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The Asymmetric Effects of Corporate Tax Changes on Employment

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In response to declining numbers of manufacturing jobs, an OECD-high corporate income tax rate, and a slow post-recession recovery, United States policymakers are debating corporate tax reform. While the federal corporate income tax has not been substantially changed since 1994, state legislatures frequently adjust the way in which their jurisdictions tax business profits. Since 2008, fifteen states have reduced their statutory corporate income tax rates and twelve states have changed the method by which taxable income of multi-state corporations is apportioned. Since such reforms are often enacted with the stated goal of increasing employment, the objective of this empirical examination is to inform the debate about the effects of corporate tax rates and income apportionment formulae on the resulting levels of employment.

While the economic impact of corporate taxation has been thoroughly studied, analysis has often focused on the federal level (Romer and Romer 2010). Research concentrated at the state level has often been limited to an explanation of how corporate income taxation affects non-employment economic indicators such as growth and business location decisions (Buss 2001, Bartik 1985). Meanwhile, literature that seeks to estimate the effect of state corporate tax policy on employment often neglects the income apportionment formula, a crucial component of tax policy that likely influences a company's labor investment decisions. Although some literature examines the income apportionment formula's effect on employment, the dependent variable is either sector-specific or uses an inappropriate measurement of employment. Further, few studies have examined the existence of asymmetric effects of tax changes.

This empirical examination will estimate the effects of the income apportionment formula and statutory tax rates on a state's employment level and will seek to identify an asymmetry in the effect of a tax policy change on employment level. Panel data for states from 1979 to 2015 and control for various structural economic variables will be used to analyze the relationship between state corporate income tax policy and employment.

This paper does not find sufficient evidence that the level of the statutory corporate income tax rate has a significant real effect on state employment. However, the effect of a tax rate change is significant and asymmetric. A 1% increase in the corporate tax rate decreases the state's employment level approximately by 0.4%. However, a 1% decrease in the tax rate has no significant effect on the level of employment. The results also suggest that neither the level nor changes in the payroll weight from the income apportionment formula had a significant effect on employment in the period from 1979 to 1997. The interaction between the statutory tax rate and payroll weight, called the corporate payroll tax burden, also failed to demonstrate an effect on employment significantly different from zero. The lack of significance for the latter two corporate tax parameters suggest that corporations are more responsive to the statutory income tax rate than the true tax burden they bear with respect to payroll.

Examining the consequences of changes in corporate tax policy is challenging for several reasons. First, changes in tax policy are unlikely to be random and are instead altered as a result of economic and political conditions. In recessions, for example, state legislatures may vote to decrease the corporate income tax rate with the expressed intent of easing the burden on businesses in a weak economy. However, a state legislature may also reduce corporate taxes for

reasons independent of the economy, such as the ideological leanings of elected officials. Even if changes in tax rates were implemented randomly, assumptions about macroeconomic variables of interest are necessary in order to develop a counterfactual that allows for estimates of the effect of a corporate tax change on employment. Because the data used to measure employment level includes the total number of both full-time and part-time jobs, this analysis cannot isolate the effects of the corporate tax rate on full-time employment, a measurement for which policymakers have greater interest.

The paper proceeds in five parts. Section 1 presents a review of relevant literature. Section 2 identifies the sources, features, and problems with the data. Section 3 summarizes the empirical specification. Section 4 presents the results. The conclusion is set forth in Section 5.

I. Literature Review

This paper will build upon insights from past work that focused on the relationship between state-level corporate tax policy and employment. Empirical work on U.S. state corporate taxation remains inconclusive about the effects on employment.

With respect to corporate income tax rates, Bartik (1992) summarizes in a literature review of research from 1979 to 1991 that tax rates had a negative impact on business activities such as employment, output, business capital stock, and number of business establishments. In a separate literature review, Wasylenko (1997) noted that two of three empirical studies which focused strictly on the relationship between corporate tax rates and employment found a significant negative effect of increased tax rates. Wasylenko also observed that over time, tax differences between states have become a less significant determinant of employment. However, Goss and Phillips (1994) find that while personal income tax rates reduce employment growth, the corporate tax rate variable does not affect job growth. Shuai and Chmura (2013) discover a negative effect of higher corporate income tax rates on employment growth. Ljungqvist and Smolyansky (2016) use a difference-in-difference border-discontinuity approach to determine while state corporate income tax rate increases are unambiguously harmful to employment level, a corporate tax cut has no statistically significant effect. With such results, Ljungqvist and Smolyansky are the first authors with findings that may point to asymmetric effects of corporate tax changes.

While the above literature is generally sound in its methodology in analyzing statutory corporate income tax rates, studies will fail to capture the comprehensive effects of corporate tax policy on employment if the income apportionment formula is omitted from the analysis. The income apportionment formula allows a multi-state corporation to divide its profits into an in-state portion and an out-of-state portion based on the company's presence in that jurisdiction. Each state, in the same manner that it chooses a statutory corporate income tax rate, selects its own apportionment formula weights.

The purpose of income apportionment is to avoid double taxation of a corporation's profits. However, when state corporate income taxes were adopted in the first half of the 20th century, common standards for partitioning multi-state corporate profits among the various jurisdictions did not exist. In the 1950's, state tax officials in more than 20 states agreed to common use of an equally-weighted three-factor formula that considered a company's sales, property, and payroll.

However, in *Moorman Manufacturing Co. v. Bair*, 437 U.S. 267 (1978), the Supreme Court held that a state's use of an equally-weighted three-factor formula was not constitutionally binding.

The income apportionment formula states that if a firm's profit is π, its income attributed to state j, π_j, is

$$(1) \qquad \pi_j = \left(\alpha_j^P \frac{P_J}{P} + \alpha_j^W \frac{W_J}{W} + \alpha_j^S \frac{S_J}{S}\right)\pi$$

where P is total property, W is total payroll, and S is total sales for a given company, P_J, W_J, and S_J are the property, payroll and sales in state j, and α_j^f is the weight in the apportionment formula for factor f in state j.

