STATE AND LOCAL TAXES AND ECONOMIC PERFORMANCE: AN EMPIRICAL STUDY OF HOW MUCH TAXES MATTER TO ECONOMIES

by

Juan Feng

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APPROVAL

of a thesis submitted by

Juan Feng

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

Douglas J. Young ______________________ (Signature) 4-18-02 Date

Approved for the Department of Agricultural Economics and Economics

Myles J. Watts ______________________ (Signature) 4/18/02 Date

Approved for the College of Graduate Studies

Bruce McLeod ______________________ (Signature) 4-19-02 Date

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Date 04/22/02

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ABSTRACT

Per capita income levels and growth vary considerably among the contiguous 48 states of America. This can be attributed to several factors, such as tax policies, government services, economic structures, education, and/or demographic structures. Analysis offered in this study focuses on the influence of taxes, controlling for other factors, on the levels and growth of per capita income among the U.S. states.

Evidence does not show that taxes are an important factor in either income levels or growth when other factors are controlled. Nevertheless, estimates on the disaggregate tax variables show taxes on personal incomes have some negative effect on income levels and growth, and the change in overall tax burdens is negatively related to growth.

There is strong evidence for conditional convergence among state economies. Development in education and metropolitan areas is important for both income levels and growth. A state's higher energy cost is compensated by higher wages. In addition, the constitution of a state's population affects its economy: the larger the non-labor force, the lower the income level.

CHAPTER 1

INTRODUCTION

Levels of per capita income vary considerably among the contiguous 48 states of the U.S.[1] For example, per capita personal income was $38,505 in Connecticut in 1999, while residents of Mississippi had incomes of only $20,180 per person (see Table 1). Growth in income has also varied a great deal among states over the last 40 years, namely from 1959 to 1999: the highest growth rate of real per capita personal income, 2.9 percent per year, was achieved by South Carolina, which is 0.7 percentage point higher than the national average, 2.2 percent. Nevada had the slowest growth at 1.7 percent per year, 0.5 percentage point below the national average. Noticeably, California, Delaware, and Montana all had the second lowest annual average growth rate (1.8 percent) from 1959 to 1999, but the levels of per capita income of these three states in 1999 are poles apart. California ranked the 10th in 1999, Delaware ranked the 12th, and Montana ranked 44th (see Table 1).

In addition, as the regional statistics in Table 1 indicate, the Southeastern states, such as Alabama, Florida, and Georgia, have grown 0.7 percentage point faster on average than states of the Great Lakes (the "Rustbelt", a declining manufacturing area),

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[1] This study excludes Alaska and Hawaii, where economies have been subject to somewhat different forces. The surge in per capita income in Alaska during 1970s and 1980s was almost entirely due to the construction of the Alaska pipeline. After that, Alaska's economy fell back to the level before 1970s. The performance of Hawaii's economy has been strongly affected by Japan: boom in the 1970s and 1980s, and stagnation in the 1990s. In addition, migration between Alaska, Hawaii, and the contiguous states is more costly than within the contiguous states.

and 0.5 percentage point faster on average than the region made up of the states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. The growth of all the states in this region, except Colorado, is below the national average.

Why do income levels and growth differ so much among the states? There is no single factor, policy, or characteristic of the states that provides a complete explanation for differences illustrated in Table 1. Rather, several factors play a role, including tax policies, government services, economic structures, education, and/or demographic structures. Tax policies, as one important factor, receive many studies by growth economists. Economists give advice on government policy making by studying the relation between taxes and economic activity.

Many economists believe that taxes and income levels as well as growth are closely related. The emerging consensus among economists now says that taxes do matter to economies (Phillips and Goss, 1995). Some even assert that relatively low-tax states grow faster than high-tax states (Vedder, 1996). The plausible negative relationship between taxes and growth is illustrated in Table 2. High-tax states throughout 1959 to 1999, such as New York, Montana, and Wyoming, have a lower-than-average annual growth rate during these four decades. And relatively low-tax states, such as Alabama, New Hampshire, South Carolina, Tennessee, Texas, and Virginia, have an above-average growth rate from 1959 to 1999.

Another argument is that it is not the levels of the tax burden but the change in it that is related to a state's growth (Vedder, 1996). The plausible relationship between the change in tax burdens and growth is also illustrated in Table 2. A very slow growth from 1959 to 1999 is associated with an observable rise in the tax burden. For example, Delaware raised its tax burden by 3.64 percentage points in four decades, which was the third largest raise during that period among 48 states. Meanwhile its average annual growth rate was among the second lowest—1.8 percent. Other states dropped their tax burdens and experienced fast growth. South Dakota is among such states. It was the champion taxer in 1959 but fell in the rank of tax burdens by 44 places four decades after. Specifically, its tax burden was reduced by 3.03 percentage points. Noticeably, its growth rate during that period was as high as 2.8 percent, one of the second highest.

Table 2 also indicates that for states which always had low taxes, if they raised their taxes, their growth would slow down even though their tax burdens were still relatively low compared with other states after the raise in taxes. An example is Illinois, which ranked at the bottom in tax burdens in 1959 and also not high in 1999. However, it raised its tax burden by 3.15 percentage points, and at the same time experienced slow growth. Conversely, states originally having high taxes would benefit from a tax cut even if their tax burdens were still high among all states, for example, Vermont. Vermont's tax burden ranked the 3rd and the 8th in 1959 and 1999, respectively, but it's growth rate from 1959 to 1999 was the third highest among 48 states. Perhaps because its relative position of tax burden among states fell, it was able to keep a fast growth.

An alternative interpretation of the data in Table w is also possible: High growth may result in falling tax rates, while slow-growing states may increase taxes. If this is the case, tax changes result from—rather than cause—income changes.

In addition, statistics in Table 2 imply that there must be factors other than taxes playing an important role in the health of an economy. Some states, exemplified by Connecticut and Kentucky, experienced a fast income growth even when their tax burdens climbed drastically from 1959 to 1999. It implies that other factors, such as economic structures, education levels, and/or the composition of population, may affect the observed tax-growth relationship. Therefore, taxes may or may not play a role in economies after other factors are taken into account. Or if taxes do matter to economic performance, the size of their effect may be small compared with other factors' influences. Also, since state economies are similar in respect to preferences, technology, and political environment, according to the conditional convergence theory[2] in the neoclassical growth model, the gap in growth of the state economies will be eliminated in the long run (Barro, 1997).

This study examines the influence of taxes and other factors on the levels and growth of per capita incomes among the U.S. states. The findings may be of interest for those considering the direction of state and local tax policies.

The first contribution of this study is to present a model featuring the effect of taxes on income levels and growth, controlled for other factors, particularly, the cost of living, amenities and disamenities, age distribution of population, educational attainment, economic structures, and energy cost. Moreover, the property of conditional convergence of economic growth is incorporated in the model specifically featuring the effect of taxes on growth.

[2] Conditional convergence: The idea that poor countries grow faster than rich ones for given values of government policies, propensities to save and have children, and other variables (Barro, 1997).

The second contribution of this study is to apply the cross-sectional time-series framework to expand the sample information. According to Barro, although the main evidence comes from the cross-sectional variation, the time-series dimension provides some additional information (1997). Few studies of state-level growth have employed this approach.

This study is organized as follows. The next chapter reviews the previous works done on this subject and presents the theoretical model. Chapter 3 addresses the empirical models and the definitions of variables. Chapter 4 introduces the sources of data. Chapter 5 discusses the estimation methods and results for the models in Chapter 3. And Chapter 6 is the conclusion.

Table 1. Comparison of the Levels and Growth of Per Capita Personal Income of States and Regions

	Real Per Capita Personal Income ($1999 using CPI-U-X1)					Rank of Real PC Inc	Real Growth In PC Inc (%/Year)
State	1959	1969	1979	1989	1999	1999	59-99
AL	8,045	11,620	16,207	20,018	22,987	39	2.6%
AZ	10,407	14,753	19,371	22,260	25,189	35	2.1%
AR	7,444	11,074	15,958	18,558	22,244	45	2.6%
CA	14,446	19,197	24,418	27,899	29,910	10	1.8%
CO	11,920	15,586	21,604	24,920	31,546	8	2.4%
CT	14,931	20,495	24,700	34,660	39,300	1	2.4%
DE	14,361	18,694	21,498	28,120	30,778	12	1.8%
FL	10,597	15,472	19,990	25,588	27,780	21	2.3%
GA	8,752	13,370	17,385	22,576	27,340	22	2.8%
ID	9,970	13,823	17,772	19,889	22,835	41	2.0%
IL	13,929	18,411	23,061	26,379	31,145	7	2.0%
IN	11,235	15,704	19,843	22,531	26,143	28	2.1%
IA	10,681	15,442	20,519	22,252	25,615	31	2.1%
KS	11,103	15,002	20,802	22,965	26,824	23	2.2%
KY	8,457	12,563	17,200	19,618	23,237	38	2.5%
LA	8,884	12,267	17,590	18,806	22,847	43	2.3%
ME	9,753	13,277	16,878	22,687	24,603	34	2.3%
MD	12,252	17,797	22,592	29,559	32,465	5	2.4%
MA	12,811	17,789	21,325	30,173	35,551	3	2.5%
MI	12,432	17,527	21,840	24,555	28,113	16	2.0%
MN	10,887	15,979	21,183	25,482	30,793	9	2.6%
MS	6,564	10,182	14,744	16,848	20,688	48	2.8%
MO	11,209	15,057	19,616	22,952	26,376	27	2.1%
MT	10,666	13,886	18,684	19,647	22,019	44	1.8%
NE	10,660	15,104	19,776	22,676	27,049	20	2.3%
NV	14,493	19,112	24,236	26,291	31,022	14	1.7%
NH	11,198	15,831	19,769	27,724	31,114	6	2.6%
NJ	14,024	19,134	23,569	31,701	35,551	2	2.3%
NM	9,991	12,351	17,153	18,924	21,853	46	1.9%
NY	14,208	19,463	22,349	29,512	33,890	4	2.1%
NC	8,335	12,901	16,797	22,221	26,003	30	2.8%
ND	8,852	12,905	18,907	19,289	23,313	36	2.4%
OH	12,200	16,635	20,827	23,949	27,152	19	2.0%
OK	9,790	13,523	19,103	20,509	22,953	40	2.1%
OR	11,831	15,548	21,196	23,139	27,023	25	2.0%
PA	11,810	16,131	20,769	25,158	28,605	15	2.2%
RI	11,509	16,343	19,350	26,410	29,377	17	2.2%
SC	7,339	11,954	15,859	19,930	23,545	37	2.9%

Table 1, continued

	Real Per Capita Personal Income ($1999 using CPI-U-X1)					Rank of Real PC Inc	Real Growth In PC Inc (%/Year)
State	**1959**	**1969**	**1979**	**1989**	**1999**	**1999**	**59-99**
SD	8,246	12,664	18,367	19,840	25,045	33	2.8%
TN	8,425	12,546	17,151	21,340	25,574	32	2.7%
TX	10,270	14,262	20,102	21,931	26,858	24	2.4%
UT	10,386	13,121	17,529	18,779	23,288	42	1.9%
VT	9,659	14,326	17,680	23,535	25,889	29	2.5%
VA	9,938	15,045	20,251	26,575	29,789	13	2.7%
WA	12,548	17,324	22,435	25,084	30,392	11	2.2%
WV	8,420	11,831	16,732	18,177	20,966	47	2.3%
WI	11,731	15,861	20,895	23,242	27,390	18	2.1%
WY	12,010	15,155	23,801	22,011	26,396	26	1.9%
New England	12,727	17,734	21,350	29,827	34,173		2.4%
Mideast	13,333	18,313	22,180	28,744	32,628		2.2%
Great Lakes	12,558	17,117	21,543	24,477	28,348		2.0%
Plains	10,750	15,155	20,240	23,184	27,350		2.3%
Southeast	8,673	13,040	17,678	22,162	25,703		2.7%
Southwest	10,186	14,081	19,686	21,620	25,862		2.3%
Rocky Mountains	11,108	14,546	19,949	22,013	27,072		2.2%
Far West	13,866	18,690	23,927	27,184	29,727		1.9%
United States	11,678	16,263	20,780	24,944	28,542		2.2%

Source: US Dept of Commerce, Bureau of Economic Analysis,
http://www.bea.doc.gov/bea/regional/spi/

Note: For the mean value, maximum, minimum, and standard deviation of the natural logarithms of real per capita personal income of 1959, 1969, 1979, 1989, and 1999, please see Appendix C.

Table 2. Comparison of Tax Burdens among States in Terms of Average Tax Rates*

State	Average Tax Rate In 1959	Rank In 1959	Average Tax Rate In 1999	Rank In 1999	ΔAverage Tax Rate (1959-1999)	PC Growth Rate (1959-1999)
AL	7.27	40	8.72	46	1.45	2.6%
AZ	9.22	14	10.05	31	0.83	2.1%
AR	8.59	26	10.03	32	1.44	2.6%
CA	9.14	18	10.51	24	1.37	1.8%
CO	9.65	10	9.29	44	-0.36	2.4%
CT	6.82	45	11.80	7	4.98	2.4%
DE	7.06	43	10.70	18	3.64	1.8%
FL	8.67	25	9.43	41	0.76	2.3%
GA	7.97	32	9.89	36	1.92	2.8%
ID	9.21	16	10.78	15	1.56	2.0%
IL	6.81	46	9.96	35	3.15	2.0%
IN	7.95	33	10.56	22	2.60	2.1%
IA	9.57	11	10.59	21	1.02	2.1%
KS	9.95	7	10.61	20	0.66	2.2%
KY	7.17	41	10.73	16	3.56	2.5%
LA	10.75	4	10.43	26	-0.31	2.3%
ME	9.17	17	12.83	2	3.67	2.3%
MD	7.85	34	9.97	34	2.12	2.4%
MA	9.27	13	10.50	25	1.23	2.5%
MI	8.55	27	10.64	19	2.09	2.0%
MN	9.88	8	12.19	3	2.31	2.6%
MS	10.04	6	10.39	28	0.35	2.8%
MO	6.74	47	9.60	39	2.86	2.1%
MT	10.61	5	10.89	13	0.29	1.8%
NE	8.12	29	11.03	10	2.92	2.3%
NV	8.93	22	9.66	38	0.73	1.7%
NH	7.85	35	8.49	47	0.64	2.6%
NJ	7.40	39	10.51	23	3.11	2.3%
NM	8.77	24	12.18	4	3.40	1.9%
NY	9.27	12	13.63	1	4.36	2.1%
NC	7.84	36	9.87	37	2.04	2.8%
ND	11.24	2	11.84	6	0.60	2.4%
OH	6.96	44	10.42	27	3.46	2.0%
OK	9.03	20	10.19	29	1.16	2.1%
OR	9.22	15	10.01	33	0.79	2.0%
PA	7.12	42	10.17	30	3.05	2.2%

Table 2, continued

State	Average Tax Rate In 1959	Rank In 1959	Average Tax Rate In 1999	Rank In 1999	ΔAverage Tax Rate (1959-1999)	PC Growth Rate (1959-1999)
RI	8.35	28	11.09	9	2.74	2.2%
SC	8.07	31	9.59	40	1.53	2.9%
SD	12.01	1	8.99	45	-3.03	2.8%
TN	7.78	37	8.47	48	0.69	2.7%
TX	7.64	38	9.29	43	1.65	2.4%
UT	8.91	23	10.70	17	1.79	1.9%
VT	11.07	3	11.76	8	0.69	2.5%
VA	6.61	48	9.34	42	2.73	2.7%
WA	9.01	21	10.90	12	1.89	2.2%
WV	8.07	30	10.94	11	2.87	2.3%
WI	9.10	19	12.12	5	3.02	2.1%
WY	9.80	9	10.87	14	1.07	1.9%

Note:
1. The definition of the average tax rate will be introduced in Chapter 2. Now treat it as a measure of a state's overall tax burden.
2. For the mean value, maximum, minimum, and standard deviation of average tax rates of 1959 and 1999, please see Appendix C.

