Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms

Juan Carlos Suárez Serrato
Duke University, NBER

Owen Zidar
Chicago Booth, NBER

July 28, 2016

Appendices for Online Publication

This appendix contains several sections. Section A discusses tax measurement, supplemental data sources, and the variation in tax rates. Section B provides a characterization of the establishment problem under apportionment and several derivations of expressions in the main text. Section C discusses the effects of a local corporate tax change on the welfare of agents in other locations and on efficiency. Section D derives revenue-maximizing corporate tax rate expressions in the main text. Section E contains a detailed description of estimates underlying Figure 4 in the main section, a discussion of several supplemental robustness tables for key tables in the main text, a step-by-step guide through our estimation approach, an alternative equation-by-equation discussion of estimation that provides more intuition for the estimating equations relative to the system approach in the main text, and details on the structural estimation with all shocks. Section F and G provide more detail on our robustness exercises that account for the welfare effects of changes in government spending and local prices, respectively.

A Data

This section describes advantages of local areas called PUMAs in Section A.1, the derivation of composition-adjusted outcomes in Section A.2 and the tax data used in Section A.3. In particular, we provide institutional detail on apportionment and how that informed how we constructed tax rates that account for apportionment in Section A.3.1, the sources for corporate tax parameters in the main text in Section A.3.2, the source and methodological overview for our personal income tax rate data in Section A.3.3, a discussion of the limitations of our tax change measure in Section A.3.4, data on local prices in Section A.4, and data sources for variables that only appear in appendix tables in Section A.5. Finally, section A.6 describes variation in tax rates.

A.1 Advantages of Using PUMAs

There are several advantages of using "consistent public-use micro-data areas (PUMAs)." 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. Finally, this level of 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.

A.2 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 who are not institutionalized and that are not in the farm sector. We define an individual as skilled if they have a college degree.[1]

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.[2] 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 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

[1] 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.

[2] 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.

the number of bedrooms, an interaction between number of rooms and number of bedroom, a dummy for building age (every ten years), interactions of the number of room with building age dummies, and interactions of the number of bedrooms with building age dummies.

A.3 Tax Data

A.3.1 Apportionment Details

The tax liability for unitary businesses[3] 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 its establishments in the United States. 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 its 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: $\tau_i^E \equiv \tau_i^A - \tau_i^D$.

A.3.2 Additional Tax Rate and Tax Base Data Sources

In addition to the sources listed in the main text, we also rely on tax rate data collected by the authors of the following papers: Seegert (2012) , Bernthal et al. (2012), Chirinko and Wilson (2008),

[3] Unitary businesses are businesses with close connections between units in separate states. See Appendix Section A.3.4 for more detail.

and Wilson (2009). 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. Wilson (2009) shared panel data on R&D tax tax credits.

In terms of tax base rules, we primarily use data from CCH (1980-2010). However, for combined reporting and throwback rules are based on the panel provided by Bernthal et al. (2012).[4] Information regarding the federal deductibility of state corporate income taxes across states and years in the analysis period were gathered from the corporate income tax tables of the CSG (1976-2011), published biennially until 2002, and published annually thereafter. We enumerate the specific tax base variables we consider in subsection E.4.1 of Appendix Section E.4.

A.3.3 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.

A.3.4 Tax Data Limitations

While our measure of local business tax changes $\Delta \ln(1-\tau^b)_{c,t,t-h}$ captures several important features of business taxation, the measure has a number of limitations.

First, we assume that multi-state corporations are all unitary businesses, which has implications for how profit is apportioned across states. 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 in practice. Our approach of treating this firm as a unitary business would incorrectly apportion profits of the combined entity rather than keeping the establishments separate. We view our treatment as a reasonable but imperfect approximation. We provide incidence estimates in Appendix Table A21 that use only variation in statutory corporate taxes, which, in the case of the orange grove

[4] We did not verify every state-year observation on throwback and combined reporting rules. We believe that the throwback series is fairly accurate, but some spot-checking revealed that approximately 15% of the combined reporting entries before 1993 may be inconsistently classified. Given the wide-variety of robustness checks and the consistency of our results, we do not expect this to have a material impact on our findings but wanted to flag for other researchers the potential accuracy issues for this series on combined reporting from Bernthal et al. (2012), especially in years before 1993.

and steel plant, would be the correct and separate rates. We find that the results with our measure of business taxes and with statutory corporate tax rates are similar.

Second, an important limitation 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. Properly measuring the ownership structure of individual firms is not possible with our data. To the extent that firm ownership shares among states are fairly stable, specifications with state fixed effects, which are in Appendix Table A23, can partially address this concern.

Third, our ability to measure the tax base is imperfect. While we account for state investment tax credits (see Appendix Section E.3), the presence of gross receipt taxes (see Appendix Section E.4), and several specific state tax base rules (enumerated in Appendix subsection E.4.1): state throwback and combined reporting rules, state research and development tax credits, state loss carry-back and carry-forward rules, state franchise taxes, state rules governing whether or not federal corporate taxes are deductible, state choices of whether or not they follow the federal income tax base and federal accelerated depreciation rules, state depreciation rules, state bonus depreciation adoption, there are other ways that state tax bases differ that we do not capture. For example, there are possible interactions due to limited loss offset, other deductions, and other credits that we are not able to capture. Importantly, we can not directly measure firm profits. Instead, we scale up costs based on wage changes under the assumption that firms markup prices over costs. The product demand elasticity ε^{PD} governs the magnitude of this markup.[5] We can not measure wages at the establishment level, so we use local measures of wages (as described above in Appendix Section A.2). The level of analysis in the paper – PUMA-decade – reflects the importance of our wage measure and how we are able to measure it.

Fourth, while the establishment-firm data represents a step forward in terms of empirically implementing state apportionment, the available data are imperfect. We are able to link establishments and firms and construct payroll activity shares, but comparable data on property is not available. We assume that firms' factor cost shares are the same across locations, i.e., if 60% of their labor costs are in New York, then New York will also have 60% of their property costs. Different establishments have different factor cost shares in practice. We view our approach as an imperfect but reasonable approximation. In addition, we are not able to measure the destination of all sales for every firm. 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.

Fifth, we do not incorporate local property taxes. Since rates, rules, and institutional details differ materially across local areas within states and over-time, correctly measuring local property taxes for every county in the U.S. represents a herculean data construction exercise that is beyond the scope of this paper. Specifications that control for government spending per capita, which should indirectly measure local finance pressures (via financing inflows from state-to-local governments), yield similar results to the main incidence findings of the paper.

We present several pieces of evidence to address these measurement concerns. Results with state fixed effects, variation exclusively from changes in statutory state corporate taxes, and controls for tax base differences all yield very similar results. In addition, estimates using external variation from tax changes in other states imply similar incidence results. Finally, the structural parameters that rationalize the effects we estimate align with existing estimates from the local labor markets literature. If measurement error were a substantial problem, it is unlikely we would find results that are not only consistent across several specifications, but also in line with other estimates from the literature that use completely different sources of variation for estimation.[6] It is possible but unlikely that our

[5] We also provide results for a range of ε^{PD} values, e.g., Figure 5, and estimate it directly in Appendix Section E.5.

[6] See the discussion in section 6.1 of Bartik (1991); Notowidigdo (2013); Albouy and Stuart (2013) regarding supply-

estimates would be materially different with better data.

A.4 Local Price Data

A.4.1 Local Price Data from ACCRA

We measure local prices using data purchased from the American Chamber of Commerce Researchers Association (ACCRA). These data report survey measures of price levels for a number of categories of spending in several cities and the quarterly reports of inter-city price indices go back to 1980 and continue to the present.[7] Previous researchers using these data include Basker (2005), Moretti (2013), and Albouy (2008). Basker (2005) describes this data in detail.

We took the following steps to generate a price index at the PUMA-level (a geographic unit which is defined in section A.1) from these data:

1. The first step in processing the raw data from ACCRA is digitization. The data for years 1980-1989 were available in PDF form, and had to be hand coded. For each metro area in the ACCRA reports, three indices were recorded: the *composite index*, which is the index derived from all items in the survey, as well as the indices for *grocery items* and *miscellaneous goods and services*.

2. The second step was to create yearly values for these prices. We took the mean price within a city-year-category pair, where missing quarterly values were dropped.

3. The third steps was to use the city-level information to generate a price-index that is similar to our level of geography. The ACCRA data are coded at the city level but we found problems in the assignment of cities to either CBSA or MSA codes. Instead, for each metro area, we identified the primary county assigned these three indices to that county. In order to assign the price index to the relevant surrounding counties, we used a crosswalk between counties and commuting zones to assign the price index to all counties in the same commuting zone as the primary county.[8] Finally, we assigned counties to PUMAs using our county-to-puma crosswalk, and each puma's price index was calculated by averaging the price indices of all included counties that had an assigned price index.

4. The final step in generating the price index is dealing with missing values. The data generated in the previous step has a wide geographical range but there are some missing values. In order to generate a balanced panel dataset with the widest-possible geographic coverage, we estimated a linear model of PUMA-level prices changes on state-level prices changes and used predicted values of this regression to fill gaps in the data. Some of the PUMAs had a significant number of imputed observation. We exclude these cities from our analysis by restricting to areas with a low number of imputed values. This procedure generated a panel data of 400 PUMAs where only 5% of the data were imputed.

side parameters and Hamermesh (1993); Kline and Moretti (2014) regarding demand-side parameters.

[7] Note that although the ACRRA index does measure some local prices for services (e.g., haircuts, doctor's visit, dry cleaning), local prices for services may not fully reflected in the price index, which is based on the prices of specific consumption goods (e.g., the price of one dozen large grade A eggs, a gallon of gasoline, a man's barber shop haircut with no styling, a 100 tablet bottle of aspirin, the cost of adult teeth cleaning at the dentist, etc).

[8] This crosswalk can be found on David Dorn's website: http://www.ddorn.net/data.htm. For robustness, we also did the same based on definitions of MSA's using the county-to-MSA crosswalk available from the http://www.dol.gov/owcp/regs/feeschedule/fee/fs04ctst.xls and found very similar results.

A.4.2 Local Price Data from BLS

We construct a supplemental measure of local prices using price indices corresponding to "All Urban Consumers" (CPI-U) that are calculated by the Bureau of Labor Statistics (BLS) for several major metropolitan areas. Price data stretches from 1984 through 2014, with 2014 prices rebased as an index value of 100 in all CMSAs.

For states where only one associated CMSA is measured, the state price index is identical to the corresponding urban CPI. Arizona and the Phoenix metropolitan area are one such example. In total, 27 CMSAs are measured. Note that several states lack any associated urban CMSA as measured by the BLS, and are therefore excluded from the final panel (Alabama, Arkansas, Idaho, Iowa, Louisiana, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, and Wyoming). In instances in which a state is associated with multiple CMSAs with a price index—Indiana for example, is mapped to both Cincinnati and Chicago— we construct a state-year panel collapsing the CMSA level data to the state year level average prices. The underlying price index for each CMSA can be downloaded here: http://www.bls.gov/cpi/cpiovrvw.htm.

A.5 Other Data Sources for Appendix Tables

In addition to the sources referenced in the notes of Table 5, we also use a few other data sources for control variables for Appendix Table A20, Appendix Table A21, Appendix Table A22, and Appendix Table A23. Data on the political party of state governors and sales tax rates were hand-collected from annual editions of the Book of the States. Corporate tax revenue measures are from the U.S. Census Bureau's Government Division: Database on Historical State Tax Collections.

State level gross receipts taxes are developed strictly from information provided in the CSG (1976-2011), in notes corresponding to corporate income tax tables and descriptions of recent legislative changes to rates. Other media reporting, including descriptions of tax systems by state government websites, were not considered. When rates included thresholds of graduation, the highest reported rate was used. Gross receipts taxes levied by states on particular industries—Connecticut and New York enacted such a tax on oil companies in 1980, for example—are not included. When states employ corporate income taxes with a gross receipts component, only the gross receipts tax is considered. Additional taxes, such as Kentucky's Limited Liability Entity Tax—in which the lesser of 0.095% of an entity's gross receipts or 0.75% of its gross profits are taxed—as well as allowances for small business to pay a gross receipts tax in replacement of the standard corporate income tax (most recently in Idaho and Montana), are also excluded. Finally, taxes must be based on gross receipts to be considered in the Appendix specifications that control for gross receipts taxes. Franchise taxes or income taxes that use gross receipts as a threshold marker for graduation levels are not included.

We use establishment level data from the National Establishment Time Series dataset to perform additional robustness checks in Tables A15 and A17. In particular, we use these data to compute the fraction of establishments that belong to single-state firms at the PUMA-decade level. We then combine these data with the County Business Patterns establishment counts in order to analyze the effects of business taxes on single-state firms. Specifically, we use the NETS data to obtain the fraction of establishments that belong to single-state firms at the PUMA-decade level for the years 1990, 2000, and 2010 and multiply the establishment counts from the County Business Patterns by this fraction. We use this product to create new changes in the number of establishments across decades and use this variable as the dependent variable in Tables A15 and A17. This analysis alleviates concerns of endogeneity of apportionment formulas.

A.6 Variation in Tax Rates

This subsection briefly describes variation in tax rates. There are a substantial number of changes to both statutory corporate tax rates and apportionment factors that impact local areas across the United States. Panel (a) of Figure A6 shows the histogram of ten-year changes in the statutory state corporate rate and panel (b) shows a similar figure for ten-year changes in payroll apportionment weights. Of the 1470 PUMA-decade observations in the main dataset, there are hundreds of sizable changes in both aspects of corporate tax policy over three periods of interest: 1980-1990, 1990-2000, and 2000-2010.

In terms of the describing the determinants of state tax policy changes, we follow the approach that Goolsbee and Maydew (2000) use to address endogeneity concerns in section 4.2 of their paper.[9] We find similar results. Specifically, we find that tax competition with other states is the main factor that is related to the decision to change these state tax policies. Neither economic factors nor other state tax policies are significant for any of the policy probits. For example, for the policy probit for which the dependent variable is an indicator that equals one if payroll apportionment weights are changed, only the average payroll apportionment weights of other states are significant at the 5% level. None of the economic factors or other tax rates are significant. See Appendix Tables A34 and A35 for the policy probit results for payroll apportionment and statutory corporate tax changes, respectively.

B Model Details

This section characterizes the establishment problem under apportionment in Section B.1 and derives the expression for profits, local labor demand, and incidence in Sections B.2, B.3, and B.4, respectively.

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:

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

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 and $a_{is}^w \equiv \frac{w_c l_{ijc}}{W_i}$ is the local share of national payroll, W_i, for firm i.[10] Sales and property activity weights are defined similarly.[11] In

[9] Specifically, we run policy probits where the dependent variables are an indicator that equals one if a given state tax policy changes. For apportionment weights, the indicator equals one if the apportionment weight is different from the year before. For state corporate tax rates, the indicator equals one if the tax rate change exceeds 0.5 percentage points. For each, the explanatory variables are the current and lagged mean of the dependent variable in other states, other state tax policies that are not the dependent variable, and lagged levels of state per capita income growth and national unemployment rates. This specification follows that of Goolsbee and Maydew (2000) for payroll apportionment and extends it to include more recent data and a new outcome: state corporate tax rates.

[10] 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.

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

addition, $\tau^A_{i/j}$ and $\Pi^p_{i/j}$ 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: $(\tau^A_i - \tau^A_{i/j})\Pi^p_{i/j}$. 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:[12]

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

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.

$$\pi_{ijc} = (1-\tau^A_i)\left(y_{ijc}^{\frac{1}{\mu}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} - w_c l_{ijc} - \int\limits_{v\in J} p_v x_{v,ijc} dv\right) - \rho k_{ijc} - (\tau^A_i - \tau^A_{i/j})\Pi^p_{i/j},$$

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 changes in the geographical distribution of payroll and capital.[13] 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: [14]

$$\frac{y_{ijc}^{\frac{1}{\mu}}}{\mu}\frac{\gamma}{l_{ijc}} I^{\left(\frac{1}{\varepsilon^{PD}}\right)} = \underbrace{w_c\left(\frac{1-\tau^A_i + \frac{\Pi^p_i}{W_i}\left[\tau^c_s\theta^w_{is} - \sum_{s'} a^w_{is'}\tau^c_{s'}\theta^w_{is'}\right]}{1-\tau^A_i}\right)}_{\equiv \tilde{w}_c}, \tag{25}$$

[12]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.

[13]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., $\tau^c_s\theta^w_{is}(1-a^w_{is})$.

[14]Note the following auxiliary derivative $\frac{\partial \tau^A_i}{\partial l_{ijc}} = \frac{\tau^c_s \theta^w_{is}}{W_i} w_c - \sum_{s'} \frac{\tau^c_{s'}\theta^w_{is'} W_{is'}}{W_i^2} w_c = \frac{w_c}{W_i}\left[\tau^c_s\theta^w_{is} - \sum_{s'} a^w_{is'}\tau^c_{s'}\theta^w_{is'}\right]$ where the second equality exploits the assumption that all of a firm's activity in a given state is done by one establishment.

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

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.[15] These conditions and the input demand for the bundle of intermediate goods yield an expression for firm revenues and costs that takes the form:[16]

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

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 ratio 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 goods to labor ratios:

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

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

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

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.

[15] 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.

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

B.2.1 Profits

We 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 goods 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 markup 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 markup term and κ is a constant term across locations.[17]

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.

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

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

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 ten 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.

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

Taking logs yields (log) labor demand:

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

Simplifying this expression yields the (log) local labor demand curve.[18]

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

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.[19]

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:

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

[18]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.

[19]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:

$$\frac{\partial \ln N}{\partial \ln(1-\tau^c)} = \varepsilon^{LS}\frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}}$$

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

$$\frac{\partial \ln r_c}{\partial \ln(1-\tau^c)} = \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right)\frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}}$$

$$\frac{\partial \ln w_c}{\partial \ln(1-\tau^c)} - \alpha\frac{\partial \ln r_c}{\partial \ln(1-\tau^c)} = \sigma^W\varepsilon^{LS}\frac{\frac{-f_c^C}{(\varepsilon^{PD}+1)\sigma^F}}{\varepsilon^{LS}-\varepsilon^{LD}}$$

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

This section discusses the effects of a local corporate tax change on the welfare of agents in other locations and on efficiency. The final section analyzes extreme cases of incidence.

C.1 Global Welfare

The welfare effects derived in Section 2.2 would provide sufficient information for a state-elected official 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:[20]

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

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.

[20] 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).

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

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

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. (2015) 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.[21] 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:

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

where $\bar{\pi}_c^p$ is the average pretax profit of establishments in location c and RR is the government's revenue requirement.[22]

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.[23] 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

[21] 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.

[22] 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 California had a 5% rate. If California has a 6% rate, cutting corporate taxes there by one percent would not only increase production but also reduce distortions. However, if California 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 California.

[23] See Hendren (2015) for a discussion of the generality of this calculation.

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 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.[24]

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 policymakers. Additionally, we derive states' revenue-maximizing tax rates and relate them to the efficiency costs of state corporate taxes.

C.3 Extreme Incidence

This section explores limiting cases where the formulae in Table 1 display extreme incidence shares. We focus our discussion on the effects of three main parameters that govern worker mobility (σ_W) , firm mobility (σ_F), and the housing market response (η). We complement our theoretical discussion with numerical examples presented in Table A1. We consider variations of three cases where one of the agents receives 0% of incidence and where the remaining incidence may be split or allocated 100% to one of the other agents. Table A1 provides examples of parameters for each of the following cases:

A: 0% to Workers. This situation occurs when $\sigma_W = 0$ implying that workers are perfectly mobile. There are no constraints on how the remaining incidence can be allocated. Sufficiently large values of σ_F imply that labor demand will not be affected such that workers are fixed and $\beta^R = 0$. This would imply that 100% of the gains go to firm owners. Alternatively, it could also be the case that landowners bear 100% of the benefit while firm owners receive 0%. This occurs when, holding all other parameters constant, η is such that

$$1 + \gamma(\varepsilon^{PD} + 1)\left(\frac{\frac{\mu-1}{\sigma^F}}{\frac{1+\eta-\alpha}{\alpha} - \varepsilon^{LD}} - \frac{\delta}{\gamma}\right) = 0.$$

Note that this does not rely on extreme values of σ^F and is rather a knife-edge case. Indeed, holding η at this level as well as all other parameters and decreasing σ^F, implying relatively more mobile firms, would lower profits below zero.

B: 0% to land. This situation occurs when η is sufficiently large, which implies that the stock of housing is perfectly adaptable to housing demand. There are no constraints on how the remaining incidence can be allocated. For instance, when workers are relatively mobile, and certainly at $\sigma_W = 0$, firm owners bear all of the benefits. As in the case above, one can also find situations where firm owners earn zero profits, which occurs in knife-edge settings that involve relatively immobile workers and that do not require $\sigma_F = 0$.

C: 0% to firm owners. In contrast to workers, firms may earn zero benefits from a tax cut even in

[24] Cullen and Suárez Serrato (2014) explores how establishment relocation affects productivity as measured by patent activity.

cases where $\sigma_F > 0$. The zero-profit condition given by:

$$1 + \gamma(\varepsilon^{PD} + 1)\left(\frac{\frac{\mu-1}{\sigma^F}}{\varepsilon^{LS} - \varepsilon^{LD}} - \frac{\delta}{\gamma}\right) = 0$$

does not have a meaningful economic interpretation beyond the fact that profits are zero. Indeed, this occurs when the profit cost of rising wages is larger than the lower costs due to a cheaper after-tax cost of capital by the exact amount of the decrease in taxes. When this condition holds, the remaining incidence can be allocated to either landowners and workers arbitrarily. One can find examples such that both this condition holds and $\sigma_W = 0$ so that all incidence is allocated to landowners. Alternatively, one can find cases where this condition holds and 100% of the incidence is allocated to workers. These situations occur when η is large, so that housing supply is very adaptable to changes in the quantity of housing demanded.

Table A1: Numerical Examples of Extreme Incidence

	A: 0% Workers			B: 0% Land			C: 0% Firms		
Parameters	Shared	100% Land	100% Firms	Shared	100% Workers	100% Firms	Shared	100% Workers	100% Land
α	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
γ	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
δ	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
ε^{PD}	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
η	3.50	**29.00**	3.50	**100000.00**	**100000.00**	**100000.00**	3.50	**100000.00**	3.50
σ_W	**0.00**	**0.00**	**0.00**	0.47	**0.12**	1.00	0.31	0.31	**0.00**
σ_F	10.00	10.00	**10000.00**	1.00	1.00	**1000.00**	**0.43**	**0.50**	**1.50**
Incidence									
Workers	0.00	0.00	0.00	0.97	2.56	0.00	1.98	2.56	0.00
Landowners	1.30	8.38	0.00	0.00	0.00	0.00	1.99	0.00	8.72
Firmowners	1.31	0.03	1.54	0.96	0.01	1.54	0.00	0.00	-0.03
Shares									
Workers	0.00%	0.00%	0.00%	50.00%	100.00%	0.00%	50.00%	100.00%	0.00%
Landowners	50.00%	100.00%	0.00%	0.00%	0.00%	0.00%	50.00%	0.00%	100.00%
Firmowners	50.00%	0.00%	100.00%	50.00%	0.00%	100.00%	0.00%	0.00%	0.00%

Notes: This table provides numerical examples where the shares of incidence are allocated in an extreme fashion. The only parameters that vary in this table are σ_F, σ_W, and η. For each case, where one of the agents receives 0% of the incidence, there exists parameters where the incidence can be allcoated in an arbitrary fashion such that the remaining agents can receive from 0% to 100% of the incidence.

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 policymaker's objective. First, we consider the case when the policymaker's objective is to maximize corporate tax revenue while ignoring other tax collections. The second case assumes the policymaker'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 policymaker's objective considers the effects of corporate tax changes on other revenue sources.[25]

D.1 Maximal Tax Rate with No Other State Taxes

Local (corporate) tax revenue is given by:

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

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

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

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

$$\tau_c^* = \frac{1}{\dot{\bar{\pi}}_c + \dot{E}_c}(1 - t_{fed}).$$

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.[26] Local tax revenue is given by:

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

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

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

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.

[25] In addition, these calculations abstract from other potential policy goals (e.g., maximizing welfare) as well as from issues related to assumptions regarding risk aversion of the agents in the model.

[26] 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 local areas rather than states collect the vast majority of property taxes. However, there are interesting fiscal externalities on localities that do collect property taxes.

State Tax Revenue

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

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

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

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

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 PUMA 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 inter-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 PUMA 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 $E_S \equiv \sum_{c' \in S} E_{c'}$ 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:

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

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 1. Following the same logic as above, it can be shown that:

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

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

This section has several components. Section E.1 provides a detailed description of estimates underlying Figure 4. Section E.2 provides detailed steps on which parameter is estimated and what data is used. Section E.3 shows evidence on the influence (or lack thereof) of investment incentive changes. In Section E.4, we support the robustness of the reduced-form incidence results using a wide-variety of control variables (the state tax base in subsection E.4.1 and state political and fiscal policy in subsection E.4.2) as well as calibration values in subsection E.4.3. In Section E.5, we provide estimation details on how we estimate the system with four additional moments from Bartik Shocks using classical minimum distance (CMD). Section E.6 presents a complementary approach to our main estimation methodology that estimates the key equations – labor supply, housing supply, and establishment location – equation-by-equation, which facilitates further discussion of our model and provides more flexibility in terms of the estimated structural parameters.