McLure (1980) has shown that the three-factor formula effectively reduces the corporate income tax to direct taxes on payroll, property, and sales. It is a direct tax because a firm's overall marginal tax rate in state j, τ_j, with an apportionment formula and statutory marginal tax rate t_j is

$$(2) \qquad \tau_j = \left(\alpha_j^P \frac{P_J}{P} + \alpha_j^W \frac{W_J}{W} + \alpha_j^S \frac{S_J}{S}\right) t_j$$

Equation (2) demonstrates the importance of both the statutory marginal tax rate and the weighted factors of the apportionment formula. In addition to the work of McLure, there is ample theoretical research suggesting that the statutory tax rate and apportionment formula should affect employment decisions of firms. Serrato and Zidar (2016) develop a spatial equilibrium model to estimate the incidence of state corporate taxes on wages, rents, and profits. Serrato and Zidar show that the incidence of state corporate tax changes depend on the elasticity of labor supply, elasticity of labor demand, and the increase in labor demand following a business tax change, represented by $\frac{\partial \ln L_c^D}{\partial \ln(1-\tau_c^b)}$ where c denotes location b denotes the tax is levied on business profits, and L^D is labor demand. The authors argue an increase in labor demand driven by a tax cut is due to firm entry (while wages of workers at existing firms also increase by the same mechanism). Therefore, assuming labor supply is not perfectly inelastic, an increase in employment is to be expected as a result of a tax cut.

Serrato and Zidar also demonstrate that the increase in labor demand is a function of firm location c and derive expressions for this parameter that depend on geographic factors (such as local wage and housing costs). However, such theoretical derivations are beyond the scope of this paper. The authors do not posit any theoretical framework that might explain an asymmetric effect of changes in the tax rate, such as those identified by Ljungqvist and Smolyansky. Nevertheless, the authors represent how tax cuts, in theory, induce increased labor demand thus leading to more employment in a locality.

Despite this theoretical work suggesting that corporate taxation should affect employment decisions of firms, existing empirical work has been less clear. Goolsbee and Maydew (2000) estimate the income apportionment formula has a significant effect on state-level manufacturing employment. Clausing (2016) finds that between 1986 and 2012, there is little evidence that state employment is sensitive to the corporate payroll tax burden, which is the payroll weight

interacted with the statutory tax rate. In the studies of both Goolsbee and Clausing, the dependent variable does not accurately represent the employed population most likely to be affected by a corporate tax rate. Goolsbee and Maydew, clearly, only study the effects on manufacturing employment. Clausing, meanwhile, uses a measure of employment that includes sole proprietors and partners, who work for businesses which are subject to personal income tax rates rather than corporate income tax rates.

II. Data

This study compiles a panel data set on state-level corporate income tax rates, apportionment formula weights, employment statistics, and various economic control variables from 1979 to 2015. The year of 1979 was selected as the first year in the sample because it was the first year following the *Moorman* ruling, after which apportionment formula rules became nationally standardized. There have been 158 statutory corporate tax rate changes and 82 apportionment formula changes between 1979 and 2015, providing the sample with adequate variation to more precise estimates of their effects.

State employment statistics were extracted from the Personal Income and Employment Summary produced by the Bureau of Economic Analysis's (BEA) Regional Economic Accounts. For each state, the BEA measures the number of both wage and salary jobs as well as proprietors' jobs. In its estimates of employment, BEA gives equal weight to full-time and part-time jobs and counts employment by place of work rather than the worker's place of residence. All estimates in this study are obtained using the number of wage and salary employees as the dependent variable. In 2015, wage and salary employees accounted for 77.5% of the United States labor force.

State tax parameters were collected from the Tax Foundation, various state law and reference libraries, and the Robert M. La Follette School of Public Affairs, University of Wisconsin-Madison. In 2015, among the 44 states with a corporate income tax, 29 states imposed a single flat rate and 15 states instituted a progressive tax on profits. The remaining 6 states, recorded as having a 0% corporate income tax rate, either levy a tax on revenue or do not collect a business tax at all. The relative proportion of states which impose either a flat, progressive, and no tax remains nearly constant throughout the sample. In the case of states with progressive tax codes, this analysis employs the top marginal tax rate as the tax rate parameter, given that for most corporations, profits well exceed the highest threshold of taxation. Therefore, the highest marginal rate is the best estimate for the income tax rate that the company will encounter. Apportionment formula data included the relative weights on the payroll, property, and sales factor for each state. In 1979, 35 states among the 44 states with a corporate income tax used an equally-weighted three-factor apportionment formula. In 2015, only 9 states used such a formula.

Economic control variables were also essential to this study. Income of wage and salary workers was also extracted from the BEA Regional Economic Accounts and was divided by the number of wage and salary workers to obtain a mean income for salary and wage workers. This figure was then adjusted for inflation with the Consumer Price Index, obtained from the Department of Labor. Average state-level personal income tax rate, another economic control, was extracted from a National Bureau of Economic Research (NBER) database constructed with use of microdata from the Statistics of Income Division of the Internal Revenue Service. See Table 1 for a table of descriptive statistics.

Table 1: Descriptive Statistics for State Panel 1979-2015

Variables	*Mean*	*Standard Deviation*
ln(wage and salary employment)	14.24	1.01
Δln(wage and salary employment)	0.0126	0.0208
Corporate Income Tax Rate	0.0652	0.0296
Personal Income Tax Rate	0.0263	0.0151
Payroll Factor	0.2278	0.1284
Corporate Tax Burden (for employment)	0.0165	0.0102
Average Worker Income	18,044	2,958
ln(average worker income)	9.787	0.157
Δln(average worker income)	0.0048	0.0167
% of Workers in Manufacturing	0.1079	0.0518
Cut of Top Rate	0.0535	-
Hike of Top Rate	0.0319	-
Cut of Payroll Weight	0.0443	-

Note: Each statistic is the average for all years and all 50 states; Corporate Tax Burden is product of corporate tax rate and payroll factor, and should be interpreted as effective corporate tax rate with respect to employment. Average worker income is in 1983 dollars; Observations = 1,850

While our employment variable better measures the working population most likely to be affected by corporate tax policy, there remain complications with our dependent variable. Included within the wage and salary employment variable are government workers and employees of other entities that do not pay a corporate income tax (sole proprietorships, non-profits, and S-corporations). The payroll factor weight, while expressed as an average above, takes on a value in the data of either 0.00, 0.25, or 0.33 in 95.68% of observations

Figure 2: Average State Corporate Income Tax Rate, 1979-2015: Highest Marginal Rate

