β^{ES} as a combination of direct and indirect effects, consider first estimating the following alternative equation for establishment share growth:

$$\Delta \ln E_{c,t} = \beta^{ES} \Delta \ln(1-\tau_{c,t}^b) + \beta_2^{ES} \Delta \ln w_{c,t} + \mathbf{D}_{s,t}' \mathbf{\Psi}_{s,t}^{ES} + \nu_{c,t}^{ES}. \quad (43)$$

If both changes in wages and changes in taxes are exogenous, Equation 43 shows that β^{ES} would be related to $\frac{1}{-(\varepsilon^{PD}+1)\sigma^F}$ and that a coefficient on wages β_2^{ES} would be related to $-\left(\frac{\gamma}{\sigma^F}\right)$. The key issue in estimating this equation is that the structural error term, i.e. the change in common productivity $\Delta \bar{B}_{c,t}$, is likely positively correlated with wages. This omitted variable would likely bias an OLS estimation and produce estimates of the output elasticity of labor γ that are negative, contrary to any plausible economic model. Indeed, Column (5) of Table A11 presents the implied estimates from such a regression. As predicted, this estimation yields a non-sensical, negative estimate of the output elasticity of labor $\hat{\gamma}$, which would imply an up-ward sloping labor demand curve.

In order to deal with this endogeneity problem we exclude the endogenous regressor $\Delta \ln w_{c,t}$ (i.e., we impose the constraint that $\beta_2^{ES} = 0$). This exclusion, however, changes the interpretation of the parameter β^{ES}. This estimate corresponds to the reduced form effects of a business tax cut on

[90] Our housing supply elasticity parameter and corresponding estimates are not directly comparable due to our model's assumption of Cobb Douglas housing demand rather than the assumption that each household inelastically demands one unit of housing. This feature makes rent a function of both wages and population rather than just population and slightly alters the functional form. We adopt the Cobb-Douglas assumption to allow households to adjust to shocks over the long run, but this feature is not an essential part of our model or results. In an earlier version of the paper, we used inelastic demand and found similar results to those reported here.

establishment growth as reported in Table 3, Column 4. The estimation of the parameter σ^F from this equation is presented in Section E.4.4.

E.4.4 CMD Estimation of the Establishment Location Equation

Estimating labor demand functions in models of local labor markets has been limited by the lack of plausibly exogenous labor supply shocks that may trace the slope of the demand function.[91] Instead, this equation exploits the empirical tradeoff firms make among productivity, corporate taxes, and factor prices to recover the parameters governing labor demand and the incidence on firm profits.

Recall from Section 3.1 that the exact reduced-form of the establishment location equation is given by:

$$\Delta \ln E_{c,t} = \underbrace{\left(\frac{\mu - 1}{\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w}\right)}_{\beta^E} \Delta \ln(1 - \tau^b_{c,t}) + \mathbf{D}'_{s,t}\boldsymbol{\Psi}^4_{s,t} + u^4_{c,t}.$$

While we derived this equation from the SEM, this equation can also be obtained by log differencing Equation 7. We can decompose the parameter β^E into two forces: the increased desirability of a location through lower taxes and the countervailing force of higher wages:

$$m(\boldsymbol{\theta}) \equiv \underbrace{\frac{1}{-(\varepsilon^{PD} + 1)\sigma^F}}_{\text{LowerTaxes}} \underbrace{- \left(\frac{\gamma}{\sigma^F}\right)\dot{w}(\boldsymbol{\theta})}_{\text{Higher Wages}} \tag{44}$$

where $\dot{w}(\boldsymbol{\theta})$ is given in Equation 10 and $\boldsymbol{\theta}$ is the vector of parameters of the model. Thus, given the parameters of the model $\eta, \sigma^W, \varepsilon^{PD}$, and γ and an estimated $\hat{\beta}^E$, one can recover an estimate of the productivity dispersion parameter σ^F.

Formally, we recover the estimate of σ^F via classical minimum distance. We first estimate β^E via OLS. Using the parameter $\hat{\beta}^E$ as an empirical moment of the data along with its respective variance $\hat{\mathbf{V}}$, the classical minimum distance estimator is the solution to Equation 22 where $m(\boldsymbol{\theta})$ is as in Equation 44. This approach takes calibrated values of the parameters $\eta, \sigma^W, \varepsilon^{PD}$, and γ, finds the value $\hat{\sigma}^F$ that solves Equation 22 and computes its variance.

Figure A13 shows estimates for σ^F from the CMD estimation using the values for calibrated parameters discussed above. The graph plots the mean values of log changes in the number of establishments for different bins of log changes in the net of business tax rate. The red line plots the relation between changes in taxes and firm mobility that is implied by the CMD estimation. The parameter estimate in this case is $\hat{\sigma}^F = 0.1(SE = 0.058)$, which is statistically significant. The black line plots the same relationship when we use an implied value of σ^F from an OLS regression that ignores the indirect effect of tax cuts on firm location through higher wages. The red line is steeper than the black line, which makes firms look more mobile than they would appear in the OLS specification and is consistent with the fact that the CMD estimate is three times smaller than the implied value from the OLS regression.[92] However, if we consider the conventional wisdom of perfect mobility as given by the vertical green line, we see that even a small value of productivity dispersion σ^F yields estimates of firm mobility that are far smaller than that implied by the conventional wisdom.

[91] Recent papers have used structural approaches to ensuring a downward-sloping labor demand curve (e.g., Notowidigdo (2013)) or have emphasized the role of local amenities in driving relative demand for skilled and unskilled workers (e.g., Suárez Serrato and Wingender (2011) and Diamond (2012)).

[92] The results of these regressions are also presented in table form in Table A11.

E.5 An Instrumental Variable Approach Based on Albouy (2009)

In this appendix we present an alternative identification strategy for the parameters of the firm location equation based on an insight of Albouy (2009). Albouy (2009) first pointed out that identical workers in higher-cost locations have a higher tax burden since the federal income tax system does not account for costs of living.[93] We use this insight to argue that a federal personal income tax cut will make higher-cost locations relatively more attractive. Thus, we use the heterogeneous effects of national personal income tax changes across locations with different housing market characteristics to isolate variation in local wages that is driven by a relative labor supply shock and that is plausibly exogenous from productivity shocks. This logic implies that the interaction of federal changes in tax rates with local cost of living indexes is a valid relative supply shock of population across areas that can be used to trace the labor demand curve.

Consider estimating the following equation for establishment share growth:

$$\Delta \ln E_{c,t} = \beta_1^{\text{Albouy}} \Delta(1 - \tau_{c,t}^b) + \beta_2^{\text{Albouy}} \Delta \ln w_{c,t} + \mathbf{D}'_{s,t} \mathbf{\Psi}_{s,t}^{\text{Albouy}} + \nu_{c,t}^{\text{Albouy}} \tag{45}$$

where ϕ_t^{Albouy} is a fixed effect, $\tau_{c,t}^b$ are corporate share weighted average of business taxes. Our strategy to recover the parameters β_2^{Albouy} is to instrument for changes in wages with the interaction of mechanical federal personal income tax changes $\Delta \ln(1 - t_t^i)$ from Zidar (2014) with lagged housing values and rental costs with lagged log rental costs from the prior decade $\ln r_{c,t-10}$. We use lagged rents from the prior decade since current rent levels are likely related to changes in productivity. Using this instrumental variable along with our measure of corporate tax changes, we can recover both γ and σ^F as functions of β_1^{Albouy} and β_2^{Albouy} and an assumed value of ε^{PD}. Table A12 presents the estimates of β_1^{Albouy} and β_2^{Albouy} as well as the implied values of γ and σ^F when we calibrate $\varepsilon^{PD} = -2.5$ for a variety of specifications. Column (1) estimates the equation via OLS and finds a negative value of γ implying an upward-sloping labor demand curve. Column (2) further controls for productivity shocks including the Bartik employment shock and a related shift-share shock on establishment-level productivity that we construct using data from RefUSA. Including these shocks helps the instrument isolate variation in wages that is not related to productivity shocks. However, the latter productivity shock is only available for the last 10 year period of our data. Columns (3) and (4) present estimates of Equation 45 using the Albouy instrument based on lagged rental costs and lagged housing values, respectively, as an instrument. While the instruments are not overly strong, as measured by the F-stat from the first stage, they provide estimates of γ that are positive and include plausible values such as 0.15 or 0.25 in their 95%-confidence intervals. Nonetheless, these estimates are not very precise. Finally, column (5) calibrates $\gamma = 0.15$, our preferred value, and estimates the respective σ^F, which is smaller than the OLS version but still slightly larger than the estimates from Section 3.

F Accounting for Changes in Government Spending

We follow Suárez Serrato and Wingender (2011) in modeling the effects of changes in government spending on the local economy. This modeling approach takes into account the effects of changes in labor demand from government, changes in the provision of public goods, and changes in the provision of infrastructure.

[93] Indeed, Albouy (2009) shows that identical workers in above-average-cost locations pay 27% tax premiums resulting in an unequal geographic burden of federal taxation.

Consider first the effects of changes on the welfare of workers. Extending the indirect utility function to account for government services GS, we have:

$$V_{nc}^{W} = a_0 + \ln w_c - \alpha \ln r_c + \phi \ln GS_c + \ln A_{nc},$$

where ϕ is the worker's valuation of government services. Including a direct effect of government services on utility leads to a naturally extension of Equation 13 for the welfare effects of a change in corporate taxes:

$$\frac{d\mathcal{V}^{W}}{d\ln(1-\tau_c^{c})} = N_c(\dot{w}_c - \alpha\dot{r}_c + \phi\dot{G}S_c),$$

where $\mathcal{V}^{W} = \mathbb{E}_{\varepsilon}[\max_c V_{nc}^{W}]$. Implementing this equation requires two pieces of data: the valuation of government services ϕ and the change in services provided. We use the results from Suárez Serrato and Wingender (2011) with an estimate of $\phi = 0.45$.[94] Government services are provided by local workers such that $\dot{G}S_c$ is determined by changes in expenditure on services as well as changes in the wages of local workers. That is, $\dot{G}S_c = \dot{E}xp_c^{GS} - \dot{w}_c$. We implement this equation empirically with:

$$\beta^{W} - \alpha\beta^{R} + \phi(\dot{E}xp_c^{GS} - \beta^{W}).$$

A key thing to note from this equation is that workers care about the effects of the policy change on their real income $\ln w_c - \alpha \ln r_c$ and that the equilibrium change in this quantity equals $\beta^{W} - \alpha\beta^{R}$ regardless of whether this change is due to increases in the demand of workers or changes in the supply of workers due to changes in government spending. For the same reason, the incidence on landowners is still given by $\dot{r}_c = \beta^{R}$.

Consider now the effects of changing infrastructure spending on the profits of firms. We model infrastructure as a component of productivity by decomposing the productivity shock $B_c = \tilde{B}_c Z^{\nu}$, where Z_c is infrastructure and ν is the firms' output elasticity of infrastructure. If changes in revenue from a change in the corporate tax rate result in changes in infrastructure spending, then the effect on firm profits can be quantified as a combined change in taxes and an infrastructure-based productivity shock. Following the incidence equations for a productivity shock in Appendix B.4, the combined effects of a tax change on profit is:

$$\dot{\pi}_c + \left[\underbrace{-(\varepsilon^{PD}+1)}_{\text{Direct Effect on }\pi} + \underbrace{\gamma(\varepsilon^{PD}+1) \times \left(\frac{\frac{1}{\sigma^{F}} - (\varepsilon^{PD}+1)}{\varepsilon^{LS} - \varepsilon^{LD}}\right)}_{\text{Effect of Wage Change on }\pi}\right] \times \underbrace{\nu\dot{Z}_c}_{\text{Size of Productivity Shock}},$$

where $\dot{\pi}_c$ is as given in Equation 14. Implementing this equation requires parameters from our structural estimates as well as two additional pieces of data: the firms' output elasticity of infrastructure ν and the change in infrastructure spending. We use the results form Suárez Serrato and Wingender (2011) with an average estimate of $\nu = 0.27$.[95] Infrastructure Z_c is assumed to be imported and does not require the hiring of local workers so that $\dot{Z}_c = \dot{E}xp_c^{Z}$.

[94] Suárez Serrato and Wingender (2011) estimate the value of government services for skilled and unskilled workers. The value we use in our calculations is the average of these two value assuming an average share of skilled workers of 25%.

[95] Suárez Serrato and Wingender (2011) estimate the output elasticity of infrastructure for the labor demand of skilled and unskilled workers. The value we use in our calculations is the average of these two value assuming an average share of skilled workers of 25%.

We require an estimate of the effects of a tax cut on revenue in order to implement these equations requires. Since the average share of corporate taxes revenue to income tax revenue is approximately 20%, a static forecast of the change in revenue following a 1% tax cut would be -.2%. Given that tax cuts lead to increases in economic activity, the static estimate would be a lower bound on the effects on revenue. We thus assume that the change in revenue following a 1% tax cut would be -.1%.

We implement these expanded incidence equations under three alternative scenarios about how the change in revenues affects expenditures on infrastructure and expenditure on government services. The first scenario assumes that, following a tax cut, the decrease in revenue will be used to decrease government services. The second scenario assumes that the associated decrease in revenue will be used to decrease the provision of infrastructure. The third and final scenario assumes that the decrease in revenue will be used to decrease both government services and infrastructure proportionally.