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

One potential concern is that 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 A5 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. Panel A of Figure 4 and Panel B of Figure 4 help visualize the resulting estimates from the ten leads and lags.

Panel A of 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. Panel B of Figure 4 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.

Regarding the precision of the event study estimates, it is worth noting three things. First, if we were to narrow the event window around the event, we would reduced the number of estimated effects and increase precision. For example, Column (3) of Table A5 shows statistically significant effects two and three years after the tax cut in a specification that includes leads and lags for five years. Second, having a long event window also reduces the number of data points. Notice that the number of observations in column (7), which corresponds to the event study, is less than half the number of observations in Column (1) and (2). The magnitudes of the two year and three year effects are similar across columns, but they become less precise when we increase the number of parameters and decrease the number of observations. Finally, note that we can reject the hypothesis that the cumulative effects are zero in specifications with fewer parameters and more observations.

E.2 Detailed Estimation Steps

This section enumerates the estimation steps and shows which parameter is being estimated, what data are used, and under what assumptions.

E.2.1 Overview

There are four main estimation steps:

1. Estimate Reduced-Form Parameters
   - Estimates β^W, β^N, β^R, β^E.
   - Results in Table 4.
2. Estimate Incidence Using Linear Combinations of Reduced-Form Estimates
   - Estimates $\beta^W - \alpha\beta^R$, β^R , and $1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right)(\beta^W - \frac{\delta}{\gamma})$ from Table 1.
   - Results in Table 5.
3. Estimate Structural Parameters
   - Estimates σ^F, σ^W, η, ε^{PD}.
   - Results in Table 6.
4. Estimate Incidence using Structural Parameter Estimates
   - Estimates $\dot{w} - \alpha\dot{r}$, $\dot{r}$, $\dot{\pi}$ from Table 1. Equations 10, 11, and 12 express $\dot{w}$, $\dot{r}$, and $\dot{\pi}$ in terms of the structural parameters.
   - Results in Table 7.

E.2.2 Estimate Reduced-Form Parameters

1. Parameter: β^W
   - Specification: Equation 21 where $Y = W$.
   - Data:
     - Cells: 490 county groups by decade: 1980-1990, 1990-2000, 2000-2010.
     - $\ln w_{c,t} - \ln w_{c,t-10}$ from ACS (see Appendix Section A.2 for wage construction details).
     - $[\ln(1 - \tau^b_{c,t}) - \ln(1 - \tau^b)_{c,t-10}]$ from sources described in section 4.2.2.
     - $\mathbf{D}_{s,t}$ are indicator variables based on geography.
   - Identification Assumption: $\mathbb{E}\left(u^W_{c,t}|[\ln(1 - \tau^b_{c,t}) - \ln(1 - \tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$[27]

[27] As we note in the main text in section 5, 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 W. We support this identifying assumption 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.

- Results in Table A7.

2. Parameter: β^N
   - Specification: Equation 21 where $Y = N$.
   - Data:
     - Cells: 490 county groups by decade: 1980-1990, 1990-2000, 2000-2010.
     - $\ln N_{c,t} - \ln N_{c,t-10}$ from BEA Regional Accounts (CA30).[28]
     - $[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b)_{c,t-10}]$ from sources described in section 4.2.2.
     - $\mathbf{D}_{s,t}$ are indicator variables based on geography.
   - Identification Assumption: $\mathbb{E}\left(u^N_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0$.
   - Results in Table A6.[29]

3. Parameter: β^R
   - Specification: Equation 21 where $Y = R$.
   - Data:
     - Cells: 490 county groups by decade: 1980-1990, 1990-2000, 2000-2010.
     - $\ln r_{c,t} - \ln r_{c,t-10}$ from ACS (see Appendix Section A.2 for rental cost details).
     - $[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b)_{c,t-10}]$ from sources described in section 4.2.2.
     - $\mathbf{D}_{s,t}$ are indicator variables based on geography.
   - Identification Assumption: $\mathbb{E}\left(u^R_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0$.
   - Results in Table A8.

4. Parameter: β^E
   - Specification: Equation 21 where $Y = E$.
   - Data:
     - Cells: 490 county groups by decade: 1980-1990, 1990-2000, 2000-2010.
     - $\ln E_{c,t} - \ln E_{c,t-10}$ from County Business Patterns.
     - $[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b)_{c,t-10}]$ from sources described in section 4.2.2.
     - $\mathbf{D}_{s,t}$ are indicator variables based on geography.
   - Identification Assumption: $\mathbb{E}\left(u^E_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0$.
   - Results in Table 4.

E.2.3 Estimate Incidence Using Linear Combinations of Reduced-Form Estimates

1. Incidence on Workers
   - Expression: $\beta^W - \alpha\beta^R$
   - Data:
     - The data for reduced-form estimates of β^W and β^R listed in section E.2.2.

[28] The comparable estimate in terms of employment rather than population uses employment data from County Business Patterns.

[29] The results for employment rather than population are in Table A9.

- α is calibrated (at different values depending on the Table).[30]

- Identification Assumptions:
  - $\mathbb{E}\left(u^W_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
  - $\mathbb{E}\left(u^R_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
- Results in Table 5.

2. Incidence on Landowners
   - Expression: β^R
   - Data:
     - The data for reduced-form estimates of β^R listed in section E.2.2.
   - Identification Assumption:
     - $\mathbb{E}\left(u^R_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
   - Results in Table 5.

3. Incidence on Firm owners
   - Expression: $1 + \left(\frac{\beta^N - \beta^E}{\beta^W} + 1\right)(\beta^W - \frac{\delta}{\gamma})$
   - Data:
     - The data for reduced-form estimates of β^N, β^E, and β^W listed in section E.2.2.
     - $\frac{\delta}{\gamma}$ is calibrated (at different values depending on the Table).[31]
   - Identification Assumptions:
     - $\mathbb{E}\left(u^N_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
     - $\mathbb{E}\left(u^E_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
     - $\mathbb{E}\left(u^W_{c,t}|[\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
   - Results in Table 5.

E.2.4 Estimate Structural Parameters

- Parameters: σ^F, σ^W, η, ε^{PD}.
- There are four moments in equation 17:
  1. $\beta^W - \dot{w}$
  2. $\beta^N - \dot{w}\varepsilon^{LS}$
  3. $\beta^R - \frac{1+\varepsilon^{LS}}{1+\eta}\dot{w}$
  4. $\beta^E - \frac{\mu-1}{\sigma^F} - \frac{\gamma}{\sigma^F}\dot{w}$
- Definitions:
  - Equation 10 defines $\dot{w}$ in terms of the structural parameters.
  - $\varepsilon^{LS} = \left(\frac{1+\eta-\alpha}{\sigma^W(1+\eta)+\alpha}\right)$ in terms of the structural parameters.

[30] See Appendix Tables A24 and A25 for iterations of this table for the following calibrated parameter values: $\alpha \in \{.5, .65\}$, respectively.

[31] See Appendix Tables A26 and A27 for iterations of this table for the following calibrated parameter values: $\frac{\delta}{\gamma} \in \{.75, .5\}$, respectively.

- $\mu = \left[\frac{1}{\varepsilon^{PD}} + 1\right]^{-1}$ in terms of the structural parameters.

- Identification Assumptions:
  - $\mathbb{E}\left(u^W_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
  - $\mathbb{E}\left(u^N_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
  - $\mathbb{E}\left(u^R_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$
  - $\mathbb{E}\left(u^E_{c,t} | [\ln(1-\tau^b_{c,t}) - \ln(1-\tau^b_{c,t-10})], \mathbf{D}_{s,t}\right) = 0.$

- Data
  - The data for reduced-form estimates of β^W, β^N, β^R, and β^E listed in section E.2.2.
  - We calibrate the output elasticity γ and ε^{PD} in some columns (see Table).

- Results in Table 6.

E.2.5 Estimate Incidence using Structural Parameter Estimates

1. Incidence on Wages
   - Expression: $\dot{w}$
   - Definitions:
     - Equation 10 defines $\dot{w}$ in terms of the structural parameters.
   - Data:
     - The data are those listed in section E.2.4.
   - Identification Assumptions:
     - The identification assumptions are those listed in section E.2.4.
   - Results in Table 7.

2. Incidence on Landowners
   - Expression: $\dot{r}$
   - Definitions:
     - Equation 11 defines $\dot{r}$ in terms of the structural parameters.
   - Data:
     - The data are those listed in section E.2.4.
   - Identification Assumptions:
     - The identification assumptions are those listed in section E.2.4.
   - Results in Table 7.

3. Incidence on Workers
   - Expression: $\dot{w} - \alpha\dot{r}$
   - Definitions:
     - Equation 10 defines $\dot{w}$ in terms of the structural parameters.
     - Equation 11 defines $\dot{r}$ in terms of the structural parameters.
   - Data:

- The data are those listed in section E.2.4.
- α is calibrated.

- Identification Assumptions:
  - The identification assumptions are those listed in section E.2.4.
- Results in Table 7.

4. Incidence on Firm Owners

- Expression: $1 + \gamma(\varepsilon^{PD} + 1)(\dot{w} - \frac{\delta}{\gamma})$
- Definitions:
  - Equation 10 defines $\dot{w}$ in terms of the structural parameters.
- Data:
  - The data are those listed in section E.2.4.
  - γ and $\frac{\delta}{\gamma}$ are calibrated. ε^{PD} is calibrated in some specifications (see Table).
- Identification Assumptions:
  - The identification assumptions are those listed in section E.2.4.
- Results in Table 7.

E.3 Robustness: Investment Tax Credit Changes

One concern is that concomitant investment incentives 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 A7 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. For further discussion on concerns regarding the tax base, such as the deductibility of federal corporate taxes and gross receipts taxes, see Appendix Section A.3.4.

E.4 Robustness: Incidence Estimates Using Reduced-Form Effects

In this section, we establish the robustness of the reduced-form incidence estimates for a few types of controls: (1) state tax base changes in E.4.1 and (2) controls for state political, fiscal policy, and economic condition in subsection E.4.2. We estimate the four main reduced-form effects – β^N, β^W, β^R, and β^E – using the specification in Equation 21 plus a given control. We then use those four reduced-form estimates to implement out incidence expressions in Table 1. To construct Appendix Table A19 Columns (1)-(12), we consecutively add the following controls to the baseline specification (i.e., Equation 21).[32]

E.4.1 State Tax Base Controls

1. Throwback rules. These rules eliminate "nowhere income" that would be untaxed by either the state with the corporation's nexus or the state in which the relevant sales were being made. Data from Bernthal et al. (2012).[33]

[32]For Column 13, we control for all of the tax base controls in Columns (1)-(12) other than Column 7. Column 7 uses a different tax rate that adjusts for federal deductibility (see equation 36), so to avoid using a different tax rate in the all controls specification in Column 13, we use the main tax rate and account for federal deductibility using an indicator for whether or not federal income tax is deductible in a given state-year in Column 13.

[33]See A.3.2 for additional details on data on throwback rules. Specifically, see footnote 4.

2. Combined reporting rules. An indicator of whether a state requires a unitary business to submit combined reporting. Data from Bernthal et al. (2012).[34]

3. Investment tax credit. This variable is the rate of the tax credit. Data from Chirinko and Wilson (2008).

4. Research and development tax credit. This variable is the statutory credit rate adjusted for recapture and type of credit. Data from Wilson (2009).

5. Loss carry-back rules. The number of years that a corporation may carry forward any excess loss following the loss year. Data from CCH (1980-2010).

6. Loss carry-forward rules. The number of years that a corporation may carry forward any excess loss following the loss year. Data from CCH (1980-2010).

7. Franchise Tax. An indicator for whether or not there exists a franchise tax in a given state-year. Data from CCH (1980-2010).

8. Federal Income Tax Deductible. An indicator for whether or not federal income tax is deductible in a given state-year. Data from CCH (1980-2010). To account for federal deductibility, we define the keep rate in for Column 7 of Appendix Table A19 as follows:

$$(1 - \tau_{s+fed,t}) = \begin{cases} 1 - \tau^c_{s,t} - \tau^c_{fed,t} & \text{if } I(FedDeductable)_{s,t} = 0 \\ (1 - \tau^c_{s,t})(1 - \tau^c_{fed,t}) & \text{if } I(FedDeductable)_{s,t} = 1 \end{cases} \tag{36}$$

   where $\tau^c_{fed,t}$ is the top U.S. statutory federal corporate tax from the University of Michigan World Tax Database.

9. Federal Income as State Tax Base. An indicator for whether or not federal income is used as the state tax base in a given state-year. Data from CCH (1980-2010).

10. Federal Accelerated Depreciation. An indicator for whether or not federal accelerated depreciation is allowed in a given state-year. Data from CCH (1980-2010).

11. Accelerated Cost Recovery System (ACRS) Depreciation. An indicator for whether or not ACRS is allowed in a given state-year. Data from CCH (1980-2010).

12. Federal Bonus Depreciation. An indicator for whether or not federal bonus depreciation is allowed in a given state-year. Data from CCH (1980-2010).

E.4.2 Controls for State Political, Fiscal Policy, and Economic Conditions

Similarly, to construct Appendix Table A20 Columns (1)-(10), we consecutively add the following controls to the baseline specification (i.e., Equation 21).

1. Political Controls. This specification includes indicators for political party. In particular, the specification is Equation 21 plus $\mathbb{I}(Gov = D)_{s,t} + \mathbb{I}(Gov = R)_{s,t} + \mathbb{I}(Gov = Indep)_{s,t}$.

2. Sales Tax Rate. This specification includes the state sales tax rate, i.e., Equation 21 plus $SalesTaxRate_{s,t}$.

3. Δ Sales Tax Rate. This specification includes the percentage change in the state sales tax rate over a 10 year period, i.e., Equation 21 plus $\ln SalesTaxRate_{s,t} - \ln SalesTaxRate_{s,t-10}$.

[34] See A.3.2 for additional details on data on combined reporting. Specifically, see footnote 4.

4. Income Tax Rate. This specification includes the state personal income tax rate, i.e., Equation 21 plus $IncomeTaxRate_{s,t}$.

5. Δ Income Tax Rate. This specification includes the percentage change in the state income tax rate over a 10 year period, i.e., Equation 21 plus $\ln IncomeTaxRate_{s,t} - \ln IncomeTaxRate_{s,t-10}$.

6. Δ Gov. Expend/capita. This specification includes the percentage change in government expenditures per capita, i.e., Equation 21 plus $\ln GovExpendPercapita_{s,t} - \ln GovExpendPercapita_{s,t-10}$.

7. Corporate Tax Rev. to GDP. This specification includes the corporate tax revenue share of GDP, i.e., Equation 21 plus $CorpTaxRevGDPratio_{s,t}$.

8. Δ Gov. Expend/capita and Corporate Tax Rev. to GDP. This specification is Equation 21 plus $\ln GovExpendPercapita_{s,t} - \ln GovExpendPercapita_{s,t-10}$ and $CorpTaxRevGDPratio_{s,t}$.

9. Bartik. This equation is the same as specification (4) in the main table. It is included for later iterations of this table, which use state statutory corporate tax rates and state fixed effects.

10. Gross Receipt Tax Control. This specification includes indicators for whether the state has a gross receipts tax. In particular, the specification is Equation 21 plus $\mathbb{I}(GRT)_{s,t}$.

To show that these results are robust to focusing on variation just from statutory state corporate tax rates, we provide estimates from each of the same 10 specifications in Appendix Table A21 for specifications with $\tau^c_{s,t'}$ in place of $\tau^b_{c,t'}$ for $t' \in \{t, t-10\}$ in the baseline Equation 21. We also provide Appendix Table A22, which uses the same specifications as Appendix Table A21, but also adjusts for federal corporate taxes and deductibility. As in Appendix Table A19, we use the keep rate definition in equation 36 for Appendix Table A22. Finally, we provide results for Equation 21 for each of our 10 controls but with state-fixed effects in Appendix Table A23.

E.4.3 Different Calibrated Parameter Values

We show how sensitive these tables are to different assumptions about the housing expenditure share α and the output elasticity ratio $\frac{\delta}{\gamma}$. Our baseline calibrated parameter values are $\alpha = .3$ for the housing expenditure share (using data from the Consumer Expenditure Survey) and $\frac{\delta}{\gamma} = .9$ for the output elasticity ratio (using data from the Bureau of Economic Analysis on gross output shares for private industries). Appendix Tables A24, A25, A26, and A27 provide iterations of Table 5 for the following calibrated parameter values: $\alpha \in \{.5, .65\}$ and $\frac{\delta}{\gamma} \in \{.75, .5\}$, respectively.

Finally, to obtain a sense of the range of the estimates for 'extreme' combinations, we run this incidence analysis for all of the combinations of parameter values in the paper, i.e., $\alpha \in \{0.3, 0.5, 0.65\}$ and $\frac{\delta}{\gamma} \in \{0.5, 0.75, 0.9\}$, for each of the specifications in the reduced-form incidence tables (i.e., Table A24-A27). Quantitatively, the extremes for each of the shares are: 0.175 - 0.374, 0.403 - 0.614, and 0.133 - 0.335 for workers, firm owners, and landowners, respectively.

E.5 CMD Estimation of the Simultaneous Equation Model

This section shows how we introduce Bartik shocks in section E.5.1 and both personal tax and Bartik shocks in section E.5.3 for the all shocks specifications.

E.5.1 CMD Estimation with Moments from Bartik Shocks

We interpret the Bartik as a proxy for changes in local productivity that may take three forms: a productivity shock to the housing supply, a mean productivity shock to the local area, or a shock to the average idiosyncratic productivity of the firms locating in a given area. In order to interpret the variation in this shock in each of the units of these three types of productivity, we estimate auxiliary parameters for the housing supply, labor demand, and establishment location equations as follows:

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

The auxiliary parameters $(\varphi, \varphi^h, \varphi^z)$ project the Bartik shock to each type of productivity shock.

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.5.2.

E.5.2 Equilibrium and Incidence Expressions with Bartik Shocks

$$\Delta \ln w_{c,t} = \phi_t^2 + (\dot{w}) \Delta \ln(1-\tau_{c,t}^b) + \frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi Bartik_{c,t} \tag{37}$$
$$- \frac{1}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^z Bartik_{c,t} + \left(\frac{\alpha\eta_c}{1+\eta_c-\alpha}\right) \frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^h Bartik_{c,t} + u_{c,t}^2$$

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

$$\Delta \ln r_{c,t} = \phi_t^3 + \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\dot{w}\right) \Delta \ln(1-\tau_{c,t}^b) + \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right) \frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi Bartik_{c,t} \tag{39}$$
$$- \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right) \frac{1}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^z Bartik_{c,t} + \left(\frac{\eta_c}{1+\eta_c-\alpha}\right) \frac{\varepsilon^{LS}(1-\varepsilon^{LD}\sigma_W)}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^h Bartik_{c,t} + u_{c,t}^3$$

$$\Delta \ln E_{c,t} = \phi_t^4 + \left(\frac{1}{-\sigma^F(\varepsilon^{PD}+1)} - \frac{\gamma}{\sigma^F}\dot{w}\right) \Delta \ln(1-\tau_{c,t}^b)$$
$$+ \left(\frac{1}{\sigma^F} - \frac{\gamma}{\sigma^F} \frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\right) \varphi Bartik_{c,t} + \frac{\gamma}{\sigma_F} \frac{1}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^z Bartik_{c,t} \tag{40}$$
$$- \frac{\gamma}{\sigma_F} \left(\frac{\alpha\eta_c}{1+\eta_c-\alpha}\right) \frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}} \varphi^h Bartik_{c,t} + u_{c,t}^4$$

E.5.3 CMD Estimation with Moments from Bartik and Personal Tax Shocks

We also can add personal tax shocks using similar steps. We incorporate personal taxes into the model in two new places: in the household problem (as mentioned in footnote 9) and in the housing market (as mentioned in footnote 11). In particular, for the household problem, we replace wages with after-tax wages:

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

This addition makes demand for varieties a function of personal tax rate $x_j = (1-\alpha)w(1-\tau^i)p_j^{\varepsilon^{PD}}$. Similarly, housing demand will have the same expenditure share, but lower total spending. Specifically, housing demand is $H_c^D = \frac{N_c \alpha w_c (1-\tau_c^i)}{r_c}$. Both of these amendments affect indirect utility:

$$V_{nc}^W = a_0 + \ln w_c(1-\tau^i) - \alpha \ln r_c + \ln A_{nc},$$

The second impact is on the supply of housing. As mentioned in footnote 11, housing supply that incorporates personal taxes is $H_c^S = (1-\tau^i)^{\chi^H}(B_c^H r_c)^{\eta_c}$. 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 a similar expression to equation 2:

$$\ln r_c = \frac{1}{1+\eta_c}\ln N_c + \frac{1}{1+\eta_c}\ln w_c - \frac{\eta_c}{1+\eta_c} B_c^H + \left(\frac{1}{1+\eta_c} - \chi^H\right)\ln(1-\tau_c^i) + a_1, \tag{41}$$

where the coefficient on the personal tax keep rate reflects both demand $\frac{1}{1+\eta_c}$ and supply forces $-\chi^H$.

With these two additions for personal taxes, we can define a new reduced-form that relates the matrix of tax and Bartik shocks $\mathbf{Z}_{c,t}$ to the same vector of outcomes $\mathbf{Y}_{c,t}$. Specifically, the shocks in our all shocks specification are:

$$\mathbf{Z}_{c,t} = \left[\Delta \ln(1-\tau^b_{c,t}) \quad \text{Bartik}_{c,t} \quad \Delta \ln(1-\tau^i_{c,t})\right],$$

The matrix $\mathbb{A}$ remains unchanged and the matrix $\mathbb{B}$ in Equation 17 is now given by:

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

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

$$\mathbf{Y}_{c,t} = \mathbb{A}^{-1}\mathbb{B}\mathbf{Z}_{c,t} + \mathbb{A}^{-1}\mathbf{e}_{c,t} \tag{42}$$

where

$$\mathbb{A}^{-1}\mathbb{B} = \left[\boldsymbol{\beta}^{\text{Business Tax}} \quad \boldsymbol{\beta}^{\text{Bartik}} \quad \boldsymbol{\beta}^{\text{Personal Tax}}\right], \ \mathbf{Y}_{c,t} = \begin{bmatrix} \Delta \ln w_{c,t} \\ \Delta \ln N_{c,t} \\ \Delta \ln r_{c,t} \\ \Delta \ln E_{c,t} \end{bmatrix}, \ \mathbb{A} = \begin{bmatrix} -\frac{1}{\sigma^W} & 1 & \frac{\alpha}{\sigma^W} & 0 \\ 1 & -\frac{1}{\varepsilon^{LD}} & 0 & 0 \\ -\frac{1}{1+\eta} & -\frac{1}{1+\eta} & 1 & 0 \\ \frac{\gamma}{\sigma^F} & 0 & 0 & 1 \end{bmatrix}.$$

The three vectors of reduced-form effects of the shocks, which are the three columns of the 4×3 matrix $\mathbb{A}^{-1}\mathbb{B}$ are the twelve moments that we use in the all shocks specification. Specifically, these three vectors are given by the following expressions.