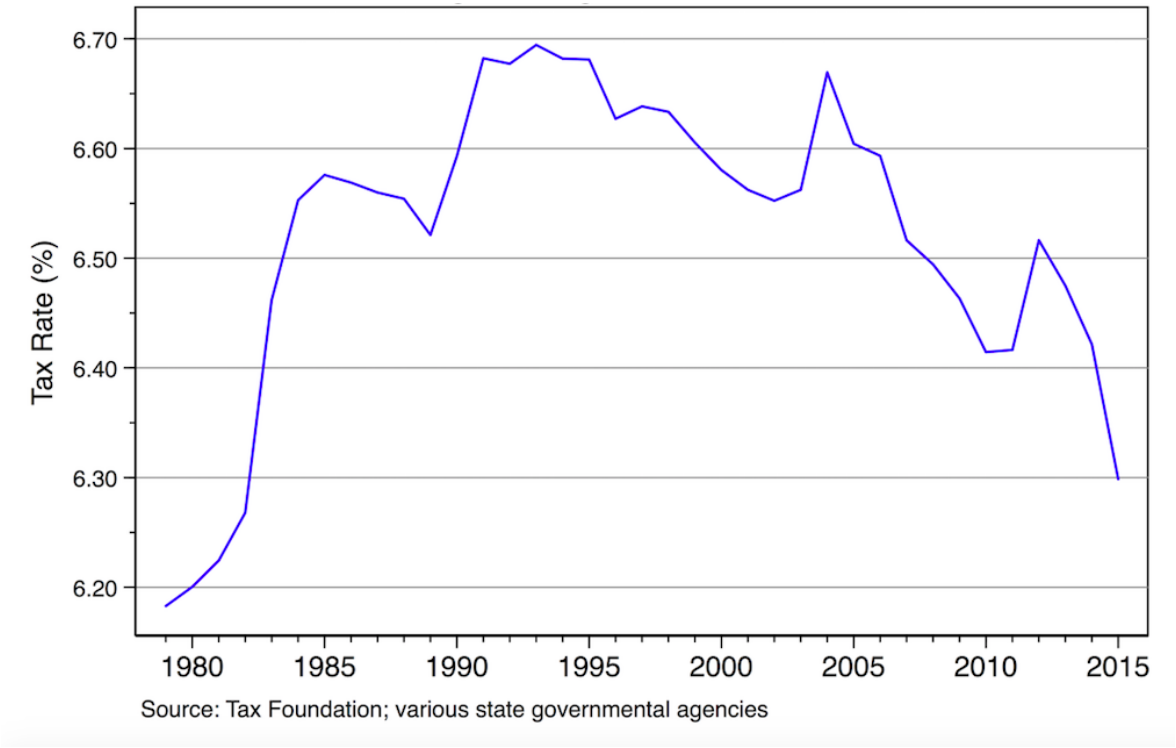
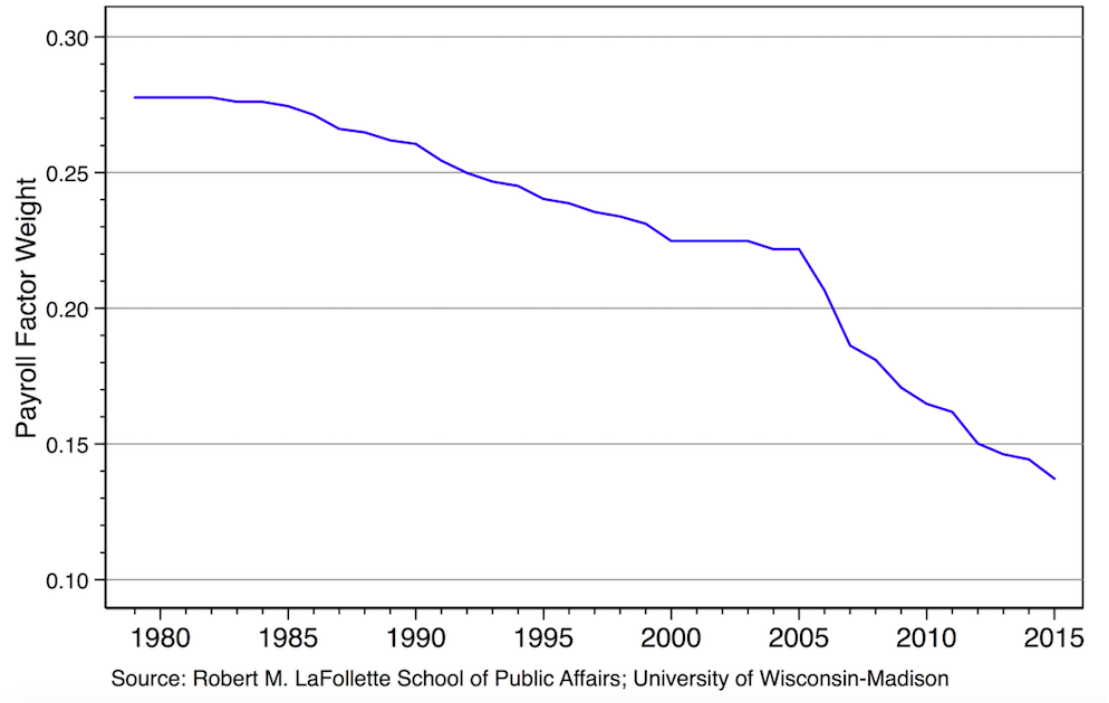
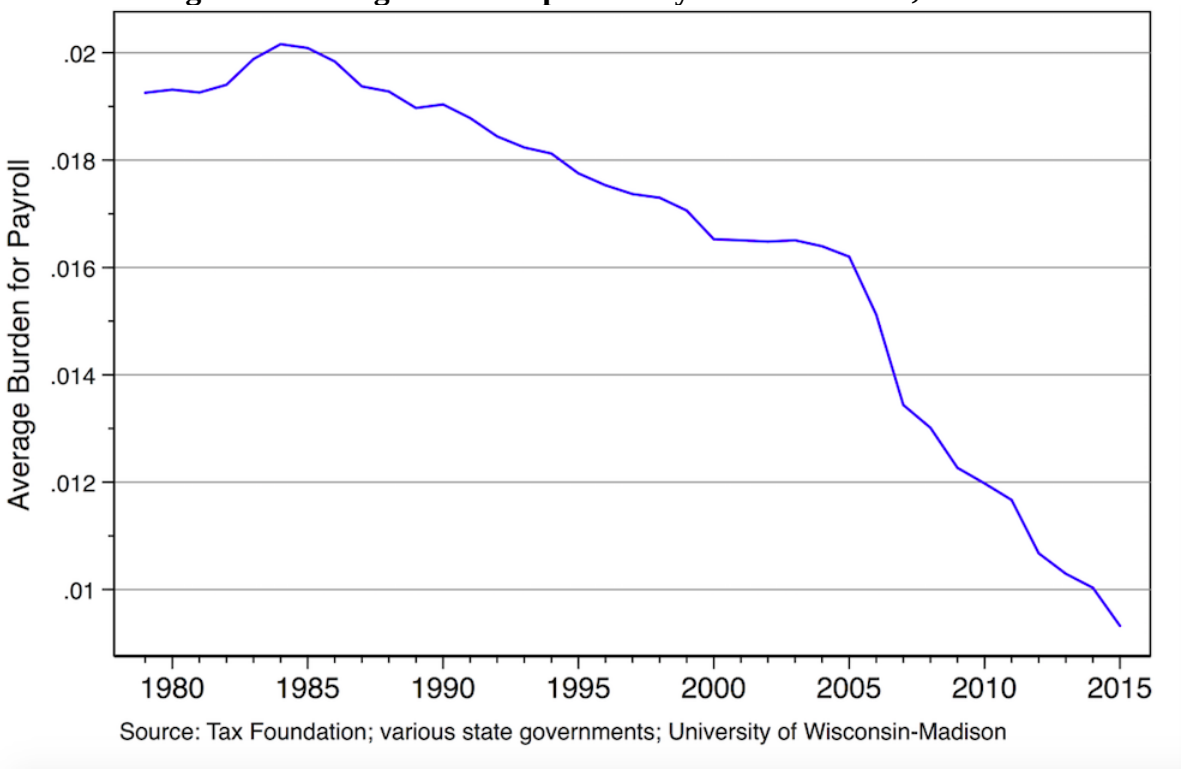