Table A1 presents the results from this exercise. Column (1) presents our baseline results that do not account for changes in government spending. Column (2) assumes that all of the change in revenue affects changes in the provision of government services. We use an average share of spending on services to individuals of 90% following data from the Annual Survey of State Finances from 2013. This implies that a 1% drop in revenue lowers expenditures on public goods by 1.11%. In this scenario, the decrease in government services lowers worker utility resulting in smaller share of the total benefits of 18%. Column (3) explores the effect of decreasing infrastructure on firm profits. In this case, since only 10% of spending is assumed to be infrastructure related, a 1% drop in revenue lowers infrastructure spending by 10%. We observe that the incidence in firm profits falls to 0.71 from 0.81. However, this decrease in profits only lowers the share of incidence accruing to firm owners to 41%. Finally, consider the case where the decrease in revenue is apportioned proportionally so that a 1% fall in revenue implies a 1% decline in spending in each category. Column (4) present the incidence resulting form this scenario. We observe that firm profits are only modestly affected while worker welfare sees a steeper decline. Relative to the baseline case, we observe that the result that firm owners bear a substantial portion of the benefit of a corporate tax cut is only strengthened by accounting for the effects on government spending.

Table A1: Incidence Estimates Accounting for Government Spending

	(1)	(2)	(3)	(4)
Assumptions for Analysis				
Value of Government Services	N	Y	N	Y
Value for Infrastructure	N	N	Y	Y
Change in Funds	None	Services	Infrastructure	Proportional
Incidence				
Landowners	0.32	0.32	0.32	0.32
Firm Owners	0.81	0.81	0.71	0.8
Workers	0.68	0.25	0.68	0.29
Share of Incidence				
Landowners	18%	23%	19%	23%
Firm Owners	45%	59%	41%	57%
Workers	38%	18%	40%	21%

Table A2: Annual Effects of Business Tax Cuts on Establishment Growth

Establishment Growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Log Net-of-Business-Tax$_t$	0.11	0.16	-0.04	0.19	0.42	0.20	0.27
	(0.16)	(0.21)	(0.24)	(0.18)	(0.26)	(0.30)	(0.38)
Δ Log Net-of-Business-Tax$_{t-1}$	0.14	0.36	0.36	0.14	0.47*	0.54**	0.59
	(0.13)	(0.22)	(0.23)	(0.14)	(0.27)	(0.27)	(0.39)
Δ Log Net-of-Business-Tax$_{t-2}$	0.48***	0.50**	0.51**	0.52**	0.54**	0.61**	0.63
	(0.17)	(0.20)	(0.24)	(0.20)	(0.25)	(0.29)	(0.38)
Δ Log Net-of-Business-Tax$_{t-3}$	0.57***	0.55**	0.58**	0.57**	0.55*	0.62*	0.50
	(0.20)	(0.23)	(0.25)	(0.22)	(0.28)	(0.31)	(0.34)
Δ Log Net-of-Business-Tax$_{t-4}$	0.20	0.19	0.17	0.15	0.16	0.17	0.13
	(0.13)	(0.13)	(0.16)	(0.25)	(0.30)	(0.34)	(0.37)
Δ Log Net-of-Business-Tax$_{t-5}$	0.02	0.03	-0.00	0.19	0.25	0.25	0.21
	(0.25)	(0.26)	(0.26)	(0.32)	(0.37)	(0.38)	(0.41)
Δ Log Net-of-Business-Tax$_{t-6}$				0.18	0.22	0.26	0.30
				(0.25)	(0.31)	(0.31)	(0.36)
Δ Log Net-of-Business-Tax$_{t-7}$				0.34**	0.43*	0.33	0.46*
				(0.16)	(0.23)	(0.23)	(0.26)
Δ Log Net-of-Business-Tax$_{t-8}$				0.21	0.21	0.15	0.26
				(0.13)	(0.17)	(0.18)	(0.18)
Δ Log Net-of-Business-Tax$_{t-9}$				0.03	0.01	0.04	0.02
				(0.14)	(0.15)	(0.16)	(0.17)
Δ Log Net-of-Business-Tax$_{t-10}$				0.26	0.25	0.32*	0.31*
				(0.16)	(0.16)	(0.16)	(0.18)
Δ Log Net-of-Business-Tax$_{t+1}$		0.10	0.03		0.13	0.20	0.02
		(0.20)	(0.20)		(0.22)	(0.23)	(0.30)
Δ Log Net-of-Business-Tax$_{t+2}$		-0.02	0.22		-0.06	0.30	0.08
		(0.16)	(0.20)		(0.18)	(0.23)	(0.31)
Δ Log Net-of-Business-Tax$_{t+3}$			-0.10			0.04	-0.05
			(0.32)			(0.33)	(0.40)
Δ Log Net-of-Business-Tax$_{t+4}$			-0.33			-0.36	-0.30
			(0.22)			(0.25)	(0.45)
Δ Log Net-of-Business-Tax$_{t+5}$			-0.33			-0.39	-0.28
			(0.23)			(0.27)	(0.42)
Δ Log Net-of-Business-Tax$_{t+6}$							-0.15
							(0.33)
Δ Log Net-of-Business-Tax$_{t+7}$							-0.30
							(0.38)
Δ Log Net-of-Business-Tax$_{t+8}$							-0.30
							(0.33)
Δ Log Net-of-Business-Tax$_{t+9}$							-0.05
							(0.11)
Δ Log Net-of-Business-Tax$_{t+10}$							-0.11
							(0.13)
Observations	13,230	12,250	10,780	10,780	9,800	8,330	5,880
R-squared	0.225	0.143	0.099	0.197	0.106	0.054	0.120
Cumulative Effect over 5 Years	1.51**	1.80*	1.59	1.77*	2.38	2.39	2.34
	(0.75)	(1.02)	(1.14)	(1.03)	(1.58)	(1.72)	(2.10)
Cumulative Effect over 10 Years				2.79*	3.49	3.49	3.70
				(1.51)	(2.27)	(2.36)	(2.81)
P-value of All Lags=0:	0.003	0.012	0.051	0.000	0.002	0.037	0.036
P-value of All Leads=0:		0.74	0.40		0.66	0.46	0.92

Notes: This table shows the effects of annual local business tax cuts on local establishment growth. Data are for 490 county-groups. See Section 4 for sources. Cumulative effects and F-stats of joint tests that all leads and lags are zero indicate that tax cuts increase local establishment growth and do not exhibit statistically non-zero pre-trends. Regressions use initial population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Effects of Business Tax Cuts on Population Growth over 10 Years

Population Growth	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1-\tau^b)$	4.28**	4.29**	4.25**	3.74**	4.11**	3.53**
	(1.65)	(1.66)	(1.66)	(1.48)	(1.59)	(1.47)
ΔITC		-0.09				0.19
		(0.25)				(0.25)
$\Delta \ln$ GOVEXPEND PER CAPITA			-0.01			-0.01
			(0.01)			(0.01)
Bartik				0.44**		0.44**
				(0.19)		(0.17)
$\Delta \ln(1-\tau^{EXT})$					-4.70***	-4.74***
					(1.70)	(1.63)
Constant	0.07***	0.07***	0.07***	0.02	0.08***	0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.112	0.112	0.115	0.138	0.135	0.164

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTES: See notes from Table 3.

Table A4: Effects of Business Tax Cuts on Wage Growth over 10 Years

Wage Growth	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1-\tau^b)$	1.45	1.50	1.45	0.78	1.42	0.82
	(0.94)	(0.94)	(0.95)	(0.82)	(0.96)	(0.84)
ΔITC		-0.37**				-0.23
		(0.15)				(0.16)
$\Delta \ln$ GOVEXPEND PER CAPITA			0.00			0.00
			(0.00)			(0.00)
Bartik				0.56***		0.54***
				(0.08)		(0.08)
$\Delta \ln(1-\tau^{EXT})$					-0.98	-0.44
					(1.02)	(0.79)
Constant	-0.09***	-0.09***	-0.09***	-0.14***	-0.09***	-0.14***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.402	0.414	0.402	0.490	0.404	0.495

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTES: See notes from Table 3.

Table A5: Effects of Business Tax Cuts on Rental Cost Growth over 10 Years

Rental Cost Growth	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1-\tau^b)$	1.17	1.33	1.17	0.32	1.02	0.43
	(1.44)	(1.40)	(1.44)	(1.37)	(1.48)	(1.36)
ΔITC		-1.13**				-0.88*
		(0.55)				(0.50)
$\Delta \ln$ GOVEXPEND PER CAPITA			-0.00			-0.00
			(0.01)			(0.01)
Bartik				0.70**		0.63***
				(0.27)		(0.23)
$\Delta \ln(1-\tau^{EXT})$					-4.25*	-2.83*
					(2.39)	(1.58)
Constant	0.08***	0.08***	0.08***	0.01	0.09***	0.03
	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.03)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.139	0.177	0.139	0.189	0.153	0.223

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTES: See notes from Table 3.

Table A6: Effects of Business Tax Cuts on Employment Growth over 10 Years

Employment Growth	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1-\tau^b)$	4.32**	4.42**	4.30**	3.54**	4.10**	3.41**
	(1.79)	(1.73)	(1.80)	(1.51)	(1.69)	(1.41)
ΔITC		-0.67**				-0.32
		(0.33)				(0.26)
$\Delta \ln$ GOVEXPEND PER CAPITA			-0.01			-0.01
			(0.01)			(0.01)
Bartik				0.65***		0.61***
				(0.17)		(0.14)
$\Delta \ln(1-\tau^{EXT})$					-6.23***	-5.53***
					(1.79)	(1.55)
Constant	0.13***	0.13***	0.13***	0.06***	0.14***	0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.139	0.177	0.139	0.189	0.153	0.223

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTES: See notes from Table 3.

Table A7: Incidence Estimates Using Reduced-Form Effects, Business Tax Changes

Panel (a) Incidence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	1.15**	1.17*	1.10*	1.10*	1.34*	0.79	1.10*	1.39***	1.39***	0.68
	(0.59)	(0.62)	(0.61)	(0.59)	(0.72)	(0.63)	(0.59)	(0.52)	(0.52)	(0.52)
Landowners $\dot{r}$	0.93	1.51	1.07	1.15	1.63	1.11	1.17	1.79	1.79	0.32
	(1.52)	(1.46)	(1.48)	(1.43)	(1.54)	(1.45)	(1.43)	(1.22)	(1.22)	(1.36)
Firm Owners $\dot{\pi}$	1.60*	1.92*	1.56*	1.63*	1.69*	1.31	1.63*	1.98**	1.98**	0.81
	(0.89)	(1.02)	(0.91)	(0.90)	(0.99)	(1.22)	(0.90)	(0.88)	(0.88)	(1.40)

Panel (b) Shares of Incidence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	0.31**	0.26***	0.29***	0.28***	0.29***	0.25**	0.28***	0.27***	0.27***	0.37
	(0.13)	(0.08)	(0.11)	(0.09)	(0.10)	(0.10)	(0.09)	(0.07)	(0.07)	(0.43)
Landowner Share	0.25	0.33**	0.29	0.30	0.35**	0.34**	0.30	0.35***	0.35***	0.18
	(0.26)	(0.15)	(0.21)	(0.19)	(0.14)	(0.17)	(0.19)	(0.13)	(0.13)	(0.48)
Firmowner Share	0.44***	0.42***	0.42***	0.42***	0.36***	0.41***	0.42***	0.38***	0.38***	0.45***
	(0.14)	(0.10)	(0.13)	(0.12)	(0.09)	(0.08)	(0.12)	(0.09)	(0.09)	(0.13)

Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Tax Rule Controls	N	Y	N	N	N	N	N	N	N	N
Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	N	Y	N	N	N	N	N	N
Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	N	Y	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	N	Y	N	Y	N
Corporate Tax Rev. to GDP	N	N	N	N	N	N	N	Y	Y	N
Bartik	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 4; See Section A.2.4 for supplemental data sources.

Table A8: Incidence Estimates Using Estimated Reduced-Form Effects, Corporate Rate Changes

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	0.58*	0.59*	0.59*	0.59*	0.58*	0.44	0.59*	0.57*	0.58*	0.41
	(0.34)	(0.35)	(0.33)	(0.33)	(0.34)	(0.35)	(0.33)	(0.33)	(0.33)	(0.28)
Landowners $\dot{r}$	0.65	0.82	0.65	0.54	0.63	0.59	0.62	0.59	0.59	0.27
	(0.58)	(0.67)	(0.60)	(0.60)	(0.60)	(0.65)	(0.60)	(0.61)	(0.61)	(0.51)
Firm Owners $\dot{\pi}$	0.91***	0.95***	0.92***	0.87**	0.92***	0.77*	0.91***	0.89***	0.90***	0.71***
	(0.32)	(0.33)	(0.35)	(0.43)	(0.29)	(0.42)	(0.33)	(0.34)	(0.33)	(0.42)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	0.27***	0.25***	0.27***	0.29***	0.27***	0.25***	0.28***	0.28***	0.28***	0.29**
	(0.09)	(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)	(0.09)	(0.09)	(0.13)
Landowner Share	0.30**	0.35**	0.30**	0.27*	0.30*	0.33*	0.29*	0.29*	0.29*	0.19
	(0.15)	(0.14)	(0.15)	(0.17)	(0.16)	(0.18)	(0.16)	(0.17)	(0.17)	(0.28)
Firmowner Share	0.43***	0.40***	0.42***	0.44***	0.43***	0.43***	0.43***	0.43***	0.43***	0.51**
	(0.09)	(0.08)	(0.08)	(0.08)	(0.11)	(0.12)	(0.10)	(0.10)	(0.10)	(0.20)

Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Tax Rule Controls	N	Y	N	N	N	N	N	N	N	N
Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	N	Y	N	N	N	N	N	N
Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	N	Y	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	N	Y	N	Y	N
Corporate Tax Revenue to GDP	N	N	N	N	N	N	N	Y	Y	N
Bartik	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 4; See Section A.2.4 for supplemental data sources.