CHAPTER 2

THEORIES AND LITERATURE REVIEW

This chapter introduces theories of taxes and economic growth, and reviews previous empirical studies.

Theories on Taxes and Economic Activities

State and local governments levy various taxes including personal income taxes, corporate income taxes, sales taxes, property taxes, and severance taxes. Tax analyses apply the framework of welfare economics, specifically the analysis of income effects and substitution effects of a change in prices. For example, personal income taxes are a decrease in wages which are the price of labor. Thus, the analysis of personal income taxes views this decrease as a change in the price and explores its income effects and substitution effects. Similarly, sales taxes are an increase in commodity prices. The effects of a raise in commodity prices can be decomposed into income effects and substitution effects. The welfare analysis is also applicable to property taxes which affect the return to capital.

The following section explores the effects of personal income taxes, general sales taxes, and property taxes in a closed economy, e.g., a state's economy. A subsequent section analyzes the effects of taxes when labor and capital are mobile between states.

A Basic Model of Taxes

First, consider the work-leisure decision for a representative individual. A higher real wage rate has two impacts on the labor supply. The first one is the substitution effect: Other things constant, a higher real wage raises the opportunity cost of leisure, which induces workers to substitute work for leisure. The second impact is the income effect: If leisure is a normal good, the worker is induced to work fewer hours by the increase in her real wage. These two impacts affect hours worked in opposite directions. Thus, the relation between real wage rates and the amount of labor supplied is ambiguous.

An income tax changes the real wage rate. Specifically, the budget constraint of an individual when there are not any taxes is:

$$c = w\,(24 - l) \qquad (2.1)$$

where c represents her total consumption, w means the real wage rate, and l means hours of leisure per day. When a proportional income tax is levied, her budget constraint becomes:

$$c = (1 - t)\,w\,(24 - l) \qquad (2.2)$$

where t represents the income tax rate, which is greater than 0 and less than 1 by definition. Consequently, increases in the income tax rate effectively reduce the real wage. Thus, the analysis of the income effect and the substitution effect indicates an indeterminate direction of the impact of a tax cut on the quantity of labor supplied (Rosen, 1998).

However, changes in taxes also affect the provision of government services, which also influence labor supply (Gwartney and Stroup, 1983). In Gwartney and Stroup's argument, the income effect of a tax cut is determined by the individual's valuation of the expansion in private goods—because of a higher disposable personal income from the tax cut—relative to the decline in public services—because of the reduction in tax revenues which finance them. When the initial level of government expenditure is optimal, the marginal utility derived from the expanded consumption of private goods is exactly offset by the decline in the marginal utility caused by the reduction in consumption of public goods. As a result, only the substitution effect remains, indicating that the tax cut will unambiguously increase hours worked.

This general equilibrium approach also implies that an increase in taxes will unambiguously lead to a decline in the quantity of labor supply, which lowers economic activities, and ultimately lowers the income levels and growth.

Barro (1997) makes a similar argument: A reduction in personal income taxes leads to a decrease in tax revenues, which leads to a decline in government expenditure. Therefore, the amount of available public goods, such as public health care and public schools, decreases. Meanwhile, the increase in the disposable income derived from the tax cut allows people to consume more private goods, e.g., private health care and private schools. If public goods and private goods are perfect substitutes, the alleged income effect of the tax cut disappears. Only the substitution effect is left.

Barro (1997) also points out that government spending may increase private sector productivity, for example by providing infrastructure. The income effects are similar to providing consumption goods.

Moreover, income taxes are also imposed on returns to capital, e.g., interest, dividends, and capital gains. In particular, an income tax reduces the after-tax rate of return to saving and investment. In other words, an income tax lowers the present value of future income, e.g., the return to saving. As a consequence, people tend to consume more and save less in the present. Therefore, income taxes may discourage saving and investment. The effects of income taxes on utility-maximizing choice of present and future consumption is called the intertemporal-substitution effects (Barro, 1997).

Mathematically, the intertemporal budget constraint absent of taxes is:

$$\begin{aligned} & c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} \\ & \Rightarrow c_2 = y_2 + (y_1 - c_1)(1+r) \\ & \Rightarrow \frac{dc_2}{dc_1} = -(1+r) \end{aligned} \tag{2.3}$$

where c_1 is present consumption, c_2 is future consumption, y_1 is present income, y_2 is future income, and r is the interest rate. The expression $\frac{dc_2}{dc_1} = -(1+r)$ implies that the cost of \$1 of consumption in the present is $1 + r$ dollars of forgone consumption in the future. Equation 2.3 also indicates that saving in the present is $y_1 - c_1$, which will earn interest at a rate r in the future.

The intertemporal budget constraint when interest income is subject to taxes and interest paid is deductible is:

$$c_1 + \frac{c_2}{1+(1-t)r} = y_1 + \frac{y_2}{1+(1-t)r}$$
$$\Rightarrow c_2 = y_2 + (y_1 - c_1)[1+(1-t)r] \qquad (2.4)$$
$$\Rightarrow \frac{dc_2}{dc_1} = -[1+(1-t)r]$$

where t is the income-tax rate and satisfies $0 < t < 1$ by definition, and so $0 < 1 - t < 1$. Thus, the opportunity cost of $1 of present consumption is $1 + (1- t)r$ dollars of future consumption under an income tax, which is less costly than the cost when there is no tax, implying people tend to consume more and save less in the present. Besides, the interest on saving from the present also brings out the same implication. The total interest when there is an income tax, $(y_1 - c_1)(1-t)r$, is smaller than that absent of an income tax, $(y_1 - c_1)r$. As a result, an income tax may discourage saving and investment.[3]

The analysis above is applied to a proportional income tax. Many states have progressive[4] income taxes. It can be shown that given the amount of revenue raised, an individual will work more under a proportional tax than under a progressive tax. This is because the substitution effect is larger the higher is the marginal tax rate. However, in comparing proportional and progressive rate structures, some individuals face higher marginal tax rates, while others face lower ones, so there are distributional effects as well. In general, progressive taxes impose higher rates on higher income individuals, and

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[3] For both the net saver and the net borrower, the substitution effect of taxing interest is less saving in the present. The income effect of taxing interest is less consumption in every period. Thus, depending on the individual's preferences, taxing interest can either increase or decrease saving (Rosen, 1998). However, the same argument applies: the negative income effect is offset by additional government services financed by tax revenues. As a result, taxing interest decreases saving unambiguously.

[4] A tax is progressive if the average tax rate rises as income rises. This may be accomplished by a series of income brackets with increasing marginal tax rates (Rosen, 1998).

so create greater incentives for them to work less (or move to another state) (Hyman, 1999).

General Sales Taxes

Sales taxes are imposed on the purchase of commodities. According to Rosen (1998), in the United States, state sales taxes covering a wide variety of goods are often given the label *general.* Although state sales taxes exempt many goods and services, for simplicity we shall view them as broad based consumption taxes.

Following the general equilibrium approach analyzing income taxes, general sales taxes have similar effects on the individual's work-leisure decision and thus on economic activities.

When a general sales tax is imposed, an individual's budget constraint is as follows:

$$\begin{aligned} (1+t')c &= w(24-l) \\ \Rightarrow c &= \frac{1}{1+t'}w(24-l) \end{aligned} \tag{2.5}$$

where t' means the general sales tax rate, which is a number between 0 and 1 by definition, implying $\frac{1}{1+t'}$ falls in the interval (0,1). Hence, a sales tax is similar to an income tax in its effects on the real after wage rates. In this simple formulation with no saving, a consumption tax at rate t' is equivalent to an income tax at rate t if $\frac{1}{1+t'}=1-t$. In this light, a sales tax may discourage people to work, and the income levels and growth go down at the margin.

One important difference between an income tax and a sales tax lies in their effects on returns to capital. As discussed previously, income taxes are also imposed on returns to capital, thus discouraging saving and investment. Yet, sales taxes only apply to consumption and will not have such an effect (Barro, 1997). To illustrate this point, the intertemporal budget constraint when sales taxes apply is:

$$
\begin{aligned}
&(1+t')c_1 + \frac{(1+t')c_2}{1+r} = y_1 + \frac{y_2}{1+r} \\
&\Rightarrow c_2 = \frac{y_1(1+r)}{1+t'} - c_1(1+r) \\
&\Rightarrow \frac{dc_2}{dc_1} = -(1+r)
\end{aligned}
\tag{2.6}
$$

where t' is the sales tax rate. Equation 2.6 shows that the opportunity cost of present consumption in terms of future consumption is not altered by the sales tax. It is still $1 + r$ as it is in Equation 2.3. Thus, sales taxes will not affect an individual's decision on present vs. future consumption, nor on saving and investment.

Property Taxes

The property tax is another important category of state and local taxes. The property tax is a tax on capital such as land and structures. Thus, property taxes tend to discourage saving and investment. Also property taxes are capitalized into property values. Revenues from property taxes are often used by communities to finance local public services, such as schools, police, and fire protection. As noted by Rosen (1998), if people value the local public services they receive, they may offset the depressing effects of high property taxes on housing values by the public services financed by these taxes.

Taxes and Growth

The Solow (1956) (Diamond, 1990) growth model is based on the production function

$$y = f(k) \tag{2.7}$$

where y is the per capita output, and k is the per capita capital stock.

Accordingly, growth is endogenous only with capital accumulation. Capital accumulation is achieved by the change in the capital stock, which is expressed as

$$\Delta k = sy - \delta k - nk = s \cdot f(k) - (\delta + n)k \tag{2.8}$$

where s is the saving rate, which satisfies $0 < s < 1$, $\delta > 0$ is the depreciation rate, and n is the population growth rate. An economy grows until $\Delta k = 0$, i.e., gross investment just cover depreciation and population growth, and the capital stock gets to its steady-state level, k^*. Meanwhile, the real per capita output reaches its steady-state level, y^*.

Saving decisions are governed by the return to capital, net of taxes and depreciation, and preferences for future consumption relative to current consumption. As previously discussed, income taxes reduce the return to saving, and thus the steady state capital stock and level of income per capita.

Moreover, growth is exogenous with technological improvements in the Solow model. The Solow model contends that a higher steady-state economy is determined solely by a technological advance that raises the economy's productivity. Better production possibilities for the private sector can also reflect improvements in public policies. Barro (1997) asserts that we should view capital in a broad sense to encompass physical capital (machines and buildings), as well as human capital (improvements in the quality of labor due to education, training, and experience and also because of better health care and nutrition). The accumulation of both physical and human capital is largely favored by improvements in public services, such as the maintenance of property rights, the delivery of superior infrastructure, and publicly provided education and health care. However, these public services must be paid for, and as we have seen, taxes generally change behaviors toward less work, saving, and investment. Taxes also reduce the rewards to profitable innovations, which appear as "technological progress" in the Solow model.

On the other hand, growth also affects taxes. Growth leads to higher income levels. Under a progressive tax structure, more tax revenues will be collected as more people enter high-income tax brackets. In addition, when growth slows down, or when the government is facing a budget deficit, tax rates may be raised. Thus, the empirical relationship between growth and taxes is theoretically ambiguous, both in terms of sign and direction of causality.

Mobility of Factors

The basic tax model is built for a closed economy. This section examines theories on taxes and economic activities under the assumption that labor and capital are fully mobile among states. The theoretical model is initially developed in terms of levels of all variables, and then extended to changes in some of these variables to address growth.

The assumption that labor and capital can costlessly and instantly move between states has strong implications. In particular, households are assumed to choose their location to achieve the highest level of satisfaction or utility. If all households are the same, i.e., people have the same tastes and preferences, utility will be equalized in all states. Otherwise, there would be an incentive for some households to move.

Equal utility does not imply, however, that states will be identical in all respects. Rather, the advantages a state may offer in one dimension may be offset by disadvantages in other respects. Specifically, some states may offer greater amenities (a better climate, beautiful sceneries, a lower crime rate, etc.), but have lower wage rates, so that utility is equal. Conversely, states having an unpleasant climate or having high crime rates may have higher than average wage rates. The difference between high wages and low wages is known as the "compensating wage differential" (Ehrenberg and Smith, 1994). It can pay for the high utility cost because of intensive cooling, the harm to health, and/or the worry over unsafe social environment.

Mathematically, the utility model expresses utility of the representative individual in state *i* as a function of per capita income, taxes, and other characteristics:

$$u_{it} = u(y_{it}, tax_{it}, z_{it}) \tag{2.9}$$

where y_{it} is the real per capita income of state *i* in year *t*, tax_{it} is state *i*'s tax burden in year *t*, and z_{it} is state *i*'s other characteristics in year *t*, such as public services, conditions of work, cost of living, and environmental and social amenities or disamenities.

The theory of equalizing differences predicts that at least in the long run, utility of the representative individual in state *i* has to be equal to utility of the representative individual in state *j*

$$u_{it} = u_{jt} \tag{2.10}$$

Otherwise, people will migrate from the lower utility state to the higher utility state. Migration reduces the supply of labor in one state and increases it in the other, thereby raising wages in one state and reducing it in another, until utility is equalized.

