State Taxes and Manufacturing Productivity: An Arkansas Case Study

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Abstract: From 2002 through 2012, Arkansas saw less growth in the dollar value of manufacturing, a greater decline in manufacturing's share of gross domestic product, and a faster rate of job loss in manufacturing compared with its surrounding states. One reason for these outcomes is manufacturing's slow growth in labor productivity, which is defined as growth in the dollar value of output per manufacturing employee. This study examines the degree to which state and local tax burdens influence worker productivity. Its analysis uses a between estimator on a fifty-state panel data set for the years 2002, 2007, and 2012. This paper finds that total state and local tax burdens hurt manufacturing labor productivity, with state and local sales and corporate income taxes primarily driving the loss in productivity. Legislators should consider the damaging effects that these taxes have on labor productivity when making policy decisions.

1. Introduction

From 2002 through 2012, Arkansas saw less growth in the dollar value of manufacturing, a greater decline in manufacturing's share of gross domestic product (GDP), and a faster rate of job loss in manufacturing compared with its surrounding states. One reason for these outcomes is manufacturing's slow growth in labor productivity, which is defined as growth in the dollar value of output per manufacturing employee. Arkansas's manufacturing labor productivity has grown significantly less than the national and regional averages over this time span, and the state has one of the lowest growth rates among its neighbors: Alabama, Kansas, Louisiana, Mississippi, Missouri, Oklahoma, Tennessee, and Texas.

Since wages are based on productivity, it is not surprising that Arkansas's manufacturing wages have lagged as well. Arkansas's manufacturing productivity and pay have both consistently been well below the national averages, and in the region, they are near the bottom.

This study examines the degree to which state and local tax burdens influence worker productivity. Legislators should consider the effects of taxes when making policy decisions, because taxes influence productivity and therefore GDP and employment.

2. Taxes and Manufacturing

States that rank favorably on tax-and-cost indices for having lower taxes and costs of doing business see faster GDP and employment growth rates than states that rank poorly (Kolko et al., 2013). While tax policy is important for the broad economy, it plays an even more important role in the manufacturing industry. Manufacturing is one of the most geographically mobile industries and has a stronger relationship with state business climates than the broad economy does (Kolko et al., 2013). With manufacturing's heightened sensitivity to business climates, it is important for a state to provide a competitive tax environment to promote the health of the manufacturing industry.

Growth in the economy largely stems from increases in productivity. Moomaw and Williams (1991) find a positive link between total factor productivity and output growth at the state level. Brandt et al. (2012) also find this relationship at both the firm and industry levels.

Increased mechanization and automation have greatly improved productivity in the manufacturing industry. Tax policy also influences productivity. Reductions in manufacturers' baseline tax liability lead to significant increases in manufacturers' value added (Funderburg et al., 2013).

Tax increases impact manufacturing productivity through various channels. A 2008 study by the Organisation for Economic Co-operation and Development finds that corporate taxes affect productivity by decreasing firm investment (Vartia, 2008). Tax increases also increase the user cost of capital, or the price a firm pays for a single unit of capital. Arnold and Schwellnus (2008) find similar results. And Gemmell et al. (2013) find that underinvestment caused by high corporate taxes especially hurts productivity growth in small firms that are behind the technology frontier.

Furthermore, tax policy shifts resources across heterogeneous plants (Restuccia and Rogerson, 2008). In other words, resources shift from high-cost producers to low-cost producers when different producers face different costs. If tax policy, such as special tax breaks or subsidies for specific firms, alters firm costs in a way that makes less-productive firms become low-cost producers, resources will shift from high-productivity firms to low-productivity firms. This shift, in turn, decreases overall productivity and economic growth.

Individual income tax policy has also been found to impact productivity. Vartia finds that high top marginal personal income tax rates "impede long-run productivity . . . through the channel of entrepreneurial activity" (Vartia, 2008). The higher the personal income tax rate, the less incentive there is for an individual to become an entrepreneur. Steering human capital in a different direction hurts productivity.

3. Econometric Framework

This paper estimates the impact of state and local taxes on labor productivity in the manufacturing industry. It examines the impact of the total state and local tax burden through

the lens of capital accumulation before breaking down the total tax burden. Then, it closes off the channel of capital accumulation to see if taxes impact productivity through other means.

The models use a panel data set for the years 2002, 2007, and 2012 due to data limitations. Because this study is primarily interested in the differences in labor productivity across states, it uses a between estimator. The between estimator uses only the variation between groups, or states in this case, and applies the ordinary least squares estimator to the time-averaged equation. The between model is written as:

$$\bar{y}_i = \alpha + \bar{\mathbf{x}}'_i \boldsymbol{\beta} + (\alpha_i - \alpha + \bar{\varepsilon}_i),\ i = 1,\ldots,N, \text{ where } \bar{y}_i = \mathbf{T}^{-1} \Sigma_t y_{it},\ \bar{\varepsilon}_i = \mathbf{T}^{-1} \Sigma_t \varepsilon_{it}, \text{ and } \bar{\mathbf{x}}_i = \Sigma_t \mathbf{x}_{it}\ . \quad (1)$$

The full, base specification is as follows:

$$LaborProductivity_i = TaxBurden_i + Education_i + PopulationDensity_i + ManufacturingEmploymentRatio_i + PetroleumIndustryRatio_i + CapitalLaborRatio_i \quad (2)$$

3.1 Data

Labor productivity is measured as manufacturing GDP per manufacturing employee. Manufacturing GDP data come from the Bureau of Economic Analysis's Regional Economic Accounts and are measured in 2009 chained dollars. Manufacturing employee data come from the Quarterly Census of Employment and Wages from the Bureau of Labor Statistics.

The tax burden is measured as state and local tax collections as a percentage of total state GDP. Collections data include property taxes, sales taxes, individual income taxes, corporate income taxes, motor vehicle license taxes, and other taxes, all at the state and local levels. The collections data come from the United States Census Bureau's Annual Survey of State and Local

Government Finances, while total state GDP data come from the Bureau of Economic Analysis. Data regarding the dummy variables for inventory taxes, capital stock taxes, and business-to-business sales taxes on manufacturing machinery come from the Tax Foundation's State Business Tax Climate Index reports.

Education is measured as the percentage of the population age 25 and older that holds a bachelor's degree or higher. These data come from two sources. Data from 2007 and 2012 stem from the United States Census Bureau's American Community Survey. Data from 2002 come from the United States Census Bureau's Statistical Abstract.

Population density is measured as population per square land mile. Population data come from the United States Census Bureau's Population Estimates Program. Land size data come from the United States Census Bureau's State Quick Facts.

The manufacturing employee ratio is measured as manufacturing employees as a percentage of total state employees. Employee data come from the Quarterly Census of Employment and Wages from the Bureau of Labor Statistics.

The petroleum industry ratio is also considered. States with a larger share of petroleum product manufacturing may appear to have more productive labor because the industry is extremely capital intensive. The petroleum industry ratio is calculated as petroleum and coal products manufacturing GDP as a percentage of total manufacturing GDP. GDP figures come from the Bureau of Economic Analysis's Regional Economic Accounts.

The capital-labor ratio is measured as the gross value of depreciable assets in the manufacturing industry at the beginning of the year per manufacturing employee. Capital data come from the United States Census Bureau's Economic Census. The survey is conducted only in years ending in 2 and 7. Data are reported in nominal terms, but have been deflated to reflect

chained 2009 dollars. Employee data come from the Quarterly Census of Employment and Wages from the Bureau of Labor Statistics.

