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Sub-national Tax Policy and State Level Growth Dynamics: Evidence from U.S. States

William Gbohoui[*]*, François Vaillancourt*[†]

Résumé/abstract

To understand the role of subnational tax policies in explaining regional growth, we present stylized facts on U.S. state income and state-level tax policies. We use real Gross State Products (GSP) as the indicator of economic performance in contrast to the existing literature, which relies on Personal Income. The results reveal an increase in per capita income disparities, and time - persistent differences in human capital and physical capital between U.S. states. In addition, we find that subnational tax policies vary widely between states. Using augmented Barro regressions, we show that educational attainment, and state-level tax policies are the key determinants in explaining the differences between state-level economic growth. More precisely, higher corporate income or general sales taxes significantly retard economic growth, while human capital positively impacts state-level growth.

Mots clés/keywords : Regional growth, state and local taxation

Codes JEL/JEL Codes : H71, R11

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1 Introduction

In the economic literature, a large body of empirical work has studied the growth effects of taxation. While policymakers may believe that tax policies matter for growth, traditional models (Solow (1956)) once assumed that long-term growth is exogenous, or determined by demographic and technological factors but not subject to policy influence. Physical capital accumulation was viewed as the key determinant of growth in the neoclassical model. The first extensions of the neoclassical growth model broaden capital to include human capital and allow for spillover effects (Romer (1986), Lucas (1988), Rebelo (1991), Mulligan and Sala-I-Martin (1993)). But as theoretical growth models have grown more sophisticated, recent models allow growth rate to be endogenous and consider shocks, including tax policy as influencing demographic and technological variables. Most of the empirical research on economic growth and tax policy has been inspired by this endogenous growth theory.

Several researchers used augmented *Barro regression*[1] to test the relationship between growth rates and tax policies across countries. While most of the cross-country studies suggest that taxes have a negative effect on economic growth, evidence of negative and significant tax effects on economic growth across U.S. states has been mixed, yielding very inconsistent results. The coefficients on tax variables ranging from positive to negative. Insignificant coefficients are common. For example, Newman (1983) and Plaut, and Pluta (1983) both use cross sectional data from two time periods. The former finds negative effects of corporate tax rates on growth and the latter yields mixed results. Thompson and Mattila (1959), and Carlton (1983) find no relationship between taxes and growth. Using pooled time series (from 1965 through 1979) of cross sections of 48 states, Helms (1985)[2] conclude that significant increases in state and local taxes retard economic growth when the revenue is used to fund transfer payments. However, when the revenue is used instead to improve public services (such as education, highways, and public health and safety), the higher level of public services may create positive impacts on location and production decisions and counterbalance the

[1] Barro regressions referred to regressions used by Barro to test the convergence hypothesis. For a review of this literature on Barro regressions, see Sala-Martin (1996).

[2] Mofidi and Stone (1990) find similar results.

disincentive effects of the associated taxes. More recently, Yamarik (2000) find mixed results while Reed (2008), Poulson and Kaplan (2008) report negative correlations between growth and taxes at subnational level[3]. Ojede and Yamarik (2012) report that property and sales tax rates have negative effects on long-run income growth, while income tax rates have no impact.

The contribution of this paper to assessing the effects of sub-national taxes on economic growth across U.S. states is twofold. Firstly, almost all of the existing literature on state-level taxes and economic growth use Personal Income (real or nominal) as the indicator of economic growth. In contrast, we use the real Gross State Product (GSP), which is better measure of GDP for states. Secondly, we follow the economic theory and consider that the tax base matters for the tax effects on growth to be correctly captured. In fact, corporate taxes reduce the incentive to accrue profits that can in turn be used to invest in capital goods, while income taxes affect labor and saving of individuals as well as investment by non-corporate business owners. Consumption taxes, such as sales taxes, affect suppliers of labor and capital. Therefore, ignoring this distinction between tax instruments may lead to imprecise results. Despite the theoretical predictions, most of the existing studies do not distinguish between taxes paid on income, consumption or property. Mullen and Williams (1994) and Becsi (1996) include one estimate of the total effective marginal tax rate in their growth regressions, when studying the effects of taxes on the growth of U.S. states. Yamarik (2000) uses real GSP and estimated disaggregated tax rates but ignores physical capital in his regression. By doing so, he does not control for the effects of physical capital on output considered in the growth theory as a key determinant of growth. Ojede and Yamarik (2012) controls for this effect but use Personal Income as indicator of growth instead of real GSP.