The theory, however, does not predict that per capita incomes will be equalized, since income differences may be offset by differences in taxes, public services, amenities, etc.

Differentiating the utility function (2.9) with respect to income and taxes, one obtains a predicted relationship between the variables:[5]

$$\begin{aligned} du &= \frac{\partial u}{\partial y}dy + \frac{\partial u}{\partial tax}dtax = 0 \\ \Rightarrow \frac{dy}{dtax} &= -\frac{\partial u/\partial tax}{\partial u/\partial y} \end{aligned} \tag{2.11}$$

It is plausible that utility is positive related to per capita income, *ceteris paribus*, i.e.,

$$\frac{\partial u}{\partial y} > 0 \tag{2.12}$$

Thus,

$$\frac{dy}{dtax} \gtrless 0 \Leftrightarrow \frac{\partial u}{\partial tax} \lessgtr 0 \tag{2.13}$$

If taxes lower an individual's utility at the margin, then the model predicts that the depressing effect of taxes is compensated by higher per capita income. Conversely, if taxes raise an individual's utility at the margin by supplying more public services, then per capita income is lowered to balance out the amenity. Rosen's opinion is that the tax system imposes decreases in utility that exceed the benefits of revenue collections (1998).

[5] State and time subscripts are omitted in differentiation for convenience.

If this is the case, long run equilibrium requires that per capita incomes be higher in states with higher tax burdens.

The utility model is based upon two crucial assumptions—migration is costless and people are identical. Reality does not perfectly meet the theoretical assumptions. First, if migration is costly, it takes time to adjust to the long run equilibrium, so that utilities are not exactly equalized in any given year. Also, if u_{it} is greater than u_{jt}, then state *i*'s economy may grow faster than state *j*'s economy as people move in.[6]

This study uses observations of ten years apart. As an empirical matter, most state policies have been fairly stable over time. Thus, 10 years is a fairly long period during which a great deal of adjustment would be expected to take place.

A second violation of the assumptions is that people are not identical. They may sort themselves according to preferences, or economic status. People who choose some low-income states and areas, like Montana, because they value fresh air, safe communities, and pleasant work conditions more than a good pay. Therefore, Montanans feel better off than if they lived in New York, while New Yorkers prefer living in their own state rather than Montana.

The Theory on the Conditional Convergence

The central assumption underlying the Solow model (1956) is the diminishing returns to capital, which the convergence property derives from. The convergence theory

[6] However, as the crucial assumption for convergence in the neoclassical growth model is diminishing returns to capital, land, and labor, rapid population growth is hypothesized to adversely affect the per capita income level and bring a slow per capita income growth.

is first developed in an absolute sense; that is, if all economies are the same except for their starting capital intensities, then the lower the starting level of an economy, the higher is the predicted growth rate.

However, economies usually differ in various respects including propensities to save, access to technology, and government policies. In this circumstance, the convergence theory applies only in a conditional sense (Barro, 1997). The growth rate tends to be high if an economy's initial level of per capita income is far below its steady-state position. In other words, among economies with the same steady-state position, the poor ones tend to grow faster than the rich ones. The steady-state position of an economy is determined by technological advance, political regulations, government actions, such as taxation, provision of infrastructure services, protection of intellectual property rights, financial markets, and other respects of the economy. Thus, economies converge in the long run conditional on the determinants of the steady state of the economy.

The Theory on Economic Structure and Transformation

States differ in their economic structures, i.e., which industry or industries they are specialized in. Determined by the natural-resource endowments, location factors, and the history, some states, such as North Dakota and Montana, have a comparative advantage in producing unskilled labor-intensive agricultural goods, so they are specialized in agriculture. Some, like Michigan, have a comparative advantage in producing capital-intensive goods, and are specialized in manufacturing.

The U.S. economy overall has experienced a structural transformation, namely, the decline of agriculture as the dominating sector, since the late nineteenth century (Caselli and Coleman, 2001). States with relatively high per capita income growth tend to be those in which a relatively large fraction of the population moved out of farms. One argument for the faster economic growth of the southeastern states in the last 40 years is the relatively low tax burden there. An alternative explanation is the structural transformation in those states, typically the decline of agriculture as the dominating sector.

Accompanied by the structural transformation is the regional convergence of average wages between the Southern states and the Northern states and between the Midwest and the Northeast—a nationwide convergence of agricultural wages to non-agricultural wages. The structural transformation is another possible explanation for the eliminating gap in state economic growth other than the conditional convergence theory.

In addition, the fortunes of various industries change over time, and adjustments may be slow. There has been a long-term decline in farm prices relative to the Consumer Price Index (CPI), interrupted only briefly by higher prices in the 1970s. The price decline has been partially offset (or even caused) by productivity increases. However, to the extent that incomes in agriculture lag behind those in the rest of the economy, states that are heavily dependent on agriculture are hypothesized to have lower per capita incomes. The same logic is applied to the mining industry.

A similar but somewhat different change occurred in manufacturing as labor-saving technologies, foreign competition, and the decline in the importance of goods industries relative to service industries decreased the share of employment in manufacturing. This decline was concentrated in states of the Great Lakes (the "Rustbelt"), and partially accounts for the decline in the relative earning of high school graduates as compared with college graduates.

The Theory on Demographic Structure

Per capita income levels are predicted to be positively related to the fraction of the population that are of working age. It is argued that few people younger than 18 and older than 65 are in the labor force. States with high percentage of young population or senior population tend to have less economic activities, thus, lower per capita income levels and growth. However, the negative relation between senior population and income levels tends to be vague or smaller in recent years. Particularly, at the beginning of the sample period examined (1959-1999), the elderly had a higher poverty rate than did the general population; but in recent years, the poverty rate of the elderly is actually lower than the general population.

Educational attainment is also closely related to the income level and economic growth. Theories predict that education is positively related to growth, as well as the level of income (Barro, 1997; Mankiw, 2000). In the neoclassical growth model, education brings about technological progress and higher productivity, as well as a higher steady-state position. Income levels may also differ by educational requirements. People with more investment in education expect higher incomes when working. Consequently, they tend to locate themselves in states where they can earn relatively more money. In addition, higher education is more and more important as economies move from labor-intensive to capital, technology, and information intensive. The positive relation between education and income levels and growth is stronger in recent years.

Another characteristic of a state's demographic structure is the percentage of its metropolitan population. Specifically it embodies the adjustment of income levels and growth to the cost of living, and also takes amenities and disamenities into account. Generally, the cost of living is higher in metropolitan areas than in small towns and rural areas (Becker, Glaeser, and Murphy, 1999; Power and Barrett, 2001). From the standing point of utility maximization, people living in cities are better paid on average so that they can yield equivalent utility as people in other places do. Or, they will move.

The National Center for Policy Analysis (NCPA) made following points based on Edward Glaeser and David Mare's 2001 study "Cities and Skills":

> Cities are focal points of commerce and economic activity. Their residents are more productive and are paid higher wages than people living in rural areas. In fact, wages are 33 percent higher in big metropolitan cities, compared to smaller cities and towns.
>
> A better explanation of the wage differential, say some researchers, is that cities have a higher accumulation of human capital compared to other areas. Cities are better at fostering learning and specialization (which increase wages) and they also have more coordinated labor markets (which let workers find the best paying jobs). (11-14-2001)

Amenities and disamenities mainly refer to differences in the social and natural environments of states (Power and Barrett, 2001). The percentage of metropolitan population indirectly measures the differences in amenities from one state to another by measuring the percentage of population living in metropolitan areas. If a state is composed of metropolitan areas, it may be characterized by increased crowding, increased commuting times, high crimes, as well as cultural offerings such as the arts or professional sports. Conversely, a state mostly composed of rural areas is likely to be less crowded and offer more natural amenities.

Review on Empirical Tax Literature

Literature on taxation and economic performance is voluminous. Several review studies are done on both previous theoretical and empirical tax studies, including Bartik's (1992), Phillips and Goss's meta-analysis[7] (1995), Wasylenko's (1997), Katharine Bradbury et al.'s (1997), and Terry Buss's (2001).

In Phillips and Goss's meta-analysis of the effect of state and local taxes on economic development (1995), Roger Schmenner's view is first introduced: tax literature before 1980s suggested that taxes had little impact on business location decisions, while state policymakers ignored this advice and aggressively used tax incentives to promote the state's economy. According to Phillips and Goss (1995), more recent studies using improved data and methodologies had begun to show that taxes do matter. And this point of view has been dominating in recent tax literature.

In contrast, Buss (2001) indicates that empirical findings are so disparate that they offer little guidance to policy makers except that they ought to care. Advocates believe that tax incentives either work or do little harm to the economy. Skeptics believe that most tax incentives are inefficient and harmful. Buss argues that it is easy to show that tax incentives either work or do not by selecting some studies and not others. One reason

[7] Meta-analysis is a method for statistically analyzing results across empirical studies (Phillips and Goss, 1995).

for the poor results of tax studies is that modeling tax studies is difficult and never accurate (Bartik, 1992).

Difficulties of Modeling Tax Studies

Bartik (1992) raises five problems of existing tax studies in his review essay. First, he claims that regional growth is the result of individual decisions about firm expansion, contraction, location, or abandonment, but it is difficult to model complex individual decisions using aggregate data. Though most studies use aggregate data as measures of growth and individual decisions affect aggregate measures of growth, Bartik has doubts on the use of aggregate data as a suitable proxy.

The second problem is that past levels of economic activity affect current levels. Thus, it is necessary to control for past conditions, but many studies neglect to do this.

The third difficulty is the weakness of data on some key variables. For example, data on public services is weak, especially measures of their quality. For this reason, a lot of studies do not include any control variables for public services. As discussed in more details in the previous section, while people wish to minimize their tax burdens, they are also attracted by the benefits of public services, which may be financed by government revenues. Studies ignoring the government expenditure are likely to attribute to taxes what is the result of expenditures.

The fourth issue is the impossibility of controlling for all factors that are pertinent to business decision-making and economic growth. Estimates for included variables that are correlated with an omitted variable will be biased. As a result, correlations attributed to variables in models probably represent relationships outside the model. A variety of non-tax variables are included in some studies but excluded in others. These variables vary from climate, energy cost, and unionization levels, to proximity to markets. Any omitted variables correlated with taxes will inadvertently attribute to taxes an influence coming from some other source.

The final difficulty is the endogeniety of variables of tax revenues. It may be, for example, that while lower taxes bring on higher incomes and promote growth, higher incomes and faster growth also lead to higher taxes.

Besides Bartik's criticisms, more recent criticisms on tax studies suggest that many correlations of taxes and economic growth are very likely artifacts of data sources, time periods, variable selection, measurement, and estimation methods (Fisher, 1997). In fact, Barro (1997) recognizes the importance of tax distortions for growth, but he argues, "... further measurement and investigation is important for obtaining reliable results."

Measures of Taxes

Measures of taxes can be categorized as aggregate and disaggregate measures. The former measures the total tax burden, and the latter measures the effects of different taxes, such as personal income taxes, general sales taxes, property taxes, and severance taxes. Measures of taxes also differ by definition: the average tax rate, the relative tax rate, and the marginal tax rate.

In empirical studies, variables measuring the overall effect of taxes are most commonly used. There are two such variables. One is the average total tax rates, defined as the percentage of the total tax revenue in personal income: TR/PI, where TR is total state and local tax revenues, and PI is the state personal income. This measure can be used when there is a significant difference in tax policies in different states. By definition, this measure is endogenous with personal income. In modeling the effect of overall tax burden on personal incomes and growth, correction for the endogeniety is called for. This can be achieved by applying instrumental variables (Bartik, 1992).

The other measure for the overall effect of taxes is the relative tax rate, defined as $\frac{TR/PI}{\frac{1}{48}\sum_{i=1}^{48} TR/PI}$, which is each state's average total tax rate divided by the mean of the average total tax rates of the 48 states. The relative tax rate suggests that in terms of interstate tax competition, it is the relative position of each state compared to the mean of all other states that matters (Benson and Johnson, 1986). This variable is supposed to pick up the effects of taxation on business location decisions.

Noting the different effects of income taxes, sales taxes, and property taxes, Yamarik (2000) shows that disaggregate tax rates provide a better measure of tax distortions. He criticizes that the estimation using the measure of total taxes because such a measure does not distinguish the effects of taxes paid on income, consumption or property, while by theory, income taxes, sales taxes, and property taxes operate differently regarding their effects on investment, output, and productivity. Following Koester and Kormendi's approach to produce "marginal" tax rates,[8] Yamarik creates disaggregate "marginal" tax rates with respect to total production, personal income, and

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[8] Koester and Kormendi's approach is to estimate equation: $Revenue_t = lump_t + MTR \cdot Base_t$, where $Revenue_t$ is tax revenue collected, $lump_t$ is lump-sum taxes that do not affect individual decisions (a constant term), the estimate of MTR is the marginal tax rate, and $Base_t$ is the tax base—total production, personal income, or general sales.

general sales. Among the estimates of disaggregate tax rates, the personal income and property tax rates are negative and significant, while the general sales tax rate is insignificant. His empirical findings imply that income taxes and property taxes may be more harmful than sales taxes.

In addition, tax literature argues that only distortionary taxation affects the economy. By definition, distortionary taxes are those that alter the price of an accumulated factor of production—physical capital, human capital and technology (Yamarik, 2000). The marginal income tax rate is one example of the distortionary tax rates. These rates prescribe the fraction that the government takes from an additional dollar of income. In deciding how much to work, produce, and invest, households and firms take account of these marginal tax rates (Barro, 1997).

Both the average income tax rate and the marginal income tax rate are used in tax literature as a measure of influences of income taxes on economic behavior and ultimately on income levels and growth, but Becsi (1996) indicates that marginal income tax rate is a better theoretical measure because changes of the tax rate on the last taxable dollar induce individuals to change behavior and lower tax burdens.

The Concept of Tax Elasticity

Most tax studies employ the concept of elasticity. A tax elasticity is defined as the percentage effect on state and local economic activity caused by a 1% change in state and local taxes (Buss, 2001). And the measures for economic activity vary from employment, investment, the Gross Domestic Product (GDP), and income, to the birth or location of business. Studies in Wasylenko's review essay use a wide range of dependent variables as measures for economic performance, and Wasylenko summarized the econometric results of tax effects from a large number of studies without differentiating dependent variables to obtain the range and the average of tax elasticity estimates. According to him, the mean elasticity is –0.3 and the range of tax elasticity is from –0.1 to –0.6 (1997).