Figure 3: Average State Payroll Factor Weight in Apportionment Formula, 1979-2015



The average top marginal statutory corporate income tax rate in the 50 states (Figure 2) increased from 1979 until the early-1990's and has since been trending downwards ever since. The average weight on the payroll factor (Figure 3) has consistently trended downwards since the *Moorman* ruling clarified that the equal-weighted three-factor formula is not required. Given consistently declining payroll factor weights and recently-declining statutory tax rates, the interaction of these two figures has also unsurprisingly decreased also. Indeed, the average tax burden with respect to payroll (Figure 4) in 2015 is less than half of its level in 1979.

Figure 4: Average State Corporate Payroll Tax Burden, 1979-2015



III. Methodology

A. Specification

Using this data, our basic empirical model will regress the log of wage and salary employment in state *i* in year *t* as follows:

$$\ln(emp_{it}) = \beta_0 + \beta_1(Tax_{it}) + \Gamma_1'(Z_{it}) + \lambda_t + \alpha_i + \varepsilon_{it} \quad (3)$$

This fixed effects model includes Z_{it}, a vector of state-specific time trends and state-level controls, such as population level, personal income tax, average income per salary and wage

earner, average employee income growth, and percent of the workforce in manufacturing. The fixed effects model also includes time dummies (λ_t) which absorb macroeconomic conditions that affect all states such as recessions, interest rates, and federal government spending. Tax_{it} is our variable of interest which, depending on the specification, may be statutory corporate tax rate, corporate tax burden, payroll weight, or magnitude of tax increase or decrease.

Due to the nature of the data set, panel data econometric models perform better than pooled ordinary least squares (OLS). A Hausman test was performed on the model specification and suggested that fixed effect panel models are preferred to random effects. F-tests were performed on various specifications for the presence of both state fixed effects and time fixed effects. In general, while the coefficients for each individual state and year may be significant in the specification, it is possible that jointly their effect could not be significant. All regressions in this paper (both fixed effects and probit) use heteroskedastic robust standard errors, given the variation in size between states.

In the results section, specifications with and without time fixed effects are reported, and all specifications have state fixed effects. Although Shuai (2013) was not able to reject the null hypothesis of no state fixed effects, our F-tests indicated a p-value of 0.00 for rejecting the absence of both state and time fixed effects. The disagreement between our results and Shuai's results may follow from substantial methodological differences.[1]

Indeed, use of a state fixed effects model is essential to prevent spurious statistical correlations that could easily result from omitted variables. In a model similar to (3) but that omits state fixed effects,

$$\ln(emp_{it}) = \beta_0 + \beta_1(Tax_{it}) + \Gamma_1'(Z_{it}) + \lambda_t + \varepsilon_{it}^* \quad (4)$$

the composition of error term ε^*_{it} becomes

$$\varepsilon_{it}^* = \alpha_i + \eta_{it}$$

where α_i is an unobserved fixed effect (i.e. a characteristic specific to each state correlated with tax variables that affects employment level). For this reason, $\mathbb{E}(\varepsilon_{it}^*|x_{it}) \neq 0$, meaning the estimates of specification (4) will be biased. For example, if a given state is business-friendly (in some unobservable manner) and is therefore also more likely to have lower tax rates, then without state fixed effects, estimations would risk attributing increases in employment solely to the low tax rate, when other aspects of the state's policies may be far more important. By including state fixed effects, $\eta_{it} = \varepsilon_{it}$ and $\mathbb{E}(\varepsilon_{it}|x_{it}) = 0$.

A matter of great methodological importance is the decision to include state-specific time trends in addition to state fixed effects and year dummies. The general fixed effect model with time dummies can control for both unobserved time-specific changes that affect all states and unobserved state-specific characteristics that exist across time. However, such a model can only capture phenomena that vary across time within a given state through explicitly including state control variables (i.e. population, manufacturing percentage in labor force, income tax rate, etc.). In the absence of such variables, changes in the dependent variable within a state across time not captured by time or state fixed effects will remain unexplained. Including state-specific time

trends ameliorate this problem by accounting for trends of numerous explanatory and control variables in individual states. Regression results are reported both with and without state-specific time trends.

B. Independent Variables

Certain specifications use variables that account for the change in the statutory rate for a tax hike and the change in the statutory rate for a tax cut.[2] The magnitude of tax cut and hike variables resemble the "first difference" of the statutory tax rate, except the values for both variables are always greater than or equal to zero since a "change" is a strictly positive value. Despite the magnitude of a tax cut and magnitude of a tax hike's similarity to a first difference, specifications with these variables are not first difference models. In these particular fixed effects regressions, although explanatory power about the level of the statutory tax rate on employment is lost, it provides insight into the potential asymmetric effects of changes in the tax rate on employment level. Further specifications also use magnitude in the changes of both the payroll weight of the income apportionment formula and corporate payroll tax burden. Specifications with change in payroll weight only include magnitude of a cut, because no state has ever increased the weight of the payroll factor in the income apportionment formula.

