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State Taxes and Manufacturing Productivity: A Case Study of Arkansas

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Abstract: From 2002 through 2012, compared with its surrounding states Arkansas saw less growth in the real dollar value of manufacturing, a greater decline in manufacturing's share of gross domestic product, and a faster rate of job loss in manufacturing. 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, adjusted for inflation. This study examines the relationship between state and local taxes and labor productivity in manufacturing. It is found that total state and local tax burdens reduce output per manufacturing employee, primarily through sales and corporate income taxes. Legislators across all states should consider the distortionary effects of taxes when making tax-policy decisions because those decisions will influence not only manufacturing productivity, but also the rate of economic growth.

1. Introduction

From 2002 through 2012, Arkansas saw less growth in the real 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 than 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, adjusted for inflation. Arkansas's manufacturing-labor productivity grew significantly less than the national and regional averages over this time span, and the state had one of the lowest growth rates among the states in the region: 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 also lagged. Arkansas's manufacturing productivity and pay have both consistently been well below the national average. In its region, Arkansas's manufacturing productivity and pay lie near the bottom.

This study examines the degree to which state and local tax burdens impact worker productivity in the manufacturing sector. Tax policy has important implications for economic productivity, particularly in capital-intensive industries such as in manufacturing. Higher taxes lead to less productivity and therefore less output. Legislators across all states should consider the distortionary effects of taxes when making tax-policy decisions because those decisions will influence not only manufacturing productivity, but also economic growth.

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 than states that rank poorly (Kolko et al., 2013). Tax policy is important for the overall economy but plays an especially important role in the manufacturing sector.

Manufacturing is one of the most geographically mobile sectors and has a stronger relationship with state business climates than the overall economy does (Kolko et al., 2013). Manufacturing's heightened sensitivity to business climates means that the health of a state's manufacturing sector is increasingly tied to its tax environment.

Economic growth largely stems from productivity increases. 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 manufacturing productivity. However, tax policy also can influence productivity. Reductions in manufacturers' baseline tax liability can lead to significant increases in manufacturers' value added (Funderburg et al., 2013).

Tax increases impact manufacturing productivity through various channels. 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. Underinvestment caused by high corporate taxes especially hurts productivity growth in small firms that are behind the technology frontier (Gemmell et al., 2013).

Furthermore, tax policy shifts resources across heterogeneous plants (Restuccia and Rogerson, 2008). Resources shift from high-cost producers to low-cost producers when different producers face different costs. If tax policy, such as targeted tax incentives, 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 decreases overall productivity and economic growth.

Individual income-tax policy also affects productivity. Vartia (2008) finds that high top marginal personal income-tax rates "impede long-run productivity … through the channel of entrepreneurial activity." The higher the personal income tax rate, the less incentive there is for an individual to become an entrepreneur. Cebula and Alexander (2006) also find that "state income tax burdens … consistently act as a deterrent to net in-migration." Because higher individual income taxes discourage in-migration, those states with high tax burdens may experience disruptions in both the composition and amount of labor, affecting productivity.

3. Econometric framework

My analysis first examines the impact of total state and local tax burdens on manufacturing-labor productivity through the lens of capital accumulation. Next, I disaggregate the total tax burden to analyze the impact of individual tax components. Finally, I exclude the channel of capital accumulation, thereby allowing taxes to impact productivity through other means.

The models use a panel data set for the years 2002, 2007, and 2012. The panel is confined to these specific years because data used to calculate the capital-labor ratio come from the United States Census Bureau's Economic Census, which is conducted only in years ending in 2 and 7. Appropriate data are not available in in-between years.