The Omission of Measuring the Quality and Quantity of Public Services

Although involving the analysis on government services can distinguish the effect of higher taxes from the effect of services paid for by revenues, unfortunately tax literature usually does not include measures for the quality and quantity of public services for four reasons. First, good data on government services are generally not available. Second, total government expenditures are highly correlated with taxes, resulting in multicollinearity in the empirical model. Third, components of expenditure, e.g. education, safety, are not available, particularly for the early years. Fourth, there is almost no data on the quality of government services (Bartick, 2001).

Most previous studies omit variables of expenditures. A few studies include some expenditure variables. For example, the approach developed by Helms (1985) is to formulate the budget of a state. Specifically, a state's budget is equal to the sum of all state and local revenue sources (e.g., tax revenues) less the sum of state and local spending:

$$Budget = \sum Revenues - \sum Expenditures. \qquad (2.14)$$

If Equation 2.14 is greater than 0, then the state has a budget surplus, or, a deficit. The budget equation explains that increases in taxes are associated with either decreased government spending, or increased surplus, or maybe both. Since the increased surplus may be from sources other than taxes, Helm's approach is just an approximate measure for the net effect of taxes and expenditure.

Due to the lack of control for public services, the estimated coefficients on the tax variables are interpreted as the combined effects of tax revenues and expenditures. In principle the coefficients can be either positive or negative, for more public services or higher taxes can either increase or decrease the attractiveness of a state, respectively.

Measures of Economic Activity

Wasylenko (1997) lists some common measures of economic development in one of his studies on taxation and economic development. These measures are income, employment, investment, plant expansions, relocations, and births. He points out that income levels and growth have been used less frequently in studies of state and local economic development. Thus, using per capita personal income is still a new endeavor among similar studies. However, as Wasylenko also indicated, personal income data are not necessarily good measures of economic activity in a state because personal income is a broad measure that includes so many other things other than labor income (wages and salaries and self-employment income).

CHAPTER 3

ECONOMETRIC MODELS

This chapter introduces variables and data, and develops the econometric specifications.

Models of Income Levels

The theoretical discussion presented in Chapter 2 indicates that it is appropriate to specify an empirical model that shows the relation between economic activities (in terms of both income levels and income growth) and the other factors. The general function of such a model is as follows:

$$\log y_{it} = f(tax_{it}, z_{it}), \tag{3.1}$$

where y_{it} is the real per capita income level of state i in year t, tax_{it} is tax variables of state i in year t, and z_{it} represents other factors affecting incomes, including percentages of metropolitan population, population younger than 18, and population of 65 or older, percentages of adults without a high school degree and adults having a bachelor's or higher, the income shares of farming, mining, and manufacturing industries, and the energy cost.

For additional information, a relatively long period is desired. And especially for modeling the economic growth, long intervals are required for the underlying theory relating to long-term growth. To serve these purposes, intervals of ten years are chosen in this study. Data are chosen for the years 1959, 1969, 1979, 1989, and 1999.[9] When data for these specified years are not available, data for the closed years are used. A summary of which years are the data exactly for is attached as Appendix B. The 48 contiguous states are the cross-sectional dimension of this framework.

Dependent Variables

The dependent variable in the models of income levels is the natural logarithm of the real per capita personal income of state *i* at the beginning of a decade. The real per capita personal income is measured as personal income divided by population, and then deflated with the Consumer Price Index for all goods (CPI-U-X1)[10]. Personal income is a broad measure that includes wages and salaries, self-employment income (including farm income), dividends, interests and rents, and transfer payments such as social security.

Since transfer payments are financed by tax revenues, the relation between taxes and personal incomes is ambiguously determined. Thus, the natural logarithm of the real per capita personal earning—the labor income only (wages and salaries and self-employment income)—is an alternative dependent variable.

Data of personal incomes and personal earnings are obtained from the website of the U.S. Department of Commerce, Bureau of Economic Analysis: http://www.bea.doc.gov/bea/regional/spi/.

[9] The years were chosen primarily because of data availability. With the exception of 1959, each year corresponds (or is close) to a business cycle peak.
[10] Source: *Economic Report of the President*, 2001, Table B-62.

Tax Variables And Hypotheses

Tax variables in this study are categorizes as three types according to the tax structure: personal income taxes, general sales taxes, and property taxes,[11] and two types according to the definition: the average tax rates and the marginal tax rates.

As the theory indicated in Chapter 2, there are various measures for taxes. The models of income levels employ seven tax variables: $Total\ Tax_{it}$, $Property\ Tax_{it}$, $Sales\ Tax_{it}$, $Income\ Tax_{it}$, $Property\ Rate_{it}$, $Sales\ Rate_{it}$, and $Income\ Rate_{it}$.

The basic model (Model 1) studies the impact of total tax revenue on personal income levels. The simplest tax variable, $Total\ Tax_{it}$, is total state and local tax revenues divided by income. It is also called the average tax rate. It is a broad indicator of the overall level of taxation in a state.

The definition of average tax rates implies possible endogeniety in the estimation. One can argue that high taxes discourage working and result in low income levels. On the other hand, one can also argue that high revenues are caused by high incomes, as income taxes are often progressive. Also, states often raise taxes when income is low. Thus, there is no clear causal-effect relationship between taxes and incomes. The variable $Total\ Tax_{it}$ is endogenous with the dependent variable. To correct for the endogeniety, the two stage least squares (2SLS) is performed.

Instrument variables for $Total\ Tax_{it}$ in 2SLS estimation include the effective property tax rate on residential property (denoted as $Property\ Rate_{it}$), the state-wide general sales tax rate (denoted as $Sales\ Rate_{it}$), and the top marginal tax rate on the

[11] Other taxes, including severance taxes, are not measured due to lack of data.

personal income (denoted as *Income Rate*$_{it}$). Since they are statutory tax rates, they are treated exogenous with the model. Other instruments are all of the explanatory variables, except *Total Tax*$_{it}$, in the model, including the constant.

Taxes are disaggregated into property, personal income, and general sales in order to assess whether the various taxes may have different relationships with income levels (Model 2). Now, the notation *tax*$_{it}$ in Equation 3.1 represents three variables: *Property Tax*$_{it}$, *Sales Tax*$_{it}$, and *Income Tax*$_{it}$. These tax variables are also average tax rates in that they are defined as the percentages of state and local government revenues from property, general sales, and personal income taxes, respectively, to the total state personal income.

Since the disaggregate average tax rates involve the personal income as the denomination in definition, they are also endogenous with the dependent variables. 2SLS estimations are called for. Instrumental variables are the same as they are in Model 1.

In addition, *Property Rate*$_{it}$, *Sales Rate*$_{it}$, and *Income Rate*$_{it}$ are not only the instruments in Model 1 and 2, they are also incorporated as explanatory variables. As theories in Chapter 2 indicated, all measures of tax revenues can be criticized because revenues depend both on tax rates and on the economy, which implies that a significant relationship between tax revenues and income levels may reflect a causal-effect of tax rates on income levels, or of incomes on tax revenues, or (most likely) some combination. Thus, a third model (Model 3) is constructed to analyze the effect of the statutory tax rates of property, general sales, and income taxes.

Model 3 also examines the separate effects of different taxes. The only difference between Model 2 and Model 3 is the difference in measures of taxes. Model 2 uses average tax rates (a measure of revenue) generated by dividing tax revenues by income, while in Model 3 the are tax rates are the statutory rates imposed by government, and therefore, are considered exogenous from the model.

A measure for the balance of the mixed tax revenue is created for the argument that a balanced tax structure, i.e., the tax burden evenly falls onto property, income, consumption, and so forth, does less harm to economic activities than an unbalanced tax structure. However, the estimate of this variable is not significant itself, nor changes the estimates of other variables. Thus, it is not discussed in this study.

Most data for state and local tax revenues are extracted from *Government Finances* (U.S. Bureau of the Census). Several exceptions are: (1) Data of revenues from personal income and general sales taxes in 1959 are drawn from *State Tax Collections in 1959* (U.S. Bureau of the Census). Since the local government did not impose a lot of taxes at that time, the difference between state taxes and state and local taxes can be ignored. Data at the state level is a good approximation. (2) Data of general sales and income taxes of 1969 are drawn from the *State Government Finances in 1969*, Series GF69-No. 3 (U.S. Bureau of the Census). They are also on the state level. (3) The general sales tax revenues of 1989 are found in *Significant Features of Fiscal Federalism*, Vol. 2, "Revenues and Expenditures", published by the Advisory Commission on Intergovernmental Relations (ACIR, 1991).

Data of tax revenues collected are all in nominal terms. Nevertheless, since the average tax rates are computed as the ratio of tax revenues to personal income, it does not matter if they are deflated or not, as long as nominal terms of both taxes and incomes are used in the computation.

The top marginal rates on state personal incomes of 1960, 1970, 1980, and 1998 are drawn from the *Book of the States*; and those of 1989 are drawn from the ACIR (1990). Data of state general sales tax rates of 1959, 1970, and 1998 are drawn from the *Book of the States*, and those of 1980 and 1989 are from the ACIR. The effective state property tax rates are primarily from the ACIR, with the exception of 1998 data, which are collected from the Minnesota Taxpayers Association.

Theoretically, the predicted signs of estimates of tax variables are negative, at least for income and property taxes. However, due to the omission of expenditure data and the endogeniety of tax measures, the signs of the estimated coefficients may not be consistent with theories.

Non-fiscal Explanatory Variables And Hypotheses

Major non-fiscal variables, denoted as z_{it} in Equation 3.1, include $Metro\ Pop_{it}$, $Less\ Than\ 18_{it}$, $65\ And\ Over_{it}$, $Not\ A\ High\ School_{it}$, $Share^{j}_{it}$ (j = different sectors), and $Energy\ Cost_{it}$.

$Metro\ Pop_{it}$ is defined as the percentage of state i's population living in metropolitan area in total population in year t. This variable is included as a proxy for the role of cities. According to the theory in Chapter 2, the sign of $Metro\ Pop_{it}$ is predicted to be positive, i.e., the metropolitan population is positively related to income levels.

Most data on population are collected from *Statistical Abstract of the United States*, which collects population data from sources published by the Department of Commerce, Bureau of the Census.

Particularly, data of total metropolitan population for 1960 is from *U.S. Census of Population: 1960*, Vol. I and *Current Population Reports*, Series P-25, No. 427.[12] Data of the percentage of state metropolitan population in 1970 is from *1980 Census of Population, Supplementary Report, Metropolitan Statistical Areas*, PC80-S1-18, and *Current Population Reports*, Series P-25, No. 1039.[13] Data of the percentage of state metropolitan population in1980 is from *1990 Census of Population and Housing, Supplementary Reports* (1990 CPH-S-1-1).[14] Data for the percentage of metropolitan population in 1990 and 1999 are downloaded from http://www.census.gov/population/estimates/metro-city/ma99-06.txt (U.S. Census Bureau).

The variable *Less Than* 18_{it} is the percentage of state *i*'s population younger than 18 years old in total population in year *t*. The argument for including this variable is that people younger than 18 years old do not work many hours and do not contribute much to a state's income. For this reason, the higher the percentage of people younger than 18 in the population, the lower the per capita income level. That is, the sign of *Less Than* 18_{it} is negative.

65 And $Over_{it}$ is the ratio of population aged 65 and over to total population of state *i*

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[12] Metropolitan statistical areas (MSA) as defined by the Bureau of the Budget, July 1, 1969.
[13] MSA as defined by U.S. Office of Management and Budget, June 30, 1989.
[14] MSA as defined by U.S. Office of Management and Budget, June 30, 1993.

in year *t*. For the same argument for *Less Than 18*$_{it}$, seniors tend to work few hours and make little contribution to a state's income, the higher the ratio of seniors to total population, the lower the per capita income level. Therefore, the predicted sign of *65 And Over*$_{it}$ is negative.

Data for total population and population by age in 1958, 1969, 1979, and 1989 are obtained from *Current Population Reports*, Series P-25, No. 214, 437, 875, and 1058, respectively. The 1999 data is from http://www.census.gov/population/estimates/state/st-99-08.txt and http://www.census.gov/population/estimates/state/st-99-09.txt (U.S. Census Bureau).

Variables *Not A High School*$_{it}$ and *College And Higher*$_{it}$ are measures for the educational attainment. *Not A High School*$_{it}$ is the ratio of adult[15] population having no high school diplomas to total adult population. *College And Higher*$_{it}$ is the ratio of adult population having a bachelor's degree or higher to total adult population.

Since better education is associated with higher economic productivity, the signs of *Not A High School*$_{it}$ and *College And Higher*$_{it}$ are predicted to be negative and positive, respectively.

The education data for 1960, 1970, 1980, and1990 are extracted from *U.S. Census of Population: 1960, 1970, 1980*, and *1990*, Vol. I, Chapter C. Data for 1999 are drawn from *Current Population Reports*, P20-528.

The notation $Share^{j}_{it}$ represents the percentage of state *i*'s income produced in agricultural, mining, and manufacturing industry in its total personal income in year *t*

[15] As persons 25 years old and over.

when j means agricultural, mining, and manufacturing, respectively. To simplify the study, the measure of income originating from agriculture is farm products, the measure of income originating from mining industry is products of fuels and power, and income from manufacturing industry is approximately measured by finished goods.

Income shares by industry are intended to account for the role of a state's economic structure. The larger the income share of an industry, the more important this industry is in a state's economy. The formula to construct such variables is:

$$Share_{it}^{j} = 100 * \frac{INC_{it}^{j}}{TOTINC_{it}} * \frac{CPI_t}{PPI_t^{j}}, \tag{3.2}$$

where INC_{it}^{j} is state i's personal income originating in sector j in year t, and $TOTINC_{it}$ is its total personal income in that year. They are in nominal terms. Since an increase in income can be resulted from an expansion of output and/or a raise in prices, and prices of farming, mining, and manufacturing products did fluctuate a great deal from 1950s to 1990s, the weight of sector j in a state's personal income in year t needs to be adjusted by appropriate price indexes. Multiplier $\frac{CPI_t}{PPI_t^{j}}$ is the inverse of the ratio of the producer price index for products of sector j (PPI_t^{j})[16] to the overall consumer price index of year t. With this multiplier, INC_{it}^{j} is deflated by PPI_t^{j} and $TOTINC_{it}$ is deflated by CPI_t. Therefore, $Share_{it}^{j}$ represents the real income share of sector j in total personal income.

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[16] Source of PPI-Farm Products, PPI-Fuels & Power, and PPI-Finished Goods (excluding consumer goods): *Economic Report of the President*, 2001, Tables B-65 and 67. 1959 figure of PPI-Finished Goods is extrapolated from 1969 using the proportional change in PPI for all finished goods.