3.2. Total Tax Burden and Labor Productivity

Theory says that taxes hurt productivity by slowing capital accumulation. Because taxes increase the user cost of capital, or the price firms must pay for each unit of capital, the relative prices of capital and labor become distorted. The price of capital becomes more expensive relative to labor, inducing firms to invest in more labor than capital. Over time, factor misallocation occurs. Factor misallocation stemming from taxes means that there is not enough equipment per worker, so workers produce less output than they otherwise could. This is troublesome because workers rely on machinery to make them more efficient. Low productivity levels caused by factor misallocation slow economic growth in the manufacturing industry.

Table 1 tests this theory and displays the results of two models examining the impact of the total state and local tax burden on labor productivity while controlling for education, population density, and the manufacturing employment ratio. The models differ in that one controls for the petroleum industry ratio while the other does not. States with a larger share of petroleum product manufacturing may appear to have more productive labor because the industry is extremely capital intensive. These specifications allow for the impact of taxes to work through the channel of capital accumulation.

[table 1 about here]

Both models indicate that total state and local taxes have a significant, negative impact on labor productivity in the manufacturing industry when taxes are allowed to work through capital accumulation. States with higher total taxes see less manufacturing labor productivity than states

with lower taxes. For every one percentage point increase in total state and local tax collections as a percentage of state GDP, manufacturing labor productivity decreases by approximately 8 percent.

To further test the notion that capital accumulation is impacted by increased state and local taxes, the model is rearranged to examine the impact of the total tax burden on the capital-labor (KL) ratio. Labor productivity is removed from the equation and the capital-labor ratio is moved from an independent variable to the dependent variable. All other variables remain the same.

[table 2 about here]

The results in table 2 indicate that the state and local tax burden, when considered in totality, does not have a statistically significant impact on the capital-labor ratio. There is no evidence that the total state and local tax burden contributes to differences in the capital-labor ratio across states. This statistical insignificance fails to support the theory that states with higher total taxes have accumulated less capital per employee than states with lower total taxes. Instead, it indicates that taxes impact productivity across states through channels other than capital accumulation, such as resource shifting and entrepreneurship. This paper will explore this idea in later sections.

3.3. Tax Components and Labor Productivity

While the finding that total state and local tax burdens dampen manufacturing productivity across states is important, it is perhaps more interesting to discover which taxes are driving the loss in productivity. To examine this question, the state and local tax burden is broken down into five parts: corporate income taxes, individual income taxes, property taxes, sales taxes, and all other taxes not included in the four major categories.

Table 3 displays the results of four regression models examining the impact of the individual tax components on manufacturing labor productivity. The first two models include only the four major tax components (corporate income, individual income, property, and sales), with one of these two models controlling for the petroleum industry ratio. The other two models are similar, but add the fifth component (all other taxes) of state and local taxes. All four models do not account for the capital-labor ratio, allowing for tax components to work through the channel of capital accumulation.

[table 3 about here]

Table 3 shows that when taxes are allowed to work through capital accumulation, state and local corporate income taxes and sales taxes have a significant, negative impact on manufacturing labor productivity across states. However, the burdens imposed by state and local individual income taxes, property taxes, and other taxes do not have a statistically significant effect on labor productivity in the manufacturing industry. Thus, manufacturers in states with higher corporate income taxes and sales taxes see less output per employee than states with lower corporate income and sales tax burdens, all else equal.

To further test whether the corporate income tax and sales tax burdens are working through the channel of capital accumulation, the model is again rearranged in similar fashion to the models in table 2. Table 4 shows the results.

[table 4 about here]

As table 4 demonstrates, the impact of the corporate income tax burden on the capital-labor ratio is statistically significant in three of four specifications. When accounting for only the four major tax components, there are mixed results. Corporate income taxes are significant at the 10 percent level when the petroleum industry ratio is considered, but are not significant when the

petroleum industry ratio is removed from the equation. However, when all five tax components are accounted for, the corporate income tax burden is shown to have a strongly significant, negative impact on the capital-labor ratio. Although these results are not fully robust, evidence suggests that state and local corporate income tax burdens partially explain differences in capital-labor ratios across states.[1] This result supports the notion that corporate income taxes affect labor productivity through the channel of capital accumulation.

Table 4 reveals mixed results for the state and local sales tax burden. When accounting for only the four major tax components, the negative impact of the sales tax burden on the capital-labor ratio is significant at the 10 percent level. When all five tax components are considered, though, the sales tax burden is statistically insignificant. This result suggests that sales taxes impact labor productivity through channels other than capital accumulation.[2]

3.4. Inventory, Capital Stock, and Business-to-Business Taxes

That the sales tax burden does not impact manufacturing labor productivity through the capital-labor ratio is not necessarily surprising. Many states exempt manufacturers from paying sales tax on manufacturing machinery and equipment, effectively removing manufacturers from the distortion of sales taxes.

However, some states, such as Arkansas and Mississippi, do tax the business-to-business sale of manufacturing machinery in some form. Taxing the sale of manufacturing equipment creates distortionary effects by raising the user cost of capital.

Arkansas and Mississippi also collect both an inventory tax (I) and a capital stock tax (CS). States that levy an inventory tax, or a property tax on the value of a firm's inventory, distort

[1] Robustness checks find more evidence that corporate income taxes have a significant, negative impact on the capital-labor ratio.
[2] Robustness checks find that sales taxes have a statistically insignificant impact on the capital-labor ratio.

manufacturing production decisions. Firms become more wary of the amount of tax they will be paying on inventory, rather than focusing decisions on economic principles. Capital stock taxes, or taxes based on a corporation's wealth, often act as a duplicate of the corporate income tax.

This section explores whether states that levy inventory taxes, capital stock taxes, and business-to-business sales taxes (B2B) on manufacturing machinery see less manufacturing labor productivity than states that do not. Table 5 displays four regressions that include dummy variables for each of the three taxes. Dummy variables are used because of a lack of tax collection data for these specific taxes as well as the nonuniform implementation of the taxes that prevents rate comparison. Challenges in data collection require the models to use data from 2010, 2011, and 2012. Two of the models in table 5 account for the total state and local tax burden, while the other two models allow the dummy variables to stand on their own. Control variables are structured similarly to those used in previous tables.

[table 5 about here]

The results in table 5 indicate that the presence of an inventory tax, a capital stock tax, or a business-to-business sales tax on manufacturing machinery has no impact on manufacturing labor productivity across states. In all four models, the three dummy variables are not statistically significant. Manufacturing labor productivity is not hurt by the mere fact that a state implements an inventory tax, a capital stock tax, or a business-to-business sales tax on manufacturing machinery.[3] However, the results in table 5 also further indicate that the total state and local tax burden has a significant, negative impact on labor productivity in the manufacturing industry.

[3] Although data challenges prevent this study from examining how tax rates or tax collections from inventory, capital stock, and business-to-business sales taxes impact productivity, it would nevertheless be an interesting examination.

3.5. Impacting Productivity through Other Channels

Theory suggests that taxes impact labor productivity through channels other than capital accumulation, such as resource shifting and entrepreneurship. The results in tables 2 and 4 provide evidence that taxes are, in fact, hurting labor productivity through means other than the capital-labor ratio. To further test this notion, the capital-labor ratio must be controlled for. Controlling for the capital-labor ratio disallows taxes to work through the channel of capital accumulation.

Table 6 presents two models that examine the impact of the total state and local tax burden on labor productivity while controlling for the capital-labor ratio. All other control variables are similar to the two models presented in table 1.

[table 6 about here]

The results displayed in table 6 indicate that the total state and local tax burden still has a significant, negative impact on labor productivity across states when closing off the channel of capital accumulation. This result suggests that taxes, when considered in totality, do work through multiple channels to decrease output per employee in the manufacturing industry.

To examine which taxes are driving the loss in productivity, table 7 breaks down the total state and local tax burden into the five tax components. Two models include only the four major taxes (corporate income, individual income, sales, and property) while two other models include the fifth component (other taxes).