Other specifications use a constructed a corporate payroll tax burden that is simply the product of the statutory tax rate and the payroll factor weight. While this variable ought to capture a corporate payroll tax burden, the true burden for a company will also be dependent on state-level tax incentives and exemptions for employment that are not recorded in the data. In addition, corporate tax avoidance strategies such as dividing into dozens of subsidiaries despite functioning identically as one incorporated entity are not captured in the model. Nevertheless, accounting for the effect of both the statutory rate and the apportionment formula on employment level affords this study explanatory power regarding two key policies over which legislators possess clear power.

Controlling for employee income was another methodological concern. While a state's level of employment likely depends on both the level of mean employee[3] income and the growth of mean employee income, previous literature has been inconsistent regarding which variable should be included in regressions. In this paper, regression results are reported with specifications which control on the natural logarithm of mean employee income.

C. Endogeneity Concerns

Certain specifications use variables Studies about the effect of the tax policies can be afflicted with concerns about endogeneity, given that tax changes are not assigned randomly. As Clausing (2016) notes, endogeneity concerns could bias the coefficients in opposite directions. For example, if a state legislatures select payroll weights and statutory tax rates aimed at stimulating a weak economy, regression results may find a positive relationship between employment and higher payroll weights or tax rates due to this policy impetus. Likewise, as previously mentioned, the magnitude of coefficients may be overstated in the case where states that are inherently friendly to business also adopt lower payroll weights and tax rates.

However, this paper's analysis is responsive to these concerns in a number of ways. With respect to the first endogeneity concern, businesses are nearly always aware of a tax policy change many months before it takes effect. Even in bad economic conditions employers that are aware of impending tax relief may choose to expand hiring. Second, use of state-fixed effects in all specifications minimizes the risk of misattributing the effects of a state's underlying economic fundamentals to corporate tax parameters. Nevertheless, this paper follows the approach of both Goolsbee (2000) and Clausing by testing for possible endogeneity with a probit regression on the likelihood of a tax policy change depending on various independent variables. Regression results for probits for the likelihood of both a cut in the statutory tax rate and a cut in the payroll weight of the apportionment formula are reported in the results section.

IV. Results

A. General Statutory Corporate Income Tax Rate

Table 5 summarizes the effect of statutory corporate income rates on employment level between 1979 and 2015. The general specification follows the form of equation (3), where Tax_{it} contains only the state's statutory corporate income tax rate.[4] Throughout all analysis, Z_{it} is a vector of state control variables including population, average wage and salary employee income, average personal income tax rate, and fraction of labor force in manufacturing.[5] All analysis in Table 5 includes state-fixed effects and certain specifications also included year dummies and state-specific time trends.

Table 5: Basic Effect of Corporate Tax Rate (1979-2015)

	(1)	(2)	(3)
Corporate tax rate	0.515	-0.0272	-0.113
	(0.279)	(0.924)	(0.630)
Population	0.994***	0.711***	0.864***
	(0.000)	(0.000)	(0.000)
Average employee income	0.310*	0.212*	0.481***
	(0.014)	(0.036)	(0.000)
Personal income tax rate	1.242	-0.676	0.0848
	(0.185)	(0.327)	(0.882)
Fraction of labor force in manufacturing	0.210	1.514***	2.390***
	(0.509)	(0.000)	(0.000)
State fixed effects	Yes	Yes	Yes
Year dummies	No	Yes	Yes
State-specific time trend	No	No	Yes
Observations	1850	1850	1850
Adjusted R-Squared	0.859	0.957	0.980

Notes: p-values in parentheses; dependent variable in regressions is natural log of wage and salary employment). Population and average employee income are natural logs

* p<0.05, ** p<0.01, *** p<0.001

Across all specifications in Table 5, the effect of the statutory corporate income tax rate was determined to be insignificant. Specification (1) had an unexpectedly positive coefficient for the corporate tax rate, while the sign on the coefficients in (2) and (3) is negative. Adding time fixed effects changed the coefficient on the corporate tax rate variable from positive to negative. Adding state-specific time trends increased the magnitude of the negative coefficient on the tax rate variable, although the p-value in specification (3) was still 0.630, meaning the effect of the corporate tax rate on employment still cannot be identified to be significantly different from zero. The expected sign on the tax rate coefficient in specifications (2) and (3) supports the case for time fixed effects, which are likely essential to include because macro shocks to the national economy affect employment levels in all states. Further, adding state-specific time trends – in other words, de-trending those unobserved factors which affect employment level within a state – are likely methodologically sound, since over a 37-year period the influence of unobserved factors within a state determining employment is likely to increase or decrease. In the absence of state-specific time trends, the effect of tax rates may go undetected in the case that their potential true effect on employment is in the same direction as the unobserved state-specific factors.

The coefficients for the statutory tax rate from Table 5 support the claim that the level of the statutory rate itself has no statistically significant effect on a state's employment. This conclusion is in accordance with the recent findings of Ljungqvist (2016) and Clausing (2016). For comparison to studies which use a measure of employment that includes sole proprietors and partners, the appendix includes results tables for regressions using both measures of employment as dependent variables.

B. Asymmetric Effect of Changes in Statutory Tax Rate

After examining the level of the statutory rate, we then examine the effect of changes in the statutory rate on a state's level of employment. In the regressions for Table 6, Tax_{it} is a two-variable vector containing both the magnitude of a tax cut and the magnitude of a tax hike. The dependent variable in specifications (1) – (3) is the natural log of wage and salary employment. In specifications (4) – (6), the dependent variable is the log of all employment.

The results from the first three regressions of Table 6 indicate a likely asymmetric effect of changing the statutory corporate income tax rate on the employment level of wage and salary employees. Specifications (1) – (3) reveal a significant negative effect of a tax hike on the level of employment. Importantly, the coefficient on the magnitudes of the tax hike variable was significant in the specification with state-specific time trends, a model which most accurately measures of the true effect of the policy change. The effect of the magnitude of a tax cut, while expectedly positive in all specifications, was not determined to be statistically significant from zero. While the p-value in specifications (3) indicate near significance of the effect of a tax cut on employment of wage and salary earners, one can conclude that changes in the corporate income tax rate on employment are asymmetric, whereby a tax increase is of greater cost than the benefits of a tax cut.