Data of personal incomes by industry are downloaded from the same website as where total personal income data are: http://www.bea.doc.gov/bea/regional/spi/ (U.S. Department of Commerce, Bureau of Economic Analysis).

Energy Cost$_{it}$ is spending on heating and cooling of state *i* in year *t*. This variable is constructed as the national real energy price[17] times the total heating degree days and cooling degree days for the largest city in each state. The formula is as follows:

$$EnergyCost_{it} = \left(HDD_{it} + CDD_{it}\right) * \frac{PPI_t^{Energy}}{CPI_t}, \tag{3.3}$$

where HDD_{it} means total heating degree days of state *i* in year *t*, and CDD_{it} means total cooling degree days of state *i* in year *t*. It is argued that the higher the energy cost of a state, the higher income people in that state expect to earn. Thus, *Energy Cost*$_{it}$ is predicted to be positively related to income levels.

The source for data—heating degree days and cooling degree days—is the U.S. National Oceanic and Atmospheric Administration, *Comparative Climatic Data,* annual. They are airport data for period of record through 1994.

Finally, four dummy variables are created: *D59, D69, D79,* and *D89*. They take on the value of 1 if they occur in year 1959, 1969, 1979, and 1989, respectively, and 0 otherwise. These variables account for the different economic bases of different decades, and differentiate the intercept of the pooled estimation. Since 1999 is the base year, the estimated intercept in the pooled model will be interpreted as the fixed personal income

[17] Source of PPI-Energy: *Economic Report of the President*, 2001, Tables B-65.
Energy prices also vary among states. For not all of the state energy prices are available, the state variation is not accounted in this study.

level of 1999. And because the fixed personal income levels of previous years are lower than those of 1999, the coefficients of these dummies are hypothesized to be negative, and increasing in magnitude from 1989 back to 1959.

A summary of definitions of variables and their predicted signs are attached as Appendix A. And the summary of descriptive of variables is shown in Appendix C.

Plugging the above variables into Equation 3.1, the general form of models of income levels is as follows:

$$\begin{aligned}\log y_{it} &= \alpha_0 + \alpha_1 tax_{it} + \alpha_2 MetroPop_{it} + \alpha_3 LessThan18_{it} + \alpha_4 65AndOver_{it} \\ &+ \alpha_5 NotAHighSchool_{it} + \alpha_6 CollegeAndHigher_{it} + \alpha_7 Share^j_{it} + \alpha_8 EnergyCost_{it} \\ &+ \alpha_9 D59 + \alpha_{10} D69 + \alpha_{11} D79 + \alpha_{12} D89 + \varepsilon_{it}\end{aligned} \tag{3.4}$$

where tax_{it} is a general notation of all tax variables.

The log-linear functional form is employed to interpret the estimates of the right hand side variables, denoted as $\hat{\alpha}$'s, as the percentage change in income levels. That is, a one-unit change in any right hand variable is associated with an $\hat{\alpha}$ percent change in y. The log-linear functional form also facilitates to transfer the estimates of tax variables into tax elasticities by simply manipulating the definition of tax variables. The manipulation is discussed in Chapter 4 where empirical results are presented and interpreted.

The Growth Model

According to the conditional convergence theory, the income level at the beginning of the tested period is used as the proxy for the start-off point of an economy. In addition, this study still focuses on the influence of state and local taxes. Other important factors affecting economic performance are controlled. The general function of the endogenous growth model is as follow:

$$GrowthRate_{it} = f(\log y_{it-10}, tax_{it-10}, z_{it-10}) \tag{3.5}$$

where *Growth Rate*$_{it}$ means the average annual growth rate of the real per capita personal income of state i in a decade. It is defined as the annual percentage point of growth from year t-10 to t (t = 69, 79, 89, and 99, which refers to four decades: 1959 – 1969, 1969 – 1979, 1979 – 1989, and 1989 –19 99, respectively), i.e., 100 times the difference of the logarithms of y_{it} and y_{it-10}. The formula of this definition is:

$$GrowthRate_{it} = \frac{\Delta \log y}{10} \cdot 100 = (\log y_{it} - \log y_{it-10}) \cdot 10 \approx \Delta\%/yr \tag{3.6}$$

Variables y_{it-10}, tax_{it-10}, and z_{it-10} are state i's level values of the real per capita personal income, tax, and other variables, respectively, at the beginning of each decade. Descriptive statistics of *Growth Rate*$_{it}$ are shown in Appendix C.

Equation 3.5 is similar to the model that Barro used in his cross-country study (1997) and the cross-state study he did with Sala-i-Martin (1992). They argued that the initial levels of per capita personal income and other factors determine the growth during the defined period. A variation made to their model is that changes in variables over time, especially the tax variables, are included because one argument is that it is not the level of tax, but the change in tax, that hurts or helps economy (Vedder, 1996). More specifically, a high tax state may help itself with a tax cut, even if its average tax burden after the tax cut is still fairly high relative to other states. The general function of such a model is as follows:[18]

$$GrowthRate_{it} = f(\log y_{it-10}, tax_{it-10}, \Delta tax_{it}, z_{it-10}) \tag{3.7}$$

where Δtax_{it} is the change in taxes over the period from *t-10* to *t*.

As in the models of income levels, measures of both tax revenues and tax rates are used in the growth models. The measure of tax revenues is *Total Tax*$_{it-10}$, and measures of tax rates are *Property Rate*$_{it-10}$, *Sales Rate*$_{it-10}$, and *Income Rate*$_{it-10}$. They are all defined the same as they are in models of income levels; except they are values lagged by ten years.

The control variables, denoted as z_{it-10}, include *Metro Pop*$_{it-10}$, *Sectoral Comp*$_{it-10}$, and *College And Higher*$_{it-10}$. *Metro Pop*$_{it-10}$ and *College And Higher*$_{it-10}$ are defined the same as they are in the models of income levels. They are proxies for the role of cities and human capital, respectively, in growth.

Sectoral Comp, i.e., sectoral composition, is a modification of variables of the economic structure in the level models. The formula to construct it is:

$$SectoralComp_{it} = \sum_{j} \Delta P_t^j * Share_{it-10}^j \tag{3.8}$$

where $Share_{it-10}^j$ is defined as Equation 3.2. And ΔP_t^j means the percentage change of the real price of the major product of industry *j* over a decade. The formula is as follows:

$$\Delta P_t^j = \frac{PPI_t^j / CPI_t - PPI_{t-10}^j / CPI_{t-10}}{PPI_{t-10}^j / CPI_{t-10}} \tag{3.9}$$

[18] The effect of changes in several non-tax variables was tested, but there were no empirical findings for it. Therefore, variables Δz_{it} are not included later in this thesis.

As the formulas 3.8 and 3.9 show, state *i*'s income share of sector *j* at the beginning of a decade is weighted by the percentage change of the price index of sector *j* adjusted by the overall CPI-U-X1 during that decade. Such a variable reflects shocks to a sector in a way that interacts with state *i*'s concentration in the sectors that do relatively well or badly in terms of price because of the shocks. If an industry is not very important for state *i*, then state *i*'s economy will not respond to the shock to the price of major products of that industry. In other words, aside from the effect of changing sectoral shares within a state, the growth of real per capita personal income in state *i* from year $t - 10$ to t speeds up if there is an improvement in the net change in prices of all industries. In light of this, the predicted sign of $Sectoral\ Comp_{it}$ is positive. Descriptive statistics of data for $Sectoral\ Comp_{it}$ are shown in Appendix C.

As discussed previously, $Metro\ Pop_{it-10}$ is intended to explain the role of cities, which includes the adjustments of income levels and growth to the cost of living, and also amenities and disamenities. Specifically, the initial level of urbanization of a state affects its growth positively (Becker, Glaeser, and Murphy, 1999). The increased population density resulted from higher population and greater urbanization promotes specialization and greater investment in human capital, and also more rapid accumulation of new knowledge. These "increasing returns" from specialization and accumulation of know-how would raise per capita incomes in cities both in terms of magnitude and speed (Becker, Glaeser, and Murphy, 1999).

Human capital appears in the variable of educational attainment $College\ And\ Higher_{it-10}$ in the growth models. According to Barro's study, the initial level of a state's education is positively related to the growth rate. In addition, the effects of human capital and the role of cities are closely related in the way of specialization and accumulation of knowledge that Glaeser et al. discussed (1999; 2001).

CHAPTER 4

ESTIMATION TECHNIQUES AND EMPIRICAL RESULTS

This chapter presents the estimation techniques and analyzes the empirical results.

Ordinary Least Squares (OLS) on Models of Income Levels

The three models presented in Chapter 3 are initially estimated by the method of OLS. The pooled models estimate the time-series cross-sectional effects of factors on personal income levels. The year-by-year estimations pick up the cross-sectional side of the influences of the discussed variables.

Model 1

As shown in Table 3, the coefficients associated with the variable $Total\ Tax_{it}$ switch in signs in the pooled estimation and year-by-year estimations, and none of them are statistically significant. This result is consistent with the prediction in Chapter 3. That is, government spending is excluded in the model, and so the variable $Total\ Tax_{it}$ picks up the joint effect of both tax burdens and public services. Therefore, the sign for it and its explanation power is unpredictable. However, if only the pooled estimation is looked at, even though the coefficient of the $Total\ Tax_{it}$ is statistically insignificant, it gives some explanation for the plausible negative relation between taxes and income levels, i.e., a one percentage point increase in the ratio of taxes to personal incomes reduces the levels of personal income by 0.3%. Noticeably, the variable $Total\ Tax_{it}$ is defined as 100 times the percentage of tax revenues in personal incomes and its mean is around 10. Thus, a one percentage point change in the ratio of tax revenues to personal income is equivalent to a ten percent change in tax revenues. That is, a 10% raise in tax revenues reduces the levels of personal income by 0.3%, i.e., the tax elasticity is –0.03. This result is about tenth in magnitude of the mean and the range of tax elasticity estimates summarized by Wasylenko on a considerable number of tax studies.

Variables $Metro\ Pop_{it}$, $Less\ Than\ 18_{it}$, $65\ And\ Over_{it}$, $Not\ A\ High\ School_{it}$, $College\ And\ Higher_{it}$, and $Energy\ Cost_{it}$ all have the predicted signs and are statistically significant at all levels in the pooled estimation, indicating that theories related to these variables are supported by empirical findings. Moreover, in the year-by-year estimations their coefficients are consistent with theory for most of the years. Any breaking of the hypotheses might be attributed to statistical problems, but not the theoretical framework.

The estimated coefficients of $Share_{it}^{j}$ switch in signs and are seldom statistically significant. Evidence is consistent with the hypothesis that the economic structure of mining and manufacturing has no relations with income, but inconsistent with the hypothesis that farming is inversely related to income levels.

Evidence also indicates that energy costs are positively associated with income levels, implying residents of states of high energy costs are compensated with a higher pay.

Model 2

As shown in Table 4, the estimated coefficients of the control variables in concern: $Metro\ Pop_{it}$, $Less\ Than\ 18_{it}$, $65\ And\ Over_{it}$, $Not\ A\ High\ School_{it}$, $College\ And\ Higher_{it}$, and *Energy Cost*$_{it}$, are consistent with the hypotheses in most cases. However, the tax variables, *Property Tax*$_{it}$, *Sales Tax*$_{it}$, and *Income Tax*$_{it}$, do not have significant statistical meanings. In practice, the small, insignificant estimated coefficients of *Sales Tax*$_{it}$ are consistent with the hypothesis that general sales taxes have no effects on incomes, at least at current tax levels. And all the estimates of *Income Tax*$_{it}$ are negative even though insignificant, implying that income taxes may be inversely related with income levels.

The F-test on the joint effect of *Property Tax*$_{it}$, *Sales Tax*$_{it}$, and *Income Tax*$_{it}$ is summarized in Table 8. The test cannot reject the null hypothesis that property taxes, sales taxes, and income taxes jointly have no effect on income level in either the pooled estimation or the year-by-year estimations.

<u>Model 3</u>

As shown in Table 5, the estimates of *Metro Pop*$_{it}$, *Less Than 18*$_{it}$, *65 And Over*$_{it}$, *Not A High School*$_{it}$, *College And Higher*$_{it}$, and *Energy Cost*$_{it}$ support the hypotheses once again. Moreover, property taxes are directly related to personal income, income taxes are inversely related to personal income, and general sales taxes have no relation with personal income.

The same F-test (shown in Table 9) is performed and the null hypothesis is rejected only for the pooled estimation, which indicates that property taxes, general sales taxes, and income taxes jointly have effects on income levels cross states and over time, in terms of their effective tax rates.

Two-stage Least Squares Estimations (2SLS) on Models of Income Levels

As discussed in Chapter 3, the variable $Total\ Tax_{it}$ in nature is jointly dependent with the dependent variable in Model 1, which biases the OLS estimation and makes it inconsistent. The joint dependency shows in the correlation between the problem variable and error terms, i.e.,

$$\text{Cov}(Total\ Tax_{it}\ \ \varepsilon_{it}) \neq 0.$$

To correct the joint dependency bias and inconsistency, 2SLS involving instrumental variable estimation must be used. The instruments attempt to eliminate the simultaneous equation bias.[19] Previous studies have used the lagged values of average tax rates as the instrument. As already introduced in the model specification, the statutory tax rates property, general sales, and income taxes are used as instruments because they are exogenous with the model and have some correlations with average tax rates.

The two-stage model specifications are as follows:

Stage I: $$Total\ Tax_{it} = \alpha_0 + \alpha_1 Metro\ Pop_{it} + \alpha_2 Less\ Than\ 18_{it} + \alpha_3 65\ And\ Over_{it}$$
$$+ \alpha_4 Not\ A\ High\ School_{it} + \alpha_5 College\ And\ Higher_{it}$$
$$+ \alpha_6 Share_{it}^{farming} + \alpha_7\ Share_{it}^{mining} + \alpha_8\ Share_{it}^{manufacturing}$$
$$+ \alpha_9 Energy\ Cost_{it} + \alpha_{10} Property\ Rate_{it} + \alpha_{11} Sales\ Rate_{it}$$
$$+ \alpha_{12} Income\ Rate_{it} + \alpha_{13} D59 + \alpha_{14} D69 + \alpha_{15} D79 + \alpha_{16} D89 + u_{it}$$

[19] Candidate instrumental variables can be exogenous variables outside the model, lagged values of the problem variables, or predicted values of the problem variables. Whichever instrumental variables are used, they must meet two requirements: they must be uncorrelated in limit with error terms in the original model, and they should have some correlation with the problem variable as the sample size gets large (Pindyck and Rubinfeld 1997).