[table 7 about here]

The models in table 7 show mixed results for the state and local corporate income tax burden when the channel of capital accumulation is closed. When only the four major tax components are controlled for, the corporate income tax burden has a significant, negative impact on

manufacturing labor productivity across states. However, when all five tax components are accounted for, the corporate income tax burden is statistically insignificant. The fact that the corporate income tax burden loses some significance when the capital-labor ratio is controlled for supports the notion that corporate income taxes decrease labor productivity through the channel of capital accumulation.

Conversely, the models in table 7 provide clear results for the state and local sales tax burden. The models indicate that the state and local sales tax burden has a significant, negative impact on labor productivity when controlling for the capital-labor ratio. States that have higher state and local sales tax burdens see less productivity in the manufacturing industry than states that have lower sales tax burdens. This finding indicates that sales taxes hurt labor productivity through channels other than capital accumulation, which is consistent with earlier results.

The state and local property tax burden was also found to have a significant, negative impact on labor productivity when controlling for the capital-labor ratio. This finding contrasts with earlier findings that show property taxes to be statistically insignificant when allowing taxes to work through the channel of capital accumulation.

3.6. Robustness Checks

Levels models were also tested. In all specifications, the total state and local tax burden had a significant, negative impact on labor productivity. When evaluating individual tax components, two tax categories had relatively robust results. The state and local sales tax burden was the most robust, with sixteen of the eighteen models finding a significant, negative relationship with manufacturing labor productivity. In eleven of the eighteen models tested, the state and local

corporate income tax burden was found to have a significant, negative impact on manufacturing labor productivity. Full levels model estimations are in the appendix.

4. Arkansas Regional Analysis

From 2002 through 2012, Arkansas's manufacturing industry suffered more than that of any other state in the region. The state saw manufacturing's share of GDP decline by 6.25 percentage points, manufacturing employment decrease by more than 27 percent, and real manufacturing GDP decline by nearly 12 percent. Table 8 displays regional rankings in each of these categories. Arkansas ranks last in all three.

[table 8 about here]

Driving the lag in Arkansas's manufacturing industry was slow growth in labor productivity. From 2002 through 2012, Arkansas's real labor productivity grew by just 21.2 percent, ranking last in the region by more than 10 percentage points. As of 2012, Arkansas ranked last in the region, with the average manufacturing employee producing $94,317 worth of output. This output trailed that of the average Mississippi employee by more than $13,000. Figure 1 displays 2012 real manufacturing output per manufacturing employee among the nine regional states.

[figure 1 about here]

Arkansas's lack of labor productivity has suppressed wages for manufacturing employees. In 2012, the average Arkansas manufacturer earned $40,084 per year in chained 2009 dollars, ranking eighth among the nine regional states. Arkansas ranked ahead of only Mississippi, while trailing the highest-paid state of Texas by nearly $17,000. Figure 2 displays the region's 2012 average real salaries in chained 2009 dollars.

[figure 2 about here]

As indicated by the results of this study, Arkansas's relatively weak labor productivity is in part due to the state's high tax burden. In 2012, Arkansas was second to last in the region, with total state and local tax collections totaling nearly 9.3 percent of its GDP. This rate was more than two percentage points higher than the burdens in Texas, Louisiana, and Tennessee. Only Mississippi had a higher effective tax burden than Arkansas. Figure 3 illustrates each regional state's 2012 total state and local tax collections as a percentage of state GDP.

[figure 3 about here]

One specific tax driving the loss in manufacturing labor productivity is the state and local sales tax. In 2012, Arkansas ranked last among the nine regional states with a sales tax burden of more than 4.5 percent of state GDP. Mississippi was the only other state to have its sales tax burden eclipse more than 4 percent of state GDP. Figure 4 displays each regional state's 2012 state and local sales tax collections as a percentage of state GDP.

[figure 4 about here]

Though they are a much smaller piece of total tax collections, state and local corporate income tax burdens also hurt manufacturing labor productivity. In 2012, Arkansas had the third-highest corporate income tax burden in the region, behind Tennessee and Mississippi. Each regional state's corporate income tax collections as a percentage of state GDP are displayed in figure 5.

[figure 5 about here]

The state's relatively high corporate income tax environment has negatively impacted capital accumulation, which is a vital component of labor productivity. In 2012, Arkansas ranked seventh in the nine-state region, with the average manufacturing employee having $194,144 in gross depreciable assets at his or her disposal. Arkansas ranked ahead of only Oklahoma and

Kansas. Figure 6 displays each regional state's 2012 capital-labor ratio in chained 2009 dollars. Louisiana's capital-labor ratio is disproportionately high because the state's manufacturing industry primarily consists of petroleum and coal products manufacturing.

[figure 6 about here]

4.1. Arkansas Policy Implications

The results of this study have clear policy implications. Policy makers must focus on creating a regionally competitive tax environment to improve the health of Arkansas's manufacturing industry. The estimates from tables 1 and 6 indicate that if Arkansas decreased its overall state and local tax burden by one percentage point, manufacturing labor productivity would increase by approximately 7.7 percent to 8.3 percent, with other conditions remaining the same.

Perhaps a more interesting approach is to examine the gains in productivity that Arkansas would experience if the state instead had the region's median tax burden. In 2012, Missouri had the median total tax burden, with total state and local tax collections reaching 7.68 percent of state GDP. If Arkansas were to decrease its overall state and local tax burden from 9.28 percent to 7.68 percent, Arkansas's manufacturing labor productivity would increase by approximately 12.3 percent to 13.3 percent, all else equal. This translates to a gain of $11,601 to $12,544 in manufacturing output per employee over the state's 2012 productivity levels. If each of Arkansas's 155,561 manufacturing employees in 2012 were able to produce $11,601 to $12,544 more in output, Arkansas's manufacturing GDP would have increased by $1.8 billion to $1.95 billion.

Similarly, Arkansas could work toward achieving the region's average total tax burden. In 2012, the average total state and local tax burden was 7.93 percent. By decreasing Arkansas's

tax burden to 7.93 percent, manufacturing labor productivity could be expected to rise by 10.4 percent to 11.2 percent. This productivity gain would have increased manufacturing output per employee by $9,809 to $10,564 over 2012 levels and would have boosted total manufacturing GDP by $1.53 billion to $1.64 billion.

To lower the state's total tax burden, Arkansas should focus on decreasing the state and local sales tax burden. In 2012, Arkansas had the highest sales tax burden in the region, with state and local sales tax collections reaching 4.57 percent of state GDP. This total was almost a full percentage point higher than Alabama's, which had the region's median sales tax burden of 3.62 percent. Sales taxes eat away at workers' incomes and discourage consumption, incentivizing labor to move to regions with lower sales taxes. Although most states exempt manufacturing firms from paying sales tax on new manufacturing equipment, Arkansas does not exempt manufacturers from paying sales tax on the partial repair and partial replacement of equipment. Other states in the region do. By taxing the repair and partial replacement of equipment, Arkansas is increasing the cost of capital and causing a misallocation of resources.

Arkansas should also focus on reducing the corporate income tax burden. In 2012, Arkansas had the third-highest burden in the region, with corporate income tax collections reaching 0.36 percent of state GDP. While corporate income taxes are a small portion of total tax collections, they nevertheless play a vital role in capital accumulation. By stymieing capital accumulation through higher corporate income tax burdens, Arkansas is hurting manufacturing labor productivity. Arkansas's 2016 top marginal corporate income tax rate of 6.5 percent ties with Tennessee's and Alabama's for the region's third highest. On top of this tax, Arkansas assesses a surcharge of 3 percent of the taxpayer's total liability.

By lowering these tax burdens to regionally competitive levels, Arkansas will see more labor productivity in its manufacturing industry. This, in turn, will help the dollar value of manufacturing, manufacturing's share of GDP, manufacturing employment, and manufacturing wages.