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

$\boldsymbol{\beta}^{\text{Bartik}}$ is a vector of reduced-form effects of Bartik shocks in equations 37 38, 39, 40, i.e.,

$$\boldsymbol{\beta}^{\text{Bartik}} = \begin{bmatrix} \beta^{W,Bartik} \\ \beta^{N,Bartik} \\ \beta^{R,Bartik} \\ \beta^{E,Bartik} \end{bmatrix} = \begin{bmatrix} \left(\frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi - \frac{1}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^z + \left(\frac{\alpha\eta_c}{1+\eta_c-\alpha}\right)\frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^h\right) \\ \left(\varepsilon^{LS}\frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi - \frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^z + \left(\frac{\alpha\eta_c}{1+\eta_c-\alpha}\right)\frac{\varepsilon^{LS}\varepsilon^{LD}}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^h\right) \\ \Bigg(\left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right)\frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi - \left(\frac{1+\varepsilon^{LS}}{1+\eta_c}\right)\frac{1}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^z + \left(\frac{\eta_c}{1+\eta_c-\alpha}\right)\frac{\varepsilon^{LS}(1-\varepsilon^{LD}\sigma_W)}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^h\Bigg) \\ \Bigg(\left(\frac{1}{\sigma^F} - \frac{\gamma}{\sigma^F}\frac{\left(-(\varepsilon^{PD}+1)+\frac{1}{\sigma^F}\right)}{\varepsilon^{LS}-\varepsilon^{LD}}\right)\varphi + \frac{\gamma}{\sigma_F}\frac{1}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^z - \frac{\gamma}{\sigma_F}\left(\frac{\alpha\eta_c}{1+\eta_c-\alpha}\right)\frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}}\varphi^h\Bigg) \end{bmatrix},$$

and $\boldsymbol{\beta}^{\text{Personal Tax}}$ is a vector of reduced-form effects of personal tax shocks, i.e.,

$$\boldsymbol{\beta}^{\text{Personal Tax}} = \begin{bmatrix} \beta^{W,Personal\ Tax} \\ \beta^{N,Personal\ Tax} \\ \beta^{R,Personal\ Tax} \\ \beta^{E,Personal\ Tax} \end{bmatrix} = \begin{bmatrix} \left(\frac{-\alpha\chi^H(1+\eta)}{\sigma^F(\varepsilon^{LS}-\varepsilon^{LD})[\alpha+\sigma^W(1+\eta)]} - \frac{\varepsilon^{LS}}{\varepsilon^{LS}-\varepsilon^{LD}} \right) \\ \left(\frac{-\varepsilon^{LD}[1+\eta+\alpha(-1+\chi^H(1+\eta))]}{\sigma^F(\varepsilon^{LS}-\varepsilon^{LD})[\alpha+\sigma^W(1+\eta)]} \right) \\ \left(\frac{\chi^H(1+\eta)-\varepsilon^{LD}[\sigma^W(\chi^H\eta-\chi^H-1)-1]}{(\varepsilon^{LS}-\varepsilon^{LD})[\alpha+\sigma^W(1+\eta)]} \right) \\ \left(\frac{-\gamma[1+\eta+\alpha(-1+\chi^H(1+\eta))]}{\sigma^F(\varepsilon^{LS}-\varepsilon^{LD})[\alpha+\sigma^W(1+\eta)]} \right) \end{bmatrix}.$$

E.5.4 Model Fit

We evaluate the fit of our model by comparing the estimated reduced-form effects to the predictions of our model. Table A32 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 6. 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 6, 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.6 Single-Equation Estimates of Labor Supply, Housing Supply, and Establishment Location

In this subsection, 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 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.6.1 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:

$$\Delta \ln N_{c,t} = \frac{\Delta \ln w_{c,t} - \alpha \Delta \ln r_{c,t}}{\sigma^W} + \frac{\Delta \bar{A}_{c,t}}{\sigma^W}. \tag{43}$$

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:

$$\Delta \ln N_{c,t} = \beta^{LS} \Delta \ln \text{Real Wage}_{c,t} + \mathbf{D}'_{s,t} \boldsymbol{\Psi}^{LS}_{s,t} + \nu^{LS}_{c,t} \tag{44}$$

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 $\nu_{c,t}^{LS}$ is the error term. From Equation 43, 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 $\Delta \ln(1-\tau_{c,t}^c)$. The exclusion restriction is that workers only value changes in labor demand and corporate taxes only through their effects on the real wage.[35]

Table A33 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 A16 depicts the relationship of these estimates to worker mobility. Figure A16 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.6.2 Housing Market

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

$$\Delta \ln r_{c,t} = \beta^{HM}(\Delta \ln N_{c,t} + \Delta \ln w_{c,t}) + \mathbf{D}_{s,t}' \mathbf{\Psi}_{s,t}^{HM} + \nu_{c,t}^{HM} \tag{45}$$

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 A33 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

[35] 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.

of parameters from previous studies including those in Notowidigdo (2013) and Suárez Serrato and Wingender (2011).[36]

E.6.3 Establishment Location and Labor Demand

Log differencing Equation 7 we obtain the following equation:

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

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:

$$\Delta \ln E_{c,t} = \beta^{ES}\Delta \ln(1 - \tau^b_{c,t}) + \beta^{ES}_2 \Delta \ln w_{c,t} + \mathbf{D}'_{s,t}\mathbf{\Psi}^{ES}_{s,t} + \nu^{ES}_{c,t}. \quad (46)$$

If both changes in wages and changes in taxes are exogenous, Equation 46 shows that β^{ES} would be related to $\frac{1}{-(\varepsilon^{PD}+1)\sigma^F}$ and that a coefficient on wages β^{ES}_2 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 A33 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 $\beta^{ES}_2 = 0$). 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 establishment growth as reported in Table 4, Column 4. The estimation of the parameter σ^F from this equation is presented in Section E.6.4.

E.6.4 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.[37] 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:

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

[36] 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.

[37] 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)).

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:

$$m(\boldsymbol{\theta}) \equiv \underbrace{\frac{1}{-(\varepsilon^{PD}+1)\sigma^F}}_{\text{LowerTaxes}} \underbrace{-\left(\frac{\gamma}{\sigma^F}\right)\dot{w}(\boldsymbol{\theta})}_{\text{Higher Wages}} \tag{47}$$

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 47. 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 A17 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.[38] 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.

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.

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

[38]The results of these regressions are also presented in table form in Table A33.

government services ϕ and the change in services provided. We use the results from Suárez Serrato and Wingender (2011) with an estimate of $\phi = 0.45$.[39] Government services are provided by local workers such that $\dot{GS}_c$ is determined by changes in expenditure on services as well as changes in the wages of local workers. That is, $\dot{GS}_c = \dot{Exp}_c^{GS} - \dot{w}_c$. We implement this equation empirically with:

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

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 $\nu = 0.27$.[40] Infrastructure Z_c is assumed to be imported and does not require the hiring of local workers so that $\dot{Z}_c = \dot{Exp}_c^Z$.

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 A2 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

[39] 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%.

[40] 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%.

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 A2: 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
Workers	0.68	0.25	0.68	0.29
Firm Owners	0.81	0.81	0.71	0.8
Share of Incidence				
Landowners	18%	23%	19%	23%
Workers	38%	18%	40%	21%
Firm Owners	45%	59%	41%	57%

G Accounting for Changes in Local Prices

This section amends the model and incidence estimates to account for changes in local prices (i.e., the price of non-housing, non-traded goods). We present modified incidence expressions and discuss how the results change. We then provide additional detail on how we amend the demand and supply components of the model to derive the modified incidence expressions.

G.1 Incidence Estimates that Account for Non-traded Goods

With local goods, the welfare effects of a tax cut in location c on the welfare of workers are similar to the expression in equation 13. The part of the expression that accounts for local increases in rental prices, $(\alpha\dot{r}_c)$, is replaced with $(\alpha^H\dot{r}_c + \alpha^{NT}\dot{p}_c^{NT})$:

$$\frac{d\mathcal{V}^W}{d\ln(1-\tau_c^c)} = N_c(\dot{w}_c - \alpha^H\dot{r}_c + \alpha^{NT}\dot{p}_c^{NT}) \tag{48}$$

$$= N_c(\beta^W - \alpha^H\beta^R + \alpha^{NT}\beta^{NT}), \tag{49}$$

where α^H is the expenditure share on housing and $\alpha^N T$ is the expenditure share on non-housing, non-traded goods. For firm owners and landowners, the expressions are the same as in 14 and 15.[41]

We implement these modified incidence expressions in four ways. First, we use the local price index from ACCRA instead of β^R in our baseline approach, i.e., the welfare for workers is measured as follows: $\beta^W - .3\beta^{P,ACCRA}$. Mian and Sufi (2016) show that on an employment basis in their main trade-based classification of industries, non-tradable industries account for 20% of employment and construction accounts for 11% of employment. However, other work uses larger shares for expenditure on local goods. In the second implementation, we consider a larger value of $\alpha = .6$ from Beraja, Hurst and Ospina (2016).[42] In this case, the incidence expression for workers is $\beta^W - .6\beta^{P,ACCRA}$. Third, we split local goods into housing and non-traded, non-housing goods using local expenditure shares from Beraja, Hurst and Ospina (2016), resulting in the following expression for worker welfare: $\beta^W - .2\beta^{P,ACCRA,residual} - .4\beta^{P,ACCRA,NT}$ where $\beta^{P,ACCRA,residual}$ is the reduced-form impact on the portion of the local price index that is not categorized as non-traded. It is calculated using weights in the ACCRA formulas that put .47 on the items in $\beta^{P,ACCRA,NT}$, which implies $\beta^{P,ACCRA,residual} = \frac{\beta^{P,ACCRA} - .47\times\beta^{P,ACCRA,NT}}{(1-.47)}$. Finally, for the fourth importation, we use a different measure of local prices from the BLS and measure the welfare effects for workers as $\beta^W - .3\beta^{P,BLS}$.

Table A3 shows the results of accounting for local prices. We find similar estimates to our baseline results when accounting for changes in local prices. Columns (1)-(4) implement the four approaches using the reduced-form effects of local business tax cuts that control for Bartik; Columns (5)-(8) implement the same four approaches using the reduced-form effects that do not control for Bartik (i.e., column (1) of the reduced-form outcome tables). In particular, Column (1) shows the incidence on workers is $.78 - .3 \times .16 = .73$ where .78 is from the Bartik specification (i.e., Column (4)) in Table A7 and .16 is from the Bartik specification in Table A12. Column (2) uses a higher value of α, but the same reduced-form effects as the first column, resulting in a slightly lower impact on workers of, $.78 - .6 \times .16 = .68$. Column (3) shows that separating local goods into a non-traded group and a residual produces similar results. We use the reduced-form impacts from Tables A12 and A13 to implement the third approach: $\beta^W - .2\beta^{P,ACCRA,residual} - .4\beta^{P,ACCRA,NT} = .78 - .2\times.28 - .4\times.02 = .66$.[43] Finally, Column (4) uses a different measure of local prices P^{BLS}, for which the reduced-form impacts are reported in Table A14. This alternative measure is notably similar to our baseline that uses the change in rental prices. Columns (5)-(8) repeat the same calculations using slightly different inputs from the respective reduced-form tables. Overall, local price increases are modest over a ten year period. Accounting for these impacts results in similar incidence results to our baseline estimates.

[41] We also show below (in section G.2.2) that we can use $\dot{\pi}_c = 1 + Avg\dot{S}ales_c$ to measure incidence in terms of sales rather than in terms of cost. The resulting estimates are similar (e.g., compare the estimate from Column (1) in Table A15 with the incidence estimates on firm owners that use reduced-form estimates from the same specification such as those in Column (1) of Table 5). We primarily focus on the cost-based estimates for firm owners since they are more precise than those in Table A15, but these results provide further support for the conclusion that firm owners bear a substantial share of the incidence of business tax cuts.

[42] See Tables A24 and A25 for our baseline specification for $\alpha = .5$ and $\alpha = .65$, respectively.

[43] Note that $.28 = \beta^{P,ACCRA,residual} = \frac{\beta^{P,ACCRA} - .47\times\beta^{P,ACCRA,NT}}{(1-.47)}$.

Table A3: Incidence Estimates Accounting for Changes in Local Prices

	A. Using Reduced-Form Estimates w/ Bartik Controls				B. Using Reduced-Form Estimates w/o Bartik Controls			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Incidence								
Landowners	0.32	0.32	0.32	0.32	1.17	1.17	1.17	1.17
Workers	0.73	0.68	0.66	0.52	1.34	1.22	1.18	1.08
Firm Owners	0.81	0.81	0.81	0.81	1.63	1.63	1.63	1.63
Share of Incidence								
Landowners	17.2%	17.6%	17.9%	19.4%	28.3%	29.1%	29.4%	30.2%
Workers	39.3%	37.7%	37.0%	31.6%	32.3%	30.4%	29.7%	27.7%
Firm Owners	43.5%	44.7%	45.2%	49.0%	39.4%	40.5%	41.0%	42.1%
Local Price Index	P^{ACCRA}	P^{ACCRA}	$P^{ACCRA,NT}$	P^{BLS}	P^{ACCRA}	P^{ACCRA}	$P^{ACCRA,NT}$	P^{BLS}
Parameters								
α	0.3	0.6		0.3	0.3	0.6		0.3
α^H			0.2				0.2	
α^{NT}			0.4				0.4	

NOTES: This table shows incidence of local business tax changes over ten years on landowners, firm owners, and workings using different measures of local prices. Local price data are described in Appendix A.4. The first four columns show incidence results based on reduced-form estimates from Column 4 in Table 4-type tables, which controls for Bartik, for all the relevant outcomes in the incidence expressions in equations 48, 14, and 15. The last four columns repeat the same specifications but use the reduced-form estimates from Column 1 in Table 4-type tables, which does not control for Bartik. Specifically, Column (1) and (5) calculate the incidence on workers by taking the difference between the reduced-form impact on wages and $\alpha\hat{\beta}^{P,ACCRA}$ from Tables A7 and A12. For example, the worker estimate in Column (1), which corresponds to the specification controlling for Bartik, is $\hat{\beta}^{W} - \alpha\hat{\beta}^{P,ACCRA} = .78 - .3 \times .16 = .73$ and for Column (5), which corresponds to the specification not controlling for Bartik, is $\hat{\beta}^{W} - \alpha\hat{\beta}^{P,ACCRA} = 1.45 - .3 \times .38 = 1.34$. Column (2) and (6) use an α of .6 instead of .3. Columns (3) and (7) break out traded and non-traded ACCRA price indexes and to present estimates of $\beta^{W} - .2\beta^{P,ACCRA,residual} + .4\beta^{P,ACCRA,NT}$ where $\beta^{P,ACCRA,residual}$ is the ACCRA local price index on items not covered in the NT index. It is calculated using weights in the ACCRA formulas that put .47 on the items in $\beta^{P,ACCRA,NT}$, which implies $\beta^{P,ACCRA,residual} = \frac{\beta^{P,ACCRA} - .47 \times \beta^{P,ACCRA,NT}}{(1-.47)}$. These estimates are from Tables A12 and A13. The expenditure weight of .6, which is divided into .2 and .4, is based on estimates from Beraja, Hurst and Ospina (2016) on the share of total local consumption (.6) and the share of housing consumption (.2), which they assume is entirely local. Finally, Columns (4) and (8) use an alternative local price index from BLS, which isn't available for all locations but covers a large share of the population. In particular, the estimates for workers are $\hat{\beta}^{W} - \alpha\hat{\beta}^{P,BLS}$ and the reduced-form estimates for local prices $\beta^{P,BLS}$ are in Table A14.

G.2 Deriving Incidence Expressions that Account for Non-traded Goods

G.2.1 Demand with Non-traded Goods

In location c with amenities A, households maximize Cobb-Douglas utility over housing h, a composite X^{NT} of local (non-housing non-traded) goods x_j^{NT}, a composite X of tradable goods x_j while facing a wage w, rent r, local good prices p_j^{NT}, and traded good prices p_j:

$$\max_{h,x^{NT},X} \quad \ln A + \alpha^H \ln h + \alpha^{NT} \ln X^{NT} + (1-\alpha^H-\alpha^{NT}) \ln X \;\; s.t. \;\; rh + \sum_{j\in J^{NT}} p_j^{NT} x_j^{NT} + \sum_{j\in J} p_j x_j dj = w,$$

where $X^{NT} = \left(\sum_{j\in J^{NT}} (x_j^{NT})^{\frac{\epsilon^{PD,NT}+1}{\epsilon^{PD,NT}}} dj \right)^{\frac{\epsilon^{PD,NT}}{\epsilon^{PD,NT}+1}}$, $X = \left(\sum_{j\in J} x_j^{\frac{\varepsilon^{PD}+1}{\varepsilon^{PD}}} dj \right)^{\frac{\varepsilon^{PD}}{\varepsilon^{PD}+1}}$, and $\epsilon^{PD,NT} < -1$ is the product demand elasticity of local goods.

Demand from each household for local variety j in location c is:

$$x_{jc}^{NT} = (p_{jc}^{NT})^{\epsilon^{PD,NT}} I_c^{NT} (P_{jc}^{NT})^{1+\epsilon^{PD,NT}} \tag{50}$$

where $P_c^{NT} = \left(\sum_{j\in J_c^{NT}} E_c^{NT} (p_{jc}^{NT})^{1+\varepsilon^{PD}} \right)^{\frac{1}{1+\varepsilon^{PD}}}$, E_c^{NT} is the number of non-traded establishments, and $I_c^{NT} = \alpha^{NT} N_c w_c$ is total expenditures on local goods.

G.2.2 Supply of Non-traded Goods

Similar to the baseline firm problem, establishments in location c maximize profits over inputs and prices p_{jc}^{NT} 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:

$$\pi_{jc}^{NT} = \max_{l_{jc},k_{jc},x_{v,jc},p_{jc}^{NT}} \; (1-\tau_c^b) \left(p_{jc}^{NT} x_{jc}^{NT} - w_c l_{jc} - \int_{v\in J} p_v x_{v,jc} dv \right) - \rho k_{jc}, \tag{51}$$

Following the same input demand steps in appendix B.2, we can relate sales to unit costs:

$$\underbrace{p_j^{NT} x_j^{NT}}_{\equiv Sales_{jc}^{NT}} = x_j^{NT} \mu^{NT} \underbrace{\frac{1}{B_{jc}} \left[w^\gamma \rho^\delta \gamma^{-\gamma} \delta^{-\delta} (1-\gamma-\delta)^{-(1-\gamma-\delta)} \right]}_{\equiv c_{jc}} \tag{52}$$

This expression shows that local prices are a fixed-mark up over unit costs, $p_j^{NT} = \mu^{NT} c_{jc}$ where the markup on local goods $\mu^{NT} \equiv \left[\frac{1}{\varepsilon^{PD,NT}} + 1\right]^{-1}$ is constant due to CES demand. Since local prices are a fixed-mark up over unit costs, we can express after tax profits as follows:

$$\pi_{jc}^{NT} = (1-\tau_c^b)\left(p_{jc}^{NT} - c_{jc}\right) x_{jc}^{NT} \tag{53}$$

$$\pi_{jc}^{NT} = (1-\tau_c^b)\left(p_{jc}^{NT} - c_{jc}\right) \frac{Sales_{jc}^{NT}}{p_{jc}^{NT}} \tag{54}$$

$$\pi_{jc}^{NT} = (1-\tau_c^b)\left(\mu^{NT} c_{jc} - c_{jc}\right) \frac{Sales_{jc}^{NT}}{\mu^{NT} c_{jc}} \tag{55}$$

$$\pi_{jc}^{NT} = (1-\tau_c^b) \frac{Sales_{jc}^{NT}}{-\varepsilon^{PD,NT}} \tag{56}$$

where the second line comes from the definition of sales, the third line comes from the relationship between prices and costs (from equation 52) and the fourth line comes from the definition of the markup. Similar steps imply that we can express after tax profits for traded-establishments as $\pi_{jc}^{T} = (1-\tau_c^b)\frac{Sales_{jc}}{-\varepsilon^{PD,T}}$.

Therefore total after-tax firm profits is:

$$E_c^T \bar{\pi}_{jc}^T + E_c^{NT} \bar{\pi}_{jc}^{NT} = (1-\tau_c^b)\left(E_c^T \frac{AvgSales_{jc}^T}{-\varepsilon^{PD,T}} + E_c^{NT} \frac{AvgSales_{jc}^{NT}}{-\varepsilon^{PD,NT}}\right) \tag{57}$$

$$= (1-\tau_c^b)\left(\frac{TotSales_c^T}{-\varepsilon^{PD,T}} + \frac{TotSales_c^{NT}}{-\varepsilon^{PD,NT}}\right) \tag{58}$$

$$= (1-\tau_c^b) TotSales_c \left(\frac{TotSales_c^T}{TotSales_c} \frac{1}{-\varepsilon^{PD,T}} + \frac{TotSales_c^{NT}}{TotSales_c} \frac{1}{-\varepsilon^{PD,NT}}\right) \tag{59}$$

This expression shows that total sales changes reveal information about changes in total profits. In the simple case in which the product demand elasticities are the same, then the term in parenthesis is $\frac{1}{-\varepsilon^{PD}}$ and the average after-tax profit per establishment is: $\bar{\pi}_c^T = (1-\tau_c^b)\left(\frac{AvgSales_c}{-\varepsilon^{PD}}\right)$. In the case in which the product demand elasticities are different, the term in parenthesis will be constant (since the sales shares will be constant due to Cobb Douglas preferences and production technology.) Therefore, in both cases, $\dot{\pi}_c = 1 + Avg\dot{S}ales_c$. We can use this expression to quantity $\dot{\pi}_c$ when there are both traded and non-traded goods.

Table A4: Correlation in State Tax Rates

A. Tax Rates

	τ_s^c	τ_s^{sales}	τ_s^i	τ_s^{prop}
τ_s^c	1.000			
τ_s^{sales}	0.008	1.000		
τ_s^i	0.323	-0.257	1.000	
τ_s^{prop}	0.113	-0.030	0.012	1.000

B. 10 Year Differences in Tax Rates

	$\Delta\tau_s^c$	$\Delta\tau_s^{sales}$	$\Delta\tau_s^i$	$\Delta\tau_s^{prop}$
$\Delta\tau_s^c$	1.000			
$\Delta\tau_s^{sales}$	0.315	1.000		
$\Delta\tau_s^i$	0.078	-0.007	1.000	
$\Delta\tau_s^{prop}$	-0.046	-0.191	-0.176	1.000

Notes: This table shows the correlation between tax rates in levels (in Panel A) and changes (in Panel B). See Section 4 for data sources for τ_s^{corp} and τ_s^i. State sales tax rates come from the Book of the States, Table 7.10. The variable is the general sales and gross receipts tax (percent). For property taxes, we use U.S. Censuses as well as the 2009 ACS to obtain an estimate of average property tax liability at the state level. The ratio of these tax liabilities to self reported home values is our estimate of the property tax rate.

Table A5: 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 A6: 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

NOTES: See notes from Table 4.

Table A7: 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

NOTES: See notes from Table 4.

Table A8: 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

NOTES: See notes from Table 4.

Table A9: 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

NOTES: See notes from Table 4.

Table A10: Effects of Business Tax Cuts on Growth in GOS per Establishment over 10 Years

Growth in GOS per establishment	(1)	(2)	(3)	(4)	(5)	(6)
Δ ln Net-of-Business-Tax Rate	4.07**	3.92*	4.08*	3.66*	4.20**	3.50*
	(2.02)	(2.02)	(2.03)	(2.00)	(1.95)	(1.95)
Δ State ITC		1.05***				1.06***
		(0.27)				(0.32)
Δ ln Gov. Expend./Capita			0.00			0.00
			(0.00)			(0.00)
Bartik				0.34		0.42*
				(0.22)		(0.22)
Change in Other States' Taxes					3.63	2.47
					(2.33)	(2.21)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.138	0.172	0.138	0.150	0.149	0.196

NOTES: This table shows the effects of local business tax changes over ten years on gross operating surplus (GOS) per establishment. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. GOS data are from BEA regional statistics. See Section 4 for other data sources used in the table. The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A11: Effects of Business Tax Cuts on Growth in Sales Tax Revenue over 10 Years

Growth in sales tax revenue per establishment	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln$ Net-of-Business-Tax Rate	2.26	2.24	2.27	2.27	2.16	2.15
	(3.42)	(3.43)	(3.42)	(3.44)	(3.37)	(3.41)
Δ State ITC		0.09				0.23
		(0.33)				(0.31)
$\Delta \ln$ Gov. Expend./Capita			0.01			0.01
			(0.01)			(0.01)
Bartik				-0.01		-0.01
				(0.30)		(0.30)
Change in Other States' Taxes					-3.82	-4.12
					(2.57)	(2.47)
Observations	1,422	1,422	1,422	1,422	1,422	1,422
R-squared	0.539	0.539	0.539	0.539	0.543	0.544

NOTES: This table shows the effects of local business tax changes over ten years on state sales tax revenue per establishment. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups, but not all states collect sales taxes so the number of observations has 16 fewer county-groups per decade. Sales tax revenue is from the census of governments. See Section 4 for other data sources used in the table. The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A12: Effects of Business Tax Cuts on Growth in Local Price Index (ACCRA) over 10 Years

Growth in Price Index (ACCRA)	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln$ Net-of-Business-Tax Rate	0.38	0.36	0.38	0.16	0.29	0.01
	(1.39)	(1.38)	(1.39)	(1.51)	(1.43)	(1.55)
Δ State ITC		0.20				0.33
		(0.19)				(0.21)
$\Delta \ln$ Gov. Expend./Capita			-0.00			-0.00
			(0.00)			(0.00)
Bartik				0.22*		0.23**
				(0.11)		(0.11)
Change in Other States' Taxes					-2.12	-2.34
					(1.79)	(1.76)
Observations	1,201	1,201	1,201	1,201	1,201	1,201
R-squared	0.119	0.121	0.119	0.129	0.127	0.142

NOTES: This table shows the effects of local business tax changes over ten years on growth in the ACCRA price index. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups, but some local areas are not covered by ACCRA. See Appendix A.4 for data details on local prices and Section 4 for other data sources. The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A13: Effects of Business Tax Cuts on Growth in Local Non-traded Price Index (ACCRA) over 10 Years

Growth in Local Non-traded Price Index (ACCRA)	(1)	(2)	(3)	(4)	(5)	(6)
Δ ln Net-of-Business-Tax Rate	0.11	0.08	0.12	0.02	0.10	-0.06
	(0.88)	(0.86)	(0.88)	(0.91)	(0.89)	(0.92)
Δ State ITC		0.34**				0.39**
		(0.15)				(0.15)
Δ ln Gov. Expend./Capita			0.00			0.00
			(0.00)			(0.00)
Bartik				0.09		0.11**
				(0.06)		(0.05)
Change in Other States' Taxes					-0.33	-0.63
					(1.24)	(1.07)
Observations	1,201	1,201	1,201	1,201	1,201	1,201
R-squared	0.055	0.068	0.056	0.058	0.055	0.076

NOTES: This table shows the effects of local business tax changes over ten years on growth in the ACCRA non-traded price index. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups, but some local areas are not covered by ACCRA. See Appendix A.4 for data details on local prices and Section 4 for other data sources The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A14: Effects of Business Tax Cuts on Growth in Local Price Index (BLS) over 10 Years