Table 6: Asymmetric Effect of Corporate Tax Rate (1979-2015)

	(1)	(2)	(3)	(4)	(5)	(6)
Magnitude of tax hike	-1.828*	-0.667*	-0.400*	-1.477*	-0.406	-0.320
	(0.024)	(0.042)	(0.031)	(0.044)	(0.145)	(0.056)
Magnitude of tax cut	-0.568	0.110	0.516	-0.514	0.259	0.524
	(0.366)	(0.776)	(0.080)	(0.335)	(0.443)	(0.061)
Population	0.986***	0.710***	0.892***	1.059***	0.787***	0.955***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average employee income	0.340*	0.210	0.466***	0.329**	0.165*	0.309***
	(0.010)	(0.054)	(0.000)	(0.006)	(0.048)	(0.000)
Personal income tax rate	1.235	-0.722	-0.0265	1.516	-0.512	0.00708
	(0.209)	(0.302)	(0.962)	(0.099)	(0.273)	(0.989)
Fraction of labor force in manufacturing	0.335	1.579***	2.564***	-0.239	0.993***	1.895***
	(0.318)	(0.000)	(0.000)	(0.452)	(0.000)	(0.000)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	Yes	No	Yes	Yes
State-specific time trend	No	No	Yes	No	No	Yes
Observations	1800	1800	1800	1800	1800	1800
Adjusted R-Squared	0.854	0.955	0.980	0.909	0.976	0.987

Notes: p-values in parentheses; dependent variable in regressions (1) - (3) is ln (wage and salary employment); dependent variable in regressions (4) - (6) is ln(employment). Population and average employee income are natural logs

* p<0.05, ** p<0.01, *** p<0.001

In specifications (2) and (3) in Table 6, the interpretation of the coefficients for the magnitude of a tax changes is that a 1% increase in the corporate income tax causes a decrease in the state's employment level by between 0.68% and 0.40%. Meanwhile, a 1% decrease in the corporate income tax rate has no statistically significant effect on a state's level of employment. This result supports the findings of Ljungqvist, who although uses different methodology than this study, also concludes that a corporate income tax rate increase decreases employment while a tax cut has no significant effect. It contributes to the small but growing literature on asymmetric effects and incidence of tax policies (Benzarti et al.).

To demonstrate the importance of type of measurement of employment for the dependent variable, Table 6 repeats the same three specifications using total employment, including sole proprietors and partners, as the dependent variable. Notably, specification (5) and (6) do not find that an increase in the corporate income tax rate has a significant negative effect on the overall employment level. However, when the same variables are regressed on the wage and salary employment, the results indicate employment level is responsive to the corporate income tax rate.

The distinction between the magnitudes of the coefficients is to be expected. In specifications (4) – (6), tax parameters and control variables are regressed on a measure of employment that includes certain workers whose employment should not depend on the corporate tax rate. These workers which our study seeks to exclude from the analysis in the first three specifications constituted a non-negligible 22.5% of the American workforce in 2015. This sizable fraction of sole proprietors and partners explain the degree to which the coefficients corresponding to the distinct dependent variables differ. Moreover, the results of Table 6 should give pause to findings

of studies such as Clausing (2016), which use all employment as a dependent variable and determine that employment level is unresponsive to corporate tax parameters.

C. Corporate Payroll Tax Burden

In addition to examining the asymmetric effect of a statutory tax rate change, we analyze the effect of reducing the corporate payroll tax burden on the wage and salary employment level. Again, the corporate payroll tax burden is the product of the statutory corporate tax rate and payroll weight. In each of the six regressions in Table 7, none of the coefficients for various corporate tax policy parameters demonstrate significance. While the use of year dummies and state-specific time trends produced a coefficient for the corporate payroll tax burden that is expected in specification (5), the results are not significantly different from zero. The unexpectedly positive (although insignificant) coefficient on the corporate payroll tax burden variable in specification (1) reaffirms the importance of year dummies to a sound model. Specifications (2), (4), and (6) break up the corporate payroll tax burden into its constituent parts, yet fails to detect a statistically significant effect of either the income tax rate or the payroll weight on employment.

In specification (5) in Table 7 and specification (3) in Table 5 are nearly the same regression, except the independent variable in the former is the corporate payroll tax burden, and the latter is the statutory tax rate. The two regressions have the same adjusted R-squared value and the coefficients for their control variables are nearly identical. Meanwhile, the coefficient in specification (5) in Table 7 for the corporate payroll tax burden is of greater magnitude and has a lower p-value than its counterpart for the tax rate. This difference in the magnitudes of the coefficients are in accordance with McLure's (1980) claim that employment level should be more sensitive to the level of a state's payroll burden than its statutory tax rate. Nevertheless, neither tax parameter has a significant negative relationship with employment, so these results are not conclusive.

Further, drastic simultaneity of changes in the payroll factor weight rendered measuring the corporate payroll tax burden's effect on employment difficult. In the mid-2000s, many states dramatically cut their payroll factor weight, falling often even to 0.00. These cuts entailed a sharp reduction in the mean payroll tax burden (Figure 4). In 2007, for example, 9 states – a fifth of all states with a corporate income tax at the time – simultaneously changed their payroll factor weights. In addition, 7 states simultaneously changed their payroll weights in 2006. Such synchronized changes in tax policy impede our ability to obtain unbiased estimates for their effects.

Table 7: Corporate Payroll Tax Burden, Tax Rate, Payroll Weight (1979-2015)

	(1)	(2)	(3)	(4)	(5)	(6)
Payroll burden	0.139		-0.116		-0.298	
	(0.870)		(0.772)		(0.517)	
Corporate tax rate		0.515		-0.0271		-0.112
		(0.277)		(0.924)		(0.633)
Payroll weight		-0.00878		-0.00679		0.0131
		(0.905)		(0.833)		(0.722)
Population	0.994***	0.993***	0.711***	0.711***	0.866***	0.863***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average employee income	0.294*	0.309*	0.212*	0.212*	0.482***	0.481***
	(0.017)	(0.015)	(0.042)	(0.035)	(0.000)	(0.000)
Personal income tax rate	1.343	1.230	-0.681	-0.680	0.0654	0.0854
	(0.174)	(0.199)	(0.321)	(0.324)	(0.907)	(0.882)
Fraction of labor force in manufacturing	0.164	0.217	1.517***	1.517***	2.377***	2.398***
	(0.606)	(0.502)	(0.000)	(0.000)	(0.000)	(0.000)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	No	Yes	Yes	Yes	Yes
State-specific time trend	No	No	No	No	Yes	Yes
Observations	1850	1850	1850	1850	1850	1850
Adjusted R-Squared	0.858	0.859	0.957	0.957	0.980	0.980

Notes: p-values in parentheses; dependent variable in regressions is natural log of wage and salary employment. Population and average employee income are natural logs

* p<0.05, ** p<0.01, *** p<0.001

D. Endogeneity

As stated in Section III, although the model in this paper takes steps to avoid issues of endogeneity, it is also useful to examine possible determinants of policy changes. This section includes probit analyses which the determinants of state decisions to decrease the statutory corporate income tax rate (Table 8) and lower the payroll weight in apportionment formula (Table 9).