Table A9: Incidence Estimates Using Reduced-Form Effects, State Fixed Effects

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	1.26*	1.43**	1.39**	1.38**	1.54**	0.94	1.38**	1.23**	1.23**	1.18**
	(0.67)	(0.58)	(0.59)	(0.60)	(0.63)	(0.69)	(0.59)	(0.52)	(0.52)	(0.51)
Landowners $\dot{r}$	1.88	2.41*	1.33	1.28	2.37	0.69	1.27	0.82	0.82	0.61
	(1.57)	(1.48)	(1.44)	(1.40)	(1.74)	(1.61)	(1.42)	(1.45)	(1.45)	(1.56)
Firm Owners $\dot{\pi}$	1.81**	2.17**	1.80**	1.80**	2.24**	1.26	1.79**	1.65**	1.65**	1.44**
	(0.85)	(0.89)	(0.80)	(0.82)	(0.92)	(1.10)	(0.79)	(0.87)	(0.86)	(0.72)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	0.25***	0.24***	0.31***	0.31***	0.25***	0.33*	0.31***	0.33**	0.33**	0.36*
	(0.10)	(0.05)	(0.10)	(0.10)	(0.08)	(0.19)	(0.10)	(0.15)	(0.15)	(0.20)
Landowner Share	0.38**	0.40***	0.30*	0.29*	0.39***	0.24	0.29	0.22	0.22	0.19
	(0.16)	(0.10)	(0.18)	(0.17)	(0.12)	(0.31)	(0.18)	(0.26)	(0.26)	(0.35)
Firmowner Share	0.37***	0.36***	0.40***	0.40***	0.36***	0.44***	0.40***	0.45***	0.45***	0.45***
	(0.09)	(0.07)	(0.10)	(0.10)	(0.08)	(0.13)	(0.11)	(0.13)	(0.13)	(0.16)

Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Tax Rule Controls	N	Y	N	N	N	N	N	N	N	N
Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	N	Y	N	N	N	N	N	N
Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	N	Y	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	N	Y	N	Y	N
Corporate Tax Revenue to GDP	N	N	N	N	N	N	N	Y	Y	N
Bartik	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 4; See Section A.2.4 for supplemental data sources.

Table A10: Empirical and Predicted Moments from Structural Model

Panel (a) Tax Shock Only ($\gamma = .15, \varepsilon^{PD} = -2.5$)				
	Population	Wage	Rent	Establishments
Empirical Moments				
Business Tax	2.331	1.451	1.172	4.074**
	(1.51)	(0.94)	(1.44)	(1.82)
Predicted Moments				
Business Tax	2.323	1.438	1.159	4.084
$\chi^2(1)$ Stat	0.001	χ^2 P-Value	0.979	

Panel (b) Bartik and Tax Shock ($\gamma = .15, \varepsilon^{PD} = -2.5$)				
	Population	Wage	Rent	Establishments
Empirical Moments				
Business Tax	1.792	0.777	0.323	3.354**
	(1.33)	(0.82)	(1.37)	(1.43)
Bartik	0.445**	0.557***	0.702**	0.595***
	(0.18)	(0.08)	(0.27)	(0.19)
Predicted Moments				
Business Tax	1.300	1.211	0.724	2.783
Bartik	0.453	0.568	0.740	0.542
$\chi^2(2)$ Stat	0.569	χ^2 P-Value	0.752	

Panel (c) Bartik and Tax Shock ($\gamma = .15$) and estimated ε^{PD}				
	Population	Wage	Rent	Establishments
Empirical Moments				
Business Tax	1.792	0.777	0.323	3.354**
	(1.33)	(0.82)	(1.37)	(1.43)
Bartik	0.445**	0.557***	0.702**	0.595***
	(0.18)	(0.08)	(0.27)	(0.19)
Predicted Moments				
Business Tax	1.168	1.004	0.523	3.054
Bartik	0.471	0.562	0.732	0.574
$\chi^2(1)$ Stat	0.288	χ^2 P-Value	0.592	

NOTES: This table shows the estimated reduced forms used in our minimum distance estimation as well as the models predicted by our model.The reduced forms are estimated via a system OLS. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources. Panel (a) presents estimates of the model using only the tax shock for parameters ($\gamma = .15, \varepsilon^{PD} = -2.5$); panel (b) uses the Bartik shock and the tax shock for parameters ($\gamma = .15, \varepsilon^{PD} = -2.5$); and Panel (c) uses both shocks, calibrates $\gamma = .15$ and estimates ε^{PD}. Results of the χ^2 test of over identifying restrictions are below each model. Section 6 for more details on the estimation. Regressions use initial population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A11: Estimates of Structural Parameters

	(1)	(2)	(3)	(4)	(5)	(6)
	Worker Location		Housing Supply		Firm Location	
	OLS	IV	OLS	IV	OLS	CMD
Idiosyncratic Location	2.312***	0.717***				
Preference Dispersion σ^W	(0.767)	(0.277)				
Elasticity of Housing			0.963***	0.834*		
Supply η			(0.208)	(0.432)		
Idiosyncratic Location					0.331*	0.097*
Productivity Dispersion σ^F					(0.174)	(0.058)
Output Elasticity					-0.316	
of Labor γ					(0.225)	
N	1470	1470	1470	1470	1470	1470
Instrument		Bartik & Tax		Bartik & Tax		
First Stage F-stat		46.718		15.32		
Calibrated Parameters:						
ε^{PD}					-2.5	-2.5
γ						0.15
σ^W						0.7
η						1.75

Notes: This table shows the estimated coefficients of the parameters in our structural model. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources. Col (1)-(2) estimate the parameter of worker preference dispersion σ^W, Col (3)-(4) the parameter of the housing supply equation η, and Col (5)-(6) the parameters of the firm location equation γ and σ^F. Col (1)-(5) are estimated via OLS or IV as noted and the parameters are recovered via delta-method calculations. Col (6) is recovered using a classical minimum distance approach. See Section 6 for more details on the specific equations and calibration choices. ε^{PD} denotes the elasticity of product demand. Regressions use initial population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A12: Estimates of Firm Location Parameters based on Albouy IV

	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) IV
Change in Adj. Wages	0.517***	0.268	-0.798	-0.787	
	(0.156)	(0.177)	(1.243)	(1.333)	
Change in Firm Tax keep share	1.574	1.741	2.618*	2.620*	
	(1.374)	(1.244)	(1.457)	(1.460)	
$-\gamma * d\text{Wages} - \frac{d(1-t)}{\epsilon+1}$					4.082**
					(1.981)
Output Elasticity γ	-0.219	-0.103	0.203	0.200	
	(0.186)	(0.100)	(0.353)	(0.376)	
Inverse Elasticity of Firm Mobility σ^F	0.424	0.383	0.255	0.254*	0.245**
	(0.370)	(0.273)	(0.142)	(0.142)	(0.119)
N	490	490	490	490	490
Productivity Controls	N	Y	Y	Y	Y
Instrument: Fed Tax X			Lag Rent	Lag H Value	Lag Rent & Tax
First Stage F-stat			9.976	8.737	48.251
Calibrated Parameters:					
ε^{PD}	-2.5	-2.5	-2.5	-2.5	-2.5
γ					0.15

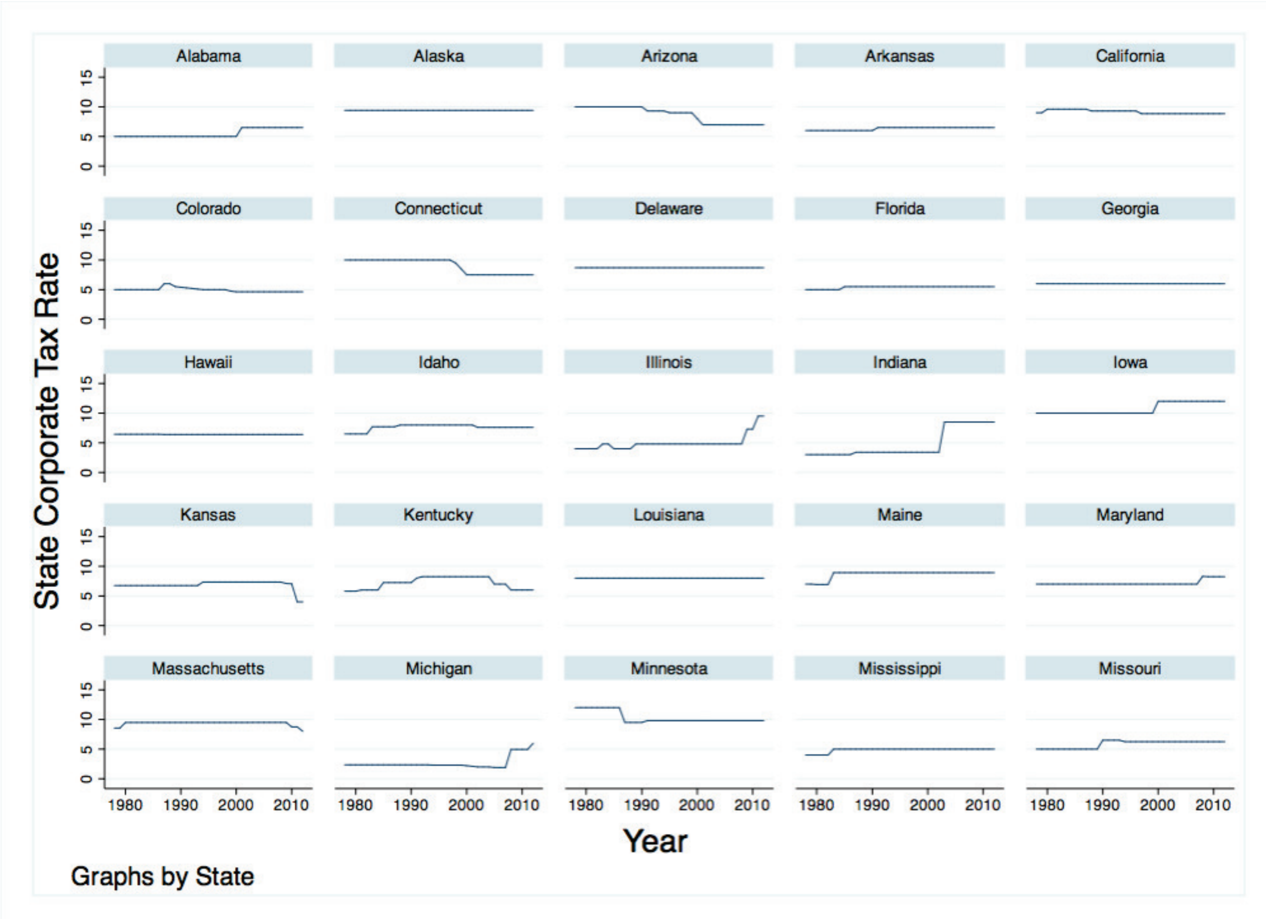
NOTES: This table shows the estimated coefficients of the firm location equation. The data are decade changes from 2000-2010 for 490 county-groups. Specifications (2)-(5) control for productivity shocks at the county-group level including the employment Bartik shock as well as a shift-share shock of plant-level productivity. The instruments used are the interactions of national changes in federal income tax rates with county-group values of the lagged log rental rate and housing value from the ACS. See Section 4 for data sources. The first three columns show the coefficients of OLS and IV regressions while the fourth and fifth columns show the associated structural parameters recovered using a delta-method calculation. Col (5) calibrates the parameters γ and ε^{PD} prior to estimation. Section E.4.4 for more details on the specific equation. Regressions use initial population as weights and include year fixed effects and dummies for states in the industrial midwest in the 1980s. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A13: Revenue-Maximizing Corporate Tax Rates By State