Growth in Local Price Index (BLS)	(1)	(2)	(3)	(4)	(5)	(6)
Δ ln Net-of-Business-Tax Rate	1.25	1.35	1.27	0.86	1.19	1.06
	(0.92)	(0.87)	(0.91)	(0.81)	(0.94)	(0.79)
Δ State ITC		-0.30***				-0.27**
		(0.09)				(0.11)
Δ ln Gov. Expend./Capita			0.00***			0.00**
			(0.00)			(0.00)
Bartik				0.22***		0.18**
				(0.07)		(0.07)
Change in Other States' Taxes					-0.50	0.17
					(1.31)	(1.13)
Observations	714	714	714	714	714	714
R-squared	0.323	0.373	0.327	0.363	0.327	0.400

NOTES: This table shows the effects of local business tax changes over ten years on growth in the BLS local price index. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups, but not all states are covered by the BLS local price index. See Appendix A.4 for data details on local prices and Section 4 for other data sources. The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A15: Effects of Business Tax Cuts on Growth in Single-State Establishments over 10 Years

Single-State Establishment Growth	(1)	(2)	(3)	(4)	(5)	(6)
Δ ln Net-of-Business-Tax Rate	4.32**	3.55**	4.30**	4.37**	4.17**	3.42**
	(1.89)	(1.47)	(1.90)	(1.87)	(1.85)	(1.47)
Bartik		0.63***				0.62***
		(0.19)				(0.18)
Δ ln Gov Expend/Capita			-0.01			-0.01
			(0.01)			(0.01)
Δ State ITC				-0.35		-0.06
				(0.29)		(0.28)
Change in Other States' Taxes					-4.20**	-3.84**
					(1.70)	(1.55)
Observations	1,470	1,470	1,470	1,470	1,470	1,470
R-squared	0.429	0.452	0.430	0.431	0.437	0.461

NOTES: This table shows the effects of local business tax changes over ten years on growth in the number of single-state establishments. The data are decade changes from 1980-1990, 1990-2000, and 2000-2010 for 490 county-groups. See Section 4 for data sources and Section A.5 for details on the construction of our single-state establishment data. The specifications are exactly the same as in Table 4. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A16: Implied Structural Parameter Estimates Using Reduced-Form Effects

	(1)	(2)	(3)	(4)
Productivity Dispersion σ_F	-.09*	-.06	-.23	-.44
	(.05)	(.07)	(.21)	(.44)
Preference Dispersion σ_W	.26	.18	.64	1.12
	(.17)	(.18)	(.98)	(1.71)
Housing Supply η	3.88	13.01	.64	1.09
	(5.24)	(57.42)	(1.1)	(1.15)
Product Demand ε^{PD}	7.59	10.01	5.66	4.8
	(6.25)	(13.01)	(4.76)	(3.15)
Test of Restriction				
P-value of $\beta^E = \beta^N - (\gamma(\varepsilon^{PD}+1)-1)\beta^W$	.12	.27	.22	.2
Specifications				
Net-of-Business Tax	Y	Y	Y	N
Net-of-Corporate Tax	N	N	N	Y
Bartik Control	N	Y	Y	Y
Net-of-Personal Tax Control	N	N	Y	Y

NOTES: This table shows the implied structural parameter estimates associated with the reduced-form effects underlying the incidence results in Table 5. Column (1) corresponds to the reduced-form effects from Columns (1)-(3) of Table 5. Recall that these columns use the same reduced-form effects with different calibrated parameter values, which results in the same implied structural parameters (other than for $\hat{\sigma}_W = .16(.13)$ in the specification that corresponds to Column (2) of Table 5, i.e., the specification with the same reduced-form effects as Column (1) but with $\alpha = .65$). Column (2), (3), and (4) in this table correspond to Column (4), (5), and (6) of Table 5, respectively. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A17: Estimates of Economic Incidence Using Reduced-Form Effects (Only Single-State Establishments)

	A. Incidence						B. Share of Incidence					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Landowners	1.17	1.17	1.17	.32	1.86	.62	.29	.33	.26	.18	.42**	.29*
	(1.43)	(1.43)	(1.43)	(1.36)	(1.56)	(.6)	(.18)	(.23)	(.19)	(.47)	(.17)	(.16)
Workers	1.1*	.69	1.1*	.68	.98	.58*	.28***	.19	.24***	.38	.22*	.28***
	(.59)	(.44)	(.59)	(.52)	(.84)	(.33)	(.09)	(.16)	(.07)	(.48)	(.12)	(.08)
Firmowners	1.71*	1.71*	2.23**	.79	1.57	.9**	.43***	.48***	.5***	.44***	.36***	.43***
	(.99)	(.99)	(.99)	(1.58)	(.97)	(.35)	(.11)	(.09)	(.16)	(.16)	(.08)	(.09)
Conventional View Test												
χ^2 of ($S^W = 100\%$ & $S^F = 0\%$)							160.50	110.78	56.94	4.03	81.33	223.27
P-value							0.00	0.00	0.00	0.04	0.00	0.00
Specification												
Net-of-Business Tax	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N
Net-of-Corporate Tax	N	N	N	N	N	Y	N	N	N	N	N	Y
Housing share α	.3	.65	.3	.3	.3	.3	.3	.65	.3	.3	.3	.3
Output elasticity ratio δ/γ	.9	.9	.5	.9	.9	.9	.9	.9	.5	.9	.9	.9
Bartik Control	N	N	N	Y	Y	N	N	N	N	Y	Y	N
Net-of-Personal Tax Control	N	N	N	N	Y	N	N	N	N	N	Y	N

NOTES: This table, which is analogous to Table 5, uses changes in single-state establishments (i.e., using the estimates in Table A15 instead of Panel A of Table 4). See Section A.5 for details on the construction of our single-state establishment data.

Table A18: Estimates of Economic Incidence Using Reduced-Form Effects (with Employment instead of Population)

	A. Incidence						B. Share of Incidence					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Landowners	1.17	1.17	1.17	.32	1.86	.62	.3*	.33	.27	.17	.4**	.3**
	(1.43)	(1.43)	(1.43)	(1.36)	(1.56)	(.6)	(.18)	(.23)	(.19)	(.5)	(.16)	(.15)
Workers	1.1*	.69	1.1*	.68	.98	.58*	.28***	.2	.25***	.37	.21*	.28***
	(.59)	(.44)	(.59)	(.52)	(.84)	(.33)	(.1)	(.16)	(.08)	(.36)	(.11)	(.09)
Firmowners	1.65	1.65	2.11*	.85	1.77	.85*	.42***	.47***	.48***	.46***	.38***	.42***
	(1.04)	(1.04)	(1.13)	(1.11)	(1.38)	(.5)	(.11)	(.09)	(.16)	(.15)	(.07)	(.07)
Conventional View Test												
χ^2 of ($S^W = 100\%$ & $S^F = 0\%$)							140.55	95.74	62.3	19.15	144.68	1321.58
P-value							0.00	0.00	0.00	0.00	0.00	0.00
Specification												
Net-of-Business Tax	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N
Net-of-Corporate Tax	N	N	N	N	N	Y	N	N	N	N	N	Y
Housing share α	.3	.65	.3	.3	.3	.3	.3	.65	.3	.3	.3	.3
Output elasticity ratio δ/γ	.9	.9	.5	.9	.9	.9	.9	.9	.5	.9	.9	.9
Bartik Control	N	N	N	Y	Y	N	N	N	N	Y	Y	N
Net-of-Personal Tax Control	N	N	N	N	Y	N	N	N	N	N	Y	N

NOTES: This table, which is analogous to Table 5, uses employment changes rather than population changes (i.e., using the estimates in Table A9 instead of A6).

Table A19: Incidence Estimates Using Reduced-Form Effects, Business Tax Changes (Tax Base Controls)

Panel (a) Incidence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Workers $\dot{w} - \alpha\dot{r}$	1.19*	1.12*	1.1*	1.16**	1.13*	1.05*	1.07**	.81**	1.35**	1.33**	1.02	1.21**	1.32**
	(.62)	(.6)	(.59)	(.59)	(.63)	(.62)	(.49)	(.34)	(.58)	(.58)	(.64)	(.59)	(.58)
Landowners $\dot{r}$	1.39	1.04	1.21	1.08	1.19	2.03	1.15	.38	1.68	1.67	.29	1.21	2.21*
	(1.44)	(1.45)	(1.47)	(1.46)	(1.49)	(1.32)	(1.32)	(.82)	(1.35)	(1.43)	(1.89)	(1.46)	(1.25)
Firmowners $\dot{\pi}$	1.94*	1.61*	1.63*	1.76*	1.51*	1.65**	1.59*	1.02**	1.68*	1.95**	1.17	1.65*	1.82***
	(1.05)	(.92)	(.89)	(.95)	(.79)	(.84)	(.84)	(.41)	(.86)	(.91)	(.8)	(.88)	(.69)

Panel (b) Shares of Incidence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Worker Share	.26***	.3***	.28***	.29***	.29***	.22***	.28***	.37**	.29***	.27***	.41	.3***	.25***
	(.08)	(.11)	(.09)	(.1)	(.11)	(.07)	(.1)	(.15)	(.08)	(.08)	(.35)	(.1)	(.08)
Landowner Share	.31*	.28	.31	.27	.31	.43***	.3	.17	.36**	.34**	.12	.3	.41***
	(.16)	(.21)	(.19)	(.2)	(.21)	(.11)	(.2)	(.27)	(.15)	(.16)	(.63)	(.2)	(.11)
Firmowner Share	.43***	.43***	.41***	.44***	.4***	.35***	.42***	.46***	.36***	.39***	.47	.41***	.34***
	(.1)	(.12)	(.12)	(.12)	(.13)	(.08)	(.12)	(.12)	(.1)	(.11)	(.29)	(.12)	(.06)
Conventional View Test													
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)	147.34	137.85	130.74	164.57	96.42	122.84	156.19	403.29	99.66	130.04	92.65	142.7	160.25
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Specifications													
Throwback Tax Rule	Y	N	N	N	N	N	N	N	N	N	N	N	Y
Combined Reporting	N	Y	N	N	N	N	N	N	N	N	N	N	Y
INvestment Tax Credit	N	N	Y	N	N	N	N	N	N	N	N	N	Y
R&D Tax Credit Rate	N	N	N	Y	N	N	N	N	N	N	N	N	Y
Loss carry-back rules	N	N	N	N	Y	N	N	N	N	N	N	N	Y
Loss carry-forward rules	N	N	N	N	N	Y	N	N	N	N	N	N	Y
Franchise Tax	N	N	N	N	N	N	Y	N	N	N	N	N	Y
Federal Income Tax Deductible Controls	N	N	N	N	N	N	N	Y	N	N	N	N	Y
Federal Income as State Tax Base	N	N	N	N	N	N	N	N	Y	N	N	N	Y
Federal Accelerate Depreciation	N	N	N	N	N	N	N	N	N	Y	N	N	Y
ACRS Depreciation	N	N	N	N	N	N	N	N	N	N	Y	N	Y
Federal Bonus Depreciation	N	N	N	N	N	N	N	N	N	N	N	Y	Y

NOTES: See notes of Table 5; See Section A.3.2 for supplemental tax data sources and Section E.4 for estimating equations and subsection E.4.1 for variable definitions.

Table A20: Incidence Estimates Using Reduced-Form Effects, Business Tax Changes (Political, Fiscal Policy, Economic Conditions)

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	1.15*	1.1*	1.54**	1.34*	1.36*	1.1*	1.39***	1.39***	.68	1.08**
	(.59)	(.61)	(.64)	(.72)	(.71)	(.59)	(.52)	(.52)	(.52)	(.49)
Landowners $\dot{r}$	.93	1.07	1.17	1.63	1.72	1.17	1.79	1.79	.32	1.12
	(1.52)	(1.48)	(1.61)	(1.54)	(1.56)	(1.43)	(1.22)	(1.22)	(1.36)	(1.21)
Firmowners $\dot{\pi}$	1.6*	1.56*	2.05**	1.69*	2.03**	1.63*	1.98**	1.98**	.81	1.6*
	(.89)	(.91)	(.9)	(.99)	(1.02)	(.9)	(.88)	(.88)	(1.4)	(.83)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	.31**	.29***	.32**	.29***	.27**	.28***	.27***	.27***	.37	.28***
	(.13)	(.11)	(.14)	(.1)	(.11)	(.09)	(.07)	(.07)	(.43)	(.1)
Landowner Share	.25	.29	.25	.35**	.34**	.3	.35***	.35***	.18	.3*
	(.26)	(.21)	(.23)	(.14)	(.17)	(.19)	(.13)	(.13)	(.48)	(.18)
Firmowner Share	.44***	.42***	.43***	.36***	.4***	.42***	.38***	.38***	.45***	.42***
	(.14)	(.13)	(.12)	(.09)	(.1)	(.12)	(.09)	(.09)	(.13)	(.1)
Conventional View Test										
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)	145.34	130.84	73.08	85.61	94.50	130.47	116.5	115.71	6.96	153.98
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000
Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Sales Tax Rate	N	Y	N	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Income Tax Rate	N	N	N	Y	N	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	Y	N	Y	N	N
Corporate Tax Rev. to GDP	N	N	N	N	N	N	Y	Y	N	N
Bartik	N	N	N	N	N	N	N	N	Y	N
Gross Receipt Tax Control	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 5; See Section A.5 for supplemental data sources and Section E.4 for variable definitions and estimating equations.

Table A21: Incidence Estimates Using Estimated Reduced-Form Effects, Corporate Rate Changes

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	.58*	.59*	.75**	.58*	.7**	.59*	.57*	.58*	.41	.52*
	(.34)	(.33)	(.3)	(.34)	(.32)	(.33)	(.33)	(.33)	(.28)	(.29)
Landowners $\dot{r}$	.65	.65	.38	.63	.52	.62	.59	.59	.27	.43
	(.58)	(.6)	(.78)	(.6)	(.73)	(.6)	(.61)	(.61)	(.51)	(.59)
Firmowners $\dot{\pi}$	.91***	.92***	.97**	.92***	.96**	.91***	.89***	.9***	.71*	.8**
	(.32)	(.35)	(.38)	(.29)	(.4)	(.33)	(.34)	(.33)	(.42)	(.34)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	.27***	.27***	.36**	.27***	.32***	.28***	.28***	.28***	.29**	.3***
	(.09)	(.08)	(.16)	(.09)	(.12)	(.08)	(.09)	(.09)	(.13)	(.11)
Landowner Share	.3**	.3**	.18	.3*	.24	.29*	.29*	.29*	.19	.25
	(.15)	(.15)	(.27)	(.16)	(.21)	(.16)	(.17)	(.17)	(.28)	(.22)
Firmowner Share	.43***	.42***	.46***	.43***	.44***	.43***	.43***	.43***	.51**	.46***
	(.09)	(.08)	(.12)	(.11)	(.1)	(.1)	(.1)	(.1)	(.2)	(.13)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Conventional View Test										
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)	167.40	282.85	433.55	125.85	572.33	189.43	195.49	188.74	39.36	154.3
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Sales Tax Rate	N	Y	N	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Income Tax Rate	N	N	N	Y	N	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	Y	N	Y	N	N
Corporate Tax Rev. to GDP	N	N	N	N	N	N	Y	Y	N	N
Bartik	N	N	N	N	N	N	N	N	Y	N
Gross Receipt Tax Control	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 5; See Section A.5 for supplemental data sources and Section E.4 for variable definitions and estimating equations.

Table A22: Incidence Estimates Using Estimated Reduced-Form Effects, Corporate Rate Changes (Including Federal Corp. Tax)

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha\dot{r}$	.82**	.79**	.82**	.79**	.76**	.82**	.8**	.82**	.59**	.72***
	(.36)	(.35)	(.33)	(.34)	(.35)	(.34)	(.34)	(.34)	(.3)	(.24)
Landowners $\dot{r}$	.34	.43	.47	.35	.61	.41	.42	.44	.27	.1
	(.87)	(.82)	(.84)	(.83)	(.79)	(.83)	(.84)	(.83)	(.87)	(.87)
Firmowners $\dot{\pi}$	1.02**	1.02**	1.05***	1**	1.04**	1.03**	1.02**	1.04**	.78	.85**
	(.41)	(.43)	(.4)	(.39)	(.43)	(.41)	(.43)	(.42)	(.48)	(.39)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	.38**	.35**	.35**	.37**	.32***	.36**	.36**	.36**	.36	.43
	(.18)	(.15)	(.15)	(.16)	(.11)	(.15)	(.15)	(.14)	(.24)	(.29)
Landowner Share	.16	.19	.2	.16	.25	.18	.19	.19	.16	.06
	(.31)	(.26)	(.26)	(.29)	(.2)	(.27)	(.26)	(.26)	(.4)	(.48)
Firmowner Share	.47***	.45***	.45***	.47***	.43***	.46***	.46***	.45***	.48***	.51***
	(.14)	(.11)	(.11)	(.14)	(.09)	(.12)	(.12)	(.12)	(.17)	(.19)

Conventional View Test										
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)	271.06	445.18	394.07	340.56	525.79	402.05	471.04	468.11	128.11	95.18
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Sales Tax Rate	N	Y	N	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Income Tax Rate	N	N	N	Y	N	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	Y	N	Y	N	N
Corporate Tax Rev. to GDP	N	N	N	N	N	N	Y	Y	N	N
Bartik	N	N	N	N	N	N	N	N	Y	N
Gross Receipt Tax Control	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 5; See Section A.5 for supplemental data sources and Section E.4 for variable definitions and estimating equations.

Table A23: Incidence Estimates Using Reduced-Form Effects, State Fixed Effects

Panel (a) Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Workers $\dot{w} - \alpha \dot{r}$	1.25	1.39**	2.31***	1.72**	2.05**	1.37**	1.01*	1.01*	1.2**	1.32**
	(.79)	(.7)	(.69)	(.7)	(.94)	(.69)	(.57)	(.57)	(.54)	(.65)
Landowners $\dot{r}$	2.44	1.77	.51	3.66**	.12	1.72	.41	.4	1.16	1.4
	(1.81)	(1.73)	(3.35)	(1.79)	(2.88)	(1.72)	(1.92)	(1.93)	(1.61)	(1.75)
Firmowners $\dot{\pi}$	1.74*	1.76*	1.96	2.57**	1.76	1.76*	1.26	1.25	1.51**	1.66*
	(1)	(.99)	(1.32)	(1.05)	(1.23)	(.99)	(1.06)	(1.05)	(.76)	(.99)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Worker Share	.23**	.28***	.48	.22***	.52	.28***	.38	.38	.31**	.3**
	(.1)	(.1)	(.46)	(.06)	(.47)	(.1)	(.33)	(.34)	(.15)	(.13)
Landowner Share	.45***	.36**	.11	.46***	.03	.35**	.15	.15	.3	.32
	(.15)	(.16)	(.61)	(.09)	(.7)	(.17)	(.54)	(.55)	(.25)	(.21)
Firmowner Share	.32***	.36***	.41**	.32***	.45	.36***	.47**	.47**	.39***	.38***
	(.09)	(.1)	(.2)	(.06)	(.28)	(.1)	(.22)	(.22)	(.13)	(.1)
Conventional View Test										
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)	89.41	90.87	6.90	158.91	8.33	88.47	66.76	65.18	83.12	89.86
	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Specifications										
Political Controls	Y	N	N	N	N	N	N	N	N	N
Sales Tax Rate	N	Y	N	N	N	N	N	N	N	N
Δ Sales Tax Rate	N	N	Y	N	N	N	N	N	N	N
Income Tax Rate	N	N	N	Y	N	N	N	N	N	N
Δ Income Tax Rate	N	N	N	N	Y	N	N	N	N	N
Δ Gov. Expend/capita	N	N	N	N	N	Y	N	Y	N	N
Corporate Tax Rev. to GDP	N	N	N	N	N	N	Y	Y	N	N
Bartik	N	N	N	N	N	N	N	N	Y	N
Gross Receipt Tax Control	N	N	N	N	N	N	N	N	N	Y

NOTES: See notes of Table 5; See Section A.5 for supplemental data sources and Section E.4 for variable definitions and estimating equations.

Table A24: Estimates of Economic Incidence Using Reduced-Form Effects ($\alpha = .5$)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	0.86*	1.13**	0.87*	0.62	0.24*	0.27**	0.24*	0.35
	(0.45)	(0.49)	(0.45)	(0.42)	(0.11)	(0.10)	(0.11)	(0.51)
Landowners	1.17	1.27	1.17	0.32	0.32	0.30	0.32	0.18
	(1.43)	(1.42)	(1.43)	(1.36)	(0.22)	(0.21)	(0.22)	(0.52)
Firm Owners	1.63*	1.79**	1.63*	0.81	0.44***	0.43***	0.44***	0.46***
	(0.90)	(0.80)	(0.90)	(1.40)	(0.11)	(0.10)	(0.11)	(0.11)
Conventional View Test								
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)					141.1	94.2	139.4	4.6
P-value					0.000	0.000	0.000	0.032
Controls								
State Fixed Effects	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: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results for $\alpha = .5$ and $\frac{\delta}{\gamma} = .9$. Recall that α is the housing expenditure share and can also reflect the influence of local prices, which may be sensitive to increases in the price of housing services (Moretti, 2013).

Table A25: Estimates of Economic Incidence Using Reduced-Form Effects ($\alpha = .65$)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	0.69	0.94*	0.69	0.57	0.20	0.23	0.20	0.33
	(0.44)	(0.51)	(0.44)	(0.47)	(0.16)	(0.17)	(0.16)	(0.57)
Landowners	1.17	1.27	1.17	0.32	0.34	0.32	0.34	0.19
	(1.43)	(1.42)	(1.43)	(1.36)	(0.24)	(0.23)	(0.24)	(0.55)
Firm Owners	1.63*	1.79**	1.63*	0.81	0.47***	0.45***	0.47***	0.48***
	(0.90)	(0.80)	(0.90)	(1.40)	(0.10)	(0.09)	(0.10)	(0.12)
Conventional View Test								
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)					108.1	71.0	107.3	3.4
P-value					0.000	0.000	0.000	0.065
Controls								
State Fixed Effects	N	Y	N	N	N	Y	N	N
$\Delta \ln$ Gov./Capita	N	N	Y	N	N	N	Y	N
Bartik	N	N	N	Y	N	N	N	Y

NOTES: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results for $\alpha = .65$ and $\frac{\delta}{\gamma} = .9$. Recall that α is the housing expenditure share. We provide this robustness table for $\alpha = .65$ to be consistent with estimates from Diamond (2012) in terms of wage-to-rent sensitivity.

Table A26: Estimates of Economic Incidence Using Reduced-Form Effects ($\frac{\delta}{\gamma} = .75$)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	1.10*	1.38**	1.10*	0.68	0.27***	0.30***	0.27***	0.33
	(0.59)	(0.59)	(0.59)	(0.52)	(0.08)	(0.10)	(0.08)	(0.29)
Landowners	1.17	1.27	1.17	0.32	0.29	0.28	0.29	0.16
	(1.43)	(1.42)	(1.43)	(1.36)	(0.20)	(0.18)	(0.20)	(0.47)
Firm Owners	1.80**	1.93**	1.80**	1.04	0.44***	0.42***	0.44***	0.51**
	(0.90)	(0.83)	(0.90)	(1.19)	(0.14)	(0.12)	(0.14)	(0.17)
Conventional View Test								
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)					83.0	89.9	81.9	87.4
P-value					0.000	0.000	0.000	0.000
Controls								
State Fixed Effects	N	Y	N	N	N	Y	N	N
$\Delta \ln$ Gov./Capita	N	N	Y	N	N	N	Y	N
Bartik	N	N	N	Y	N	N	N	Y

NOTES: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results for $\alpha = .3$ and $\frac{\delta}{\gamma} = .75$.

Table A27: Estimates of Economic Incidence Using Reduced-Form Effects ($\frac{\delta}{\gamma} = .5$)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	1.10*	1.38**	1.10*	0.68	0.25***	0.29***	0.25***	0.28
	(0.59)	(0.59)	(0.59)	(0.52)	(0.07)	(0.09)	(0.07)	(0.17)
Landowners	1.17	1.27	1.17	0.32	0.27	0.26	0.27	0.13
	(1.43)	(1.42)	(1.43)	(1.36)	(0.20)	(0.18)	(0.20)	(0.44)
Firm Owners	2.08**	2.16**	2.08**	1.42	0.48***	0.45***	0.48***	0.59**
	(0.95)	(0.89)	(0.95)	(0.96)	(0.17)	(0.13)	(0.17)	(0.29)
Conventional View Test								
χ^2 of ($S^W = 100\%$ and $S^F = 0\%$)					48.8	68.5	48.3	48.4
P-value					0.000	0.000	0.000	0.000
Controls								
State Fixed Effects	N	Y	N	N	N	Y	N	N
$\Delta \ln$ Gov./Capita	N	N	Y	N	N	N	Y	N
Bartik	N	N	N	Y	N	N	N	Y

NOTES: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results for $\alpha = .3$ and $\frac{\delta}{\gamma} = .5$.

Table A28: Estimates of Economic Incidence Using Reduced-Form Effects (Controlling for Lagged GDP growth)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	1.2**	1.6***	1.21**	.78*	.26***	.29***	.26***	.28**
	(.55)	(.56)	(.55)	(.47)	(.07)	(.09)	(.07)	(.12)
Landowners	1.74	2.1	1.74	.84	.37***	.38***	.37***	.31
	(1.11)	(1.44)	(1.11)	(.94)	(.12)	(.13)	(.12)	(.2)
Firmowners	1.71**	1.79**	1.71**	1.12*	.37***	.33***	.37***	.41***
	(.85)	(.77)	(.85)	(.63)	(.09)	(.08)	(.09)	(.08)
Conventional View Test								
χ^2 of (S^W = 100% and S^F = 0%)					98.57	96.65	97.65	262.52
P-value					0.000	0.000	0.000	0.000
Controls								
State Fixed Effects	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
Lagged State GDP Growth	Y	Y	Y	Y	Y	Y	Y	Y

NOTES: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results from the same specifications as the baseline table, but with controls for two lags of state GDP growth.