Stage II: $\log y_{it} = \beta_0 + \beta_1 \widehat{Total\,Tax}_{it} + \beta_2 Metro\ Pop_{it} + \beta_3 Less\ Than\ 18_{it}$

$+ \beta_4 65\ And\ Over_{it} + \beta_5\ Not\ A\ High\ School_{it} + \beta_6\ College\ And\ Higher_{it}$

$+ \beta_7\ Share_{it}^{farming} + \beta_8\ Share_{it}^{mining} + \beta_9\ Share_{it}^{manufacturing}$

$+ \beta_{10}\ Energy\ Cost_{it} + \beta_{11} D59 + \beta_{12} D69 + \beta_{13} D79 + \beta_{14} D89 + \varepsilon_{it}$

On the first stage, *Total* Tax_{it} is regressed on all exogenous variables in and out of the model by OLS. And on the second stage, the original model is estimated with the predicted values of *Total* Tax_{it} obtained in the stage I.

As shown in Table 6, the 2SLS estimates of *Total* Tax_{it} in all regressions but the one for 1969 are at least two times as much as those of the OLS, but the estimated coefficients of all other variables do not change very much. The suspicion that OLS estimates for *Total* Tax_{it} are biased and inconsistent is proved.

2SLS estimation is also performed on per capita personal earnings. Because personal earnings do not include transfer payments financed by taxes, theoretically we can expect the estimates on tax variables to be more robust. The regression results are shown in Table 7. The estimated coefficients of *Total* Tax_{it} are mostly negative but insignificant. The estimates here are not a lot different from them in Table 6, where dependent variable is personal incomes.

Growth Model

The growth model is built as a four equation system. In each model, the specifications of four equations are the same. They are the equations 3.4 and 3.6 set for each decade. Thus, the dependent variables are the growth rate of real per capita personal income for 1959-1969, 1969-1979, 1979-1989, and 1989-1999. Besides the essential control variables—the initial value of a state's real per capita personal income (y_{it-10}), *Metro Pop*$_{it-10}$, *College And Higher*$_{it-10}$, and *Sectoral Comp*$_{it-10}$—different forms of tax variables are tested. As shown in Table 9, regressions 1, 2, and 3 are regressions for the average tax rate, and regressions 4, 5, and 6 are for the effective tax rates of three types of tax. Moreover, regressions 1, 2, 4, and 5 imitate the basic model in most of previous studies. That is, only the initial values of influential factors are tested. Regressions 3 and 6 incorporate the change in tax to account for Vedder's argument that it is the change in tax that affects economy.

Two estimation techniques used are seemingly unrelated regression (SUR) and three-stage least-squares (3SLS). And for both methods, four equations are first regressed separately, and then the estimated coefficients of the same variable across equations are restricted to be the same. In this way, both the cross-sectional and time-series effects are captured.

Regressions 1 and 4 are by SUR, where all right-hand-side variables are treated exogenous. They are a simple start in the progress of this thesis for analyzing the importance of tax policies in economic growth and the determinants of growth. And estimations for all the others are by 3SLS. This approach of 3SLS with different instrumental variables used for each equation is used by Barro (1997) in his cross country study and the cross state study he did with Sala-i-Martin (1992). Regression 2 is where Barro's approach is exactly applied. In the second regression, only the initial real per capita personal income is treated as endogenous with dependent variables. And the instruments for it include the initial values of *Metro Pop*, *Less Than 18*, *65 And Over*, *Not A High School*, *College And Higher*, and *Sectoral Comp*.

Regression 3 treats both the initial real per capita personal income and the average tax rate as endogenous with the dependent variables. Hence, like what has been done in models of income levels, the effective tax rates of three types of tax at the beginning of a decade are used as the instruments for the initial average tax rate and for the change in the average tax rate. Additionally, two more instruments are included. One is the change in *Less Than 18* in each decade. The other is a dummy variable for whether a state has passed the state tax and expenditure limit (TEL) any time during a decade. The argument for adding them is that growth in a state's population of young people who require more state services may result in more taxes. And if other factors are held constant, state and local taxes decrease after a state has passed a TEL (New, 2001).

The estimated coefficients on the initial income levels in Table 10 are called the "conditional rate of convergence" by Barro (1997). They are highly significant and imply that the convergence effect on growth among states is about 2 to 3 percent per year, which is quite consistent with Barro and Sala-i-Martin's findings. Specifically, the estimates imply that the gap between a state's current income level and its long-run steady-state income level is eliminated at the rate of 2 to 3 percent per year, *ceteris paribus*.

Thus, state incomes do not "quickly" converge to equal values (Barro and Sala-i-Martin, 1992; Barro, 1997). It would take the economy approximately eighty-seven years to get 90% of the way toward the steady-state income level.[20]

As summarized in the first three regressions in Table 10, if other explanatory variables are held constant, then the ratio of total tax revenue to total personal income of a state at the beginning of a decade has no effect on its growth rate during this decade, while a change in this ratio is negatively related with growth. The estimated coefficient of the change in taxes is –0.29 and significant: An increase in state and local tax burdens equal to one percent of personal income (about 10% increase in taxes) would lower annual growth by about 0.3 percentage points (a 10% decrease in growth).[21] Thus, if a state increased its taxes by 10 percent, then it would experience a total decline in per capita income growth by about 0.3 percentage points at the end of a decade. This effect is much smaller than Vedder's findings, 6 percentage points in his basic model which does not include any non tax variables, and 3.64 percentage points after he controlled for some other influences.

Nonetheless, the estimate of tax elasticity derived from this result is slightly bigger than Wasylenko's mean and range of tax elasticity estimates. A 1% increase in taxes

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[20] Take the average estimate of the convergence rates from six regressions, -2.66%, as an example to find how long it would take the economy to get 90% of the way towards the steady-state income level:
$e^{-0.0266t} = 100\% - 90\% \Rightarrow t = \dfrac{\ln(0.1)}{-0.0266} \cong 87$.

[21] The variable *Total Tax*$_{it}$ is defined to be state and local tax burdens as a percentage of personal income. Its mean value is about 10. Thus, an increase in *Total Tax*$_{it}$ by about 1 means a 10% increase in tax revenues.
The mean value of the variable *Growth Rate* is around 3. Thus, a change of 0.3 percentage point in growth is about 0.3/3 = 10% change in growth.

brings about 1% decrease in growth. Accordingly, the tax elasticity obtained from the growth model is 1.

In Regressions 4, 5 and 6, since the effective tax rates are treated exogenous, only initial real per capita personal income needs correcting for the endogeniety. The instruments are the same as those in Regression 2. The findings suggest that initial sales tax rates have no effect on growth, while initial top income tax rates negatively affect growth. Initial property tax rates in three regressions are all estimated to be positive. Also, the Wald test on the joint effect of these three tax rates rejects the null hypothesis that the joint effect is nil in all regressions, implying different tax rates together matter.

Other control variables also reveal the predicted effects: more urbanization, higher education levels, and improved prices in sectors where a state specializes promote that state's growth.

Empirical findings suggest that with 90% confidence, a one percentage point increase in the metropolitan population raises the growth rate by about 0.005 percentage point. And the estimated coefficients of $College\ And\ Higher_{it-10}$ are significant in all regressions but the regression 3. The numerical findings also reveal the effect of education on growth is important: a one percentage point increase in the ratio of people holding a bachelor's degree or higher to the total population would promote the growth by about 0.06 percentage point. Finally, a state's sectoral composition positively affects the growth rate by 0.04 percentage point.

Table 3. Summary of OLS Estimation Results of Model 1
Dependent Variable: the Natural Logarithm of Real Per Capita Personal Income

Explanatory Variable	Regression Coefficients					
	Pooled	1959	1969	1979	1989	1999
$Total\ Tax_{it}$	-0.00326 (-0.70)	-0.00481 (-0.34)	0.00662 (0.55)	0.00103 (0.16)	0.00128 (0.15)	0.00879 (0.83)
$Metro\ Pop_{it}$	0.00379*** (10.87)	0.00230** (2.31)	0.00382*** (4.61)	0.00329*** (6.69)	0.00343*** (5.30)	0.00682*** (6.91)
$Less\ Than\ 18_{it}$	-0.0301*** (-9.11)	-0.0390*** (-3.74)	-0.0319*** (-3.60)	-0.0405*** (-7.85)	-0.0365*** (-6.72)	-0.0417*** (-4.24)
$65\ And\ Over_{it}$	-0.0153*** (-3.46)	-0.0330* (-1.91)	-0.0260** (-2.16)	-0.0306*** (-4.94)	-0.0132* (-1.71)	-0.0246** (-2.38)
$Not\ A\ High\ School_{it}$	-0.0086*** (-8.40)	-0.0111*** (-3.38)	-0.0083*** (-3.31)	-0.0104*** (-6.65)	-0.00384 (-1.45)	-0.00653* (-1.75)
$College\ And\ Higher_{it}$	0.0074*** (3.49)	0.0158 (0.98)	0.0098 (0.98)	-0.00843* (-1.88)	0.0138*** (3.46)	0.00434 (1.22)
$Share_{it}^{farming}$	-0.00299 (0.98)	-0.00585 (-0.71)	0.00477 (0.76)	0.0195*** (3.07)	0.00662 (0.90)	0.0205** (2.19)
$Share_{it}^{mining}$	0.00145 (1.09)	0.00125 (0.45)	-0.00184 (-0.71)	0.00572*** (2.60)	0.00215 (0.62)	0.00344 (0.84)
$Share_{it}^{manufacturing}$	0.00069 (0.73)	-0.00070 (-0.28)	0.00246 (1.17)	-0.000178 (-0.12)	0.00189 (0.97)	0.000413 (0.17)
$Energy\ Cost_{it}$	0.00003*** (4.07)	0.00004** (2.05)	0.00004*** (2.57)	0.00001 (1.31)	0.00002 (1.34)	0.00005*** (2.64)
Intercept	10.776*** (64.35)	11.333*** (16.93)	10.745*** (21.14)	11.552*** (41.29)	10.632*** (33.81)	10.784*** (28.75)
Year Dummies	Included					
R^2	96%	85%	84%	89%	90%	83%

Notes: t statistics are in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two-tailed test.

Table 4. Summary of OLS Estimation Results of Model 2
Dependent Variable: the Natural Logarithm of Real Per Capita Personal Income

Explanatory Variable	Regression Coefficients					
	Pooled	1959	1969	1979	1989	1999
Property Tax$_{it}$	0.00545 (0.89)	-0.000304 (-0.02)	0.00291 (0.18)	0.0153 (1.62)	0.00888 (0.78)	0.0323** (2.57)
Sales Tax$_{it}$	-0.00880 (-1.32)	-0.00558 (-0.25)	-0.0154 (-0.84)	-0.0111 (-1.14)	-0.00698 (-0.62)	0.00316 (0.26)
Income Tax$_{it}$	-0.00642 (-1.18)	-0.00479 (-0.17)	-0.00494 (-0.34)	-0.00547 (-0.78)	-0.00360 (-0.40)	-0.00184 (-0.18)
Metro Pop$_{it}$	0.00385*** (10.90)	0.00231** (2.20)	0.00389*** (4.36)	0.00354*** (6.90)	0.00358*** (5.34)	0.00677*** (7.27)
Less Than 18$_{it}$	-0.0284*** (-8.25)	-0.0389*** (-3.49)	-0.0298*** (-3.27)	-0.0376*** (-6.99)	-0.0351*** (-6.17)	-0.0385*** (-3.93)
65 And Over$_{it}$	-0.0153*** (-3.46)	-0.0338* (-1.88)	-0.0253** (-2.05)	-0.0322*** (-5.22)	-0.0137* (-1.73)	-0.0247** (-2.54)
Not A High School$_{it}$	-0.00807*** (-7.50)	-0.0110*** (-2.90)	-0.00863*** (-2.95)	-0.00984*** (-6.37)	-0.00303 (-1.09)	-0.00450 (-1.25)
College And Higher$_{it}$	0.00709*** (3.19)	0.0161 (0.84)	0.00794 (0.67)	-0.0104** (-2.28)	0.0129*** (3.02)	0.00409 (1.14)
$Share_{it}^{farming}$	0.00321 (1.04)	-0.00571 (-0.65)	0.00581 (0.86)	0.0225*** (3.55)	0.00691 (0.93)	0.0222** (2.51)
$Share_{it}^{mining}$	0.00156 (1.16)	0.00132 (0.45)	-0.00103 (-0.38)	0.00672*** (2.99)	0.00156 (0.45)	0.00417 (1.04)
$Share_{it}^{manufacturing}$	0.00107 (1.09)	-0.00031 (-0.12)	0.00257 (1.14)	-0.00003 (-0.02)	0.00169 (0.79)	0.00108 (0.45)
Energy Cost$_{it}$	0.00002*** (2.98)	0.00003 (1.58)	0.00004* (1.92)	0.000002 (0.24)	0.00001 (1.06)	0.00004** (2.06)
Intercept	10.733*** (65.75)	11.296*** (15.86)	10.801*** (20.32)	11.516*** (42.32)	10.621*** (34.14)	10.703*** (30.04)
Year Dummies	Included					
R^2	96%	85%	84%	91%	91%	85%

Notes: t statistics are in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two-tailed test.