Both tables show specifications that include varying numbers of independent variables. The baseline specification for Table 8 (column 1) models the policy change as depending on the state's employment growth, the mean corporate income tax rate of all states, a unified Republican government (i.e. Republican control of both houses of the legislature and the executive branch), and a unified Democratic government. The specification (2) adds further structural economic and tax variables, such as average wage and salary employee income, fraction of employees in manufacturing, top marginal personal income tax rate, and the mean payroll weight of all states. Column 3 includes lags of prior values of several variables. Table 9 executes the same specifications as Table 8, but switches corporate income tax rate and payroll weight when applicable.

Table 8: Probit Regressions on Probability of Cutting Corporate Income Tax Rate

	(1)	(2)	(3)
Employment growth	-0.502	3.479	1.551
	(0.843)	(0.219)	(0.724)
Mean corporate income tax rate	86.12*	70.40	44.45
	(0.022)	(0.143)	(0.502)
Unified Democrats	-0.169	-0.116	-0.113
	(0.198)	(0.391)	(0.449)
Unified Republicans	-0.00437	0.132	0.123
	(0.975)	(0.369)	(0.436)
Average employee income		1.394***	1.122**
		(0.000)	(0.004)
Fraction of labor force in manufacturing		-0.475	-0.111
		(0.718)	(0.947)
Mean payroll weight		-2.235	-5.213
		(0.313)	(0.055)
Top personal income tax rate		8.633***	-67.85***
		(0.000)	(0.001)
L1 employment growth			7.320
			(0.191)
L1 top personal income tax rate			36.80
			(0.157)
L1 corporate income tax rate			-52.68
			(0.053)
L1 payroll weight			3.389
			(0.378)
L2 employment growth			-4.809
			(0.284)
L2 top personal income tax rate			36.21
			(0.095)
L2 corporate income tax rate			64.14*
			(0.019)
L2 payroll weight			-1.995
			(0.604)
Observations	1617	1617	1519

Notes: p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

The most notable feature of the probit regressions is the small number of statistically significant apparent determinants of policy changes. In Table 8, the level of other states' corporate income tax rates is only a significant determinant of a tax cut in the baseline specification. Average employee income and top personal income tax rates are also associated with a cut in the corporate income tax rate. Importantly, the level of other states' corporate income tax rates is not a significant determinant of a tax rate cut in specifications (2) and (3). These results provide substantial evidence that decreases in the corporate income tax rate are not explained well by observable variables. This in turn reduces possible policy endogeneity concerns with respect to

corporate income tax rates. Income tax rate on employment are asymmetric, whereby a tax increase is of greater cost than the benefits of a tax cut. The same cannot be said, however, about the payroll weight in the income apportionment formula, as the results in Table 9 show.

Table 9: Probit Regressions on Probability of Cutting Payroll Weight

	(1)	(2)	(3)
Employment growth	1.080	0.612	7.244
	(0.743)	(0.882)	(0.167)
Mean payroll weight	-9.317***	-15.84***	-19.96***
	(0.000)	(0.000)	(0.000)
Unified Democrats	-0.325	-0.242	-0.279
	(0.050)	(0.162)	(0.115)
Unified Republicans	-0.0736	0.0829	0.119
	(0.626)	(0.611)	(0.475)
Average employee income		1.069**	1.220**
		(0.009)	(0.007)
Fraction of labor force in manufacturing		7.866***	9.881***
		(0.000)	(0.000)
Mean corporate income tax rate		216.3**	252.2*
		(0.002)	(0.018)
Top personal income tax rate		4.617	-17.10
		(0.094)	(0.295)
L1 employment growth			-13.41*
			(0.024)
L1 top personal income tax rate			-15.74
			(0.565)
L1 payroll weight			-4.616**
			(0.007)
L1 corporate income tax rate			6.164
			(0.726)
L2 employment growth			14.74**
			(0.003)
L2 top personal income tax rate			35.17
			(0.153)
L2 payroll weight			6.100***
			(0.000)
L2 corporate income tax rate			0.859
			(0.961)
Observations	1617	1617	1519
Notes: p-values in parentheses			
* p<0.05, ** p<0.01, *** p<0.001			

In the baseline specification of Table 9, the mean payroll weight of all states is a strongly significant determinant of a state's decision to cut its payroll weight. The coefficient for mean payroll weight suggests that the lower the average of all other states' payroll weights, the more likely a state is to cut their own payroll weight. Across all three specifications, we observe the mean payroll weight is a significant determinant of a state's decreasing of its own payroll weight. Moreover, a state with a higher percentage of its workforce in manufacturing is much more likely to cut its payroll tax, likely to encourage manufacturers to keep jobs in-state. Note that in

Table 8, the percent of manufacturing jobs in a state's economy is not a determinant of the state's tax rate. Partisan control of a state's legislature does not appear to be a determinant of state tax policy parameters. Nevertheless, variables such as average employee income, mean corporate tax rate, and lagged employment growth are all determinants of a state's decision to cut its payroll weight, contributing to possible endogeneity concerns.

This evidence – particularly a state's responsive to other states' payroll weights – corroborates the work of Edmiston (2002) and others who have constructed general equilibrium models for the payroll weight of state income apportionment formulae, which resembles a prisoner's dilemma game. Such game theoretical research on state corporate taxation often focuses on the apportionment formula rather than the tax rate. For this reason, it is perhaps unsurprising that endogeneity may be more of a concern with respect to payroll weights rather than with respect to the tax rates. Importantly, the results of Table 8, which ease concerns about endogeneity of cutting tax rates, substantiate this paper's earlier claim about the asymmetry of the effects of cutting the corporate income tax rate. Namely, there is still strong evidence to suggest that the corporate income tax hike has harmful effects on employment while an income tax cut has no effect on employment.