Table A29: Estimates of Economic Incidence Using Reduced-Form Effects (Dropping 1980-1990)

	A. Incidence				B. Share of Incidence			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Workers	1.49**	2.15**	1.51**	.99*	.35**	.72	.35**	.33
	(.66)	(.89)	(.65)	(.56)	(.16)	(.93)	(.16)	(.27)
Landowners	.91	-.82	.93	.62	.21	-.28	.21	.21
	(1.66)	(3.06)	(1.65)	(1.79)	(.27)	(1.43)	(.27)	(.42)
Firmowners	1.89*	1.64	1.9*	1.36	.44***	.55	.44***	.46***
	(.98)	(1.16)	(.97)	(1.08)	(.14)	(.54)	(.14)	(.16)
Conventional View Test								
χ^2 of (S^W = 100% and S^F = 0%)					68.57	2.72	67.76	70.65
P-value					0.000	0.100	0.000	0.000
Controls								
State Fixed Effects	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: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results from the same specifications as the baseline table, but without the 490 observations for the change from 1980-1990. There are 980 observations in each specification. We provide this table to address potential concerns regarding the sensitivity of the results to the Tax Reform Act of 1986.

Table A30: Incidence Estimates Using Reduced-Form Effects with Tax Rate Controls

Panel (a) Incidence	(1)	(2)	(3)	(4)
Workers $\dot{w} - \alpha\dot{r}$	1.1*	1.49**	1.1*	1.59**
	(.61)	(.59)	(.61)	(.66)
Landowners $\dot{r}$	1.07	1.15	1.21	1.2
	(1.48)	(1.52)	(1.25)	(1.6)
Firmowners $\dot{\pi}$	1.56*	1.69**	1.64*	1.75*
	(.91)	(.76)	(.88)	(.9)

Panel (b) Shares of Incidence	(1)	(2)	(3)	(4)
Worker Share	.29***	.34***	.28***	.35***
	(.11)	(.13)	(.09)	(.12)
Landowner Share	.29	.27	.31*	.26
	(.21)	(.22)	(.16)	(.23)
Firmowner Share	.42***	.39***	.42***	.39***
	(.13)	(.12)	(.11)	(.14)
Conventional View Test				
χ^2 of (S^W = 100% and S^F = 0%)	130.8	83.3	104	69.7
	0.000	0.000	0.000	0.000
Specifications				
State Sales Tax Rate	Y	N	N	Y
State Individual Income Tax Rate	N	Y	N	Y
State Property Tax Rate	N	N	Y	Y

NOTES: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results from the same specifications as the baseline table, but with controls for different state tax rates. See Table A4 for notes on data sources.

Table A31: Incidence Estimates Using Reduced-Form Effects with Tax Rate Change Controls

Panel (a) Incidence

	(1)	(2)	(3)	(4)
Workers $\dot{w} - \alpha\dot{r}$	1.1*	1.08*	1.13***	1.12***
	(.59)	(.59)	(.37)	(.37)
Landowners $\dot{r}$	1.15	1.21	1.24	1.3
	(1.43)	(1.4)	(1.15)	(1.1)
Firmowners $\dot{\pi}$	1.63*	1.65*	1.67**	1.72**
	(.9)	(.93)	(.69)	(.73)

Panel (b) Shares of Incidence

	(1)	(2)	(3)	(4)
Worker Share	.28***	.27***	.28***	.27***
	(.09)	(.09)	(.09)	(.08)
Landowner Share	.3	.31*	.31*	.31**
	(.19)	(.17)	(.17)	(.15)
Firmowner Share	.42***	.42***	.41***	.41***
	(.12)	(.11)	(.11)	(.09)
Conventional View Test				
χ^2 of (S^W = 100% and S^F = 0%)	137.7	141.6	139.8	154.7
	0.000	0.000	0.000	0.000
Specifications				
Δ State Sales Tax Rate	Y	N	N	Y
Δ State Income Tax Rate	N	Y	N	Y
Δ State Property Tax Rate	N	N	Y	Y

Notes: See notes of Table 5, which is our baseline that uses calibration values $\alpha = .3$ and $\frac{\delta}{\gamma} = .9$. This table shows results from the same specifications as the baseline table, but with controls for different state tax rates. See Table A4 for notes on data sources.

Table A32: Empirical and Predicted Moments from Structural Model

Panel (a) Business Tax Shock				
	Population	Wage	Rent	Establishments
Empirical Moments				
Business Tax	4.275***	1.451	1.172	4.074**
	(1.642)	(0.938)	(1.428)	(1.815)
A. Predicted Moments ($\gamma = .15, \varepsilon^{PD} = -2.5$)				
Business Tax	3.514	0.839	0.591	4.542
Over-id Test			Test: $\beta^E = \beta^N - (\gamma(\varepsilon^{PD}+1)-1)\beta^W$	
χ^2-Stat	2.453		T-stat	-1.566
χ^2-P-Value	0.117		P-value	0.117

Panel (b) All Shocks				
	Population	Wage	Rent	Establishments
Empirical Moments				
Business Tax	1.516	1.534	1.857	1.749
	(1.915)	(1.117)	(1.562)	(1.540)
Bartik	0.446**	0.554***	0.697***	0.600***
	(0.183)	(0.079)	(0.257)	(0.189)
Personal Tax	1.731	-0.588	-1.192	1.247
	(1.247)	(0.728)	(1.173)	(1.420)
B. Predicted Moments ($\gamma = .15, \varepsilon^{PD} = -2.5$)				
Business Tax	0.736	0.944	1.111	1.893
Bartik	0.424	0.571	0.730	0.479
Personal Tax	1.052	-0.596	-1.559	0.322
Over-id Test			Test: $\beta^E = \beta^N - (\gamma(\varepsilon^{PD}+1)-1)\beta^W$	
χ^2-Stat	4.665		T-stat	-1.217
χ^2-P-Value	0.458		P-value	0.224
C. Predicted Moments ($\gamma = .15, \alpha = .30$) *and estimated* ε^{PD}				
Business Tax	0.583	0.646	0.420	1.589
Bartik	0.397	0.572	0.725	0.447
Personal Tax	1.053	-0.359	-0.996	0.495
Over-id Test			Test: $\beta^E = \beta^N - (\gamma(\varepsilon^{PD}+1)-1)\beta^W$	
χ^2-Stat	5.378		T-stat	-1.334
χ^2-P-Value	0.251		P-value	0.182

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. All parameters assume $\delta = 0.9 \times \gamma$ and $\alpha = 0.3$. In addition, Panel (a) presents estimates of the model using only the tax shock for parameters ($\gamma = .15, \varepsilon^{PD} = -2.5$); panel (b) uses the business tax shock, the Bartik shock and the personal income tax shock for parameters ($\gamma = .15, \varepsilon^{PD} = -2.5$); and Panel (c) uses all shocks, calibrates $\gamma = .15$ and estimates ε^{PD}. Results of the χ^2 test of over identifying restrictions are below each model along with the result of the test of the restriction $\beta^E = \beta^N - (\gamma(\varepsilon^{PD}+1)-1)\beta^W$ that is implied by calibrating ε^{PD}. See 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 A33: 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 A34: Policy Probit of Payroll Apportionment Weight Changes

Independent Variables	Coefficient	Standard Error
Mean Payroll Weight of Other States	-.3608***	(.114)
Mean Payroll Weight of Other States $(t-1)$	.2737	(.1947)
Mean Payroll Weight of Other States $(t-2)$	.0491	(.1368)
Corporate Tax Rate	-.1225	(.2548)
Corporate Tax Rate $(t-1)$	.2714	(.2813)
Corporate Tax Rate $(t-2)$	-.128	(.1115)
Individual Income Tax Rate	.2006	(.2853)
Individual Income Tax Rate $(t-1)$	-.4287	(.3978)
Individual Income Tax Rate $(t-2)$	.2957	(.2492)
State Income Growth $(t-1)$	-1.4585	(1.5766)
State Income Growth $(t-2)$	-1.194	(1.5084)
National Unemployment Rate $(t-1)$	-.0792	(.0776)
National Unemployment Rate $(t-2)$	.0716	(.0938)

NOTES: This table shows how observable economic and tax policy conditions relate to apportionment formula changes. The specification is the same as the policy probit in Goolsbee and Maydew (2000). The dependent variable is an indicator that equals one if payroll apportionment weights are changed. The analysis is at the state-year level for years from 1978 through 2010. There are 1500 observations due to the lags. State income growth is the log difference in per capita GDP from BEA and the national unemployment rate is from BLS. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A35: Policy Probit of Statutory State Corporate Tax Changes

Independent Variables	Coefficient	Standard Error
Mean Corporate Tax Rate of Other States	2.7234***	(.9537)
Mean Corporate Tax Rate of Other States $(t-1)$	-3.9527***	(.9882)
Mean Corporate Tax Rate of Other States $(t-2)$	.7191	(1.0997)
Payroll Weight	-.0227	(.0185)
Payroll Weight $(t-1)$	.0056	(.0271)
Payroll Weight $(t-2)$	.0312	(.0209)
Individual Income Tax Rate	-.2777	(.3036)
Individual Income Tax Rate $(t-1)$	.1707	(.3773)
Individual Income Tax Rate $(t-2)$	.0875	(.223)
State Income Growth $(t-1)$	-.6771	(1.2064)
State Income Growth $(t-2)$	.1552	(1.5484)
National Unemployment Rate $(t-1)$	-.0539	(.089)
National Unemployment Rate $(t-2)$	.0783	(.0779)

NOTES: This table shows how observable economic and tax policy conditions relate to statutory state corporate tax rate changes. The specification is the same as the policy probit in Goolsbee and Maydew (2000), but with a different dependent variable. The dependent variable is an indicator that equals one if the statutory state corporate tax rate change exceeds 0.5 percentage points. The analysis is at the state-year level for years from 1978 through 2010. There are 1500 observations due to the lags. State income growth is the log difference in per capita GDP from BEA and the national unemployment rate is from BLS. Robust standard errors are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Table A36: Revenue-Maximizing Corporate Tax Rates By State

State	Establishment Share E_s	Revenue Ratio rev_s^{pers}/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	16.4	33	6.5	30.6	2.2	3.3
Alaska	0.3	0.4	33	9.4	32.3	24.1	36.1
Arizona	1.8	22.1	80	7.0	30.0	1.7	8.3
Arkansas	0.9	15.0	50	6.5	30.7	2.4	4.7
California	11.7	9.2	50	8.8	32.0	3.7	7.4
Colorado	2.1	21.1	100	4.6	31.0	1.7	
Connecticut	1.2	21.9	50	7.5	31.0	1.7	3.3
Delaware	0.3	9.2	33	8.7	29.6	3.7	5.5
Florida	6.7	14.6	50	5.5	31.2	2.4	4.9
Georgia	3.0	19.8	100	6.0	29.6	1.8	
Hawaii	0.4	57.3	33	6.4	28.6	0.7	1.0
Idaho	0.6	26.2	50	7.6	33.8	1.4	2.8
Illinois	4.3	9.0	100	7.3	31.6	3.8	
Indiana	2.0	20.7	90	8.5	32.9	1.8	17.7
Iowa	1.1	30.4	100	12.0	32.0	1.2	
Kansas	1.0	16.0	33	7.1	30.6	2.2	3.4
Kentucky	1.2	20.4	50	6.0	31.3	1.8	3.6
Louisiana	1.4	18.1	100	8.0	32.2	2.0	
Maine	0.6	16.9	100	8.9	34.0	2.1	
Maryland	1.8	14.0	50	8.3	31.6	2.5	5.1
Massachusetts	2.3	9.2	50	8.8	31.9	3.7	7.4
Michigan	3.0	26.4	100	4.9	31.5	1.4	
Minnesota	2.0	19.9	87	9.8	33.2	1.8	14.1
Mississippi	0.8	17.2	33	5.0	30.5	2.1	3.1
Missouri	2.1	42.8	33	6.3	31.2	0.9	1.3
Montana	0.5	13.4	33	6.8	36.8	2.7	4.0
Nebraska	0.7	22.1	100	7.8	31.6	1.7	
Nevada	0.8		100	0.0	29.2		
New Hampshire	0.5	2.0	50	8.5	31.2	12.1	24.1
New Jersey	3.1	10.6	50	9.0	31.0	3.3	6.5
New Mexico	0.6	26.1	33	7.6	32.0	1.4	2.1
New York	7.1	14.3	100	7.1	34.6	2.5	
North Carolina	3.0	14.3	50	6.9	31.3	2.5	5.0
North Dakota	0.3	14.2	33	6.4	35.3	2.5	3.8
Ohio	3.5	141.5	60	8.5	31.4	0.3	0.7
Oklahoma	1.2	24.0	33	6.0	31.7	1.5	2.3
Oregon	1.5	16.8	100	7.9	32.8	2.1	
Pennsylvania	4.1	15.1	90	10.0	33.2	2.4	23.9
Rhode Island	0.4	19.0	33	9.0	34.5	1.9	2.9
South Carolina	1.4	45.1	100	5.0	30.6	0.8	
South Dakota	0.4	34.7	100	0.0	36.5	1.1	
Tennessee	1.8	9.1	50	6.5	29.4	3.7	7.4
Texas	7.2		100	0.0	30.3		
Utah	0.9	18.3	50	5.0	31.4	2.0	4.0
Vermont	0.3	15.7	50	8.5	34.7	2.3	4.6
Virginia	1.5	18.4	50	6.0	30.1	2.0	3.9
Washington	2.4		100	0.0	31.9		
West Virginia	0.5	16.3	50	8.5	30.8	2.2	4.4
Wisconsin	1.9	14.7	100	7.9	32.8	2.4	

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

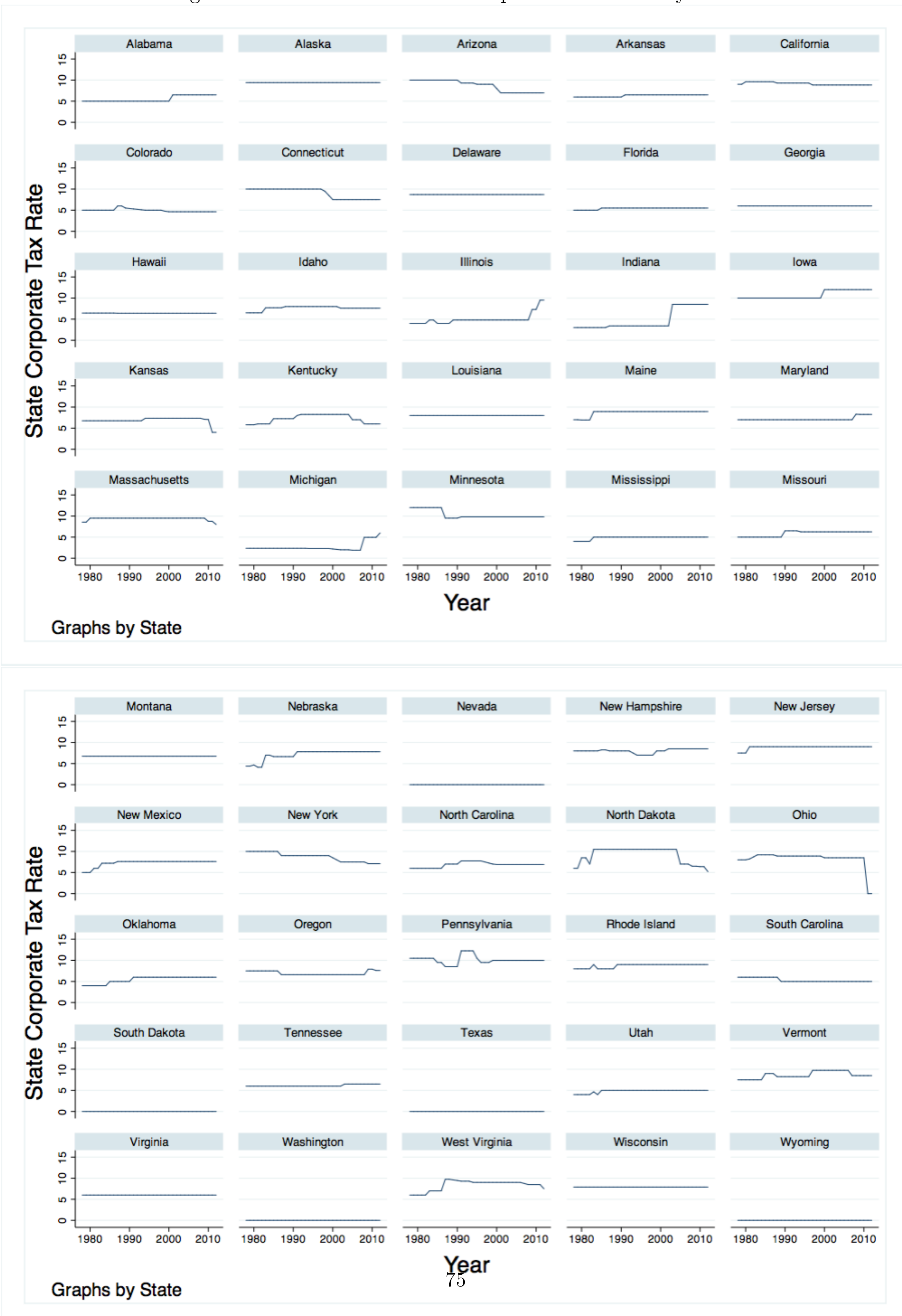
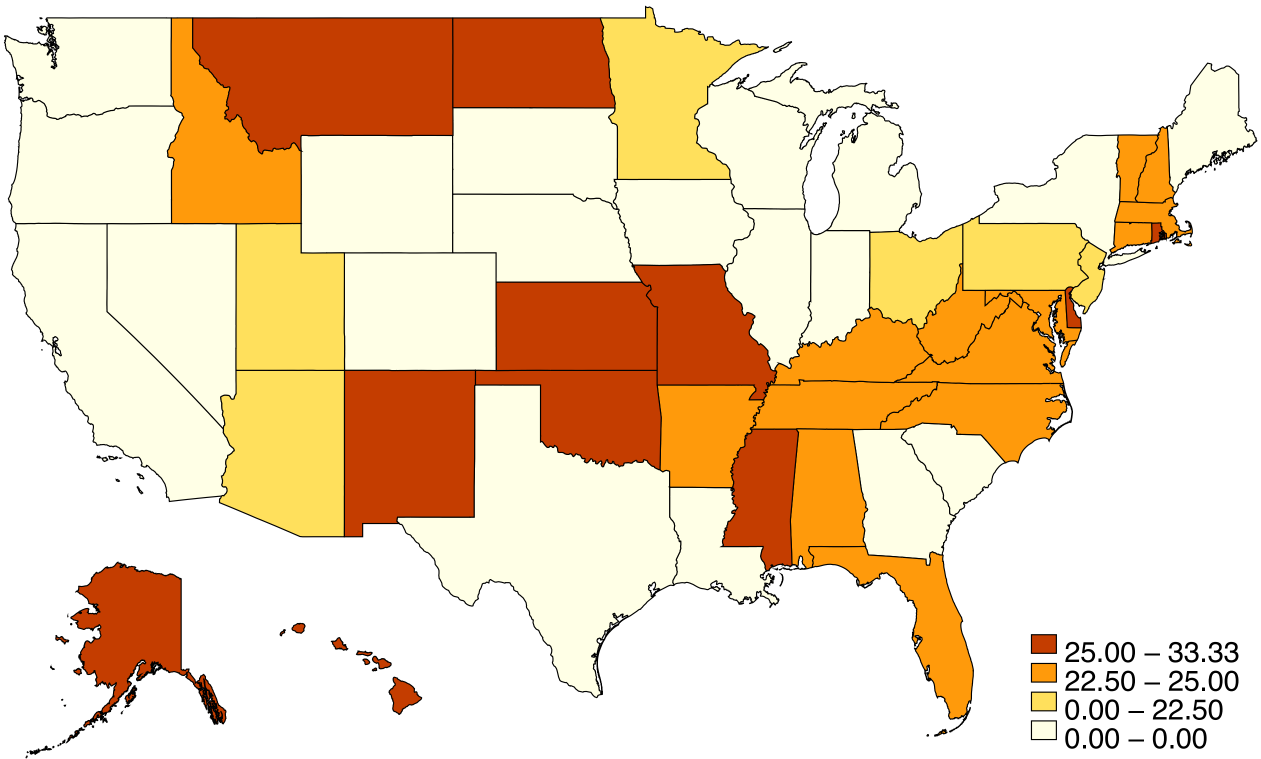


Figure A2: State Corporate Tax Apportionment Rules in 2012

A. Payroll Apportionment Rate by State



B. Sales Apportionment Rate by State

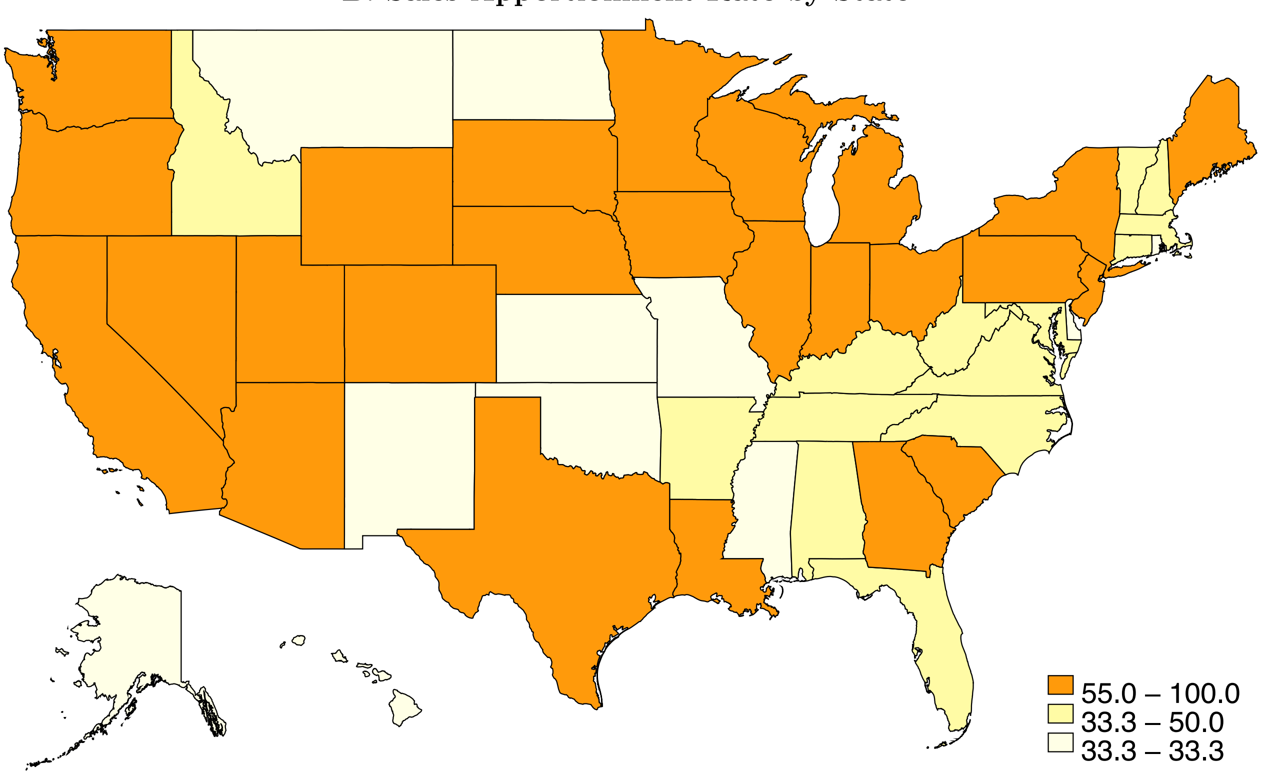
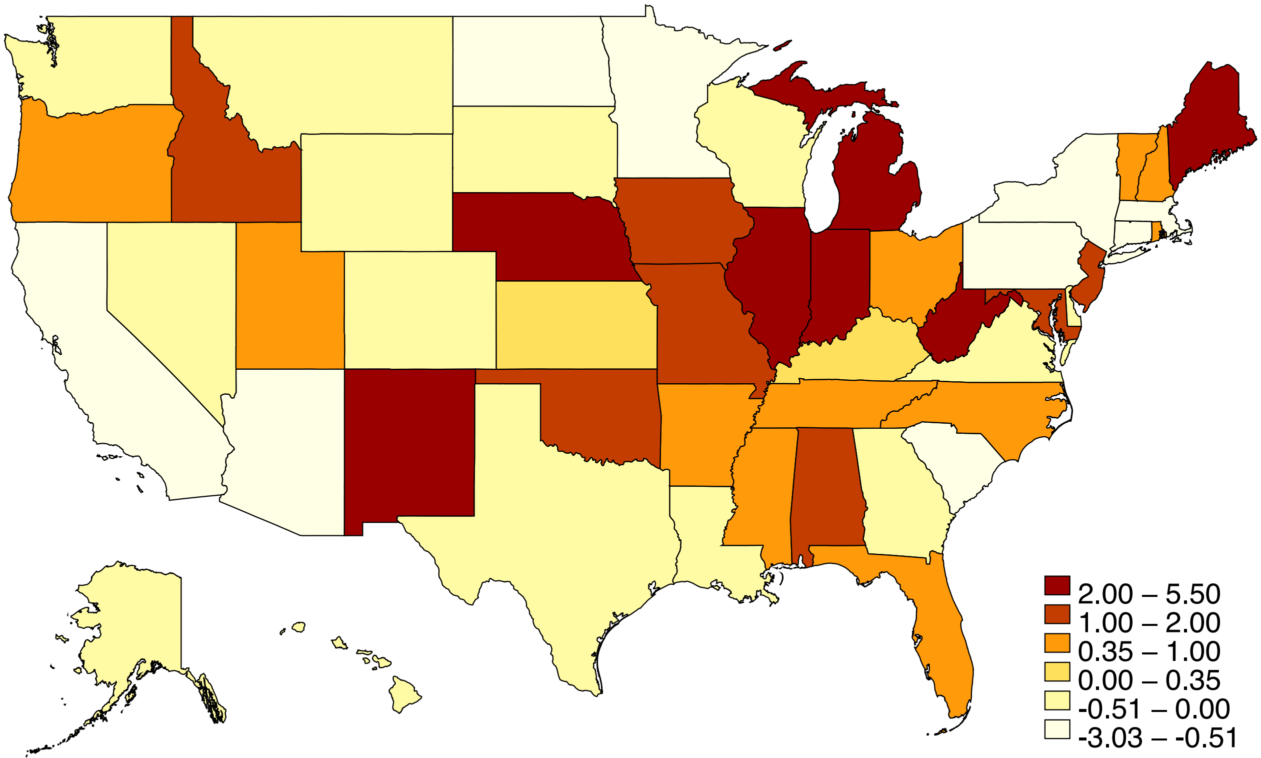