Table 5. Summary of the OLS Estimation Results of Model 3
Dependent Variable: the Natural Logarithm of Real Per Capita Personal Income

Explanatory Variable	Regression Coefficients					
	Pooled	1959	1969	1979	1989	1999
Property Rate$_{it}$	0.0207* (1.87)	-0.0278 (-0.65)	0.0169 (0.57)	0.0219 (1.43)	0.0189 (0.94)	0.0284 (1.25)
Sales Rate$_{it}$	-0.00265 (-0.75)	-0.0106 (-0.94)	-0.00697 (-0.74)	-0.000008 (-0.00)	0.00483 (0.83)	0.00208 (0.34)
Income Rate$_{it}$	-0.00282** (-2.00)	-0.00131 (-0.29)	0.00043 (0.13)	-0.00152 (-0.73)	-0.00420 (-1.52)	-0.00565 (-1.54)
Metro Pop$_{it}$	0.00354*** (9.15)	0.00258** (2.45)	0.00399*** (4.27)	0.00308*** (4.86)	0.00278*** (3.52)	0.00578*** (5.60)
Less Than 18$_{it}$	-0.0285*** (-8.47)	-0.0387*** (-3.68)	-0.0300*** (-3.27)	-0.0393*** (-7.29)	-0.0357*** (-6.36)	-0.0377*** (-3.84)
65 And Over$_{it}$	-0.0149*** (-3.33)	-0.0322* (-1.88)	-0.0265** (-2.10)	-0.0292*** (-4.39)	-0.0143* (-1.82)	-0.0220** (-2.12)
Not A High School$_{it}$	-0.00791*** (-7.70)	-0.0111*** (-3.16)	-0.00814*** (-3.10)	-0.0103*** (-6.04)	-0.00428 (-1.62)	-0.00508 (-1.37)
College And Higher$_{it}$	0.00828*** (3.80)	0.0160 (0.87)	0.00725 (0.63)	-0.00784 (-1.53)	0.0144*** (3.59)	0.00697* (1.94)
$Share_{it}^{far\min g}$	0.00218 (0.71)	-0.00563 (-0.65)	0.00528 (0.85)	0.0176** (2.59)	0.00497 (0.66)	0.0165* (1.80)
$Share_{it}^{\min ing}$	0.00141 (1.02)	0.00061 (0.21)	-0.00098 (-0.34)	0.00636*** (2.74)	0.00128 (0.37)	0.00218 (0.50)
$Share_{it}^{manufacturing}$	0.00082 (0.87)	-0.00083 (-0.34)	0.00224 (1.03)	-0.00019 (-0.13)	0.00196 (1.03)	0.00021 (0.09)
Energy Cost$_{it}$	0.00002*** (3.31)	0.00004* (1.85)	0.00004** (2.08)	0.000008 (1.00)	0.00001 (0.80)	0.00004** (2.26)
Intercept	10.701*** (66.01)	11.310*** (16.25)	10.762*** (20.50)	11.509*** (38.60)	10.693*** (34.44)	10.752*** (29.13)
Year Dummies	Included					
R^2	96%	85%	84%	90%	91%	85%

Notes: t statistics are in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two-tailed test.

Table 6. Summary of the 2SLS Estimation Results of Model 1
Dependent Variable: the Natural Logarithm of Real Per Capita Personal Income

Explanatory Variable	Regression Coefficients					
	Pooled	1959	1969	1979	1989	1999
Total Tax$_{it}$	-0.00889 (-1.06)	-0.0194 (-0.69)	0.00307 (0.17)	0.00198 (0.19)	-0.00752 (-0.58)	-0.02557 (-1.35)
Metro Pop$_{it}$	0.00376*** (10.23)	0.00227** (2.25)	0.00382*** (4.60)	0.00339*** (5.86)	0.00334*** (4.35)	0.00622*** (5.42)
Less Than 18$_{it}$	-0.0298*** (-8.96)	-0.0365*** (-3.21)	-0.0315*** (-3.52)	-0.0403*** (-7.61)	-0.0361*** (-6.41)	-0.0372*** (-3.28)
65 And Over$_{it}$	-0.0145*** (-3.26)	-0.0280 (-1.44)	-0.0254** (-2.06)	-0.0296*** (-4.53)	-0.0128 (-1.60)	-0.0188 (-1.57)
Not A High School$_{it}$	-0.00860*** (-8.17)	-0.0114*** (-3.39)	-0.00840*** (-3.30)	-0.0100*** (-6.06)	-0.00425 (-1.55)	-0.00562 (-1.32)
College And Higher$_{it}$	0.00793*** (3.62)	0.0162 (0.99)	0.0103 (1.01)	-0.00840 (-1.64)	0.0144*** (3.39)	0.00600 (1.46)
$Share_{it}^{farming}$	0.00273 (0.88)	-0.00554 (-0.67)	0.00512 (0.80)	0.0187** (2.64)	0.00586 (0.75)	0.0136 (1.24)
$Share_{it}^{mining}$	0.00153 (1.12)	0.00113 (0.40)	-0.00170 (-0.64)	0.00571** (2.47)	0.00288 (0.77)	0.00282 (0.60)
$Share_{it}^{manufacturing}$	0.000603 (0.62)	-0.00146 (-0.52)	0.00244 (1.16)	-0.00029 (-0.19)	0.00202 (1.01)	0.000154 (0.06)
Energy Cost$_{it}$	0.00003*** (4.33)	0.00004** (2.11)	0.00004** (2.52)	0.00001 (1.36)	0.00002 (1.38)	0.00006*** (2.78)
Intercept	10.802*** (60.14)	11.339*** (16.69)	10.763*** (20.97)	11.502*** (38.80)	10.706*** (32.15)	10.910*** (25.43)
Year Dummies	Included					
R^2	96%	85%	84%	90%	90%	79%

Notes: t statistics are in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two-tailed test.

Table 7. Summary of 2SLS Estimation Results of Model 1
Dependent Variable: the Natural Logarithm of Real Per Capita Personal Earning

Explanatory Variable	Regression Coefficients					
	Pooled	1959	1969	1979	1989	1999
$Total\ Tax_{it}$	-0.0152 (-1.64)	-0.0214 (-0.77)	0.00005 (0.00)	-0.0045 (0.16)	-0.0128 (-0.79)	-0.0300 (-1.39)
$Metro\ Pop_{it}$	0.0038*** (9.31)	0.0019* (1.92)	0.0036*** (4.39)	0.0036*** (5.88)	0.0035*** (3.63)	0.0071*** (5.39)
$Less\ Than\ 18_{it}$	-0.0321*** (-8.73)	-0.0355*** (-3.17)	-0.0351*** (-4.00)	-0.0430*** (-7.59)	-0.0417*** (-5.92)	-0.0412*** (-3.17)
$65\ And\ Over_{it}$	-0.0322*** (-6.54)	-0.0367* (-1.92)	-0.0455*** (-3.77)	-0.0508*** (-7.28)	-0.0370*** (-3.69)	-0.0404** (-2.94)
$Not\ A\ High\ School_{it}$	-0.0075*** (-6.43)	-0.0122*** (-3.67)	-0.0083*** (-3.32)	-0.0091*** (-5.13)	-0.0026 (-0.76)	-0.0058 (-1.18)
$College\ And\ Higher_{it}$	0.0122*** (5.02)	0.0096 (0.60)	0.0058 (0.58)	-0.0076 (-1.39)	0.0190*** (3.58)	0.0084* (1.79)
$Share_{it}^{farming}$	0.0063* (1.84)	-0.0083 (-1.02)	0.0053 (0.85)	0.0234*** (3.07)	0.0093 (0.96)	0.0174 (1.38)
$Share_{it}^{mining}$	0.0015 (1.01)	0.0003 (0.09)	-0.0024 (-0.93)	0.0071*** (2.86)	0.0014 (0.30)	0.0017 (0.31)
$Share_{it}^{manufacturing}$	0.0022** (2.09)	-0.0010 (-0.35)	0.0029 (1.40)	0.0011 (0.68)	0.0042* (1.68)	0.0036 (1.14)
$Energy\ Cost_{it}$	0.00003*** (4.19)	0.00003* (1.79)	0.00005*** (2.83)	0.00001 (1.41)	0.00002 (1.33)	0.00007*** (2.82)
$Intercept_{it}$	10.634*** (53.53)	11.344*** (16.96)	10.937*** (21.76)	11.515*** (36.31)	10.681*** (25.62)	10.767*** (21.89)
Year Dummies	Included					
R^2	94%	84%	84%	89%	88%	80%

Notes:
t statistics are in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two-tailed test.

Table 8. Summary of F-test on OLS Estimates of Model 2.
Null Hypothesis: The joint effect of property taxes, sales taxes, and income taxes on income levels is zero.

Model	Statistic	Result, .05 significant level
Pooled	F(3, 223) = 1.193	Can't reject
1959	F(3, 35) = 0.0232	Can't reject
1969	F(3, 35) = 0.287	Can't reject
1979	F(3, 35) = 1.417	Can't reject
1989	F(3, 35) = 0.447	Can't reject
1999	F(3, 35) = 2.53	Can't reject

At .05 significant level, $F_{c(3, \infty)} = 2.60$
$F_{c(3, 30)} = 2.92$
$F_{c(3, 40)} = 2.84$

Table 9. Summary of F-test on OLS Estimates of Model 3.
Null Hypothesis: The joint effect of property tax rates, sales tax rates, and income tax rates on income levels is zero.

Model	Statistic	Result, .05 significant level
Pooled	F(3, 219) = 3.633	Reject
1959	F(3, 35) = 0.392	Can't reject
1969	F(3, 35) = 0.347	Can't reject
1979	F(3, 32) = 1.146	Can't reject
1989	F(3, 34) = 1.665	Can't reject
1999	F(3, 35) = 1.876	Can't reject

At .05 significant level, $F_{c(3, \infty)} = 2.60$
$F_{c(3, 30)} = 2.92$
$F_{c(3, 40)} = 2.84$

Table 10. Summary of Estimations Results of the Growth Model
Dependent Variables: Average Annual Growth Rates of Real Per Capita Personal Income over Four Periods: 1959-69, 1969-79, 1979-89, and 1989-99

Explanatory Variable	Regression Coefficients					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6
log y_{t-10}	-3.037*** (-9.297)	-2.628*** (-6.820)	-2.025*** (-4.844)	-3.213*** (-9.060)	-3.042*** (-7.204)	-2.702*** (-5.684)
Total Tax$_{t-10}$	0.0282 (1.006)	0.0293 (0.659)	-0.0168 (-0.339)			
ΔTotal Tax			-0.2913*** (-3.880)			
Property Rate$_{t-10}$				0.2019*** (2.872)	0.1913*** (2.685)	0.2120** (2.271)
Sales Rate$_{t-10}$				0.0169 (0.7260)	0.0189 (0.8057)	0.0262 (0.9564)
Income Rate$_{t-10}$				-0.0275*** (-2.799)	-0.0267*** (-2.723)	-0.0333*** (-3.022)
ΔProperty Rate						-0.0155 (-0.1033)
ΔSales Rate						0.0188 (0.2389)
ΔIncome Rate						-0.0453 (-1.240)
Metro Pop$_{t-10}$	0.0060** (2.482)	0.0045* (1.757)	0.0046* (1.731)	0.0042* (1.788)	0.0036 (1.446)	0.0011 (0.4119)
College And Higher$_{t-10}$	0.0644*** (4.541)	0.0529*** (3.218)	0.0240 (1.221)	0.0664*** (4.444)	0.0636*** (4.092)	0.0585*** (3.266)
Sectoral Comp$_{t-10}$	0.0339*** (4.669)	0.0378*** (4.746)	0.0530*** (6.333)	0.0423*** (5.043)	0.0422*** (5.022)	0.0391*** (4.748)
R^2	.42, .59, .14, .09	.44, .60, .11, .14	.40, .73, .24, .05	.45, .63, .17, .31	.46, .63, .16, .32	.45, .68, .18, .38
Number of Observations	48, 48, 48, 48	48, 48, 45, 47	48, 48, 45, 47	48, 48, 45, 47	48, 48, 45, 47	48, 48, 45, 47

Notes: t statistics are reported in parentheses.
* statistically significant at the .10 level for two-tailed test.
** statistically significant at the .05 level for two-tailed test.
*** statistically significant at the .01 level for two tailed test.
R^2 indicates R-squared's for each equation.
Number of Observations is counted for each equation.
Each regression includes a constant. To save space, the estimated intercepts are shown in the Appendix C.

CHAPTER 5

CONCLUSION

This chapter restates the objective of studying taxes and incomes, summarizes the findings of this study, and states the limitations and possible improvement to make in further studies on this topic.

The Objective

The objective of this study has been to assess the effects of state and local taxes on incomes among the U.S. states. The relationships between taxes and income levels as well as between taxes and income growth are examined. A utility model has been set up to analyze the economic activity within a state and the economic competition among states.

It has been argued that excessive taxes are detrimental in an economy. Economists and researchers have given advice on state and local tax policies, while tax cuts for attracting business remain a hot topic in many state legislatures.

This study is intended to provide objective evidence on how much, if any, taxes matter to an economy. With a careful selection of the controlled variables, improved estimation techniques, and the more recent data, this study tested the relation between taxes and income levels and growth, controlling for the effects of other factors.

Findings

In models of income levels, OLS regressions were used initially to estimate the effect of total taxes on income levels, and 2SLS were used to correct for some statistical problems of using OLS. In models of income growth, SUR and 3SLS were performed and the estimated coefficients across equations are restricted to be equal.

Empirical results show little or no relationship between most aggregate measures of state and local taxes and income levels or growth when other influences on incomes are controlled. There is no evidence that states with higher overall taxes have either higher or lower levels of per capita income. Nor does the overall level of taxes have a statistically significant relationship with growth. The levels and mix of revenues among property, sales and income taxes are also not significantly related to income levels.

However, the data do indicate three statistically significant relationships between the tax structure and incomes: (1) States with higher top marginal tax rates on the personal income tax tend to have *lower* levels of per capita personal income as well as a slower growth. (2) States with higher effective property tax rates have *higher* levels of per capita income and grow faster. (3) The change in overall tax levels is negatively related to growth. That is, states which increased taxes as a percentage of income tended to have slower growth. (4) The effective property tax rates, the general sales tax rates, and the top marginal rates on income taxes together play a role in income growth.

Besides the association with taxes, the study shows strong evidence for the conditional convergence between economies alleged by Barro et al. State economies tend to converge at a rate of 2 to 3 percent per year, *ceteris paribus*.

Evidence also indicates that metropolitan development is important for raising income levels and promoting growth. First, the size of a metropolitan population of a state is positively related to its income levels. According to theories, it implies that disamenities and the higher cost of living drive up the income of residents in cities. And the loss in income of residents in rural states may be compensated by lower living costs and better social and natural environment (Power and Barrett, 2001). Second, the more urbanized a state is, the more business opportunities, and the faster it grows in per capita personal income (Becker, Glaeser, and Murphy, 1999; Power and Barrett, 2001).

In addition, evidence on education levels, energy costs, and age distributions of a state's population is consistent with theoretical predictions. Education plays a crucial role in economies; a state's higher energy cost may be compensated by higher wages, i.e., a higher per capita personal income; the age distribution of a state's population also affects its economy: the larger the non labor force (the elderly and the children), the lower the income level.

Limitations

The first and the most important limitation of this study is the lack of data on the quality and quantity of public services. As discussed previously, state taxes and expenditures together play a role in an economy. Heavier tax burdens can be associated with high expenditure, and perhaps better public services. The lack of this information may cause omitted variable bias in econometric analysis.