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 states and applies the ordinary-least-squares estimator to the time-averaged equation. The between model is written as

$$\bar{y}_i = \alpha + \overline{x'}_i\beta + (\alpha_i - \alpha + \bar{\varepsilon}_i), \quad i = 1, \dots, N$$
$$where\ \bar{y}_i = T^{-1}\textstyle\sum_t y_{it}, \quad \bar{\varepsilon}_i = T^{-1}\sum_t \varepsilon_{it},$$
$$and\ \bar{x}_i = T^{-1}\textstyle\sum_t x_{it}. \tag{1}$$

The full, base specification is as follows:

$$LaborProductivity_i = TaxBurden_i + Education_i + PopulationDensity_i + ManufacturingEmploymentRatio_i + PetroleumIndustryRatio_i + CapitalLaborRatio_i \tag{2}$$

3.1. Data

All data have been adjusted for inflation using 2009 chained dollars unless otherwise noted. Labor productivity is measured as manufacturing GDP per manufacturing employee. Manufacturing GDP data come from the Bureau of Economic Analysis's Regional Economic Accounts. 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 plus local tax collections, expressed 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 aged twenty-five and older that holds a bachelor's degree or higher. Data from 2007 and 2012 stem from the United States Census Bureau's American Community Survey, while 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 the number of manufacturing employees as a percentage of the total number of state employees. Employee data come from the Quarterly Census of Employment and Wages from the Bureau of Labor Statistics.

I also consider the petroleum-industry ratio. 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 GDP from petroleum- and coal-products manufacturing 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. 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

Conventional economic theory holds that taxes hurt productivity by slowing capital accumulation. Because taxes increase the user cost of capital, the relative prices of capital and labor become distorted. The price of capital becomes greater relative to the price of labor, inducing firms to invest in more labor than capital. Over time, factors become misallocated. Factor misallocation means there is not enough equipment per worker, so workers produce less output than they otherwise could. Low productivity levels caused by factor misallocation slow economic growth in the manufacturing sector.

Table 1 tests this theory and displays the results of two estimated 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. These specifications allow us to isolate the effect of taxes through the channel of capital accumulation.

Table 1. Total state and local taxes and manufacturing labor productivity, 2002, 2007, and 2012.

Independent Variables	Dependent Variable: (log) Labor Productivity	
	Base	**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)
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.*

Both models indicate that total state and local taxes have a significant, negative impact on labor productivity in the manufacturing sector when taxes are allowed to affect capital accumulation. States with higher total taxes see lower 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 eight percent. To further test the notion that increased state and local taxes affect capital accumulation, I rearrange the model to examine the impact of the total tax burden on the capital-labor ratio.

Table 2. Total state and local taxes and capital accumulation, 2002, 2007, and 2012.

Independent Variables	Dependent Variable: (log) Capital-Labor Ratio	
	Base	**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.*

The results in Table 2 indicate that the total state and local tax burden 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 fails to support the theory that states with higher total taxes accumulate less capital per employee than states with lower total taxes. Instead, it indicates that taxes affect productivity differences across states through channels other than capital accumulation, such as resource shifting and entrepreneurship. This idea will be explored in later sections.

3.3. Tax components and labor productivity

Rather than asking about the overall tax burden, it is perhaps a more practical question to ask which taxes are driving the loss in productivity. To answer this, I disaggregate the state and local tax burden into five components: 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 of state and local taxes (all other taxes). All four models allow the tax components to work through the channel of capital accumulation.

Table 3 shows that when the model allows the capital-accumulation channel, 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 output per manufacturing employee. Thus, manufacturers in states with higher corporate income taxes and sales taxes see less output per employee than states with lower corporate-income-tax 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, I again rearrange the model in similar fashion to the models in Table 2. Table 4 shows the results.

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, the results are mixed. Corporate income taxes are statistically significant at the 10 percent level when the petroleum-industry ratio is considered but are not statistically 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, the 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]

Table 3. Tax components and manufacturing labor productivity, 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.*

[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.

Table 4. Tax components and capital accumulation, 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***	13.00***	12.89***	12.66***
	(0.452)	(0.397)	(0.497)	(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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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 surprising. Many states exempt manufacturers from paying sales tax on manufacturing machinery and equipment, effectively removing from manufacturers 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.[3] Taxing the sale of manufacturing equipment creates distortionary effects by raising the user cost of capital.

Arkansas also collects 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 firms' inventory, distort 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 income tax.

This section of the study explores whether states that levy inventory taxes, capital-stock taxes, and

[3] This holds true through the time period of the data set.