Figure A3: 30 Year Change State Corporate Tax Rates and Rules: 1980-2010

A. Corporate Tax Rate Changes by State



B. Sales Apportionment Rate Changes by State

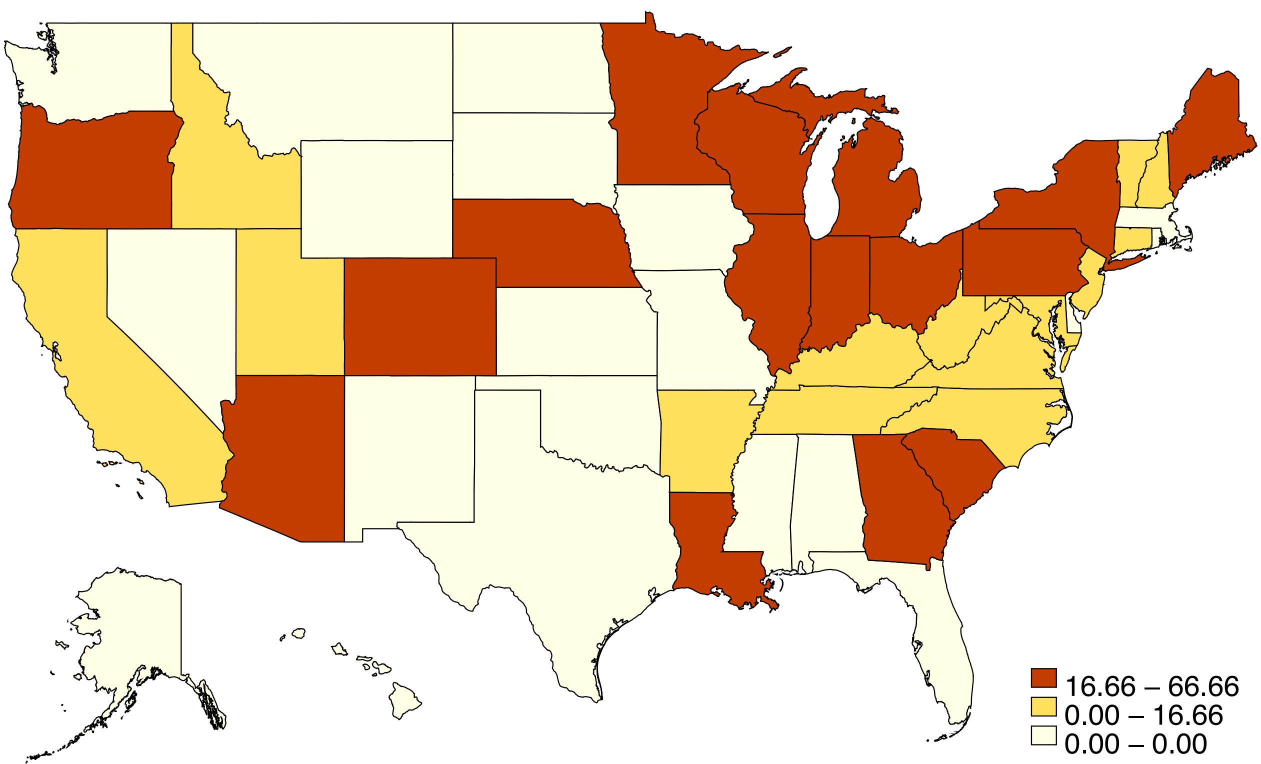
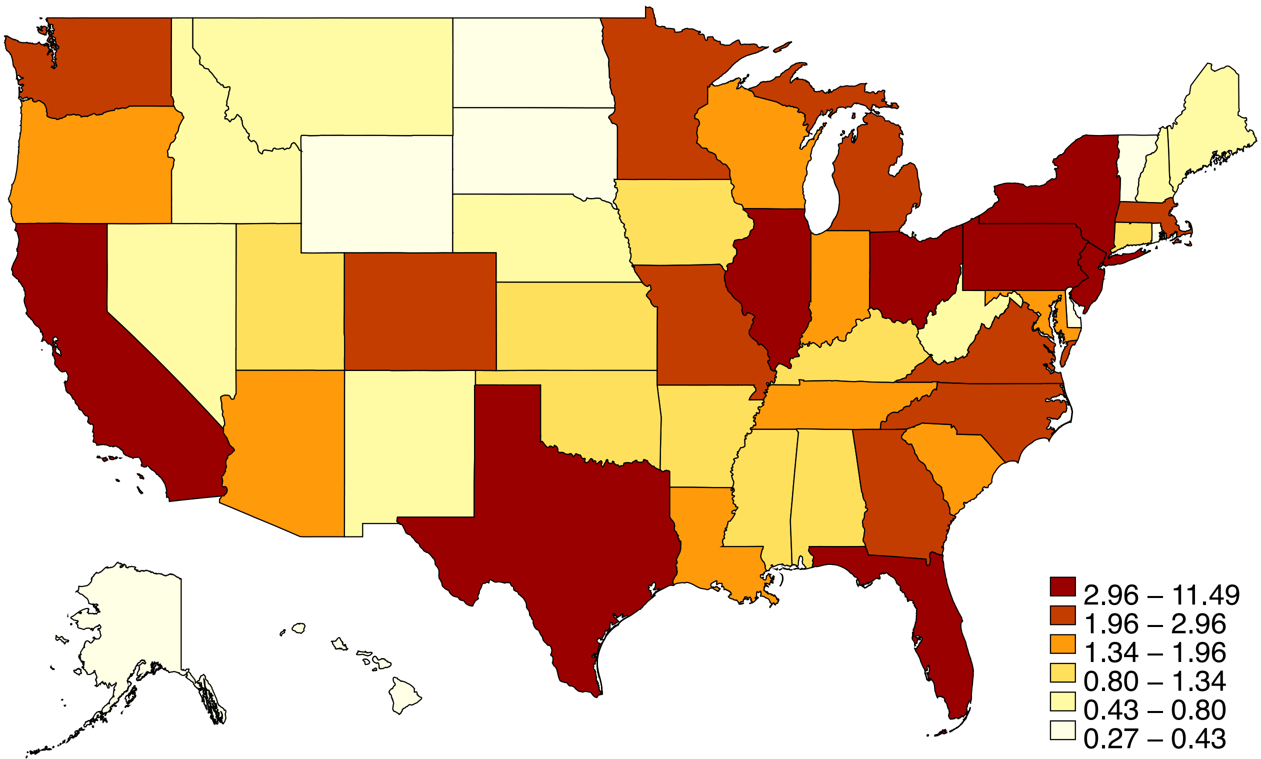


Figure A4: Shares of Total U.S. Establishments and Population in 2010

A. Establishment Share by State



B. Population Share by State

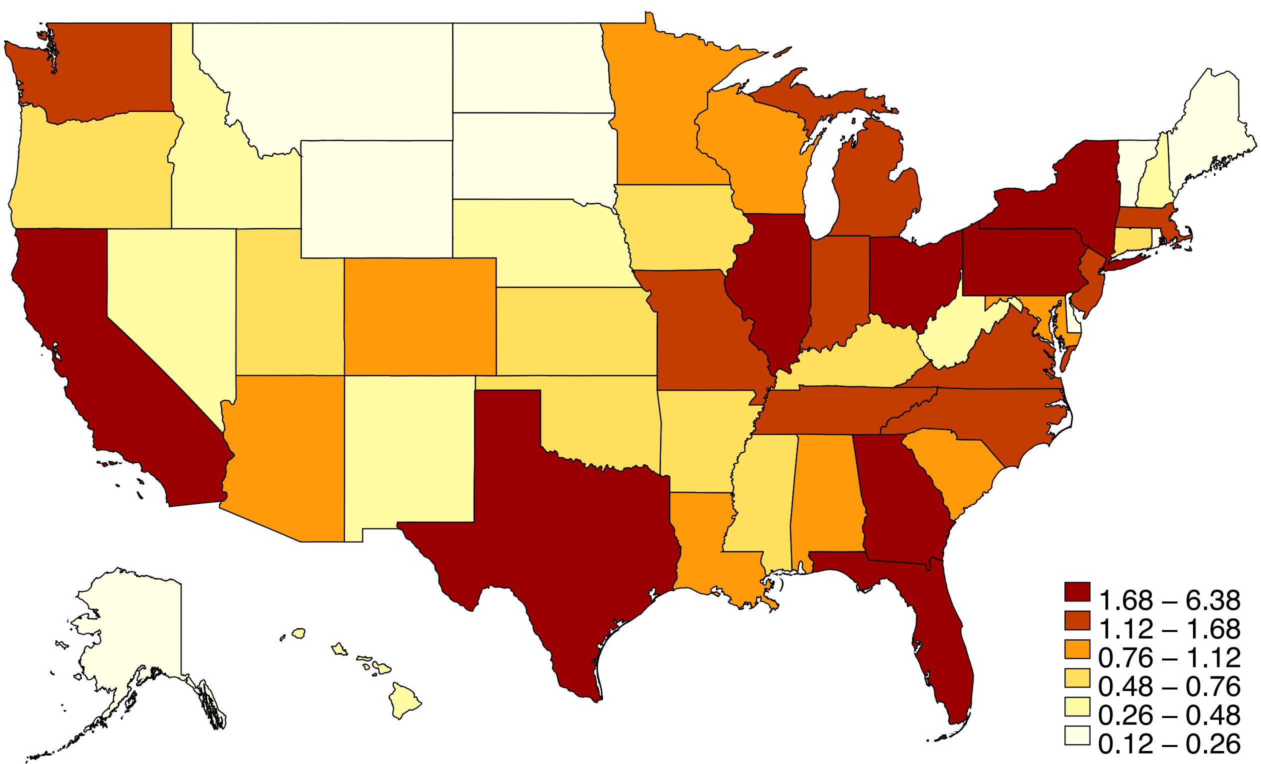
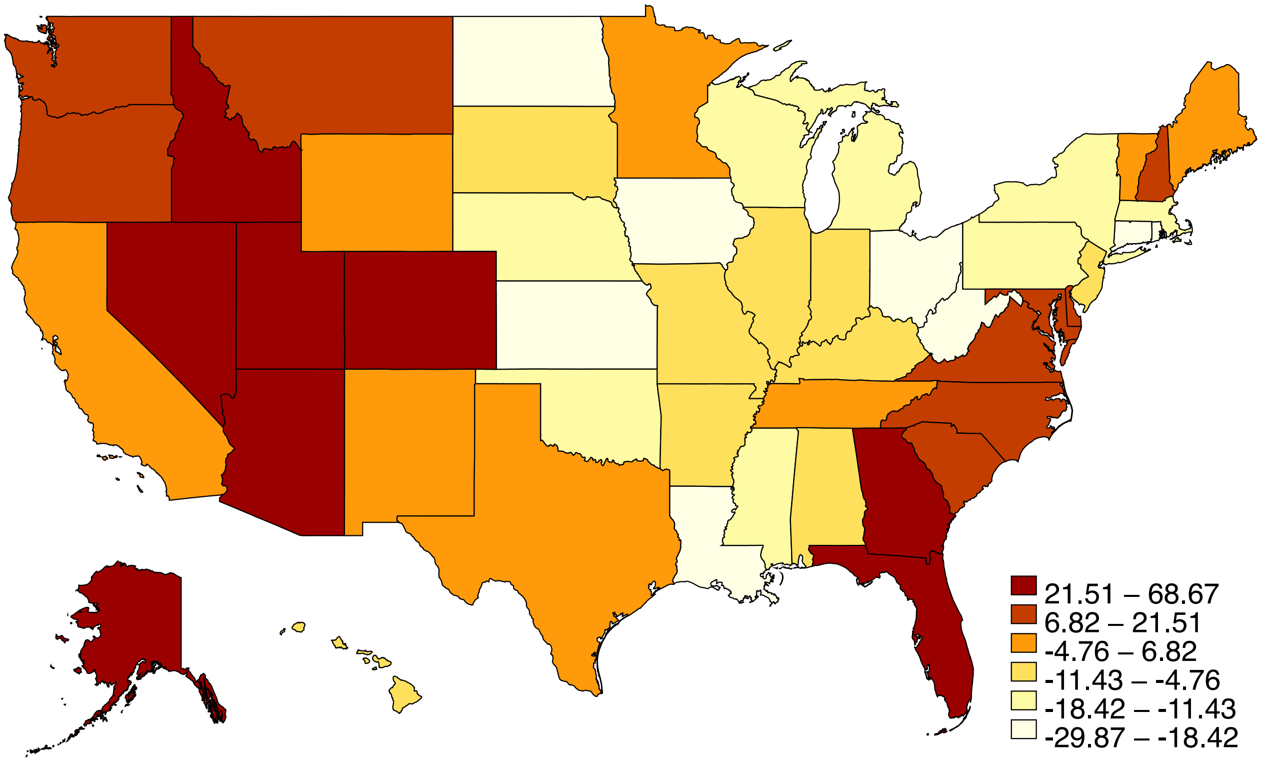


Figure A5: 30 Year Change in Share of Establishments and Population: 1980-2010

A. Change in Establishment Share by State



B. Change in Population Share by State

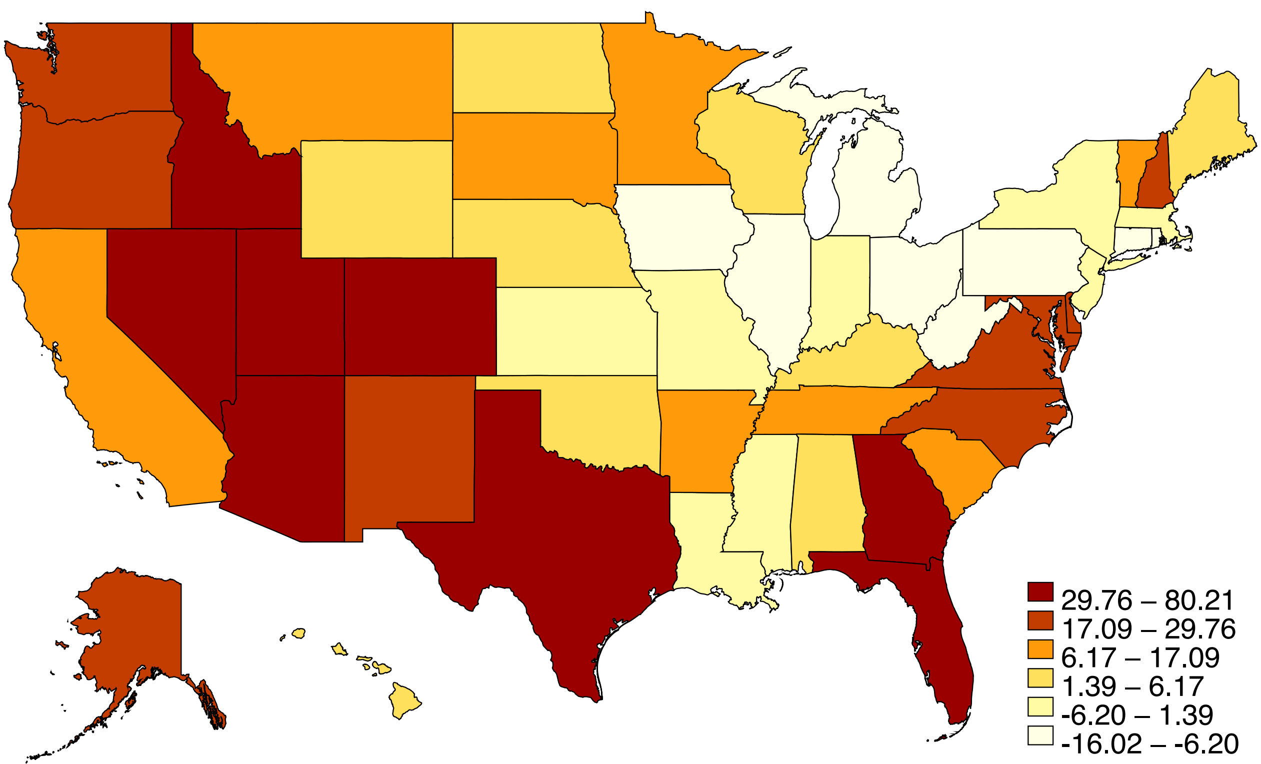
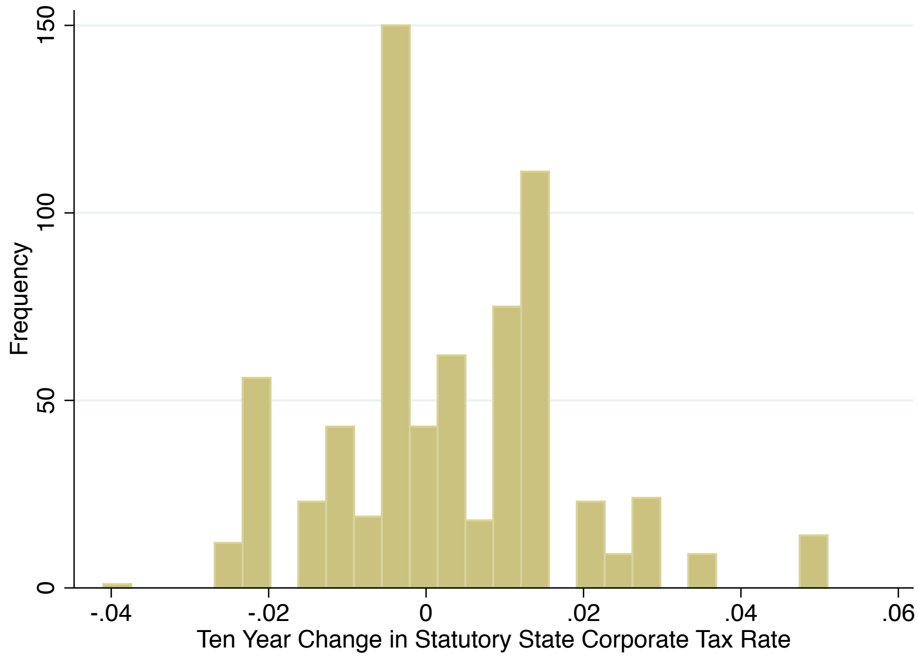
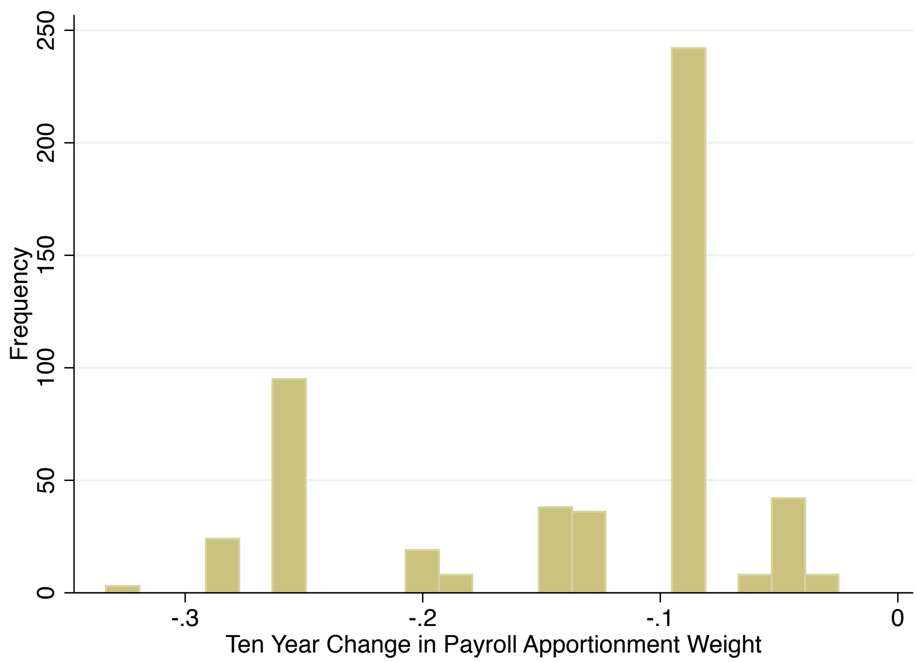