In this paper, we present an overview of the dynamic of U.S. states GSP and examine the evolution of the cross sectional dispersion within U.S. states GSP over the period 1997-2012. It appears that disparities between U.S. states' per capita income sharply increase in over the period 2004-2010. While exploring the driving forces of U.S. states GSP, we present evidence that educational attainment and per capita physical capital are essential and complementary in determining U.S. states GSP. In addition, we find that U.S. states' taxes are

[3] Grieson and ali (1977), Grieson (1980), Benson and Johnson (1986) also find similar results.

highly persistent over time. Our descriptive analysis shows that the sign of the correlation between taxes and sub-national economic growth depend on the tax base. More precisely, corporate income and general sales are negatively correlated to GSP level, while individual income tax rates are positively correlated to GSP. Since simple correlations are not conclusive, we use Barro regressions to sort out the main issues. While controlling for potential variables, which may affect economic growth, we find that higher corporate income and general sales tax rates dampen economic growth while individual income tax rate does not affect significantly economic growth. This observation holds true either for contemporaneous or delayed tax rates. Educational attainment has a positive and significant effect on economic growth, while physical capital stock doesn't varies enough to explain differences in US states growth.

The rest of the paper is as follow. Section 2 presents facts on U.S. states growth and taxes. Section 3 documents the evidence of tax effects on economic growth across U.S. states using Barro type regressions. The last section concludes.

2 Facts on U.S. States Growth and Taxes

Data used in this paper fall under three categories: Personal Income and GSP data are from the U.S. Bureau of Economic Analysis. Population data are from the U.S. Bureau of Labor Statistics. All tax and revenue data are from the Bureau of the Census. Tax and revenue data are recorded for the fiscal year which runs from July to June for most states while over data are recorded on a civil year basis. We appropriately convert all data to a civil year basis assuming that revenue is collected and expenditures are spent at a uniform rate during the year.

2.1 Evolution of cross section dispersion of U.S. states GSP

Figure 1 plots the cross-state coefficient of variation of per capita real GSP over the period 1997−2012. One feature of the plot is noteworthy: disparities between U.S. states have fluctuated over the sample period. The dispersion of GSP for U.S. states decreased from a value higher than 0.195 in 1997 to less than 0.18 in 1999, increases slightly before reaching its lowest point in 2003. Afterwards, the coefficient of variation rises, reaching its pick in 2010. Finally, it starts decreasing from 2010 to 2012. While the sharp increase over 2009-2010 is perhaps explained by the 2008 financial crisis, a closer look on the growth dynamic

of U.S. states is necessarily to explain the overall trends of income dispersion.

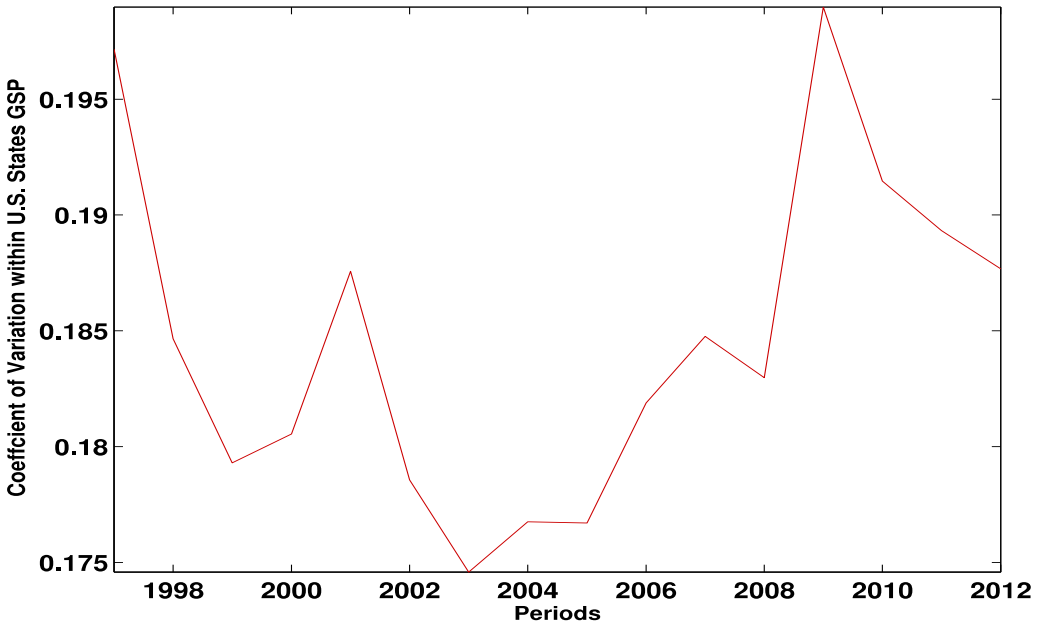

Figure 1: Dispersion of Gross State Product within U.S.