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 and because the non-uniform implementation of the taxes 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. Inventory, capital stock, and business-to-business taxes and manufacturing labor productivity, 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***	–0.115***
			(0.0271)	(0.0269)
Inventory Tax (Dummy)	0.0563	0.0462	0.0409	0.0319
	(0.108)	(0.108)	(0.0914)	(0.0912)
Capital Stock Tax (Dummy)	–0.0171	–0.0169	–0.0982	–0.0973
	(0.102)	(0.102)	(0.0885)	(0.0880)
Business-to-Business Sales Tax on Manufacturing Machinery (Dummy)	–0.134	–0.130	–0.138	–0.134
	(0.106)	(0.106)	(0.0896)	(0.0892)
Education	–0.00106	–0.000171	0.00167	0.00244
	(0.0112)	(0.0112)	(0.00951)	(0.00948)
(log) Population Density	0.0452	0.0602	0.0391	0.0527*
	(0.0342)	(0.0366)	(0.0289)	(0.0309)
Manufacturing Employment Ratio	–0.00249	0.000233	–0.00791	–0.00540
	(0.00788)	(0.00822)	(0.00677)	(0.00705)
Petroleum Industry Ratio		0.00436		0.00394
		(0.00388)		(0.00327)
Constant	11.72***	11.56***	12.76***	12.61***
	(0.332)	(0.358)	(0.372)	(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.*

The results in Table 5 indicate that the mere 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.[4] In all four models, the three dummy variables are not statistically significant. However, the results in Table 5 provide further evidence that the total state and local tax burden has a significant, negative impact on manufacturing-labor productivity.

[4] 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. Affecting productivity through other channels

Theory suggests that taxes also affect labor productivity through channels such as resource shifting and entrepreneurship. To test this notion, the analysis excludes the capital-accumulation channel by controlling for the capital-labor ratio. 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. Total state and local taxes and manufacturing labor productivity, 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.*

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 excluding the capital-accumulation channel. This result suggests that taxes, when considered in totality, do work through multiple channels to decrease output per manufacturing employee. To examine which taxes are driving the loss in productivity, Table 7 disaggregates 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).

The models in Table 7 show mixed results for the state and local corporate income-tax burden. When controlling for only the four major tax components, 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 controlling for the capital-labor ratio supports the notion that corporate income taxes decrease labor productivity through the capital-accumulation channel.

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. States that have higher state and local sales-tax burdens see lower 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.

I also found the state and local property-tax burden to have a significant, negative impact on labor productivity when controlling for the capital-labor ratio. This result, however, is not robust. Previous models found property taxes to be statistically insignificant when allowing taxes to work through the capital-accumulation channel.

3.6. Robustness checks

I also tested levels models. 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.

Table 7. Tax components and manufacturing labor productivity, 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.*

4. Arkansas policy implications

The results of this study have clear policy implications. Arkansas's manufacturing sector would improve if the state created a more regionally competitive tax environment. 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 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 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 had been able to produce $11,601 to $12,544 more in output, Arkansas's manufacturing GDP would have increased by between $1.8 billion and $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 to 11.2 percent. This productivity gain would have increased manufacturing output per employee by between $9,809 and $10,564 over 2012 levels and would have boosted total manufacturing GDP by between $1.53 billion and $1.64 billion.

To lower the state's total tax burden, Arkansas should decrease its 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. Sales taxes erode workers' incomes and discourage consumption, incentivizing labor to move to regions with lower sales taxes.

Arkansas should also reduce its 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 affecting capital accumulation. By inhibiting 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.

In short, Arkansas's manufacturing industry has suffered because of the state's high-tax environment. The high tax burden in Arkansas has reduced economic freedom and hurt economic growth. When states such as Arkansas increase tax burdens, they take money away from individuals and firms to place it in the hands of government officials who lack a profit motive (Stansel, 2013). Stripping individuals and businesses of their earnings and wealth is stripping them of their freedom to use their money in the manner that best achieves their economic goals. As Stansel, Torra, and McMahon state, individuals and firms "must pay whatever bill is demanded in taxes and accept whatever service is offered in return" (Stansel, Torra, and McMahon, 2015). Increased taxation, and thus reduced economic freedom, in Arkansas has come at the expense of the state's manufacturing industry.