State	Establishment Share E_s	Revenue Ratio $\mathrm{rev}_s^{\mathrm{pers}}/\mathrm{rev}_s^{C}$	Sales Apport. Weight θ_s^x	Corporate Tax Rate τ_s	Revenue Max. Corp. Rate τ_s^*	τ_s^{**}	$\tau_s^{**}/(1-\theta_s^x)$
Alabama	1.4	16	33	6.5	36.9	2.3	3.4
Alaska	0.3	0	33	9.4	39.4	28.1	42.1
Arizona	1.8	22	80	7.0	36.0	1.7	8.6
Arkansas	0.9	15	50	6.5	37.1	2.5	4.9
California	11.7	9	50	8.8	39.0	3.9	7.8
Colorado	2.1	21	100	4.6	37.4	1.8	
Connecticut	1.2	22	50	7.5	37.5	1.7	3.5
Delaware	0.3	9	33	8.7	35.4	3.8	5.8
Florida	6.7	15	50	5.5	37.8	2.5	5.1
Georgia	3.0	20	100	6.0	35.3	1.9	
Hawaii	0.4	57	33	6.4	33.8	0.7	1.0
Idaho	0.6	26	50	7.6	41.8	1.5	2.9
Illinois	4.3	9	100	7.3	38.3	4.0	
Indiana	2.0	21	90	8.5	40.3	1.8	18.4
Iowa	1.1	30	100	12.0	39.0	1.3	
Kansas	1.0	16	33	7.1	36.9	2.3	3.5
Kentucky	1.2	20	50	6.0	37.9	1.9	3.7
Louisiana	1.4	18	100	8.0	39.3	2.1	
Maine	0.6	17	100	8.9	42.1	2.2	
Maryland	1.8	14	50	8.3	38.4	2.7	5.3
Massachusetts	2.3	9	50	8.8	38.9	3.9	7.8
Michigan	3.0	26	100	4.9	38.3	1.5	
Minnesota	2.0	20	87	9.8	40.9	1.9	14.7
Mississippi	0.8	17	33	5.0	36.7	2.2	3.3
Missouri	2.1	43	33	6.3	37.8	0.9	1.4
Montana	0.5	13	33	6.8	46.6	2.8	4.2
Nebraska	0.7	22	100	7.8	38.4	1.7	
Nevada	0.8		100	0.0	34.8		
New Hampshire	0.5	2	50	8.5	37.7	13.2	26.4
New Jersey	3.1	11	50	9.0	37.4	3.4	6.9
New Mexico	0.6	26	33	7.6	39.1	1.5	2.2
New York	7.1	14	100	7.1	43.0	2.6	
North Carolina	3.0	14	50	6.9	37.8	2.6	5.2
North Dakota	0.3	14	33	6.4	44.2	2.6	4.0
Ohio	3.5	141	60	8.5	38.0	0.3	0.7
Oklahoma	1.2	24	33	6.0	38.5	1.6	2.4
Oregon	1.5	17	100	7.9	40.2	2.2	
Pennsylvania	4.1	15	90	10.0	40.9	2.5	24.9
Rhode Island	0.4	19	33	9.0	42.8	2.0	3.0
South Carolina	1.4	45	100	5.0	36.9	0.9	
South Dakota	0.4	35	100	0.0	46.1	1.1	
Tennessee	1.8	9	50	6.5	35.0	3.9	7.8
Texas	7.2		100	0.0	36.4		
Utah	0.9	18	50	5.0	38.0	2.1	4.1
Vermont	0.3	16	50	8.5	43.3	2.4	4.8
Virginia	1.5	18	50	6.0	36.0	2.0	4.1
Washington	2.4		100	0.0	38.9		
West Virginia	0.5	16	50	8.5	37.1	2.3	4.6
Wisconsin	1.9	15	100	7.9	40.2	2.5	
Wyoming	0.3		100	0.0	40.5		

NOTES: This table shows the corporate tax revenue-maximizing corporate tax rate τ_s^* and the total tax revenue-maximizing corporate tax rate τ_s^{**}, which accounts for some fiscal externalities. These calculations are based on 2010 data and **average national parameter estimates** and do not incorporate heterogeneous housing markets. See Section 7 and Section D in the appendix for details. Sources: U.S. Census ASG and those in Section 4.

Figure A1: Time Series of State Corporate Tax Rates by State



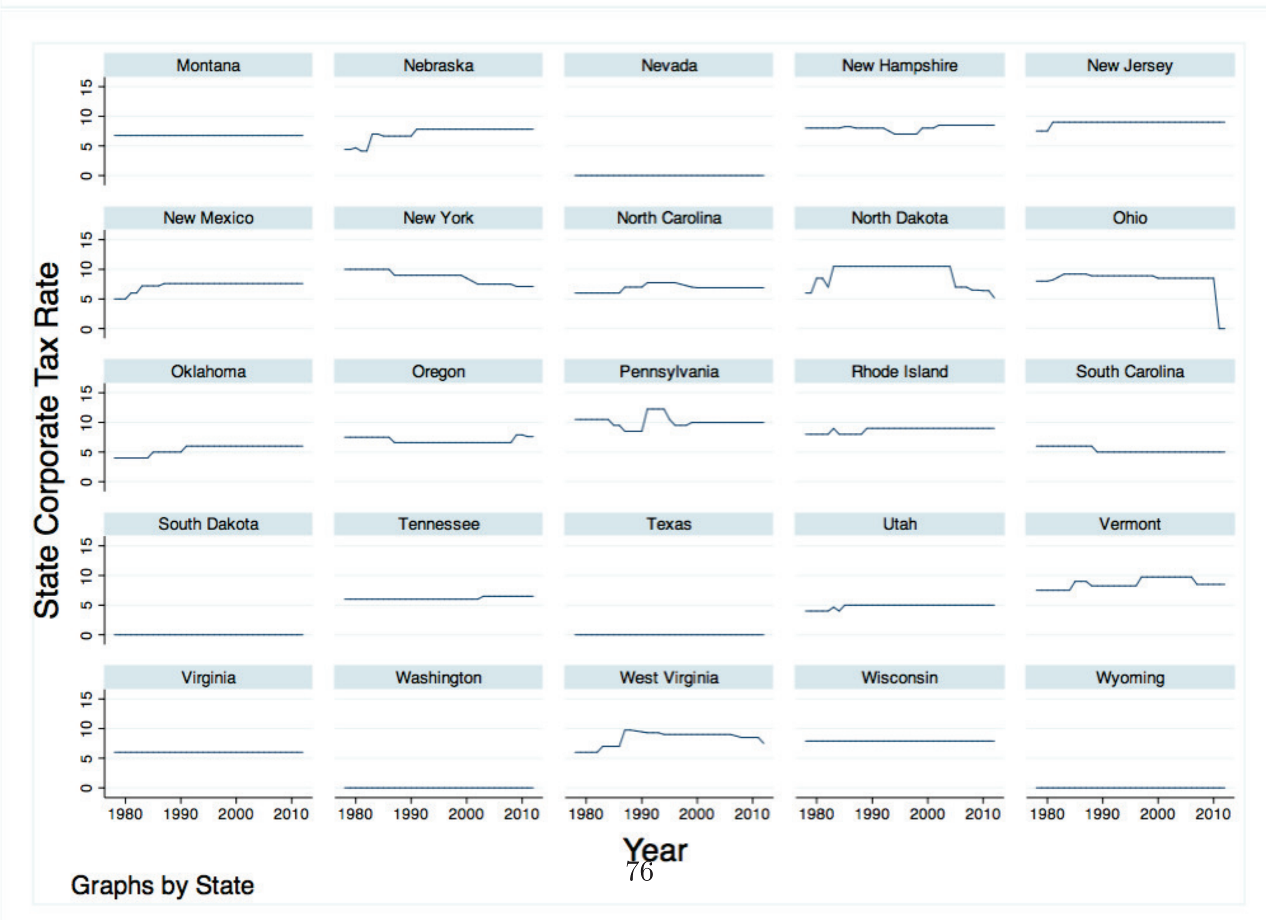
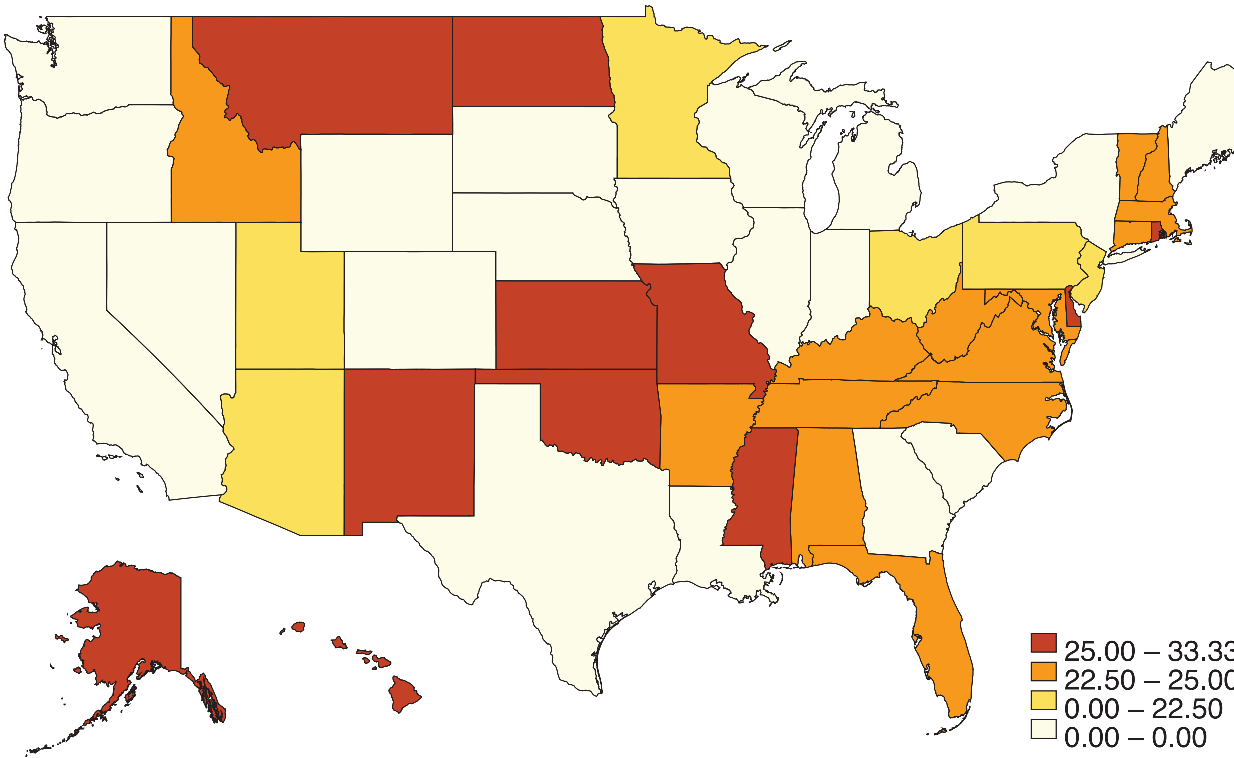


Figure A2: State Corporate Tax Apportionment Rules in 2012

A. Payroll Apportionment Rate by State



B. Sales Apportionment Rate by State

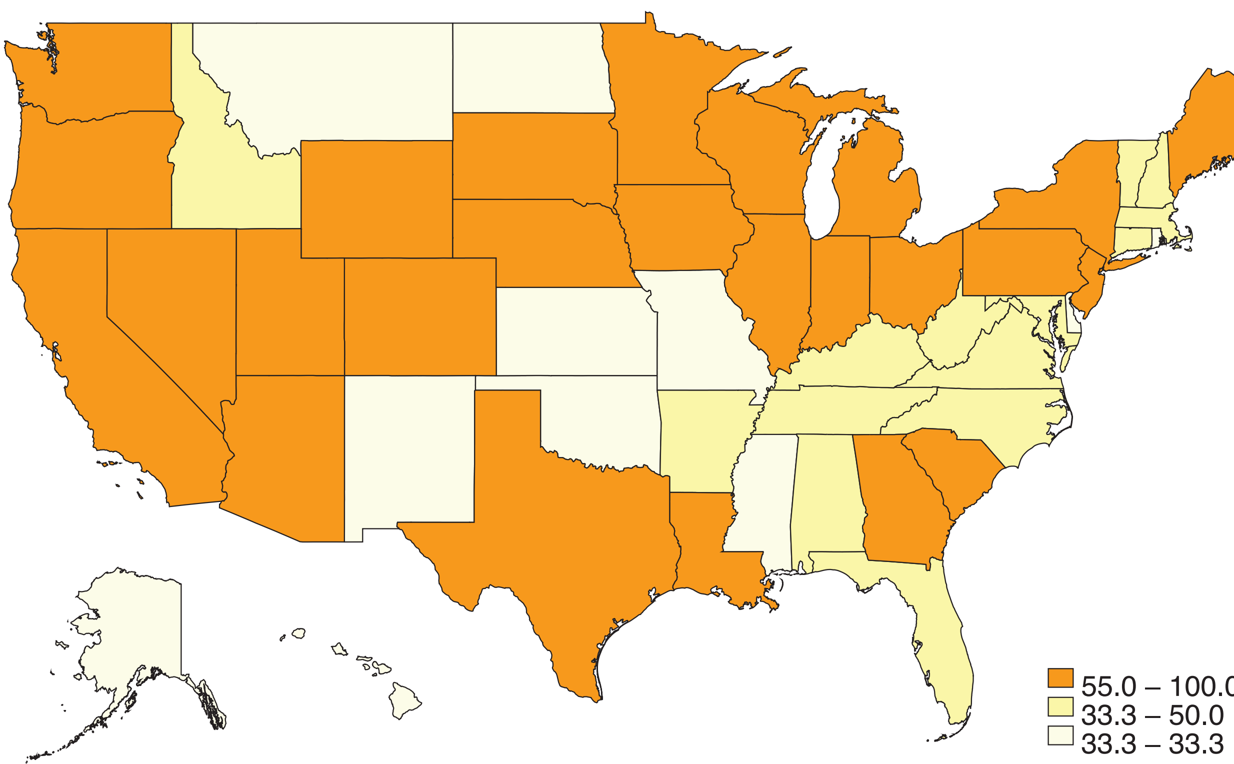
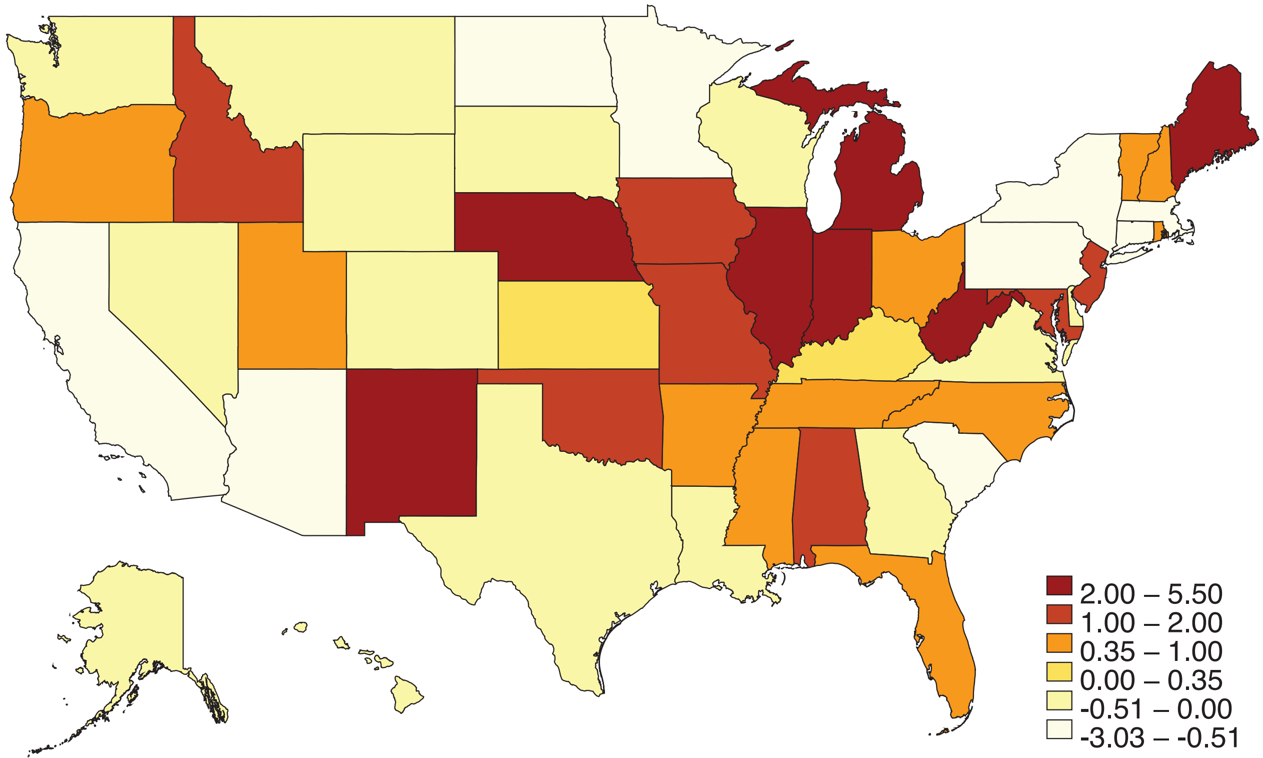