2.2 Evolution of U.S. states GSP over time

Figure 2 compares per capita real GSP in 1997 and in 2012. The states in the left-hand quadrants have per capita GSP lower than U.S. per capita GDP in 1997 while those in the upper quadrants have per capita GSP higher than the average per capita of U.S. in 2012. Then, states located in the upper left-hand quadrant are the fastest-growing states and those in the lower right-hand are the slowest-growing states over the period 1997-2012. The figure shows that U.S. states are concentrated in the lower left-hand and upper right-hand quadrants.

This reveals that per capita real GSP tended to be persistent, suggesting a lack of mobility. However, dramatic changes did occur for some states both up and down. For instance, 10 of the 12 states in the southeastern region were among the poorest state in 1997.

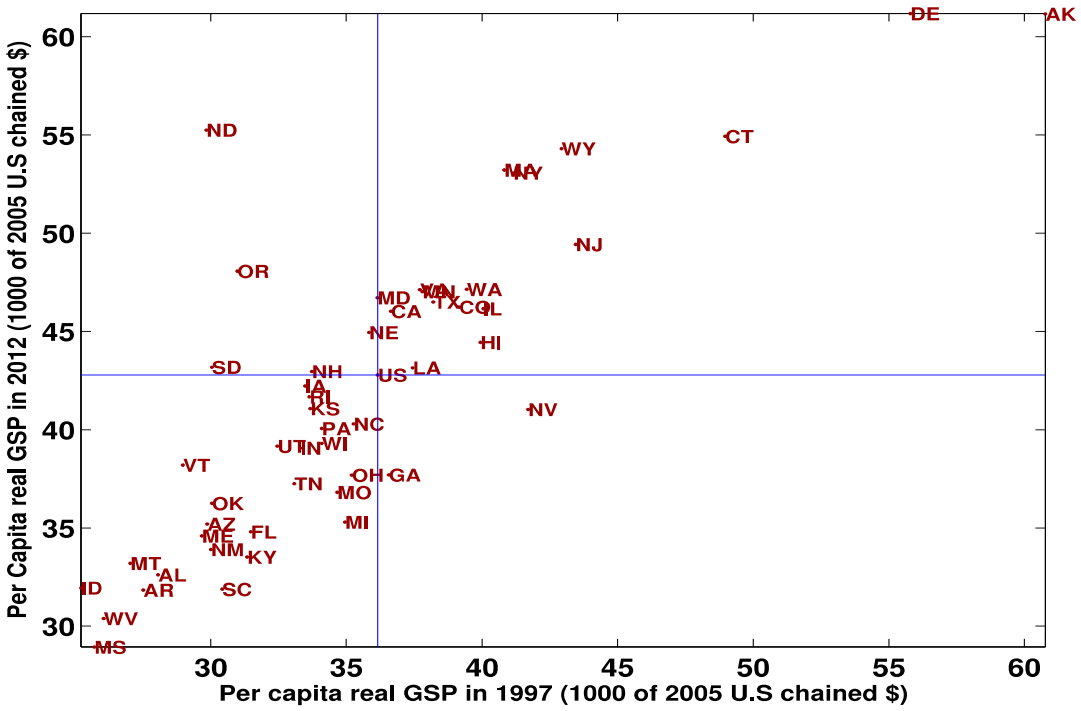

Figure 2: Gross State Product in U.S. over 1997-2012

The three exceptions are Georgia, Virginia and Louisiana. Almost all the states of New England and Great Lakes Regions were among the richest states. New Hampshire, Nebraska, North Dakota, South Dakota and Oregon left the group of the poorest states in 1997 to join the group of richest countries in 2012. Despite these big upward movers, most southern states saw only gradual changes over time. At first glance, these results seem contrary to the evidence that southeastern states have experienced a tremendous growth during the same period. Rather, our conclusion must be seen as complementary to existing studies. It suggests that despite an overall catch-up, southeastern states remain among the poorest states in U.S.

2.3 Physical Capital and real GSP

Before looking at the effects of taxation on economic growth, how does the theory identify the source of growth? A natural starting point for a growth theory is the aggregate production function, which relates the total output of a country to the country's aggregate inputs of factors of production. Factors of production are usually classified into capital, land, and labor. Capital goods are inputs into production that are themselves produced goods or reproducible.

Capital can be divided into physical capital and human capital. According to the exogenous growth model, output is an increasing function of capital inputs with diminishing return. In this study, we borrow the data relative to state level physical capital from Yamarik (2013), which provides state-by-state capital stock and investment estimates for the period 1990 – 2007 in thousands of 2000 U.S. chained dollars. Then, we compute the per capita physical capital for a given year by dividing the physical capital by the civilian labor force for this year. Data relative to civilian labor force are obtained from the Bureau of Labor Statistics.[4] Figure 3 plots per capita physical capital along with per capita real GSP, both averaged over the period 2001 – 2005.