5. Conclusion

Total state and local tax burdens hurt manufacturing labor productivity. State and local sales and corporate income taxes primarily drive the loss in productivity. Corporate income taxes drive down labor productivity through the channel of capital accumulation, while sales taxes work through other means.

Arkansas's manufacturing industry has lagged behind that of its neighbors, in part because of its relatively noncompetitive tax environment. Arkansas's high tax burden is hurting the state's manufacturing industry. When making policy decisions, legislators should consider the damaging effects that state and local taxes have on labor productivity. By reducing the state's tax burden to a regionally competitive level, Arkansas will see improvements in manufacturing labor productivity.

Data Sources

Manufacturing GDP; Total State GDP; Petroleum and Coal Products Manufacturing – Bureau of Economic Analysis: Regional Economic Accounts

Manufacturing Employees; State Total Employees; Average Annual Salaries – Bureau of Labor Statistics: Quarterly Census of Employment and Wages

State and Local Tax Collections – United States Census Bureau: State and Local Government Finance

Inventory Tax, Capital Stock Tax, and Business-to-Business Sales Tax on Manufacturing Machinery – Tax Foundation State Business Tax Climate Index Reports: 2011, 2012, 2013

Gross Value of Depreciable Manufacturing Assets – United States Census Bureau: Economic Census

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Tables

Table 1

Total State and Local Taxes and Manufacturing Labor Productivity		
Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: (log) Labor Productivity**	
	Labor Productivity: Base	**Labor Productivity: Petroleum**
Total State and Local Tax Burden	–0.0773***	–0.0834***
	(0.0284)	(0.0258)
Education	0.00184	0.00374
	(0.00746)	(0.00679)
(log) Population Density	0.0382	0.0696***
	(0.0240)	(0.0239)
Manufacturing Employment Ratio	–0.00959*	–0.00356
	(0.00565)	(0.00545)
Petroleum Industry Ratio		0.00870***
		(0.00267)
(log) Capital-Labor Ratio		
Constant	12.24***	11.96***
	(0.319)	(0.301)
Observations	149	149
Number of States	50	50
R-squared (between)	0.208	0.362
F-statistic	2.96	4.99

Between-estimator. Standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1*

Table 2

Total State and Local Taxes and Capital Accumulation		
Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: (log) Capital-Labor Ratio**	
	K-L: Base	**K-L:**

		Petroleum
Total State and Local Tax Burden	–0.000676	–0.0117
	(0.0391)	(0.0322)
Education	–0.0298***	–0.0264***
	(0.0103)	(0.00848)
(log) Population Density	–0.0103	0.0466
	(0.0331)	(0.0298)
Manufacturing Employment Ratio	–0.0117	–0.000751
	(0.00777)	(0.00680)
Petroleum Industry Ratio		0.0158***
		(0.00333)
Constant	12.97***	12.47***
	(0.439)	(0.376)
Observations	149	149
Number of States	50	50
R-squared (between)	0.214	0.479
F-statistic	3.07	8.1

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 3

Tax Components and Manufacturing Labor Productivity				
Years 2002, 2007, 2012				
Independent Variables	**Dependent Variable: (log) Labor Productivity**			
	Four Components: Base	**Four Components: Petroleum**	**Five Components: Base**	**Five Components: Petroleum**
State and Local Corporate Income Tax Burden	–0.393**	–0.375**	–0.487**	–0.371*
	(0.162)	(0.152)	(0.195)	(0.190)
State and Local Individual Income Tax Burden	–0.0478	–0.0404	–0.0332	–0.0409
	(0.0369)	(0.0346)	(0.0408)	(0.0386)
State and Local Sales Tax Burden	–0.110***	–0.102**	–0.0963**	–0.102**
	(0.0402)	(0.0376)	(0.0431)	(0.0407)
State and Local Property Tax Burden	–0.0592	–0.0561	–0.0492	–0.0564
	(0.0397)	(0.0371)	(0.0415)	(0.0392)
State and Local Other Taxes Burden			0.0572	–0.00219
			(0.0665)	(0.0671)
Education	–0.00364	–0.00185	–0.00356	–0.00185
	(0.00912)	(0.00854)	(0.00915)	(0.00865)
(log) Population Density	0.0572**	0.0809***	0.0700**	0.0805***

	(0.0260)	(0.0259)	(0.0300)	(0.0286)
Manufacturing Employment Ratio	–0.00800	–0.00287	–0.00582	–0.00293
	(0.00563)	(0.00560)	(0.00619)	(0.00595)
Petroleum Industry Ratio		0.00724**		0.00728**
		(0.00271)		(0.00294)
(log) Capital-Labor Ratio				
Constant	12.31***	11.99***	12.13***	12.00***
	(0.328)	(0.328)	(0.392)	(0.373)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.284	0.390	0.297	0.390
F-statistic	2.38	3.28	2.17	2.85

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 4

Tax Components and Capital Accumulation				
Years 2002, 2007, 2012				
Independent Variables	**Dependent Variable: (log) Capital-Labor Ratio**			
	K-L Four Component: Base	**K-L Four Component: Petroleum**	**K-L Five Component: Base**	**K-L Five Component: Petroleum**
State and Local Corporate Income Tax Burden	–0.355	–0.317*	–0.752***	–0.545**
	(0.223)	(0.183)	(0.248)	(0.221)
State and Local Individual Income Tax Burden	–0.0174	–0.00169	0.0450	0.0310
	(0.0509)	(0.0418)	(0.0517)	(0.0449)
State and Local Sales Tax Burden	–0.104*	–0.0875*	–0.0478	–0.0583
	(0.0554)	(0.0455)	(0.0547)	(0.0475)
State and Local Property Tax Burden	0.00918	0.0157	0.0517	0.0386
	(0.0547)	(0.0449)	(0.0526)	(0.0457)
State and Local Other Taxes Burden			0.243***	0.136*
			(0.0843)	(0.0782)
Education	–0.0408***	–0.0370***	–0.0404***	–0.0373***
	(0.0126)	(0.0103)	(0.0116)	(0.0101)
(log) Population Density	0.000749	0.0505	0.0551	0.0740**
	(0.0359)	(0.0313)	(0.0381)	(0.0334)
Manufacturing Employment Ratio	–0.0136*	–0.00285	–0.00438	0.000826
	(0.00776)	(0.00677)	(0.00785)	(0.00693)
Petroleum Industry Ratio		0.0152***		0.0131***

		(0.00328)		(0.00343)
Constant	13.67*** (0.452)	13.00*** (0.397)	12.89*** (0.497)	12.66*** (0.435)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.288	0.533	0.408	0.566
F-statistic	2.42	5.86	3.53	5.81

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 5

Inventory, Capital Stock, and Business-to-Business Taxes and Manufacturing Labor Productivity				
Years 2010, 2011, 2012				
Independent Variables	**Dependent Variable: (log) Labor Productivity**			
	I, CS, B2B: Base	**I, CS, B2B: Petroleum**	**Total: Base**	**Total: Petroleum**
Total State and Local Tax Burden			–0.116*** (0.0271)	–0.115*** (0.0269)
Inventory Tax (Dummy)	0.0563 (0.108)	0.0462 (0.108)	0.0409 (0.0914)	0.0319 (0.0912)
Capital Stock Tax (Dummy)	–0.0171 (0.102)	–0.0169 (0.102)	–0.0982 (0.0885)	–0.0973 (0.0880)
Business-to-Business Sales Tax on Manufacturing Machinery (Dummy)	–0.134 (0.106)	–0.130 (0.106)	–0.138 (0.0896)	–0.134 (0.0892)
Education	–0.00106 (0.0112)	–0.000171 (0.0112)	0.00167 (0.00951)	0.00244 (0.00948)
(log) Population Density	0.0452 (0.0342)	0.0602 (0.0366)	0.0391 (0.0289)	0.0527* (0.0309)
Manufacturing Employment Ratio	–0.00249 (0.00788)	0.000233 (0.00822)	–0.00791 (0.00677)	–0.00540 (0.00705)
Petroleum Industry Ratio		0.00436 (0.00388)		0.00394 (0.00327)
Constant	11.72*** (0.332)	11.56*** (0.358)	12.76*** (0.372)	12.61*** (0.389)
Observations	150	150	150	150
Number of States	50	50	50	50
R-squared (between)	0.109	0.135	0.379	0.401