Figure A3: 30 Year Change State Corporate Tax Rates and Rules: 1980-2010

A. Corporate Tax Rate Changes by State



B. Sales Apportionment Rate Changes by State

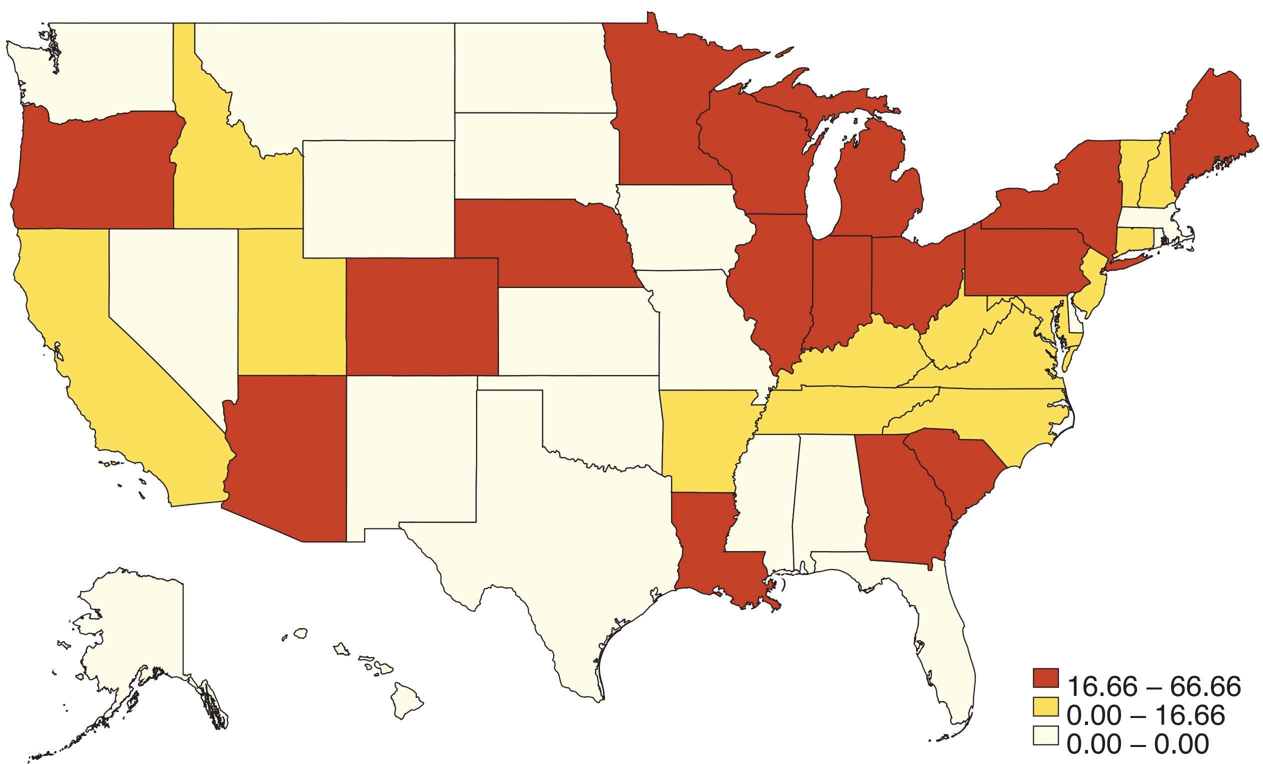
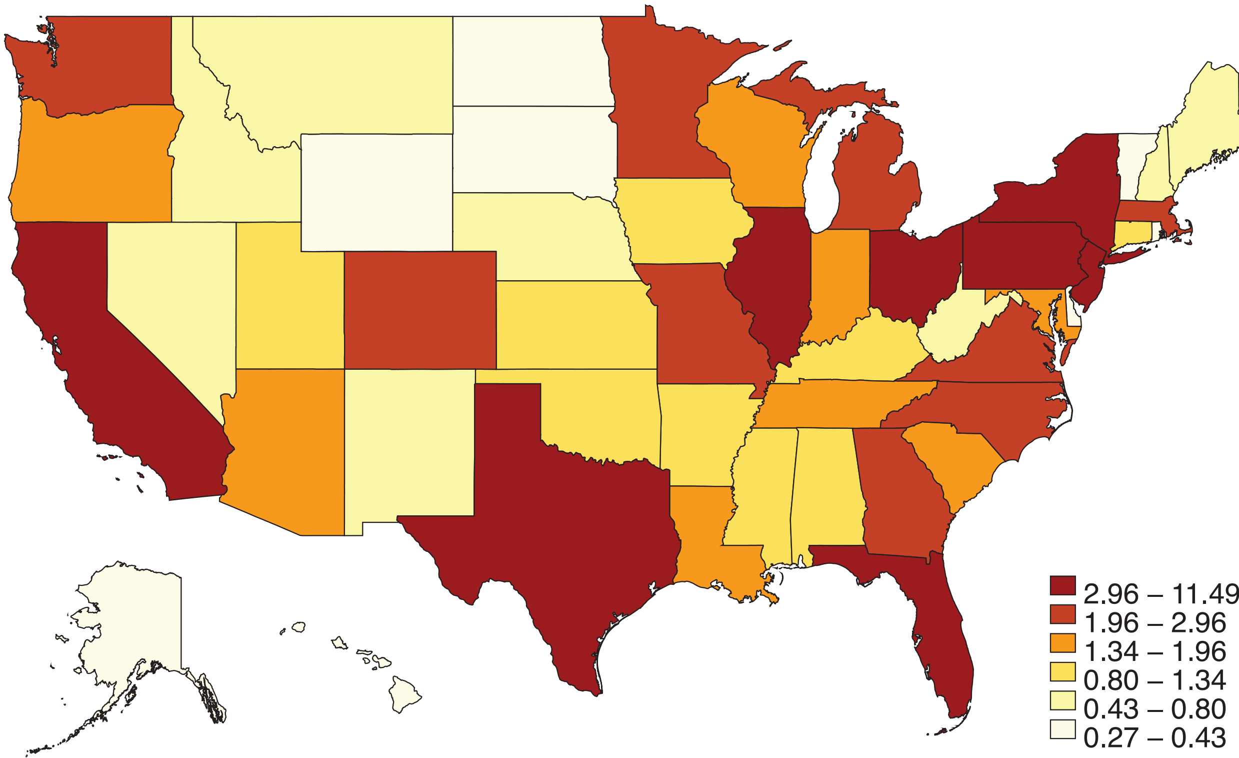


Figure A4: Shares of Total U.S. Establishments and Population in 2010

A. Establishment Share by State



B. Population Share by State

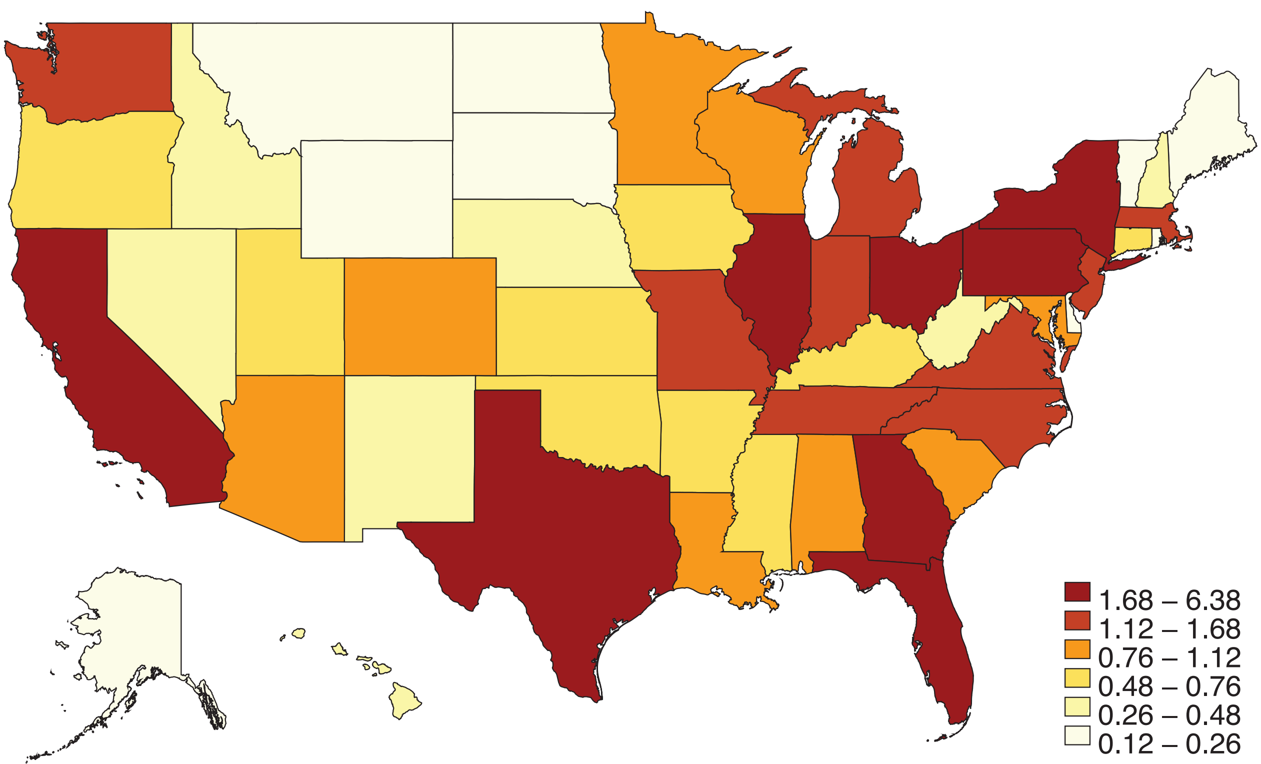
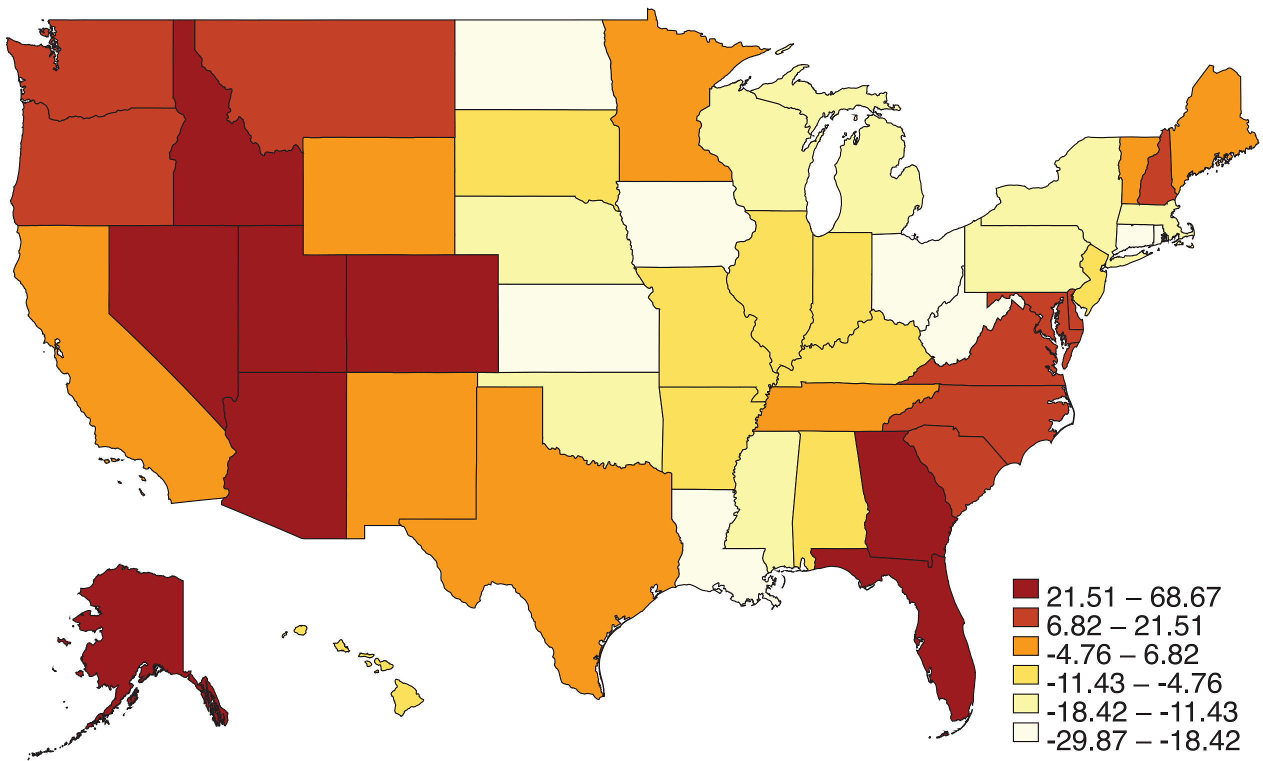