Figure A6: Decadal Changes in State Corporate Tax Policy

Panel (a) Corporate Tax Rate Changes

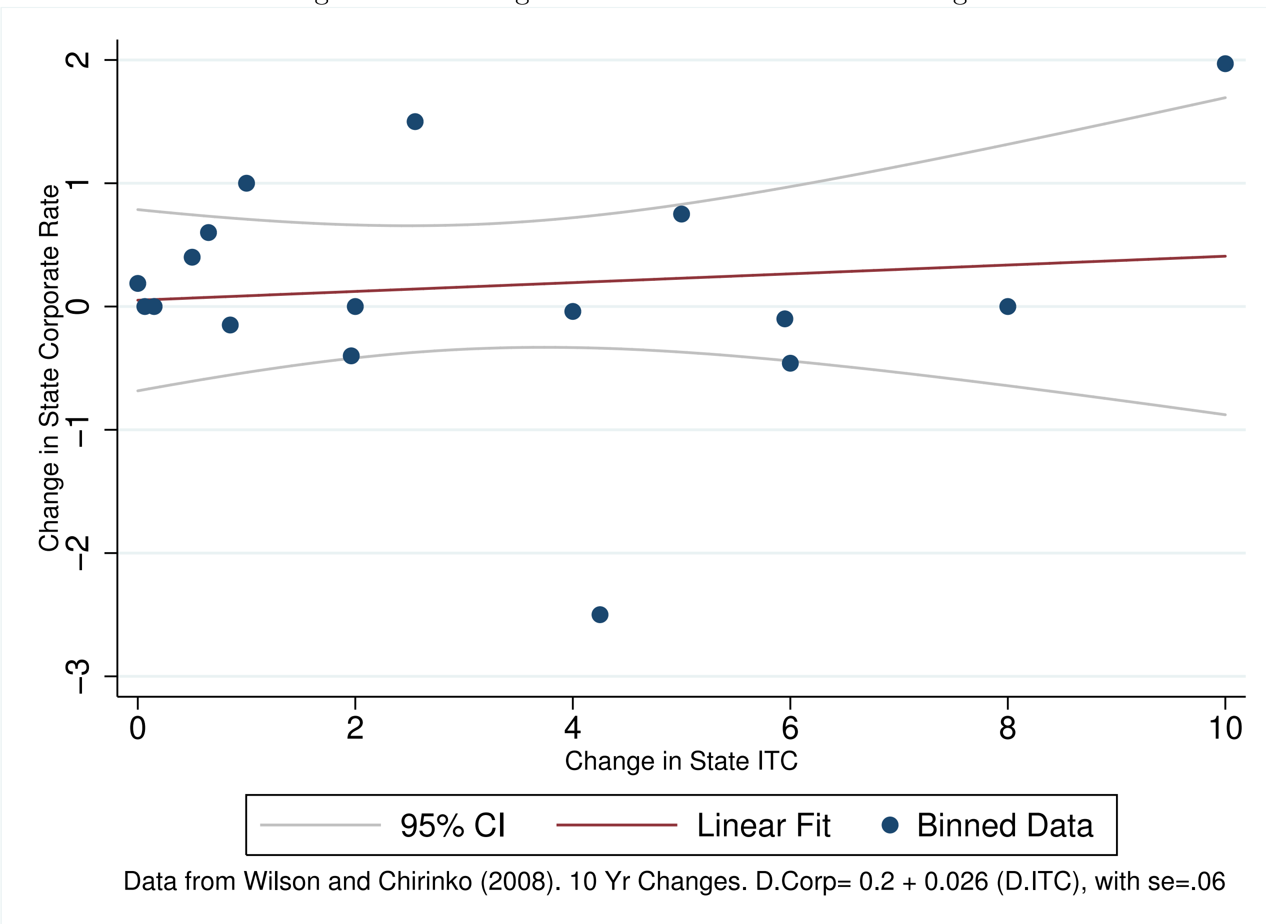


Panel (b) Payroll Apportionment Weight Changes



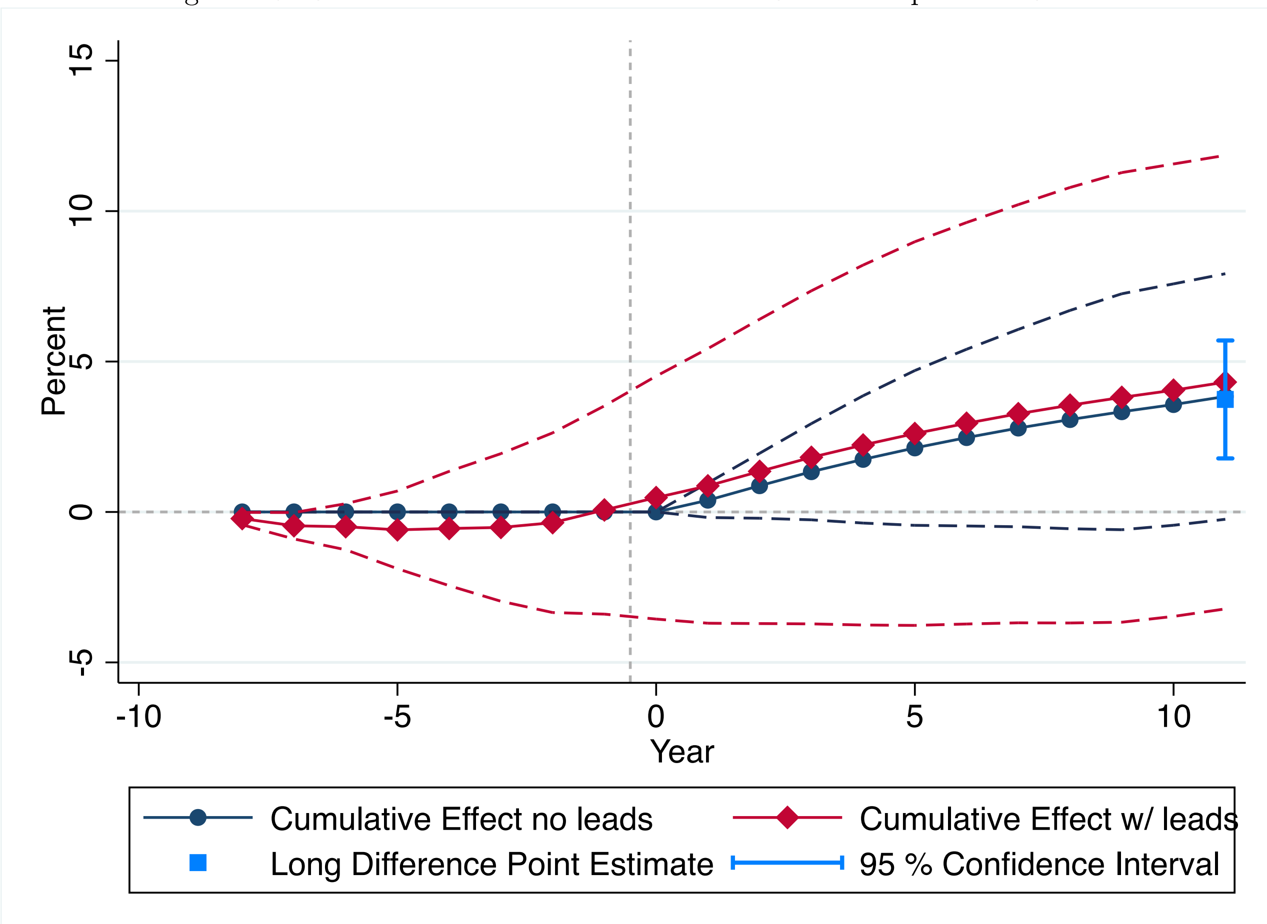
Notes: These figures show changes in corporate tax policy in the baseline PUMA-decade sample of 490 PUMAs over 1980-1990, 1990-2000, and 2000-2010. Panel (a) is a histogram showing the distribution of non-zero changes in corporate tax rates in the pooled sample. Panel (b) is a similar figure for payroll apportionment weights.

Figure A7: Testing for Concomitant Tax Base Changes



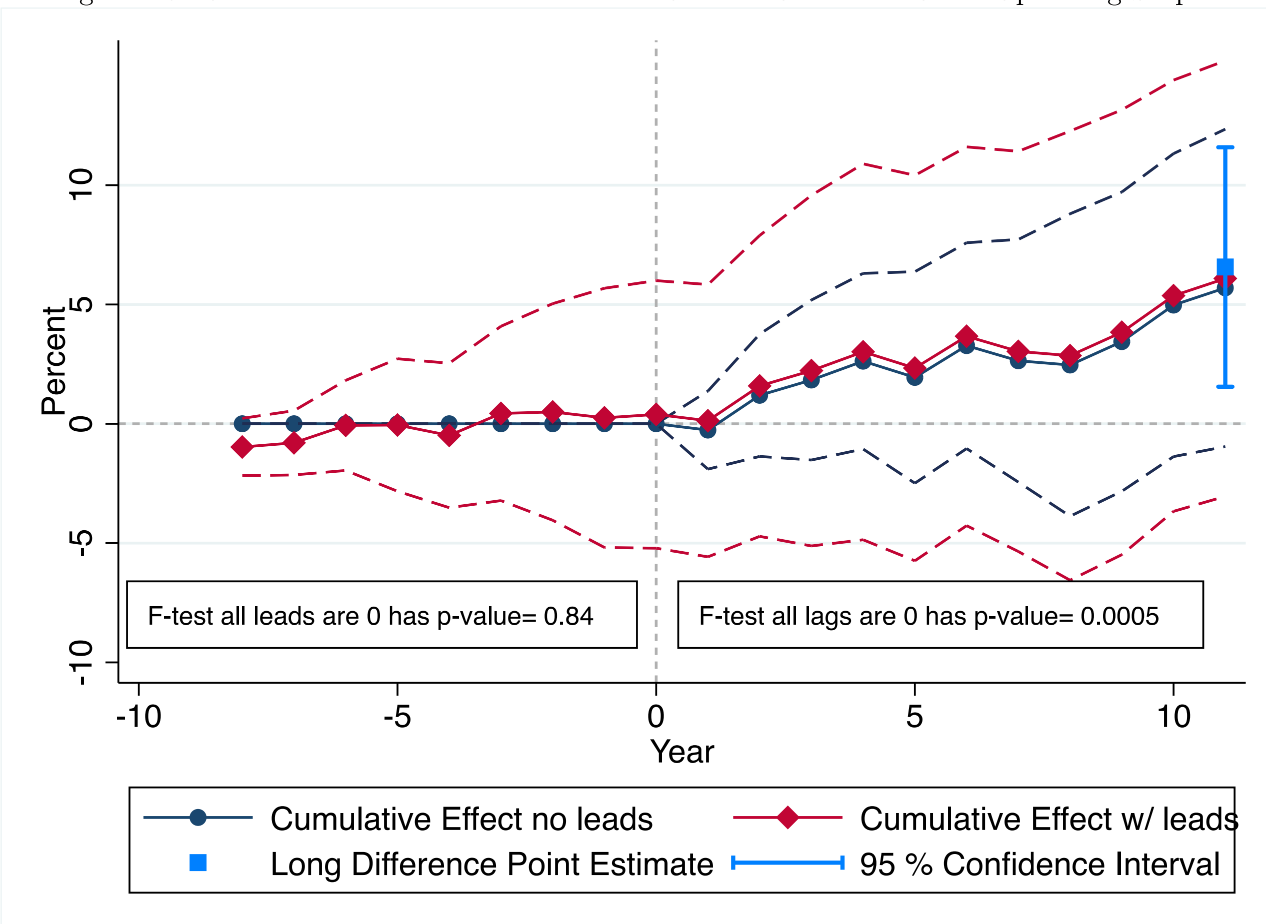
Notes: This figure, which uses data generously provided by Chirinko and Wilson (2008), illustrates that there is no detectable relationship between corporate tax rate changes and investment tax credit changes. It shows the average state corporate tax rate change for different bins of state investment 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 A8: Cumulative Effects of Business Tax Cuts on Population Growth



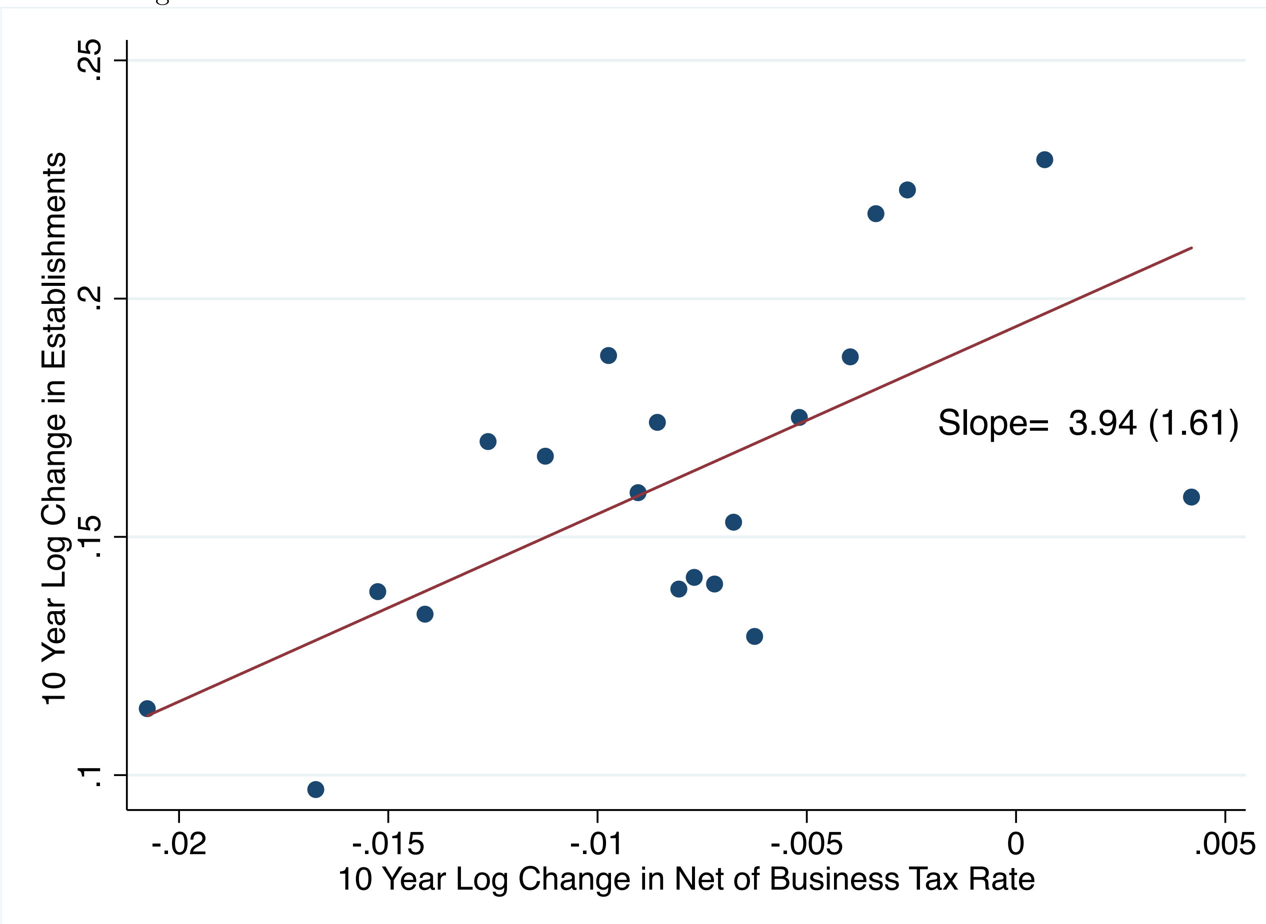
Notes: This figure shows the cumulative annual effects of local business tax cuts on local population growth over different time horizons with pre-trends. It plots the analogous estimates as Figure 4. See Section 4 for data sources and Section E for estimation details.

Figure A9: Cumulative Effects of Business Tax Cuts on Growth in Gross Operating Surplus



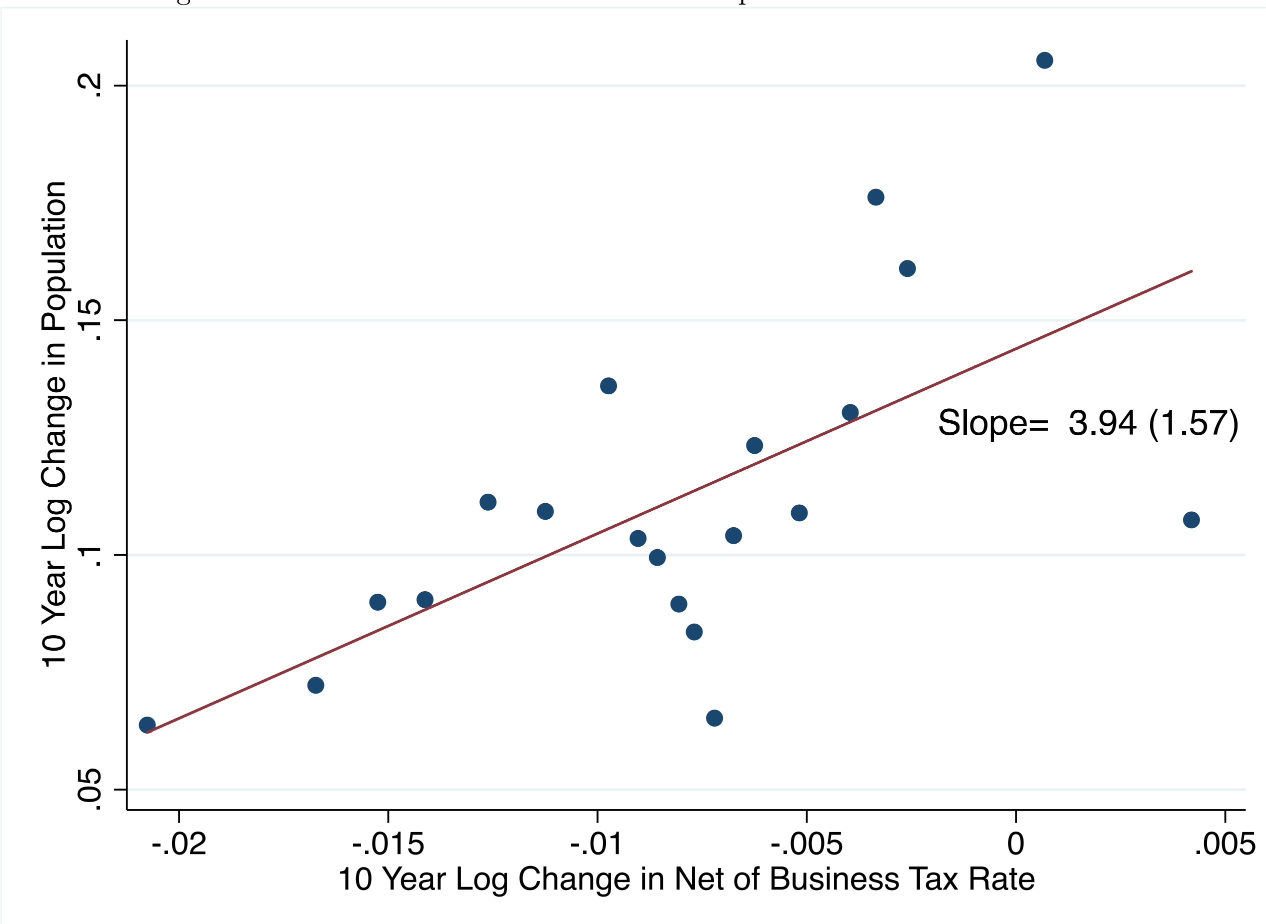
Notes: This figure shows the cumulative annual effects of local business tax cuts on state gross operating surplus over different time horizons with pre-trends. It plots the analogous estimates as Figure 4. See Section 4 for data sources and Section E for estimation details.

Figure A10: 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 adjusted for year fixed effects. 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 Population Growth over 10 Years

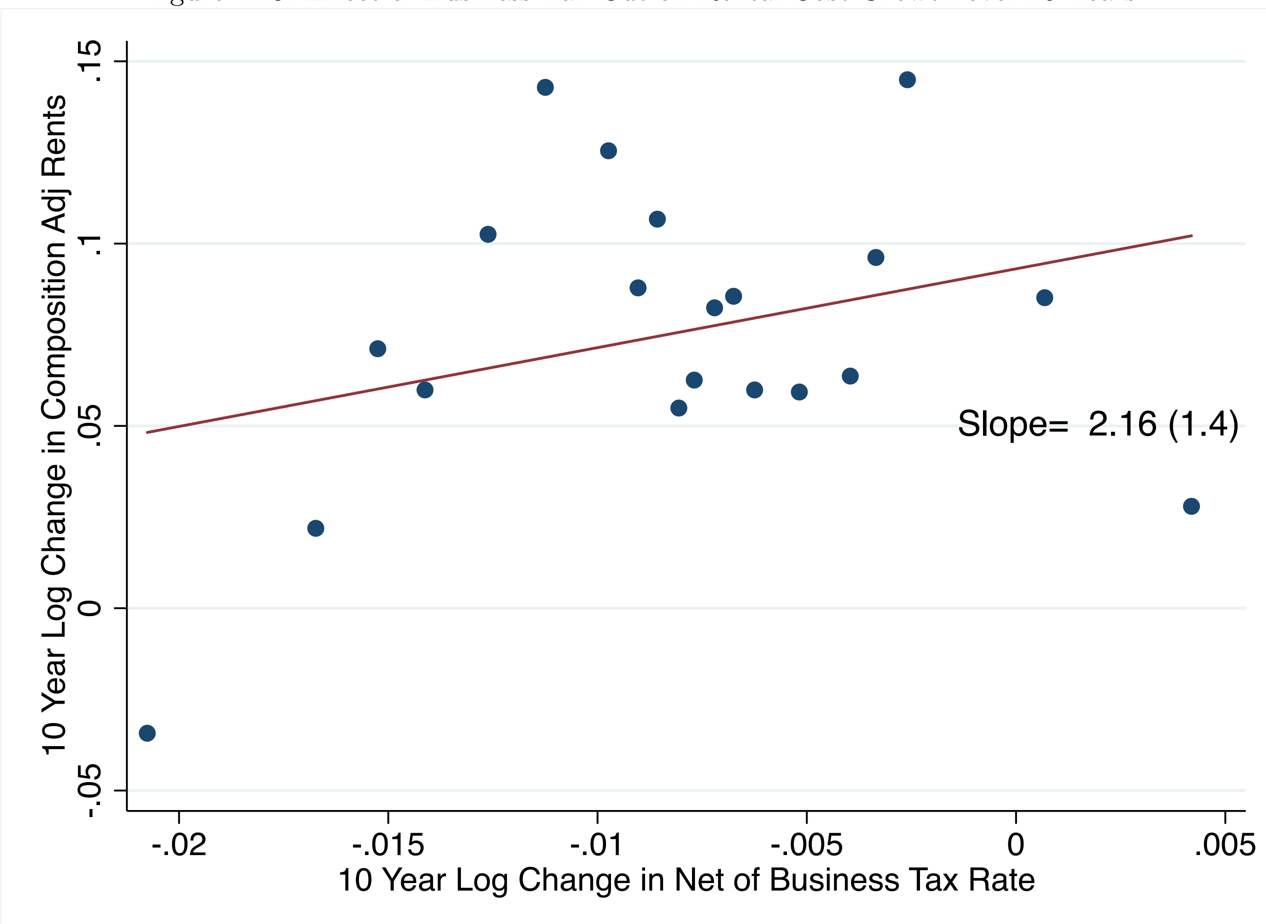


NOTES: This figure shows the mean log change in the population over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjusted for year fixed effects. Standard errors clustered by state are in parentheses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

Figure A12: Effect of Business Tax Cut on Wage Growth over 10 Years

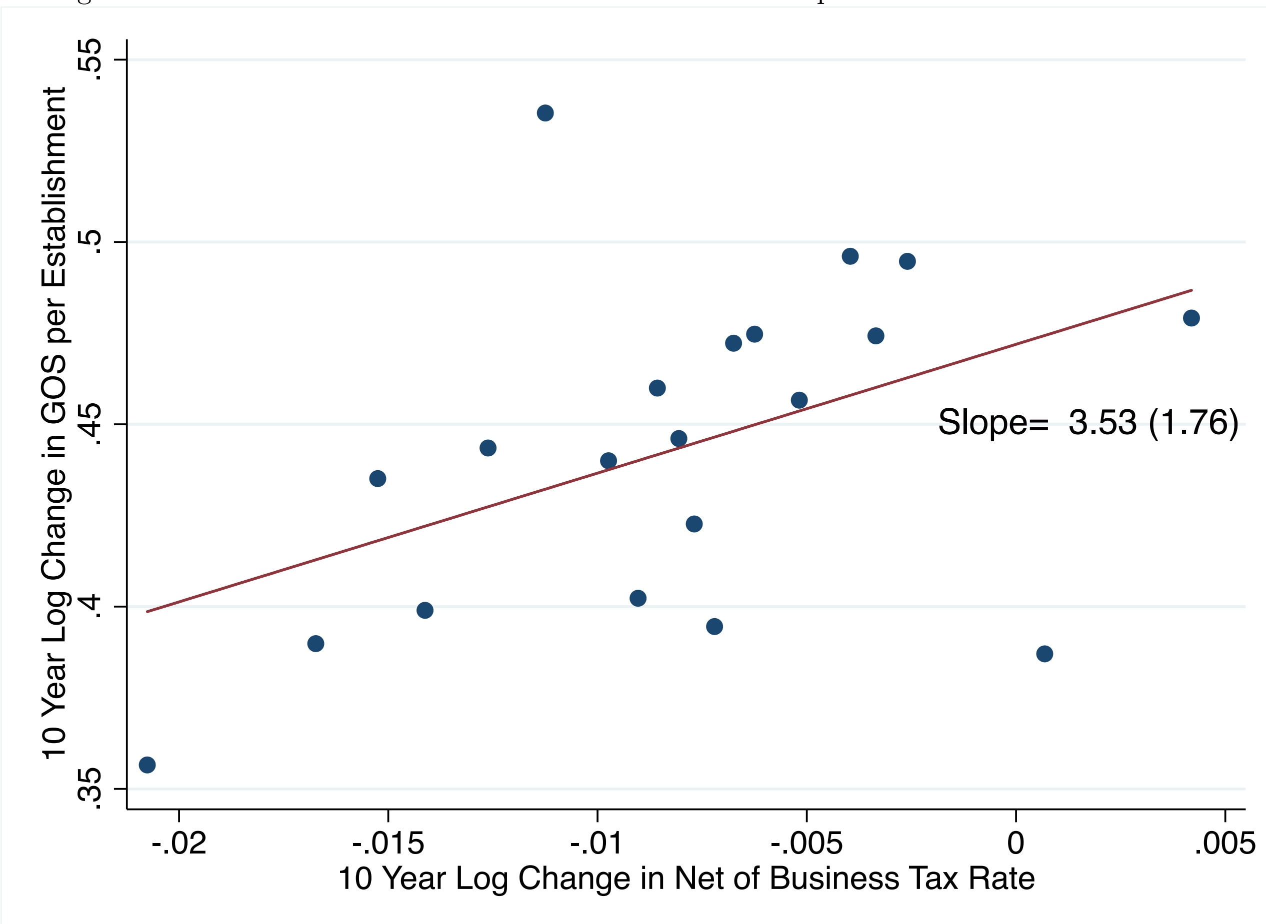
Notes: This figure shows the mean log change in wages over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjusted for year fixed effects. As in the main text, wages are a composition constant index. Standard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