F-statistic	0.87	0.93	3.67	3.43

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 6

Total State and Local Taxes and Manufacturing Labor Productivity		
Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: (log) Labor Productivity**	
	Total Tax and K: Base	**Total Tax and K: Petroleum**
Total State and Local Tax Burden	–0.0770***	–0.0791***
	(0.0231)	(0.0232)
Education	0.0147**	0.0135*
	(0.00662)	(0.00674)
(log) Population Density	0.0426**	0.0524**
	(0.0196)	(0.0220)
Manufacturing Employment Ratio	–0.00455	–0.00328
	(0.00471)	(0.00489)
(log) Capital-Labor Ratio	0.431***	0.369***
	(0.0882)	(0.108)
Petroleum Industry Ratio		0.00287
		(0.00295)
Constant	6.652***	7.358***
	(1.173)	(1.380)
Observations	149	149
Number of States	50	50
R-squared (between)	0.486	0.497
F-statistic	8.33	7.09

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 7

Tax Components and Manufacturing Labor Productivity
Years 2002, 2007, 2012

Independent Variables	Dependent Variable: (log) Labor Productivity			
	Four Components and K: Base	Four Components and K: Petroleum	Five Components and K: Base	Five Components and K: Petroleum
State and Local Corporate Income Tax Burden	–0.262*	–0.275*	–0.187	–0.186
	(0.145)	(0.147)	(0.189)	(0.190)
State and Local Individual Income Tax Burden	–0.0414	–0.0399	–0.0511	–0.0515
	(0.0322)	(0.0324)	(0.0359)	(0.0360)
State and Local Sales Tax Burden	–0.0710*	–0.0741*	–0.0773**	–0.0823**
	(0.0364)	(0.0368)	(0.0380)	(0.0386)
State and Local Property Tax Burden	–0.0626*	–0.0610*	–0.0698*	–0.0696*
	(0.0346)	(0.0348)	(0.0367)	(0.0368)
State and Local Other Taxes Burden			–0.0397	–0.0487
			(0.0637)	(0.0647)
Education	0.0115	0.00982	0.0125	0.0109
	(0.00887)	(0.00916)	(0.00910)	(0.00932)
(log) Population Density	0.0570**	0.0650**	0.0481*	0.0553*
	(0.0226)	(0.0250)	(0.0269)	(0.0282)
Manufacturing Employment Ratio	–0.00294	–0.00197	–0.00407	–0.00321
	(0.00507)	(0.00525)	(0.00543)	(0.00553)
(log) Capital-Labor Ratio	0.371***	0.316**	0.398***	0.341**
	(0.0974)	(0.121)	(0.108)	(0.126)
Petroleum Industry Ratio		0.00243		0.00281
		(0.00314)		(0.00320)
Constant	7.243***	7.888***	6.994***	7.683***
	(1.361)	(1.602)	(1.429)	(1.633)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.471	0.479	0.476	0.486
F-statistic	4.57	4.09	4.04	3.69

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 8

Regional Manufacturing Growth 2002–2012								
Manufacturing Employment			Manufacturing's Share of GDP			Real Manufacturing GDP		
Rank	State	Percent Change	Rank	State	Percentage Point Change	Rank	State	Percent Change
1	Texas	–9.10	1	Louisiana	7.86	1	Texas	52.48

2	Kansas	–10.16	2	Texas	1.68	2	Alabama	35.06
3	Oklahoma	–11.18	3	Alabama	1.03	3	Oklahoma	27.78
4	Louisiana	–11.95	4	Mississippi	0.51	4	Kansas	25.99
5	Alabama	–20.82	5	Kansas	0.18	5	Mississippi	23.99
6	Missouri	–23.07	6	Oklahoma	–0.93	6	Louisiana	21.94
7	Tennessee	–26.50	7	Tennessee	–1.60	7	Tennessee	19.65
8	Mississippi	–27.20	8	Missouri	–1.99	8	Missouri	1.23
9	**Arkansas**	**–27.27**	**9**	**Arkansas**	**–6.25**	**9**	**Arkansas**	**–11.83**