Figure A5: 30 Year Change in Share of Establishments and Population: 1980-2010

A. Change in Establishment Share by State



B. Change in Population Share by State

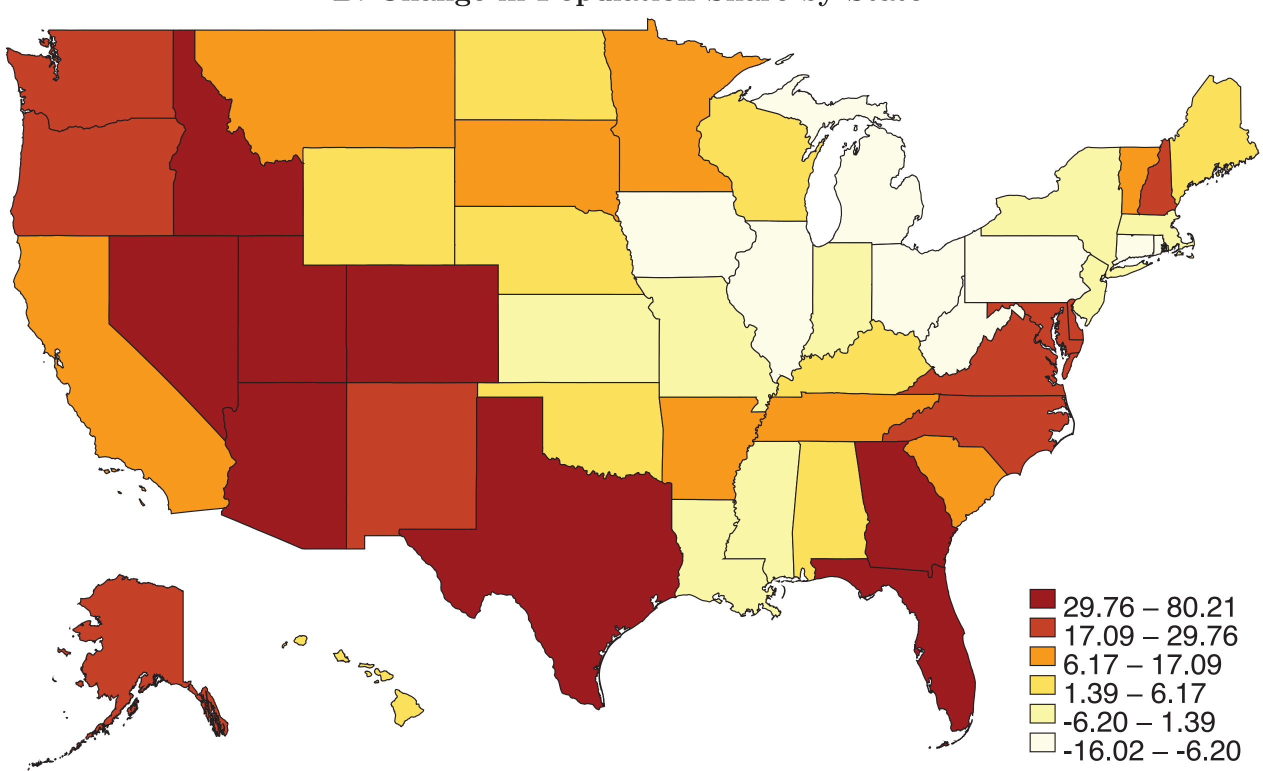
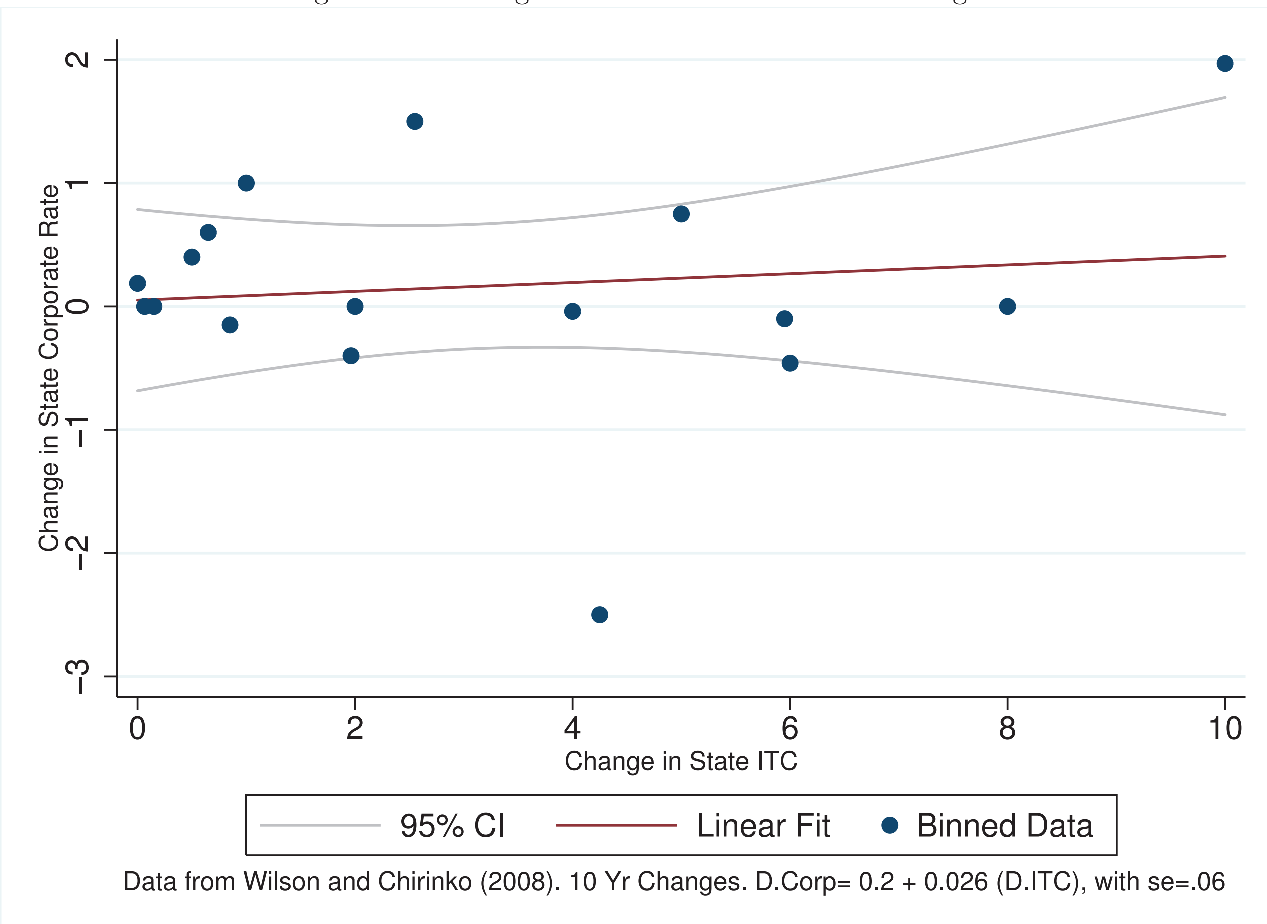
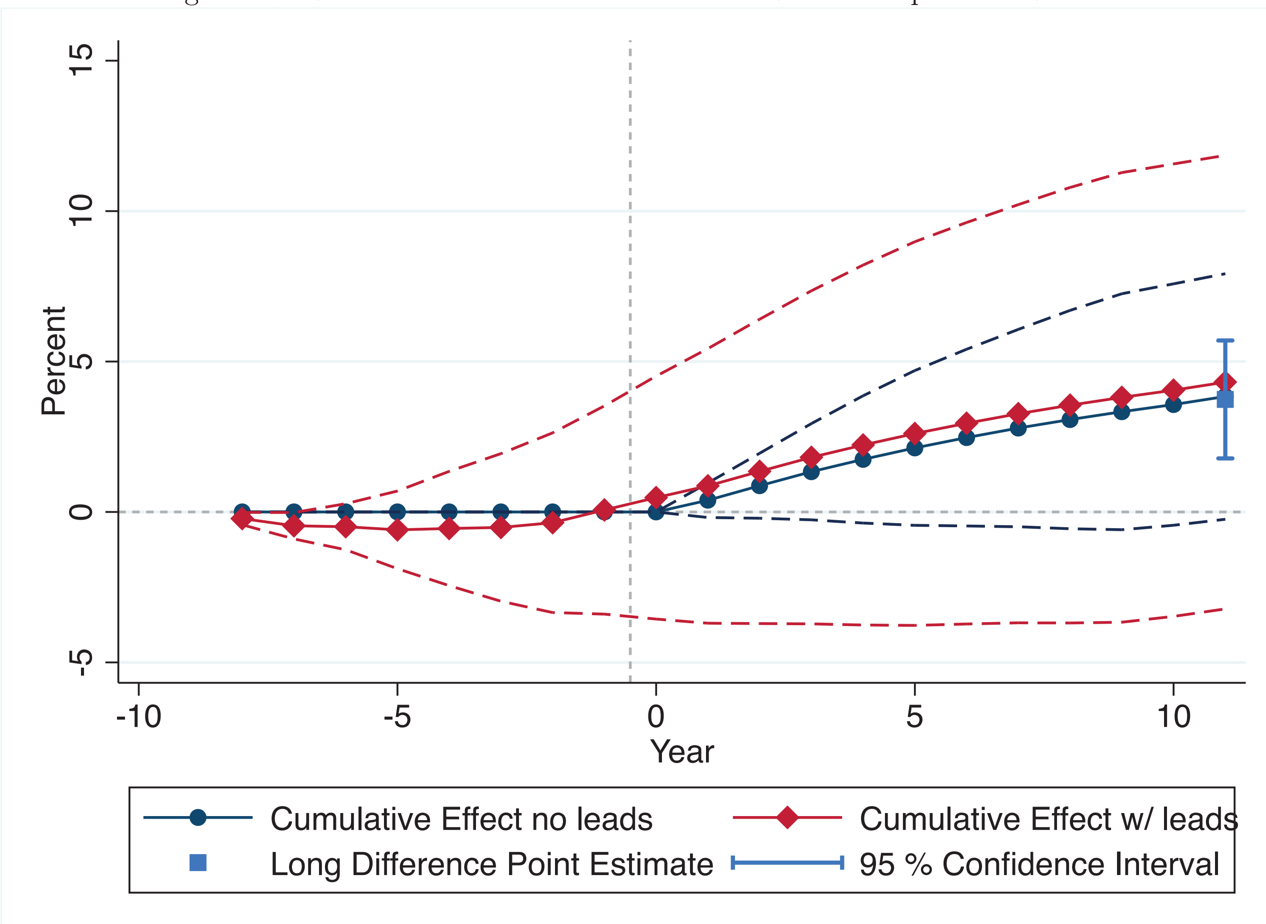