V. Conclusion

Economic theory posits that a corporate income tax places a burden on a firm's capital and labor. Therefore, a reduction in corporate income tax should relate to increased investment in one of these factors of production. A common question among public policymakers is whether a decrease in the corporate income tax rate will result in increased employment. The results of this study challenge any claim that the statutory corporate income tax rate by itself decreases employment. However, there is strong evidence of the existence of an asymmetric effect of a change in the corporate income tax rate. While a 1% increase in the tax rate has a significant negative effect on employment of approximately 0.4%, the effect of a reduction of the tax rate by the same amount is not significantly different from zero. In the case of an apportionment formula, economic theory suggests that the tax burden specifically falls on the formula's components of payroll, property, and sales. As a result, changing the weight of the payroll factor in the apportionment formula should affect employment. Our results, however, indicate that in practice state's employment levels are less sensitive to the payroll weights than they are to statutory tax rates.

As mentioned in the literature review, there are no existing theoretical explanations for asymmetry in the effects of state corporate tax changes. Indeed, assuming symmetric effects for a tax increase and decrease greatly simplifies the derivations in theoretical public finance literature. Nevertheless, given that the empirical evidence of this paper suggests asymmetry, there are several hypotheses for this phenomenon that should be considered. First, it may be the case that the board of directors of large corporations prioritize maximizing short-term shareholder payouts. Specifically, when a company receives a tax cut, it simply pays out the money saved in the form of dividends. Likewise, a company may slow its hiring or cut jobs rather than report lower quarterly earnings and pay out less to shareholders. Second, if firms prioritize giving employees raises rather than expanding their number of employees, assigning greater importance to raises could also lead to asymmetric effects. When taxes are cut, the firm would prefer to award bonuses (perhaps it believes it will raise worker productivity) rather than

expand hiring. Likewise, when taxes are raised, because the firm is often unable under the law to reduce salaries and unwillingly cut employee hours, it would prefer to eliminate jobs altogether.

The methodological concerns and limitations of this paper underscore the fact that these results are not entirely conclusive. As mentioned, this analysis explains the effect of corporate tax policy on all jobs, rather than only full-time employment. Second, although previous research has indicated endogeneity is not a grave concern, this analysis indicates that it may be an issue for at least the study of the income apportionment formula. For this reason, different program evaluation approaches will likely produce more efficient estimators for the effect of the payroll factor weight on employment. Nevertheless, this study contributes to the current literature by finding further evidence for asymmetric effects of state corporate income tax rate changes on employment.

VI. Endnotes

1. Shuai (2013) uses data from 1991 to 2012, average corporate tax rate as a regressor, and total employment as the dependent variable. This study uses data from 1979 to 2015 and regresses highest marginal tax rate on just the employment level of wage and salary workers.
2. The variables will hereafter be referred to as called "magnitude of tax hike" and "magnitude of tax cut." In years without a tax rate change or a tax change opposite that of the variable, the values are recorded as zeroes.

3. Unless otherwise specified, employee will refer to wage and salary employees only.

4. A tax rate of 5%, for example, is recorded in the data as 0.05. All states without a corporate income tax were recorded as having a 0.00 tax rate.

5. The denominator of this fraction is all employees in a state, not simply wage and salary workers. We use all employees in the construction of this variable because we desire to control for characteristics about a state's labor force makeup. If a state has many sole proprietors and few manufacturing workers, we seek for this fact to be adequately reflected in the variable.

VII. Appendix

Table A1: Basic Effect of Corporate Tax Rate (1979-2015)

	(1) ln(w-s emp)	(2) ln(w-s emp)	(3) ln(w-s emp)	(4) ln(emp)	(5) ln(emp)	(6) ln(emp)
Corporate tax rate	0.515	-0.0272	-0.113	0.392	-0.0944	-0.107
	(0.279)	(0.924)	(0.630)	(0.333)	(0.600)	(0.622)
Population	0.994***	0.711***	0.864***	1.068***	0.788***	0.931***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average employee income	0.310*	0.212*	0.481***	0.298**	0.166*	0.322***
	(0.014)	(0.036)	(0.000)	(0.008)	(0.031)	(0.000)
Personal income tax rate	1.242	-0.676	0.0848	1.526	-0.470	0.127
	(0.185)	(0.327)	(0.882)	(0.086)	(0.316)	(0.809)
Fraction of labor force in manufacturing	0.210	1.514***	2.390***	-0.352	0.941***	1.751***
	(0.509)	(0.000)	(0.000)	(0.246)	(0.000)	(0.000)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	Yes	No	Yes	Yes
State-specific time trend	No	No	Yes	No	No	Yes
Observations	1850	1850	1850	1850	1850	1850
Adjusted R-Squared	0.859	0.957	0.980	0.912	0.977	0.987

Notes: p-values in parentheses; dependent variable in regressions (1)–(3) is natural log of wage and salary employment; dependent variable in regressions (4)-(6) is ln(employment). Population and average employee income are natural logs
* p<0.05, ** p<0.01, *** p<0.001

Table A2: Corporate Payroll Tax Burden, Tax Rate, Payroll Weight (1979-2015)

	(1) ln(w-s emp)	(2) ln(w-s emp)	(3) ln(w-s emp)	(4) ln(emp)	(5) ln(emp)	(6) ln(emp)
Payroll Burden	0.139	-0.116	-0.298	-0.534	-0.454	-0.489
	(0.870)	(0.772)	(0.517)	(0.478)	(0.124)	(0.295)
Population	0.994***	0.711***	0.866***	1.067***	0.790***	0.931***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average employee income	0.294*	0.212*	0.482***	0.274*	0.164*	0.323***
	(0.017)	(0.042)	(0.000)	(0.011)	(0.035)	(0.000)
Personal income tax rate	1.343	-0.681	0.0654	1.558	-0.487	0.121
	(0.174)	(0.321)	(0.907)	(0.086)	(0.290)	(0.811)
Fraction of labor force in manufacturing	0.164	1.517***	2.377***	-0.369	0.953***	1.725***
	(0.606)	(0.000)	(0.000)	(0.219)	(0.000)	(0.000)
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	Yes	No	Yes	Yes
State-specific time trend	No	No	Yes	No	No	Yes
Observations	1850	1850	1850	1850	1850	1850
Adjusted R-Squared	0.858	0.957	0.980	0.912	0.977	0.987

Notes: p-values in parentheses; dependent variable in regressions (1)-(3) is ln(wage and salary employment); dependent variable in regressions (4)-(6) is ln(employment). Population and average employee income are natural logs
* p<0.05, ** p<0.01, *** p<0.001

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