Figure 1

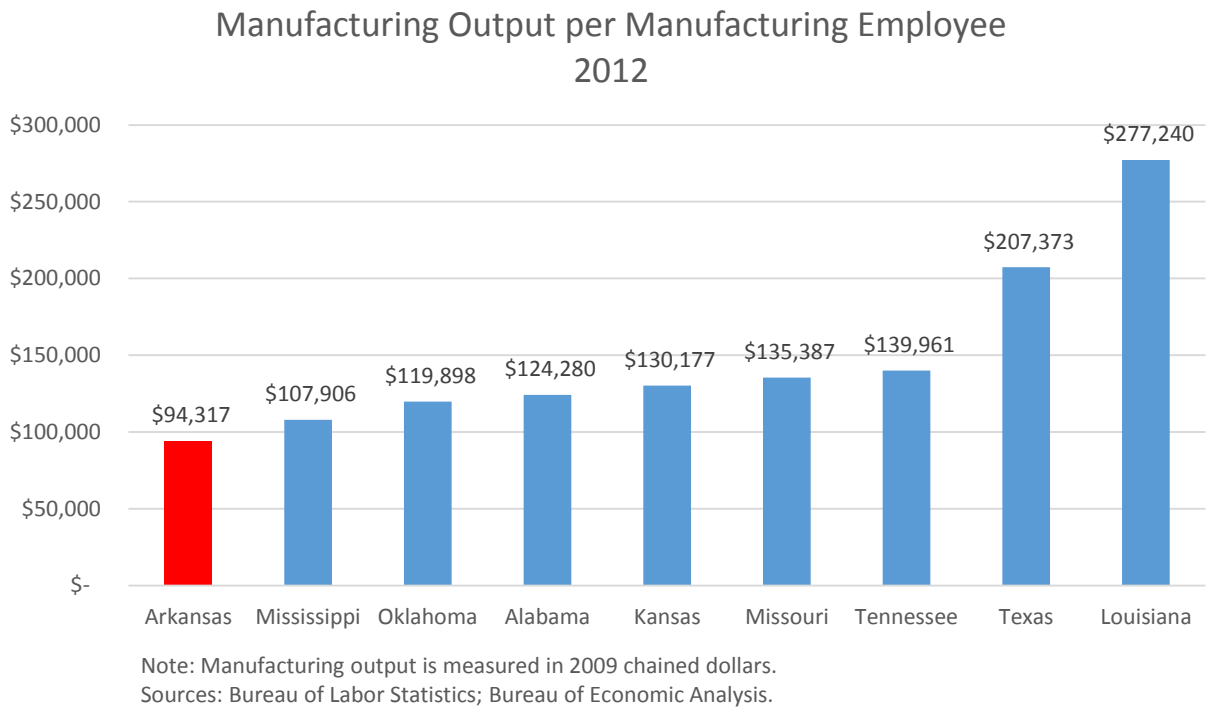
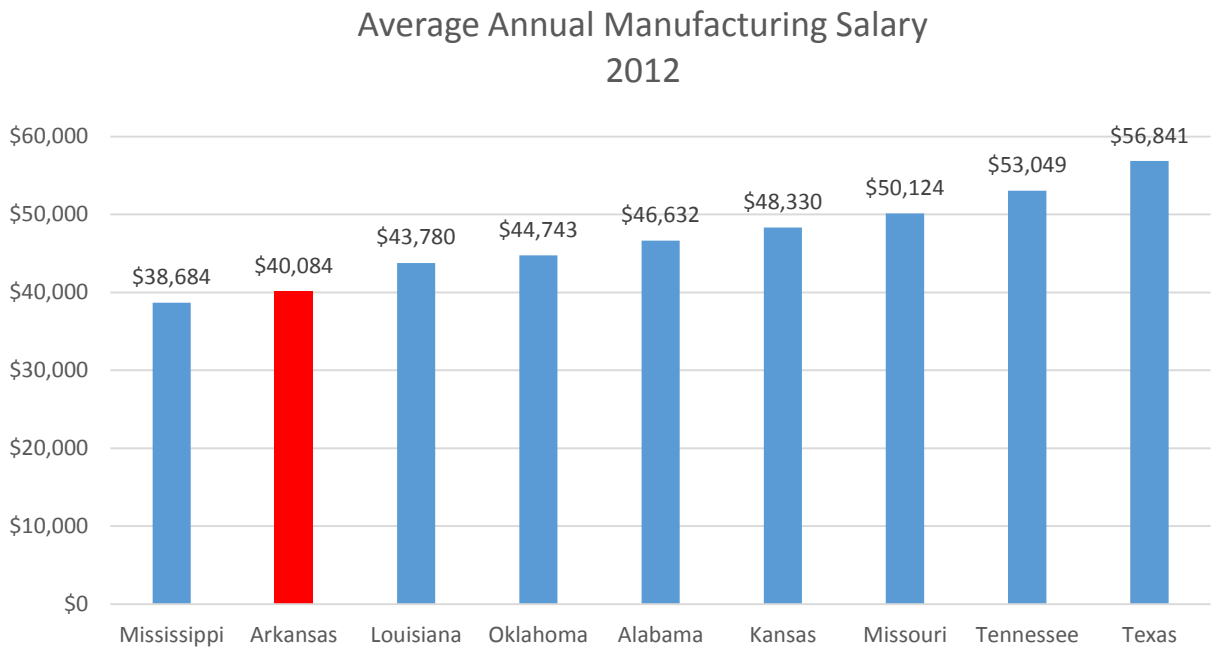
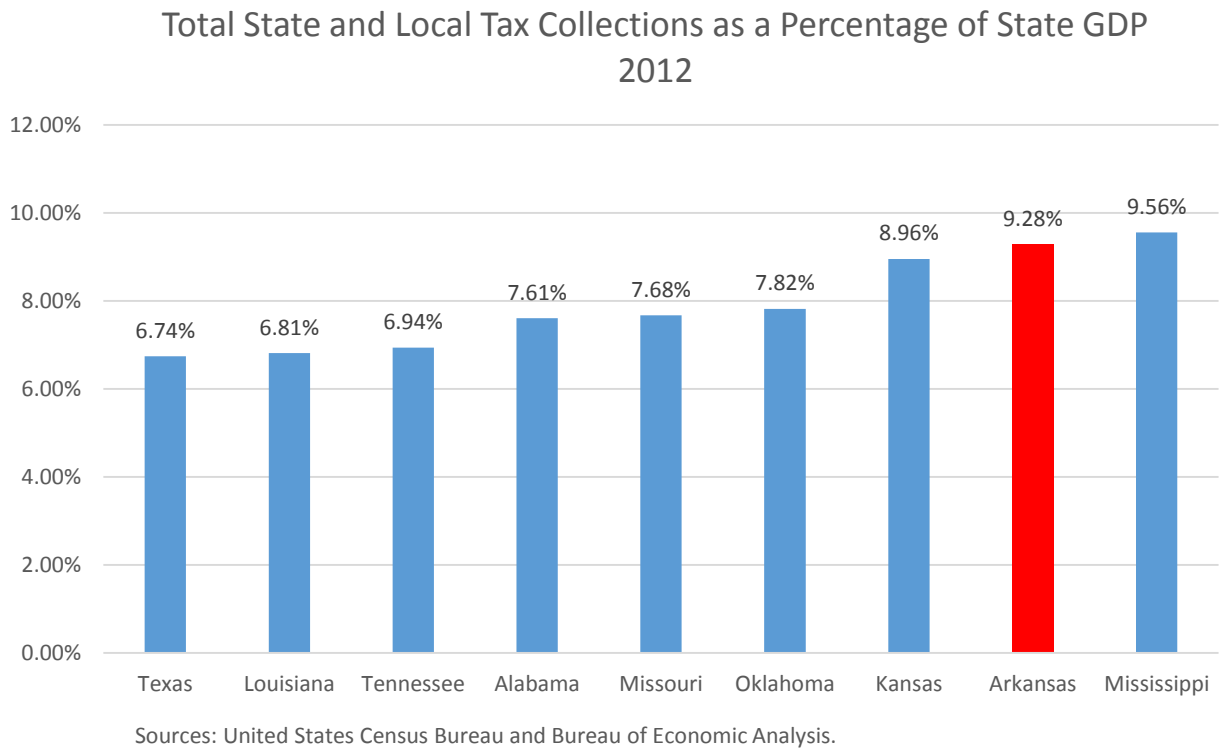


Figure 2



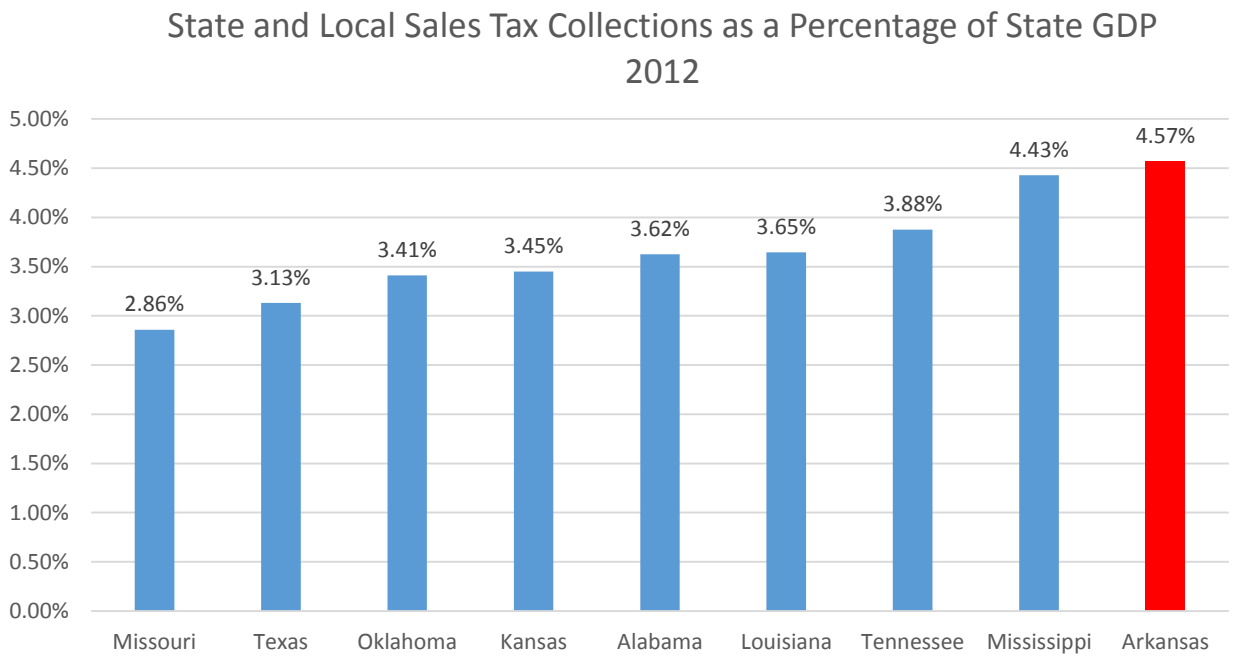
Note: 2012 average annual salary in chained 2009 dollars.
Source: Bureau of Labor Statistics.