Figure A6: Testing for Concomitant Tax Base Changes



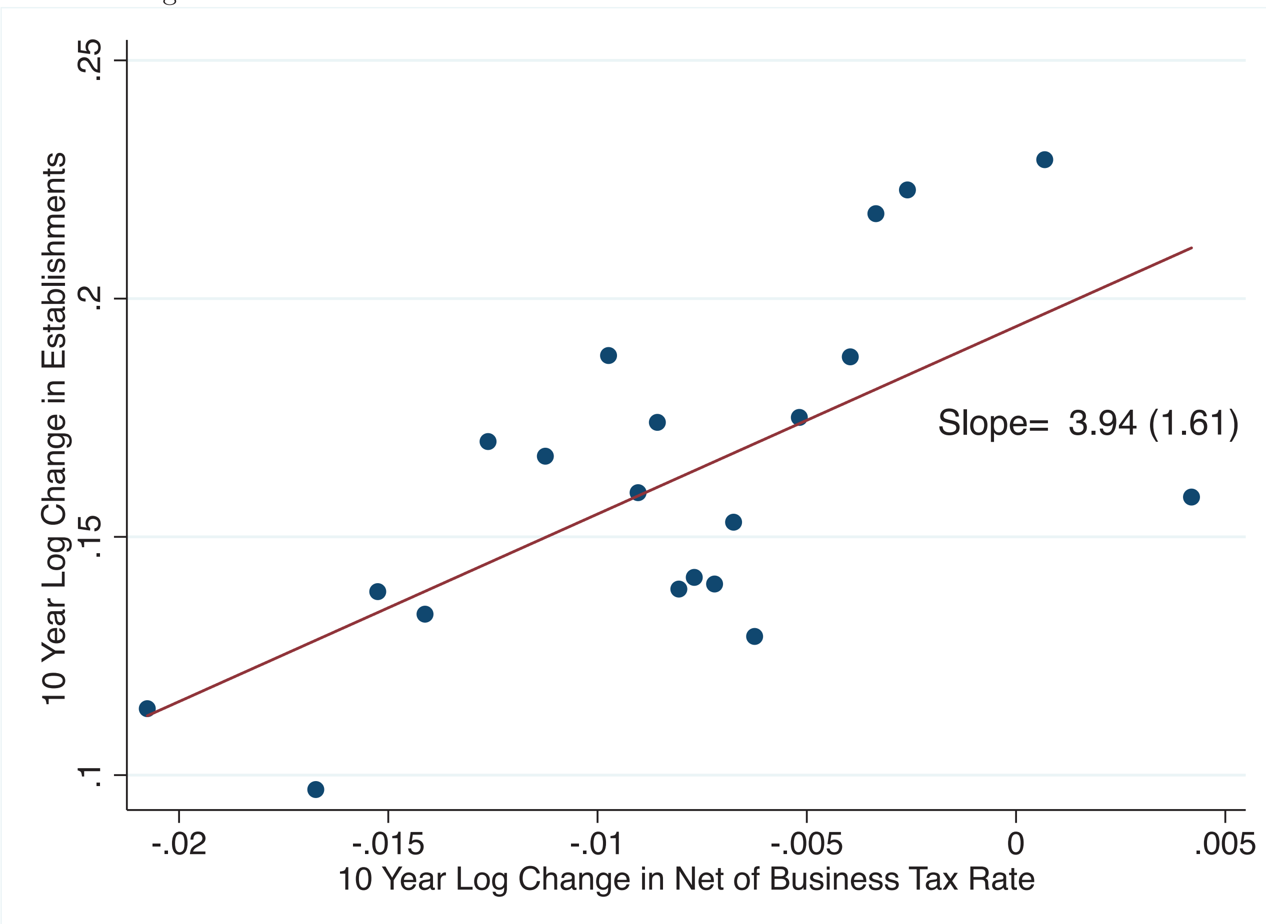
Notes: This figure, which uses data generously provided by Chirinko and Wilson (2008), illustrates that there is no detectable relationship between corporate tax rate changes and investment tax credit changes. It shows the average state corporate tax rate change for different bins of state investment credit changes. The estimated relationship is $\Delta\tau^c_{s,t} = 0.2 + 0.026\Delta ITC_{s,t}$, with se=0.06 and $R^2 = .001$. Changes are measured over ten-year periods.

Figure A7: Cumulative Effects of Business Tax Cuts on Population Growth



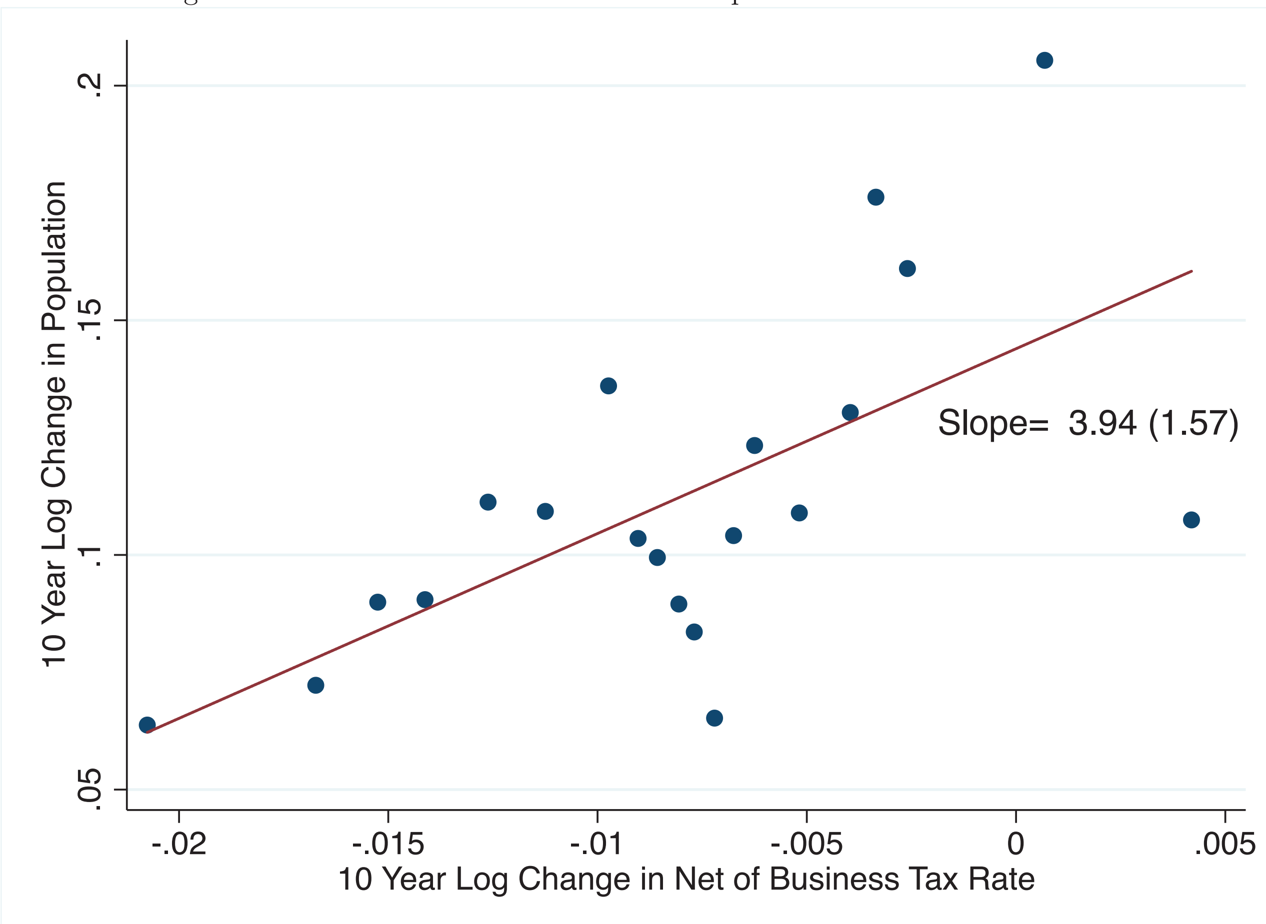
NOTES: This figure shows the cumulative annual effects of local business tax cuts on local population growth over different time horizons with pre-trends. It plots the analogous estimates as Figure 5. See Section 4 for data sources and Section E for estimation details.

Figure A8: Effect of Business Tax Cut on Establishment Growth over 10 Years



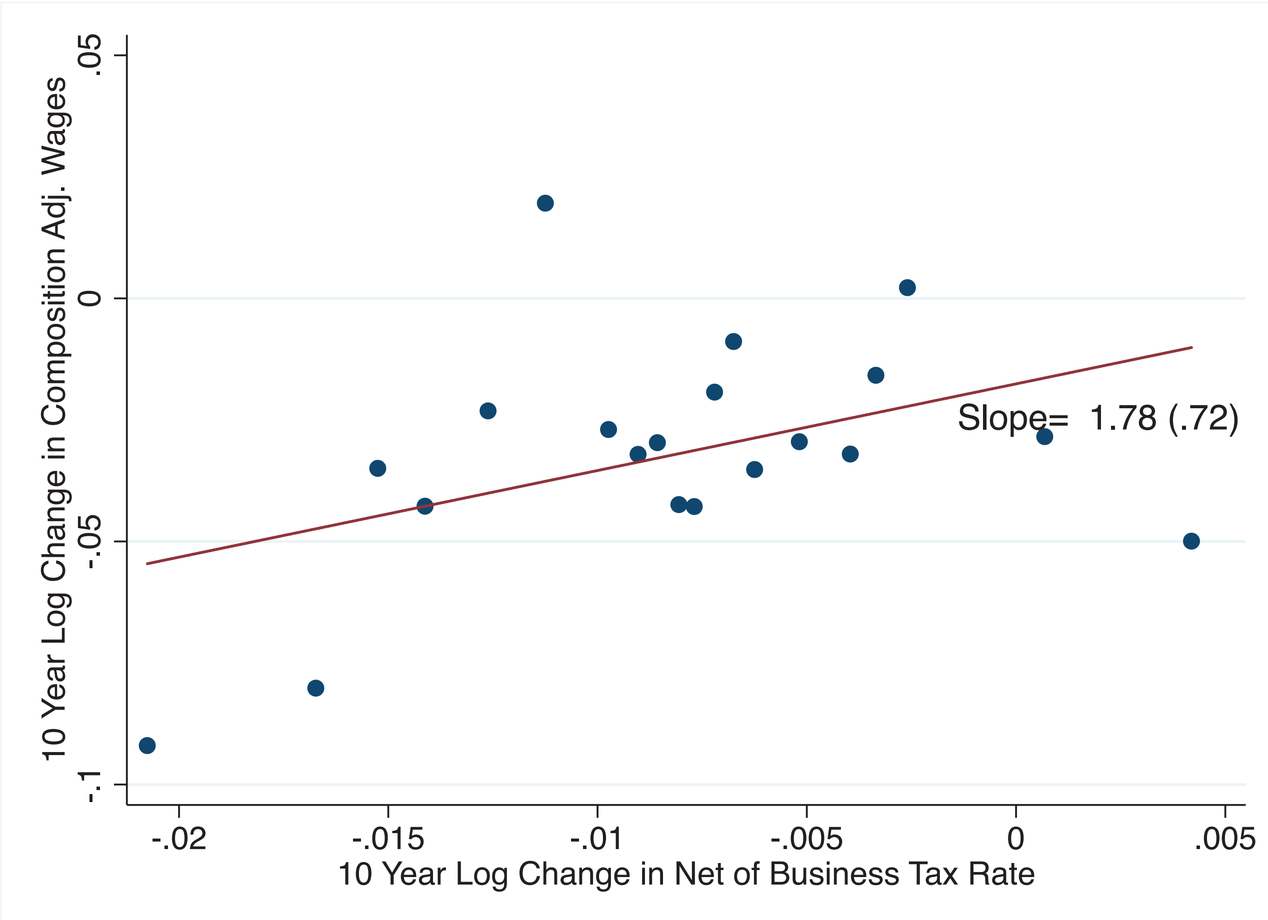
NOTES: This figure shows the mean log change in the number of establishments over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A9: Effect of Business Tax Cut on Population Growth over 10 Years



NOTES: This figure shows the mean log change in the population over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A10: Effect of Business Tax Cut on Wage Growth over 10 Years

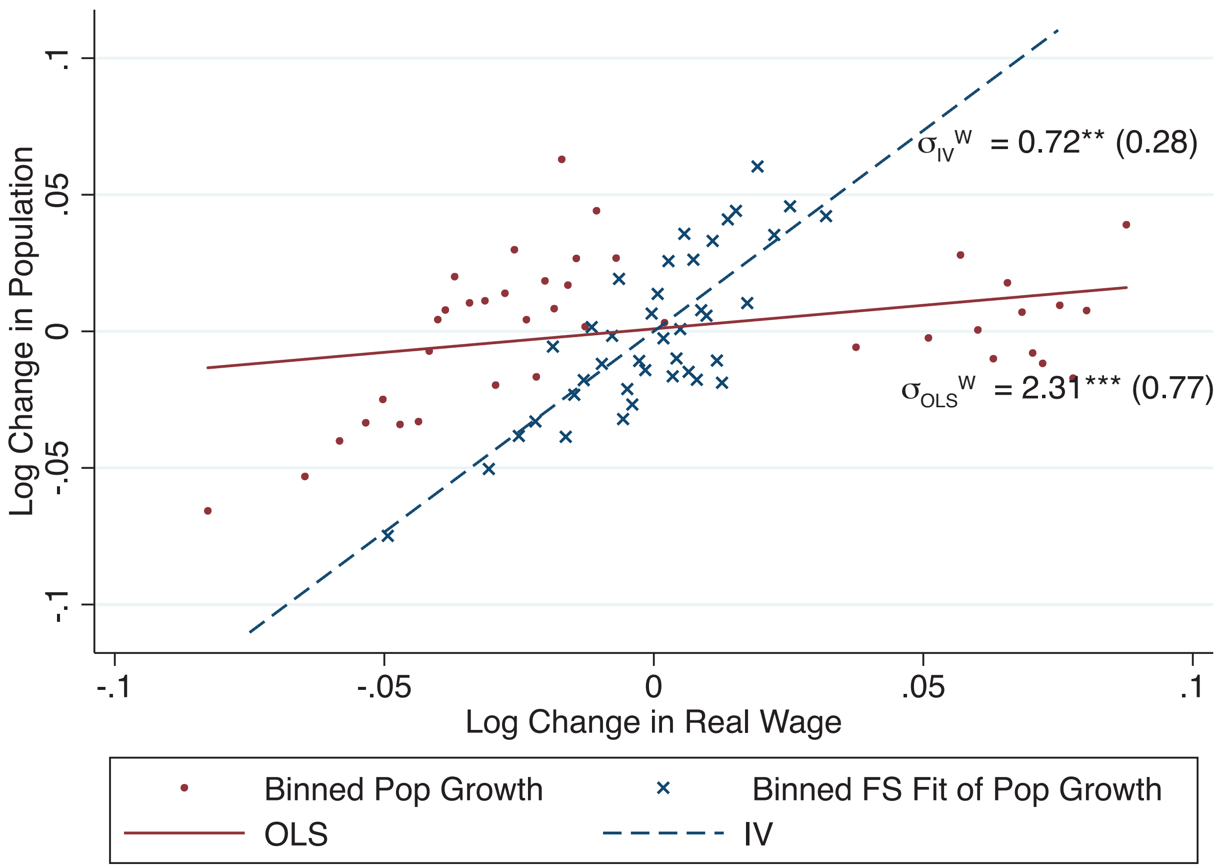


Notes: This figure shows the mean log change in wages over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. As in the main text, wages are a composition constant index. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A11: Effect of Business Tax Cut on Rental Cost Growth over 10 Years