Figure A13: Effect of Business Tax Cut on Rental Cost Growth over 10 Years



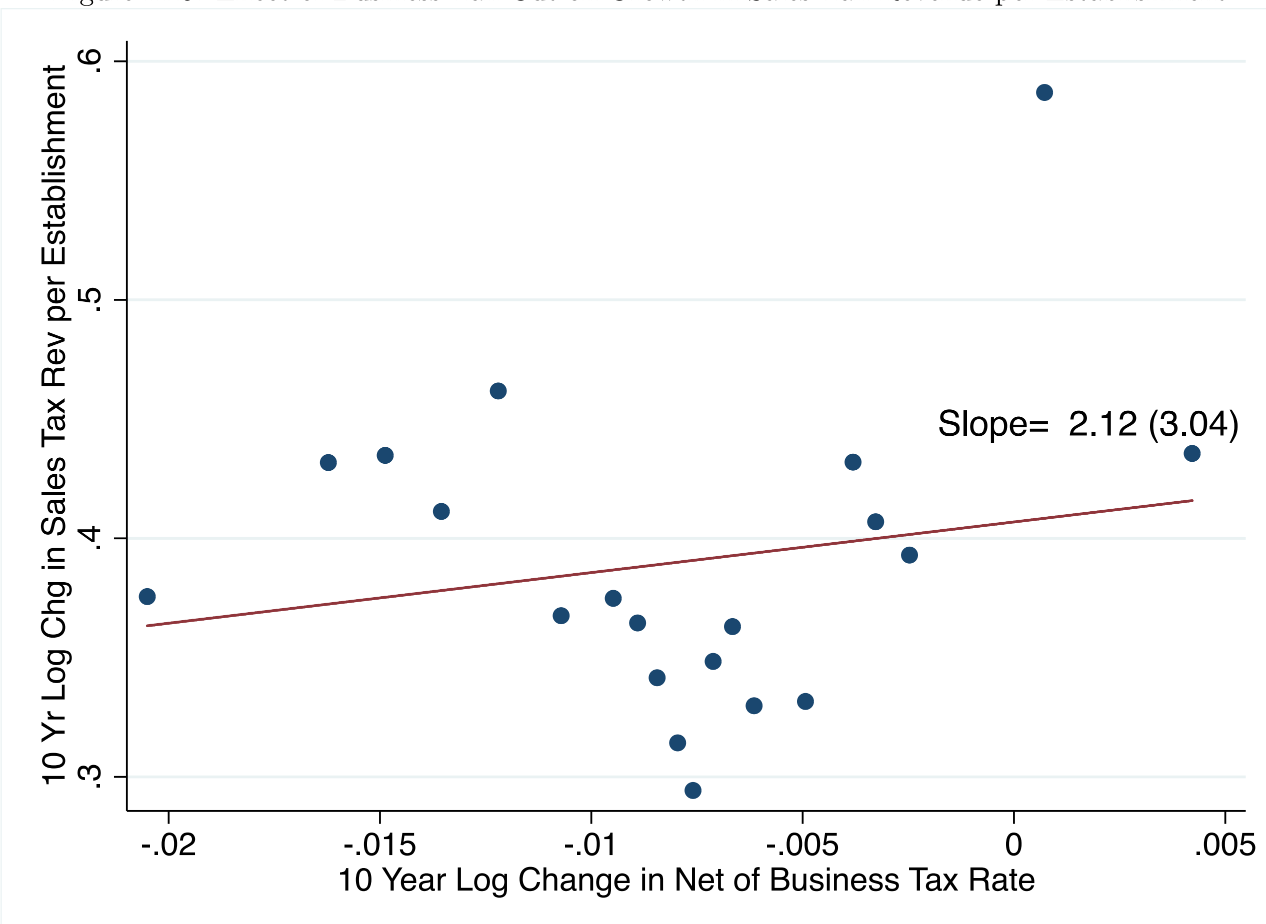
NOTES: This figure shows the mean log change in rents over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjusted for year fixed effects. As in the main text, rental costs are a composition constant index.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

Figure A14: Effect of Business Tax Cut on Growth in GOS per Establishment over 10 Years



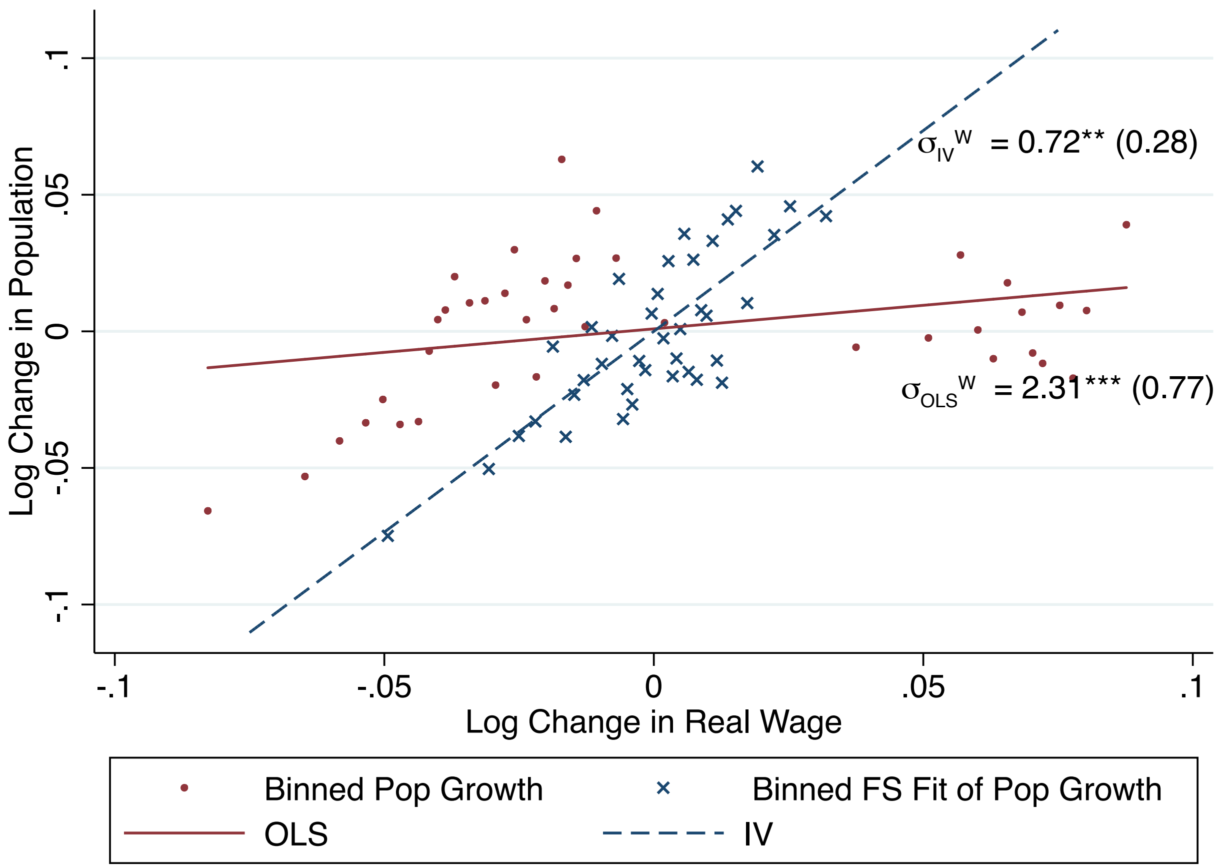
NOTES: This figure shows the mean log change in state gross operating surplus per establishment over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. To account for the consumption of fixed capital, which is 44% of GOS on average during the sample period of 1980 to 2010 (NIPA Table 1.14), one needs to multiply this point estimate by (1-.44). In particular, the point estimate implies an estimated effect of $(1 - .44) \times 3.53 = 1.98$ on net operating surplus per establishment. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

Figure A15: Effect of Business Tax Cut on Growth in Sales Tax Revenue per Establishment



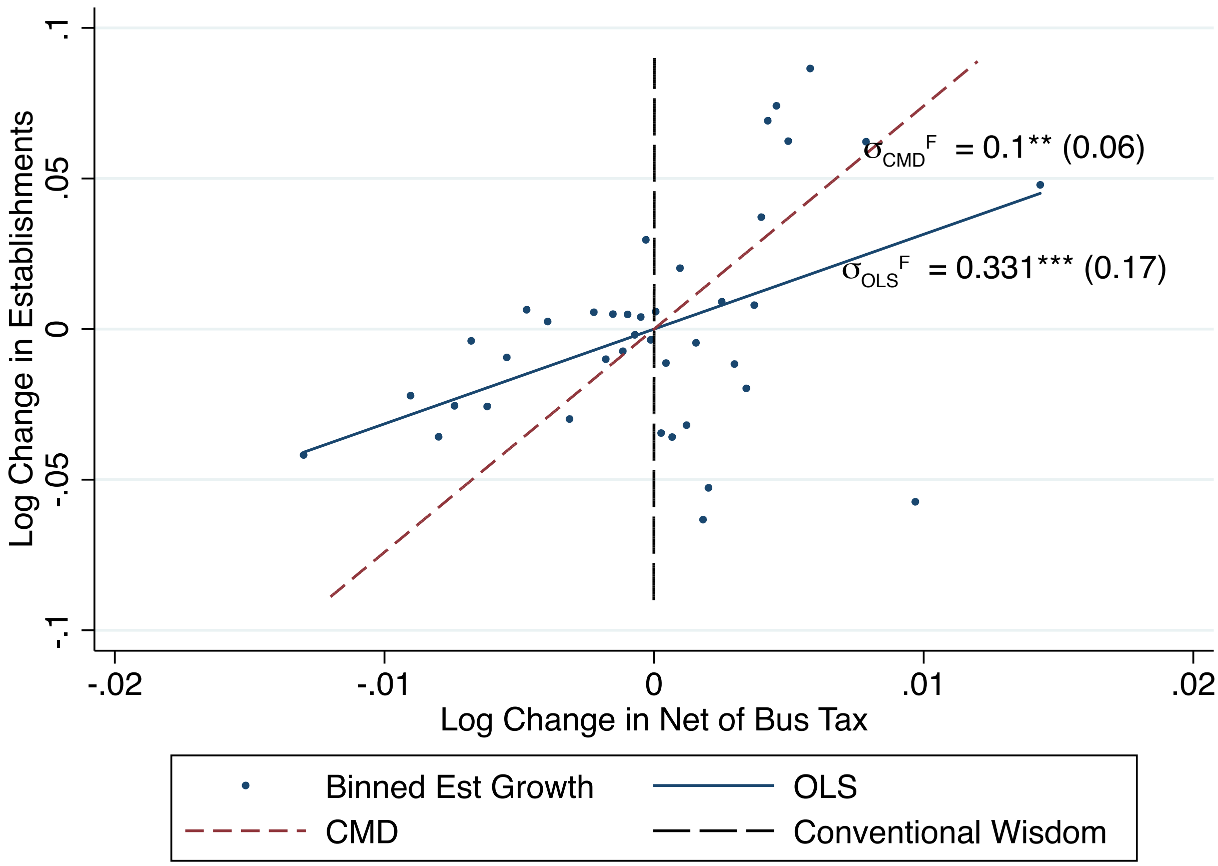
NOTES: This figure shows the mean log change in state sales tax revenue per establishment over 10 years by bin of log change in the net-of-business-tax rate τ^b over 10 years. The data are unweighted, at the county-group level, and are only adjust for year fixed effects. Standard errors clustered by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

Figure A16: 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 A33. Standard errors clustered by state are in parentheses and *** p<0.01, ** p<0.05, * p<0.1.

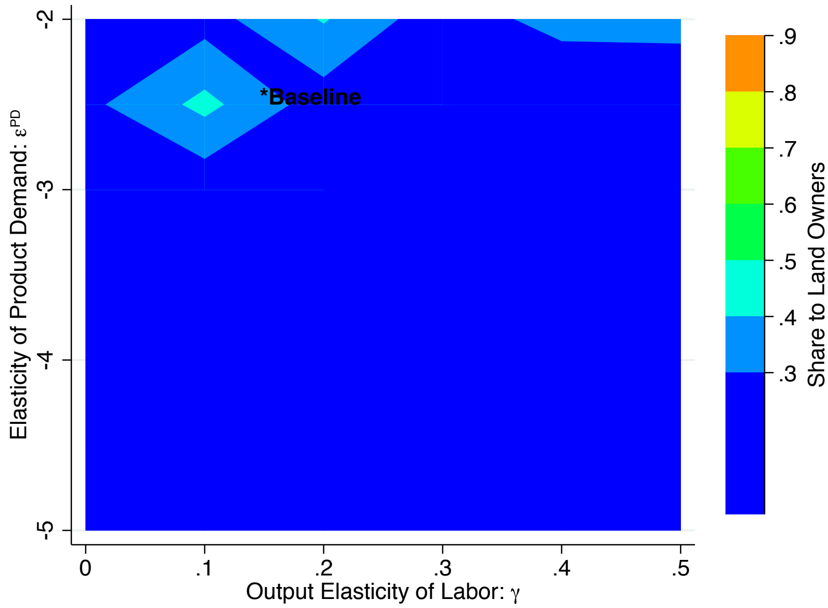
Figure A17: Estimates of Establishment Location Equation



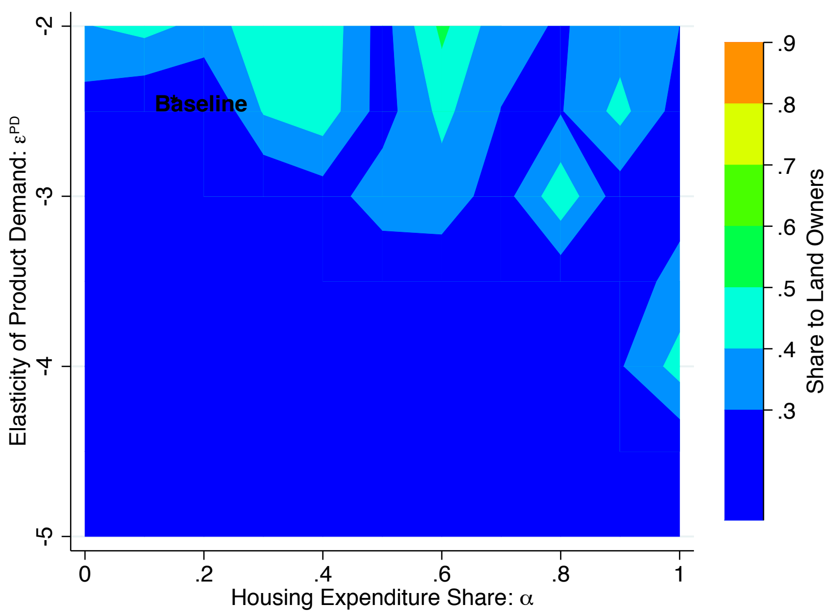
Notes: This figure illustrates how establishment location choices relate to business taxes. The conventional view on corporate taxation in an open economy, which is based on models that neither incorporate the location decisions of business nor the possibility that a business's productivity can differ 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 A33 Col. 5 and 6, respectively (see Section E.6.4 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 A16 for the analogous figure for worker location.

Figure A18: Robustness of Economic Incidence

Panel (a)
Landowner's Share of Incidence for $\alpha = 0.3$ and Calibrated Values of γ and ε^{PD}



Panel (b)
Landowner's Share of Incidence for $\gamma = .15$ and Calibrated Values of α and ε^{PD}



NOTES: This figure, which is analogous to Figure 5 for landowners instead of firm owners, shows how our estimates of landowner incidence vary across the parameter space. Specifically, the figures plot landowner incidence shares for a variety of parameter values relative to our baseline parameters values of $\gamma = 0.15$, $\varepsilon^{PD} = -2.5$, and $\alpha = .3$. See Section 6 for more detail.

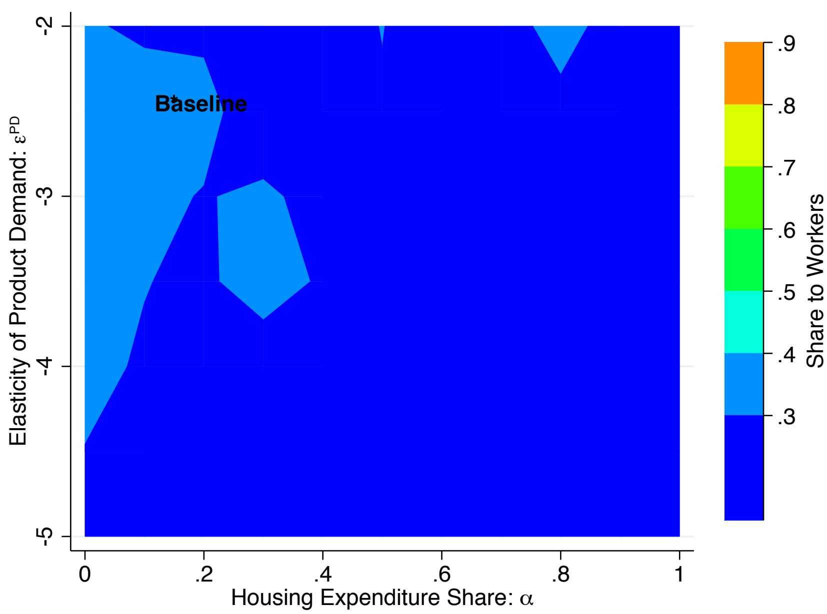
Figure A19: Robustness of Economic Incidence

Panel (a)

Workers' Share of Incidence for $\alpha = 0.3$ and Calibrated Values of γ and ε^{PD}

Panel (b)

Workers' Share of Incidence for $\gamma = .15$ and Calibrated Values of α and ε^{PD}

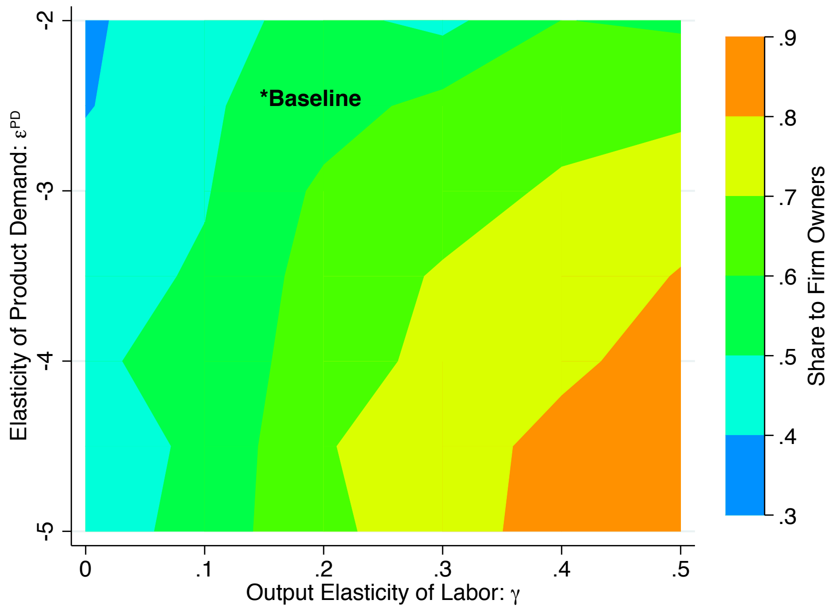


NOTES: This figure, which is analogous to Figure 5 for workers instead of firm owners, shows how our estimates of worker incidence vary across the parameter space. Specifically, the figures plot worker incidence shares for a variety of parameter values relative to our baseline parameters values of $\gamma = 0.15$, $\varepsilon^{PD} = -2.5$, and $\alpha = .3$. See Section 6 for more detail.

Figure A20: Robustness of Economic Incidence (Using Employment Effects)

Panel (a)

Firm Owner's Share of Incidence for $\alpha = 0.3$ and Calibrated Values of γ and ε^{PD}

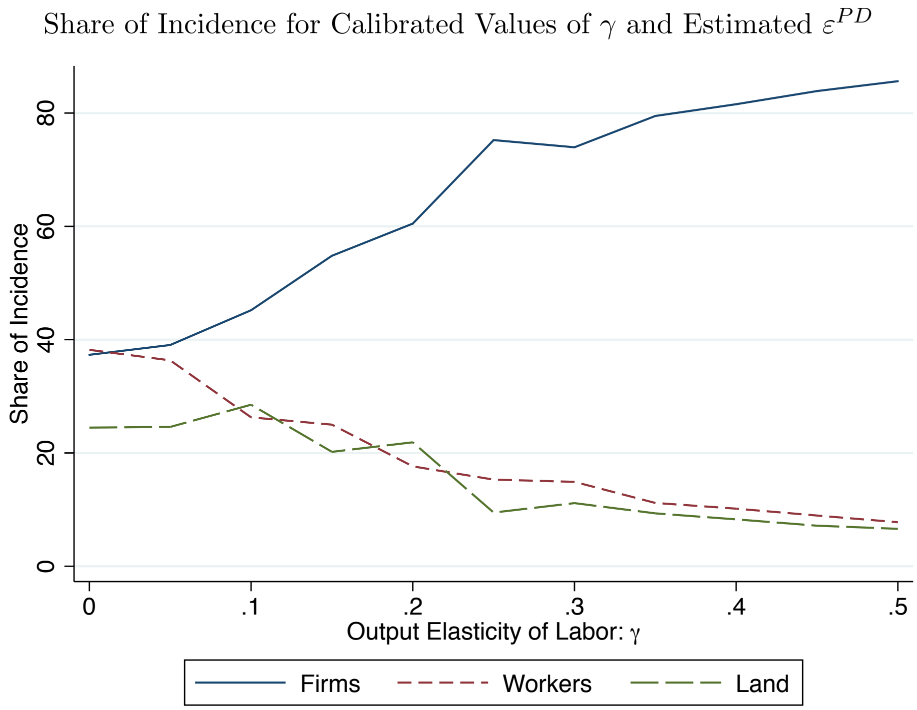


Panel (b)

Firm Owner's Share of Incidence for $\gamma = .15$ and Calibrated Values of α and ε^{PD}

NOTES: This figure, which is analogous to Figure 5 for firm owners based on employment changes rather than based on population changes (i.e., using the estimates in Table A9 instead of A6), shows how our estimates of firm owner incidence vary across the parameter space. Specifically, the figures plot firm owner incidence shares for a variety of parameter values relative to our baseline parameters values of $\gamma = 0.15$, $\varepsilon^{PD} = -2.5$, and $\alpha = .3$. See Section 6 for more detail.

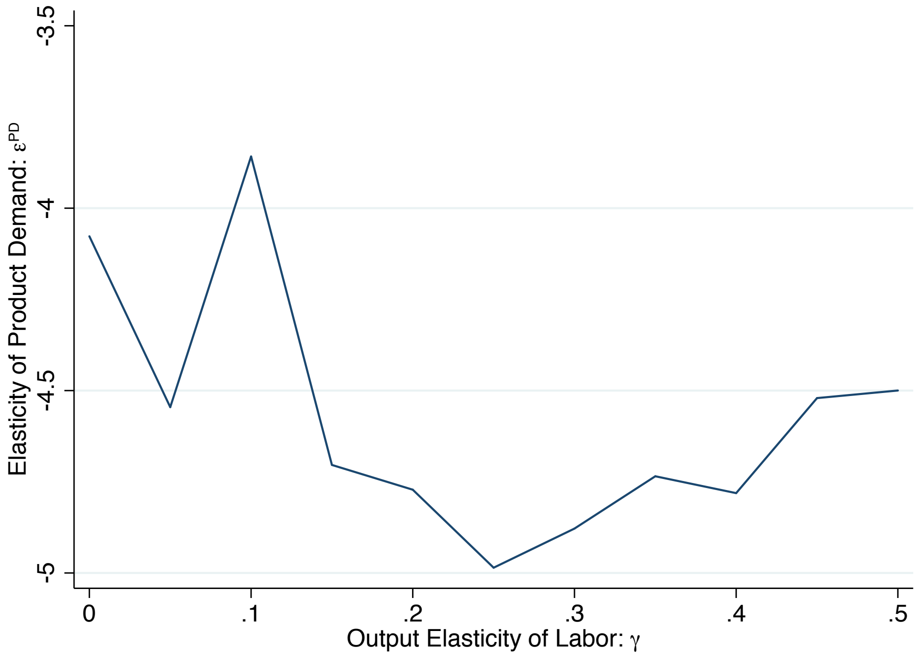
Figure A21: Robustness of Economic Incidence



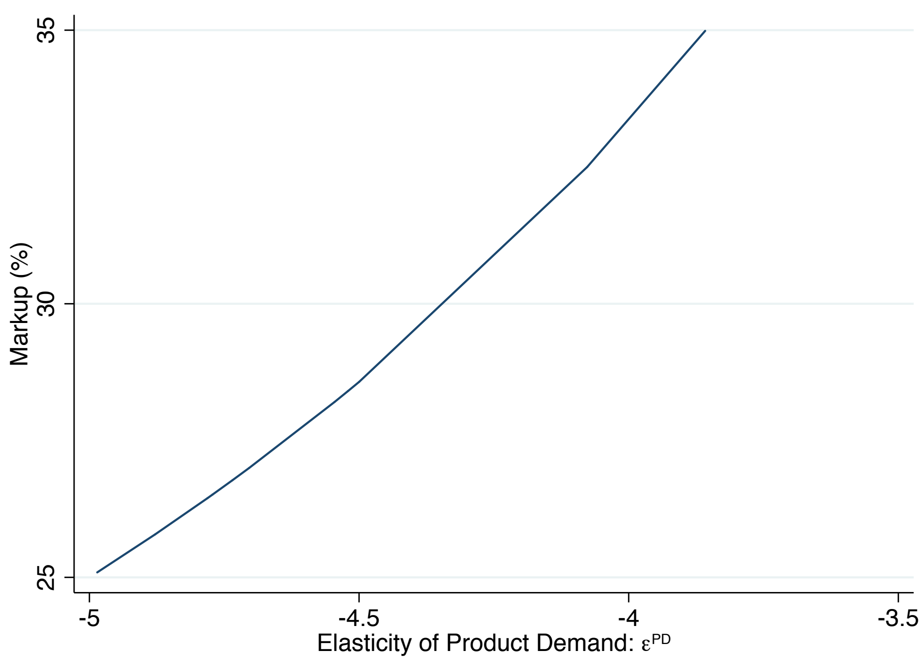
NOTES: This figure shows that the shares of incidence to firm owners, workers, and landowners are independent of the calibrated values for the output elasticity of labor γ. Similar to Part A of Figure 5, it indicates that our baseline empirical result – that firm owners bear a substantial share of incidence – is robust to using a variety of calibrated parameter values. Appendix Figure A22 shows the relationship between calibration values and estimates as well as their implications for markups. See Section 3 for more detail.

Figure A22: 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 6. Panel (b) plots the associated markup for a given value of ε^{PD}.