Figure 3



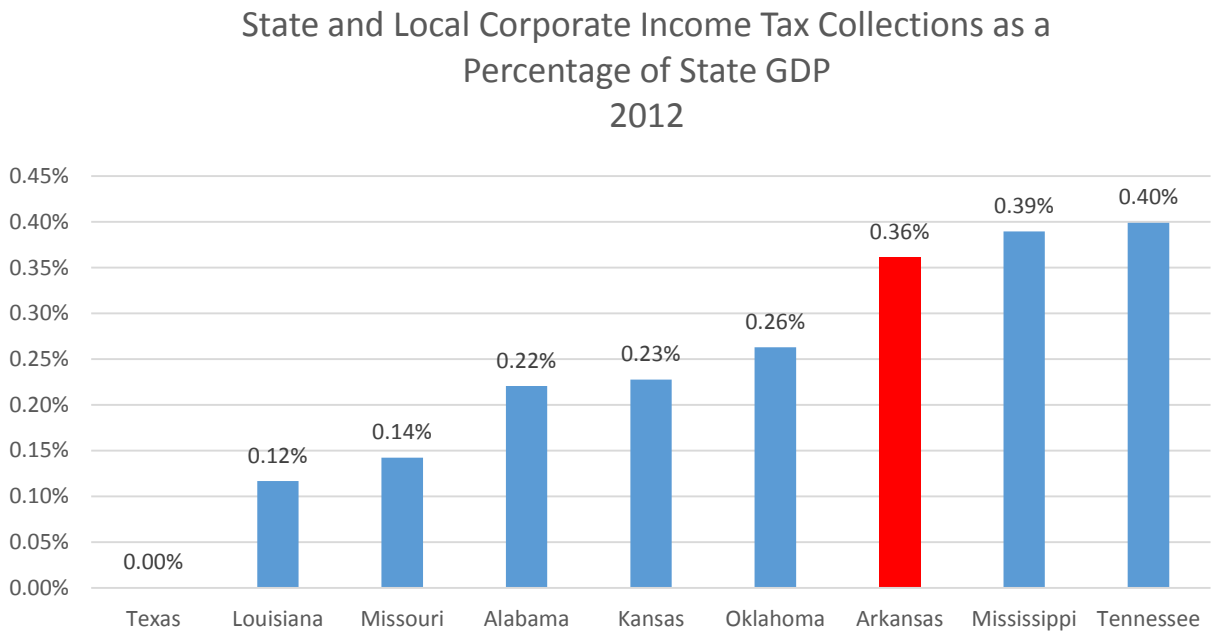
Sources: United States Census Bureau and Bureau of Economic Analysis.

Figure 4



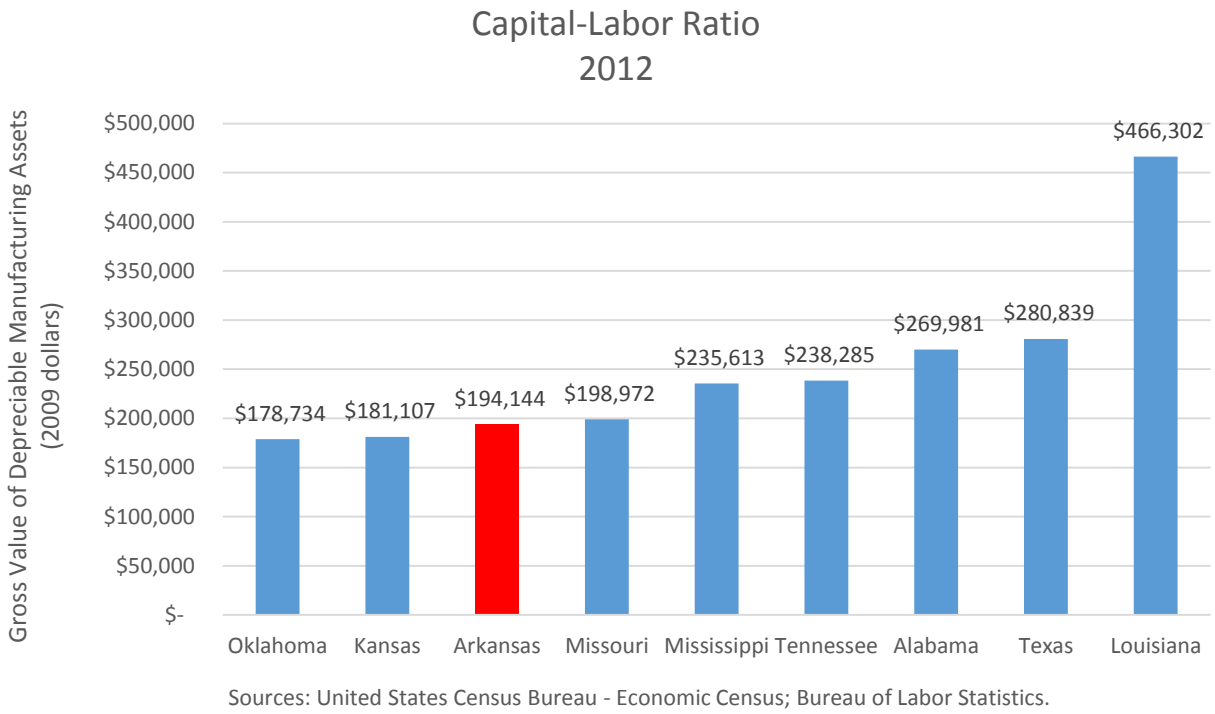
Sources: United States Census Bureau and Bureau of Economic Analysis.

Figure 5



Sources: United States Census Bureau and Bureau of Economic Analysis.

Figure 6



Sources: United States Census Bureau - Economic Census; Bureau of Labor Statistics.

Appendix

Table 1A. Robustness Check for Table 1

Total State and Local Taxes and Manufacturing Labor Productivity		
Levels Model: Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: Labor Productivity**	
	Labor Productivity: Base	**Labor Productivity: Petroleum**
Total State and Local Tax Burden	–11,354***	–12,491***
	(4,148)	(3,856)
Education	–88.75	304.1
	(1,147)	(1,070)
Population Density	26.99	37.91*
	(20.50)	(19.33)
Manufacturing Employment Ratio	–1,191	–306.5
	(803.8)	(802.4)
Petroleum Industry Ratio		1,071***
		(365.5)
Capital-Labor Ratio		
Constant	232,875***	211,945***
	(49,216)	(46,082)
Observations	149	149
Number of States	50	50
R-squared (between)	0.179	0.313
F-statistic	2.46	4.01

Between-estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 2A. Robustness Check for Table 2

Total State and Local Taxes and Capital Accumulation		
Levels Model: Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: Capital-Labor Ratio**	
	K-L: Base	**K-L: Petroleum**
Total State and Local Tax Burden	–3,079 (10,342)	–7,495 (8,168)
Education	–6,936** (2,860)	–5,411** (2,266)
Population Density	3.173 (51.12)	45.56 (40.93)
Manufacturing Employment Ratio	–3,746* (2,004)	–310.2 (1,700)
Petroleum Industry Ratio		4,160*** (774.1)
Constant	431,419*** (122,711)	350,144*** (97,601)
Observations	149	149
Number of States	50	50
R-squared (between)	0.183	0.507
F-statistic	2.53	9.05

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 3A. Robustness Check for Table 3