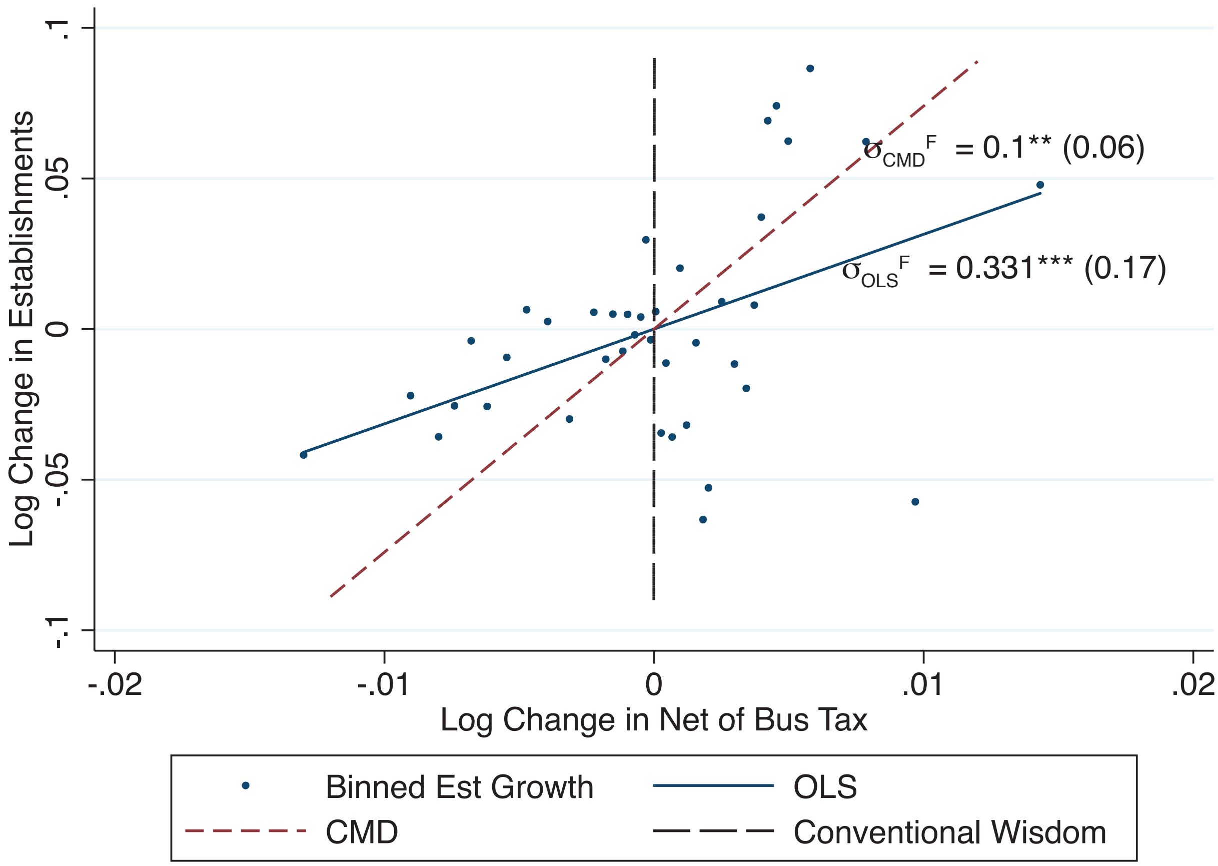
Notes: This figure shows the mean log change in rents over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. As in the main text, rental costs are a composition constant index Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A12: Estimates of Worker Location Equation



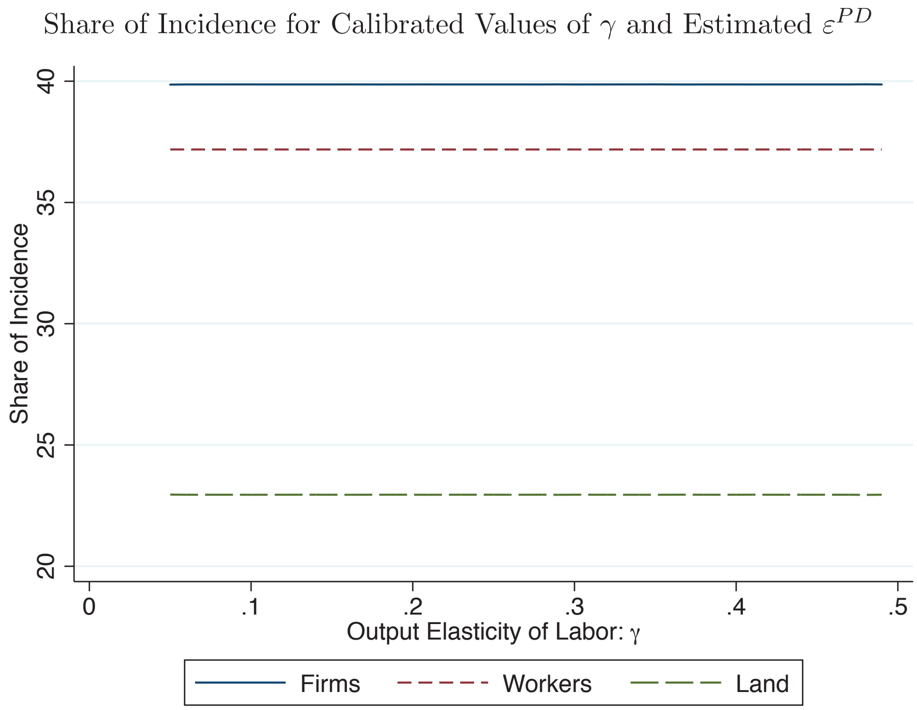
Notes: This figure illustrates the importance of accounting for regional amenities when estimating the parameters that govern worker mobility. Ignoring amenity changes attenuates the effects of wage changes on population changes. In particular, the figure shows the mean log change in population by bin of log change in real wage as well as the fitted values of a first stage regression of real wage on the Bartik shock and the tax shock. Using these fitted values illustrates how real wage changes (that are orthogonal to amenity changes) relate to population changes. The fitted lines in the figure plot the associated estimates via OLS and IV from Table A11. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A13: Estimates of Establishment Location Equation



Notes: This figure illustrates how establishment location choices relate to business taxes. The conventional view on corporate taxation in an open economy, which is based on models that neither incorporate the location decisions of business nor the possibility that a business's productivity can differ across locations, effectively implies that business location will be very responsive to tax differentials over the long-run (Gordon and Hines, 2002). This figure shows how this conventional wisdom on responsiveness compares to the empirical responsiveness of location decisions to business tax changes over a ten-year period. In particular, it shows the mean log change in establishments by bin of log change in the net-of-business-tax rate. The fitted lines plot the associated estimates via OLS and classical minimum distance (CMD) from Table A11 Col. 5 and 6, respectively (see Section E.4.4 for more detail). The OLS line shows the relationship between log changes in net-of-business-taxes and establishment growth. The positive slope indicates that tax cuts increase the number of local establishments over a ten-year period. However, ignoring equilibrium effects of tax changes on wages attenuates the effects of business tax changes on establishment growth. The CMD line shows that accounting for these impacts increases estimated responsiveness. Nonetheless, accounting for equilibrium impacts still yields substantially lower responsiveness to tax changes than the conventional wisdom implies. Section 2 quantifies how lower responsiveness affects the incidence and efficiency of corporate taxation. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1. See Appendix Figure A12 for the analogous figure for worker location.

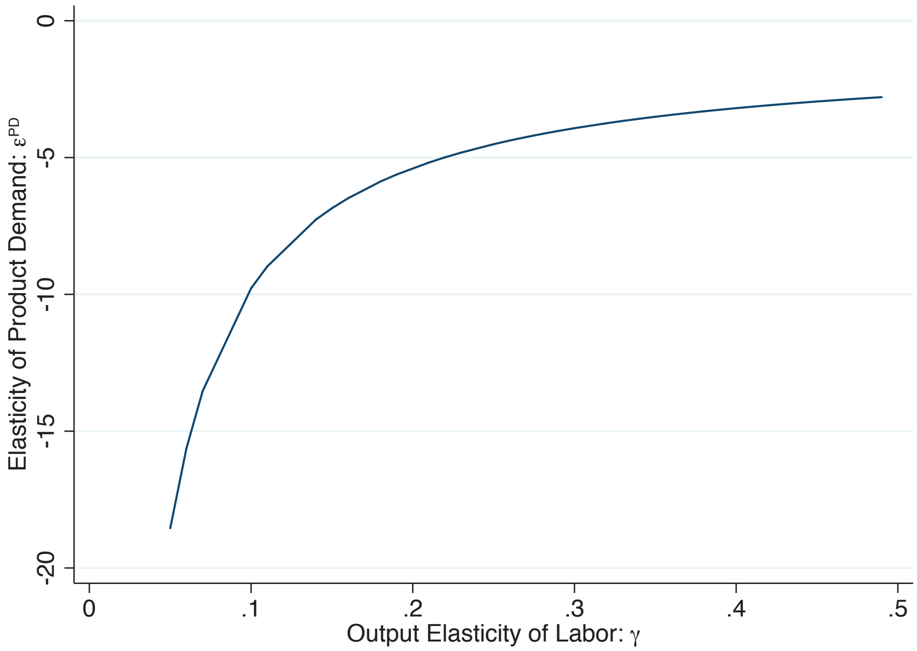
Figure A13: Robustness of Economic Incidence



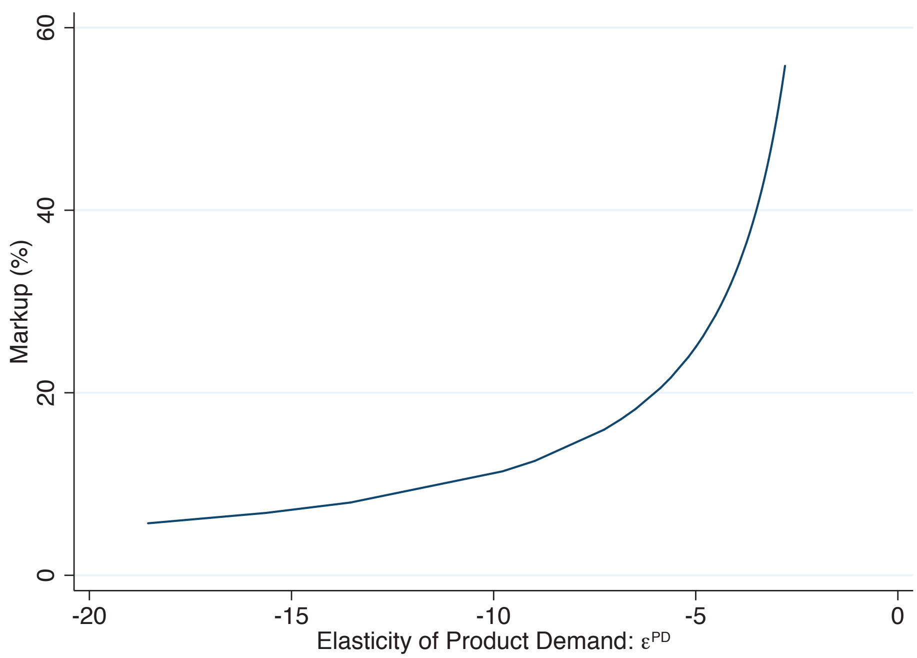
Notes: This figure shows that the shares of incidence to firm owners, workers, and landowners are independent of the calibrated values for the output elasticity of labor γ. As discussed in Section 3.2, the incidence formulae on welfare and profits are point-identified even when the individual parameters of the model are not themselves point-identified. Similar to Part A of Figure 8, it indicates that our baseline empirical result – that firm owners bear a substantial share of incidence – is robust to using a variety of calibrated parameter values. Appendix Figure A14 shows the relationship between calibration values and estimates as well as their implications for markups. See Section 3 for more detail.

Figure A14: Estimates of ε^{PD} and Associated Markups for Values of γ

Panel (a) Estimates of ε^{PD}



Panel (b) Estimates of Product Markups



Notes: These figures show the estimated value of ε^{PD} for different values of γ in Panel (a). These estimates correspond to different version of the CMD model with two shocks as in Panel (b) of Table 5. Panel (b) plots the associated markup for a given value of ε^{PD}.