Second, this study has limited controls for a state's amenities and disamenities. The only measures are variables for the percentage of state population in metropolitan areas, and the energy cost of heating and cooling. It is difficult to to measure other amenities and disamenities of a state, because they depend on people's preferences and tastes, which may change over time. Some literature on differences in amenities uses regional dummies as a control. Regional dummy variables are not used in this study, however, because there is not a clear division among states based on their amenities and disamenities.

A third limitation is the lack of proper instrumental variables for taxes to correct the endogeneity between taxes and economic activities. As discussed in Chapter 2, economic theories predict both that taxes affect economies and economies affect taxes. Sorting out the causality from observable correlations is difficult. This study employs the statutory tax rates as major instruments for tax revenues and treats the rates as exogenous of the model. However, it is hard to explain why a state changes its statutory tax rates. And state and local governments are actually likely to raise the tax rates when economies are miserable and when they are facing budget deficits. In this recognition, estimation results, especially in the growth model, may be biased.

Further Study

Economic theory does not make a clear prediction about the relationship between taxes and incomes. On the one hand, high taxes are undesirable to most people and thus discourage people from choosing a state, which in turn lower the economic activity. On the other hand, taxes provide government services that may attract people to a state and activate the state's economy. The importance of reliable measures of government services is apparent. Another further step is to develop proper control variables for differences in states' cost of living, and amenities and disamenities.

A third step worth of doing is to develop proper instruments for variables of tax revenues in the growth model. In the models for level data, measures of tax revenues can be criticized because revenues depend both on tax rates and the health of the state's economy. Therefore, three measures of tax rates are included as the instrumental variables. In the growth models, however, the change of tax rates and one of determinants this change—income growth—are of a causal-effect relationship. Instruments other than tax rates are needed. In this study, two additional instruments for the change in tax rates, such as *TEL* and *ΔLess Than 18*, are used, yet not fully solve the joint dependency problem.

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APPENDICES

APPENDIX A

SUMMARY OF EXPLANATORY VARIABLES AND THEIR HYPOTHESIZED SIGNS

Notation	Definition	Sign in Models of Income Levels	Sign in Growth Model
$log\ y_{t-10}$	the logarithm of the initial income level	N.A.	-
Total Tax	total tax revenues divided by income	-	-
Δ*Total Tax*	the change in the above variable during a decade	N.A.	-
Property Tax	revenues from property tax divided by income	-	-
Sales Tax	revenues from general sales tax divided by income	No effect	No effect
Income Tax	revenues from income tax divided by income	-	-
Property Rate	the effective property tax rate on residential property	-	-
Δ*Property Rate*	the change in the above variable during a decade	N.A.	-
Sales Rate	the state-wide general sales tax rate	No effect	No effect
Δ*Sales Rate*	the change in the above variable during a decade	N.A.	No effect
Income Rate	the top marginal tax rate on personal income	-	-
Δ*Income Rate*	the change in the above variable during a decade	N.A.	-
Metro Pop	the percentage of metropolitan population in total population	+	+

Notation	Definition	Sign in Models of Income Levels	Sign in Growth Model
Less Than 18	the percentage of population less than 18 in total population	-	N.A.
65 And Over	the percentage of population 65 and older in total population	-	N.A.
Not A High School	the percentage of population w/o high school diplomas in total population	-	N.A.
College And Higher	the percentage of population w/ a college or higher degree in total population	+	+
$Share^{farming}$	the share of income originating from farming	-	N.A.
$Share^{mining}$	the share of income originating from mining	-	N.A.
$Share^{manufacturing}$	the share of income originating from manufacturing	No effect	N.A.
Sectoral Comp	the summation of price weighted sectoral shares	N.A.	+
Energy Cost	the average spending on heating and cooling	+	N.A.

Notes:
"N.A." means "Not Applicable."
"+" means "The sign is hypothesized to be positive."
"-" means "The sign is hypothesized to be negative."

APPENDIX B

SUMMARY OF THE ACTUAL YEARS OF DATA

Variables	1959	1969	1979	1989	1999
y	X	X	X	X	X
PC Earning	X	X	X	X	X
Total Tax	X	X	X	X	97
Property Tax	X	X	X	X	97
Sales Tax	X	State Level	X	X	97
Income Tax	X	State Level	X	X	97
Property Rate	58	71	81	87	98
Sales Rate	X	70	80	X	98
Income Rate	60	70	80	X	98
Metro Pop	60	70	80	90	99
Less Than 18	58	X	X	X	X
65 And Over	58	X	X	X	X
Not A High School	60	70	80	90	X
College And Higher	60	70	80	90	X
$Share^{farming}$	X	X	X	X	X
$Share^{mining}$	X	X	X	X	X
$Share^{manufacturing}$	X	X	X	X	X

Notes:
"X" means that data is of the desired year as well as on the state and local level.
Actual years are given if data is not of the desired years.
"State Level" means that data is on the state level.

APPENDIX C

SUMMARY OF DESCRIPTIVE STATISTICS

t = 1959

	N	Mean	Std Dev	Minimum	Maximum
Dependent Variable					
log y	48	9.27	0.20	8.79	9.61
log PC Earning	48	9.07	0.19	8.61	9.42
Growth Rate	N.A.	N.A.	N.A.	N.A.	N.A.
Independent Variable					
Total Tax	48	8.67	1.28	6.61	12.01
ΔTotal Tax	N.A.	N.A.	N.A.	N.A.	N.A.
Property Tax	48	3.83	1.34	1.45	6.67
Sales Tax	48	1.10	0.88	0.00	3.53
Income Tax	48	0.72	0.68	0.00	2.68
Unbalance	48	0.24	0.16	0.02	0.67
Property Rate	48	1.27	0.46	0.48	2.21
Sales Rate	48	1.79	1.35	0.00	4.00
Income Rate	48	3.94	3.66	0.00	11.00
ΔProperty Rate	N.A.	N.A.	N.A.	N.A.	N.A.
ΔSales Rate	N.A.	N.A.	N.A.	N.A.	N.A.
ΔIncome Rate	N.A.	N.A.	N.A.	N.A.	N.A.
Metro Pop	48	51.99	25.82	0.00	97.40
Less Than 18	48	36.87	2.93	31.52	44.87
65 And Over	48	8.80	1.64	5.67	11.62
Not A High School	48	58.23	7.24	44.39	72.42
College And Higher	48	7.52	1.56	4.77	10.73
$Share^{farming}$	48	4.39	3.23	0.34	12.59
$Share^{mining}$	48	4.39	6.06	0.11	28.82
$Share^{manufacturing}$	48	20.02	8.90	3.38	35.79
Sectoral Comp	N.A.	N.A.	N.A.	N.A.	N.A.
Energy Cost	48	4298.77	970.05	1514.29	6553.37

t = 1969

	N	Mean	Std Dev	Minimum	Maximum
Dependent Variable					
log y	48	9.61	0.17	9.23	9.93
log PC Earning	48	9.40	0.16	9.04	9.70
Growth Rate	48	3.37	0.59	2.12	4.88
Independent Variable					
Total Tax	48	9.76	1.15	7.90	12.65
ΔTotal Tax	48	1.10	0.82	-0.39	3.38
Property Tax	48	3.81	1.26	1.35	6.71
Sales Tax	48	1.66	0.86	0.00	3.89
Income Tax	48	1.26	1.00	0.00	3.43
Unbalance	48	0.14	0.11	0.00	0.62
Property Rate	48	1.91	0.67	0.56	3.15
Sales Rate	48	3.23	1.30	0.00	6.00
Income Rate	48	5.42	4.43	0.00	17.94
ΔProperty Rate	48	0.64	0.35	-0.49	1.33
ΔSales Rate	48	1.44	1.18	0.00	5.00
ΔIncome Rate	48	1.48	2.51	-2.00	10.44
Metro Pop	48	63.12	23.04	15.70	100.00
Less Than 18	48	35.68	2.13	32.62	42.15
65 And Over	48	9.73	1.72	6.13	13.31
Not A High School	48	47.37	7.88	32.52	62.23
College And Higher	48	10.43	2.08	6.62	14.90
$Share^{farming}$	48	3.65	3.70	0.21	17.07
$Share^{mining}$	48	3.90	5.85	0.28	26.00
$Share^{manufacturing}$	48	20.99	8.89	3.66	38.11
Sectoral Comp	48	-2.65	0.76	-6.19	-1.32
Energy Cost	48	3904.30	881.04	1375.33	5952.00

t = 1979

	N	Mean	Std Dev	Minimum	Maximum
Dependent Variable					
log y	48	9.88	0.13	9.60	10.11
log PC Earning	48	9.62	0.14	9.34	9.86
Growth Rate	48	2.76	0.65	1.38	4.51
Independent Variable					
Total Tax	48	9.80	1.23	8.00	13.81
ΔTotal Tax	48	0.04	0.95	-2.55	2.12
Property Tax	48	3.12	1.14	0.98	5.79
Sales Tax	48	2.19	1.01	0.00	4.19
Income Tax	48	2.10	1.22	0.00	4.83
Unbalance	48	0.07	0.08	0.00	0.39
Property Rate	45	1.26	0.58	0.28	2.75
Sales Rate	48	3.63	1.50	0.00	7.50
Income Rate	48	6.48	4.66	0.00	17.50
ΔProperty Rate	45	-0.61	0.46	-1.44	0.72
ΔSales Rate	48	0.40	0.71	-1.00	2.50
ΔIncome Rate	48	1.06	2.54	-3.50	13.30
Metro Pop	48	65.68	22.40	24.00	100.00
Less Than 18	48	29.07	2.06	25.10	37.00
65 And Over	48	11.13	1.81	7.70	18.10
Not A High School	48	32.98	7.34	20.00	46.90
College And Higher	48	15.90	2.87	10.40	23.00
$Share^{farming}$	48	1.60	1.70	0.07	8.68
$Share^{mining}$	48	2.62	4.27	0.22	23.79
$Share^{manufacturing}$	48	17.48	6.94	4.10	32.10
Sectoral Comp	48	6.74	6.46	1.81	31.81
Energy Cost	48	5507.07	1242.72	1939.93	8395.39

t = 1989

	N	Mean	Std Dev	Minimum	Maximum
Dependent Variable					
log y	48	10.05	0.16	9.73	10.45
log PC Earning	48	9.71	0.19	9.37	10.15
Growth Rate	48	1.66	0.97	-0.78	3.47
Independent Variable					
Total Tax	48	10.05	1.08	7.82	13.87
ΔTotal Tax					
Property Tax	48	3.06	1.09	1.01	5.50
Sales Tax	48	2.37	1.03	0.00	5.00
Income Tax	48	2.40	1.23	0.00	5.12
Unbalance	48	0.07	0.09	0.00	0.43
Property Rate	47	1.18	0.52	0.22	2.38
Sales Rate	48	4.45	1.68	0.00	8.00
Income Rate	48	5.45	3.34	0.00	14.57
ΔProperty Rate	45	-0.10	0.37	-1.59	0.70
ΔSales Rate	48	0.83	0.85	-1.00	3.00
ΔIncome Rate	48	-1.02	2.93	-10.50	7.07
Metro Pop	48	67.57	21.26	26.90	100.00
Less Than 18	48	26.19	2.39	22.61	36.97
65 And Over	48	12.64	1.73	8.60	18.00
Not A High School	48	24.01	5.51	14.90	35.70
College And Higher	48	19.62	3.77	12.30	27.20
$Share^{farming}$	48	1.69	1.78	0.14	7.47
$Share^{mining}$	48	2.04	3.64	0.04	21.15
$Share^{manufacturing}$	48	15.23	5.77	3.58	27.39
Sectoral Comp	48	-3.07	1.04	-7.19	-0.90
Energy Cost	48	4717.12	1064.46	1661.66	7191.14

t = 1999

	N	Mean	Std Dev	Minimum	Maximum
Dependent Variable					
log y	48	10.20	0.15	9.94	10.58
log PC Earning	48	9.84	0.18	9.49	10.27
Growth Rate	48	1.50	0.40	0.70	2.36
Independent Variable					
Total Tax	48	10.48	1.07	8.47	13.63
ΔTotal Tax	48	0.43	0.70	-1.88	2.23
Property Tax	48	3.11	1.09	1.13	5.60
Sales Tax	48	2.52	1.11	0.00	5.02
Income Tax	48	2.63	1.29	0.00	5.05
Unbalance	48	0.07	0.09	0.00	0.45
Property Rate	48	1.18	0.56	0.38	2.93
Sales Rate	48	4.76	1.72	0.00	7.00
Income Rate	48	5.72	3.22	0.00	12.00
ΔProperty Rate	47	0.00	0.45	-1.49	1.00
ΔSales Rate	48	0.31	0.61	-2.00	2.00
ΔIncome Rate	48	0.27	1.26	-2.80	4.50
Metro Pop	48	68.25	20.73	27.90	100.00
Less Than 18	48	25.71	1.78	22.36	33.19
65 And Over	48	12.81	1.68	8.70	18.10
Not A High School	48	15.51	4.21	8.80	24.90
College And Higher	48	24.64	4.65	17.30	38.70
$Share^{farming}$	48	1.52	1.78	-0.06	9.23
$Share^{mining}$	48	1.75	3.19	0.02	18.79
$Share^{manufacturing}$	48	14.46	5.27	4.02	27.41
Sectoral Comp	48	-2.75	0.79	-4.60	-1.05
Energy Cost	48	3968.89	895.61	1398.09	6050.48

APPENDIX D

THE ESTIMATED INTERCEPTS IN TABLE 10

Explanatory Variable	Regression Coefficients					
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6
Intercept 69	30.582***	26.962***	22.327***	32.387***	30.861***	27.896***
	(10.409)	(7.794)	(6.106)	(10.250)	(8.207)	(6.656)
Intercept 79	30.395***	26.620***	21.491***	32.089***	30.524***	27.534***
	(10.044)	(7.472)	(5.672)	(9.900)	(7.911)	(6.348)
Intercept 89	30.099***	26.309***	21.323***	32.052***	30.447***	27.215***
	(9.759)	(7.262)	(5.563)	(9.637)	(7.700)	(6.119)
Intercept 99	29.907***	26.115***	21.241***	31.902***	30.279***	27.111***
	(9.593)	(7.143)	(5.503)	(9.487)	(7.574)	(6.046)

Notes:
t statistics are reported in parentheses.
* statistically significant at the .10 level for the two-tailed test.
** statistically significant at the .05 level for the two-tailed test.
*** statistically significant at the .01 level for the two-tailed test.