Tax Components and Manufacturing Labor Productivity				
Levels Model: Years 2002, 2007, 2012				
Independent Variables	**Dependent Variable: Labor Productivity**			
	Four Components: Base	**Four Components: Petroleum**	**Five Components: Base**	**Five Components: Petroleum**
State and Local Corporate Income Tax Burden	–59,400**	–58,079**	–59,585**	–40,539
	(23,751)	(22,713)	(28,069)	(27,505)
State and Local Individual Income Tax Burden	–4,242	–2,194	–4,202	–5,347
	(5,152)	(5,011)	(6,065)	(5,729)
State and Local Sales Tax Burden	–13,444**	–11,650**	–13,410**	–14,283**
	(5,746)	(5,552)	(6,373)	(6,010)
State and Local Property Tax Burden	–8,280	–7,823	–8,259	–9,674
	(5,910)	(5,654)	(6,207)	(5,872)
State and Local Other Taxes Burden			109.9	–10,194
			(8,588)	(9,076)
Education	–570.2	–184.3	–568.0	–285.6
	(1,352)	(1,304)	(1,378)	(1,303)
Population Density	29.46	35.37*	29.49	34.13
	(21.18)	(20.42)	(21.57)	(20.39)
Manufacturing Employment Ratio	–933.2	–252.0	–928.4	–517.4
	(825.4)	(846.3)	(914.0)	(876.1)
Petroleum Industry Ratio		857.8**		1,078**
		(385.3)		(431.1)
Capital-Labor Ratio				
Constant	233,222***	196,701***	232,865***	220,465***
	(49,973)	(50,512)	(57,767)	(54,616)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.233	0.315	0.233	0.336
F-statistic	1.82	2.36	1.55	2.25

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 4A. Robustness Check for Table 4

Tax Components and Capital Accumulation				
Levels Model: Years 2002, 2007, 2012				
Independent Variables	**Dependent Variable: Capital-Labor Ratio**			
	K-L Four Component: Base	**K-L Four Component: Petroleum**	**K-L Five Component: Base**	**K-L Five Component: Petroleum**
State and Local Corporate Income Tax Burden	–100,468* (58,250)	–94,333** (46,193)	–180,514*** (64,441)	–114,620** (56,531)
State and Local Individual Income Tax Burden	–11,071 (12,636)	–1,565 (10,190)	6,042 (13,925)	2,081 (11,775)
State and Local Sales Tax Burden	–23,667 (14,093)	–15,340 (11,292)	–9,279 (14,631)	–12,296 (12,353)
State and Local Property Tax Burden	1,507 (14,495)	3,630 (11,498)	10,668 (14,251)	5,771 (12,069)
State and Local Other Taxes Burden			47,440** (19,718)	11,791 (18,655)
Education	–8,927** (3,315)	–7,136** (2,651)	–7,995** (3,165)	–7,018** (2,678)
Population Density	14.69 (51.95)	42.14 (41.54)	27.52 (49.51)	43.58 (41.91)
Manufacturing Employment Ratio	–3,747* (2,024)	–584.9 (1,721)	–1,700 (2,098)	–277.9 (1,801)
Petroleum Industry Ratio		3,983*** (783.6)		3,729*** (886.1)
Constant	576,433*** (122,560)	406,860*** (102,727)	422,273*** (132,624)	379,372*** (112,254)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.261	0.547	0.353	0.551
F-statistic	2.12	6.19	2.79	5.46

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 5A. Robustness Check for Table 5

Inventory, Capital Stock, and Business-to-Business Taxes and Manufacturing Labor Productivity				
Levels Model: Years 2010, 2011, 2012				
Independent Variables	**Dependent Variable: Labor Productivity**			
	I, CS, B2B: Base	**I, CS, B2B: Petroleum**	**Total: Base**	**Total: Petroleum**
Total State and Local Tax Burden			–18,471***	–18,603***
			(4,999)	(4,989)
Inventory Tax (Dummy)	14,443	14,213	10,262	9,982
	(18,502)	(18,553)	(16,303)	(16,266)
Capital Stock Tax (Dummy)	–310.7	762.9	–15,548	–14,488
	(17,507)	(17,595)	(15,932)	(15,923)
Business-to-Business Sales Tax on Manufacturing Machinery (Dummy)	–20,319	–19,412	–20,912	–19,928
	(18,525)	(18,603)	(16,285)	(16,271)
Education	518.4	751.9	200.0	452.1
	(2,030)	(2,052)	(1,786)	(1,797)
Population Density	–2.216	3.310	17.45	23.62
	(33.08)	(33.75)	(29.56)	(30.02)
Manufacturing Employment Ratio	–496.5	–75.35	–1,301	–848.2
	(1,377)	(1,461)	(1,230)	(1,295)
Petroleum Industry Ratio		568.3		619.3
		(646.1)		(565.3)
Constant	137,466**	120,571*	317,580***	300,458***
	(62,016)	(65,079)	(73,131)	(74,612)
Observations	150	150	150	150
Number of States	50	50	50	50
R-squared (between)	0.055	0.072	0.286	0.307
F-statistic	0.41	0.46	2.41	2.27

Between estimator. Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Table 6A. Robustness Check for Table 6

Total State and Local Taxes and Manufacturing Labor Productivity		
Levels Model: Years 2002, 2007, 2012		
Independent Variables	**Dependent Variable: Labor Productivity**	
	Total Tax and K: Base	**Total Tax and K: Petroleum**
Total State and Local Tax Burden	–10,595***	–10,700***
	(3,314)	(3,397)
Education	1,620	1,597
	(973.6)	(991.9)
Population Density	26.21	27.02
	(16.36)	(17.10)
Manufacturing Employment Ratio	–268.7	–232.4
	(666.0)	(700.4)
Capital-Labor Ratio	0.246***	0.239***
	(0.0477)	(0.0621)
Petroleum Industry Ratio		77.26
		(410.4)
Constant	126,613***	128,279***
	(44,349)	(45,707)
Observations	149	149
Number of States	50	50
R-squared (between)	0.489	0.489
F-statistic	8.41	6.86

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

Table 7A. Robustness Check for Table 7

Tax Components and Manufacturing Labor Productivity				
Levels Model: Years 2002, 2007, 2012				
Independent Variables	**Dependent Variable: Labor Productivity**			
	Four Components and K: Base	**Four Components and K: Petroleum**	**Five Components and K: Base**	**Five Components and K: Petroleum**
State and Local Corporate Income Tax Burden	–36,914* (20,793)	–36,465* (21,356)	–13,540 (25,143)	–13,025 (25,444)
State and Local Individual Income Tax Burden	–1,764 (4,398)	–1,836 (4,490)	–5,743 (4,989)	–5,846 (5,049)
State and Local Sales Tax Burden	–8,147 (5,022)	–8,136 (5,084)	–11,044** (5,255)	–11,331** (5,360)
State and Local Property Tax Burden	–8,618* (5,001)	–8,655* (5,071)	–10,980** (5,129)	–11,060** (5,187)
State and Local Other Taxes Burden			–11,991 (7,529)	–13,024 (8,035)
Education	1,428 (1,238)	1,451 (1,267)	1,471 (1,216)	1,399 (1,242)
Population Density	26.17 (17.94)	25.71 (18.52)	22.47 (17.76)	23.67 (18.20)
Manufacturing Employment Ratio	–94.47 (726.3)	–118.0 (759.2)	–494.8 (756.0)	–450.7 (772.0)
Capital-Labor Ratio	0.224*** (0.0532)	0.229*** (0.0688)	0.255*** (0.0558)	0.240*** (0.0678)
Petroleum Industry Ratio		–54.76 (440.7)		182.7 (456.2)
Constant	104,213* (52,238)	103,481* (53,204)	125,153** (52,945)	129,399** (54,550)
Observations	149	149	149	149
Number of States	50	50	50	50
R-squared (between)	0.464	0.464	0.496	0.498
F-statistic	4.43	3.85	4.37	3.87

Between estimator. Standard errors in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*