5. Conclusion

The results of this study are significant for at least two reasons. First, the results imply that states seeking to improve productivity in the manufacturing industry can achieve this goal through state and local tax policy. The results suggest that lower total state and local tax burdens are associated with higher levels of manufacturing-labor productivity. Thus, states may improve productivity in the manufacturing industry by decreasing total state and local tax burdens.

Second, the results imply that not all taxes are created equal when it comes to their impact on manufacturing-labor productivity. In other words, tax structure matters. Total state and local tax burdens hurt manufacturing-labor productivity, but the primary drivers of the loss in productivity are sales and corporate income taxes at the state and local levels. Corporate income taxes drive down labor productivity through reducing capital accumulation, while sales taxes work through other means. Thus, states looking to improve labor productivity in the manufacturing industry must not only look to lower tax burdens, but consider which taxes to lower to achieve the desired results.

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Data Sources

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Appendix *(all models using Between estimator. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1)*

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	
	Base	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)
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

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	–7,495
	(10,342)	(8,168)
Education	–6,936**	–5,411**
	(2,860)	(2,266)
Population Density	3.173	45.56
	(51.12)	(40.93)
Manufacturing Employment Ratio	–3,746*	–310.2
	(2,004)	(1,700)
Petroleum Industry Ratio		4,160***
		(774.1)
Constant	431,419***	350,144***
	(122,711)	(97,601)
Observations	149	149
Number of States	50	50
R-squared (between)	0.183	0.507
F-statistic	2.53	9.05

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

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*	–94,333**	–180,514***	–114,620**
	(58,250)	(46,193)	(64,441)	(56,531)
State and Local Individual Income Tax Burden	–11,071	–1,565	6,042	2,081
	(12,636)	(10,190)	(13,925)	(11,775)
State and Local Sales Tax Burden	–23,667	–15,340	–9,279	–12,296
	(14,093)	(11,292)	(14,631)	(12,353)
State and Local Property Tax Burden	1,507	3,630	10,668	5,771
	(14,495)	(11,498)	(14,251)	(12,069)
State and Local Other Taxes Burden			47,440**	11,791
			(19,718)	(18,655)
Education	–8,927**	–7,136**	–7,995**	–7,018**
	(3,315)	(2,651)	(3,165)	(2,678)
Population Density	14.69	42.14	27.52	43.58
	(51.95)	(41.54)	(49.51)	(41.91)
Manufacturing Employment Ratio	–3,747*	–584.9	–1,700	–277.9
	(2,024)	(1,721)	(2,098)	(1,801)
Petroleum Industry Ratio		3,983***		3,729***
		(783.6)		(886.1)
Constant	576,433***	406,860***	422,273***	379,372***
	(122,560)	(102,727)	(132,624)	(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

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

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

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*	–36,465*	–13,540	–13,025
	(20,793)	(21,356)	(25,143)	(25,444)
State and Local Individual Income Tax Burden	–1,764	–1,836	–5,743	–5,846
	(4,398)	(4,490)	(4,989)	(5,049)
State and Local Sales Tax Burden	–8,147	–8,136	–11,044**	–11,331**
	(5,022)	(5,084)	(5,255)	(5,360)
State and Local Property Tax Burden	–8,618*	–8,655*	–10,980**	–11,060**
	(5,001)	(5,071)	(5,129)	(5,187)
State and Local Other Taxes Burden			–11,991	–13,024
			(7,529)	(8,035)
Education	1,428	1,451	1,471	1,399
	(1,238)	(1,267)	(1,216)	(1,242)
Population Density	26.17	25.71	22.47	23.67
	(17.94)	(18.52)	(17.76)	(18.20)
Manufacturing Employment Ratio	–94.47	–118.0	–494.8	–450.7
	(726.3)	(759.2)	(756.0)	(772.0)
Capital-Labor Ratio	0.224***	0.229***	0.255***	0.240***
	(0.0532)	(0.0688)	(0.0558)	(0.0678)
Petroleum Industry Ratio		–54.76		182.7
		(440.7)		(456.2)
Constant	104,213*	103,481*	125,153**	129,399**
	(52,238)	(53,204)	(52,945)	(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