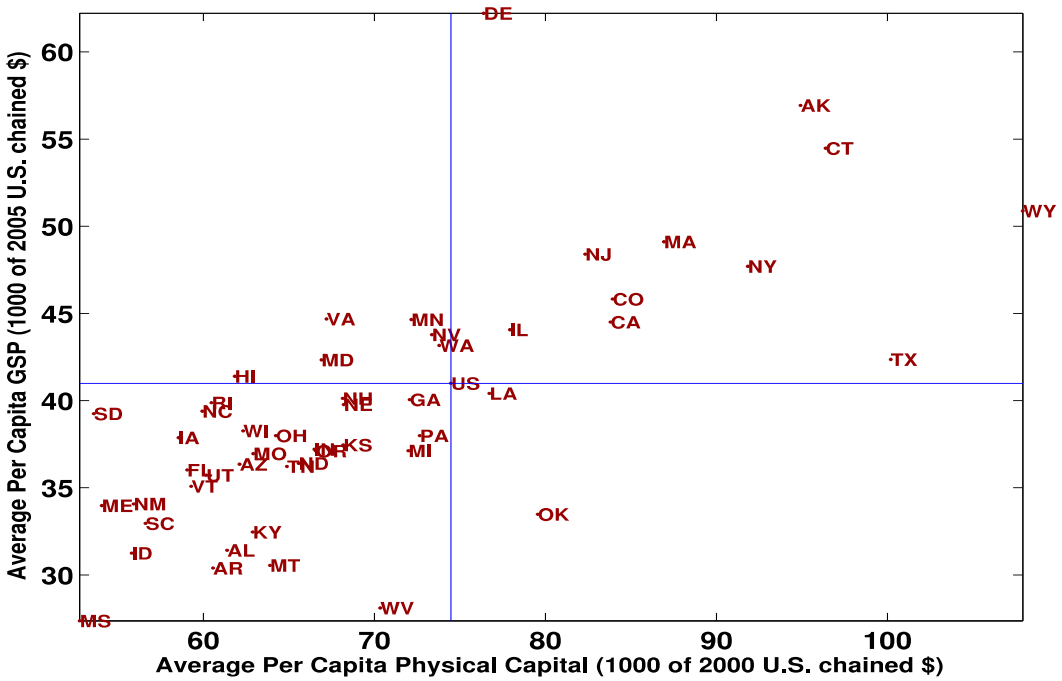

Figure 3: Per capita physical capital and Gross State Product in U.S.

All southeastern states have lower per capita physical capital than the national level. With the exception of Texas (respectively Illinois), all states in the Southwest (respectively Mideast) tend to have much lowest per capita physical capital over all the periods. The graph shows that they also have the lowest GSP over the period. Virginia, Hawaii, Maryland, Minnesota,

[4] States and selected areas: Employment status of the civilian non-institutional population, January 1976 to date, seasonally adjusted.

Nevada, Washington, Oklahoma and Louisiana do not confirm this relationship. The last two have higher per capita physical capital than the U.S average but lower output while the others experienced higher per capita output than the U.S. average with physical capita lower than U.S. average. Let assume there is not a big differential between U.S. states in terms of Total Factor Productivity. In this case, the cross-state dispersion in physical capital and GSP will be consistent only if Oklahoma and Louisiana have lower human capital, and the other six states have higher human capita than the U.S. average.

2.4 Human Capital and real GSP

In the economic growth literature, the use of educational attainment as a proxy for human capital is fairly common. We follow this literature and measure the human capital of a state as the percentage of the population holding a certain degree. For robustness checks, we compute three different proxies of human capital: *Human Capital 1* refers to the proportion in the civilian, non institutional population of 25 years and over ($PCNIP$ 25+) with high school degree or above, *Human Capital 2* is $PCNIP$ 25+ with college degree or above and *Human Capital 3* denotes $PCNIP$ 25+ with bachelor degree or above. Graph 4 plots per capita *Human Capital 3* along with per capita real GSP, both averaged over the period 2003-2005 due to data limitations.

It shows that the data are consistent with our assumption above. In fact, Oklahoma and Louisiana are in the lower left-hand quadrant while all the six other states cited above are in the upper right-hand quadrant. The graph shows U.S. states are not homogenous in terms of per capita human capital. Virginia is the only southern state with per capita human capital higher than the U.S. average per capita human capital. With the exception of Maine, average per capita human capital is much higher in all Far West states than in the U.S..

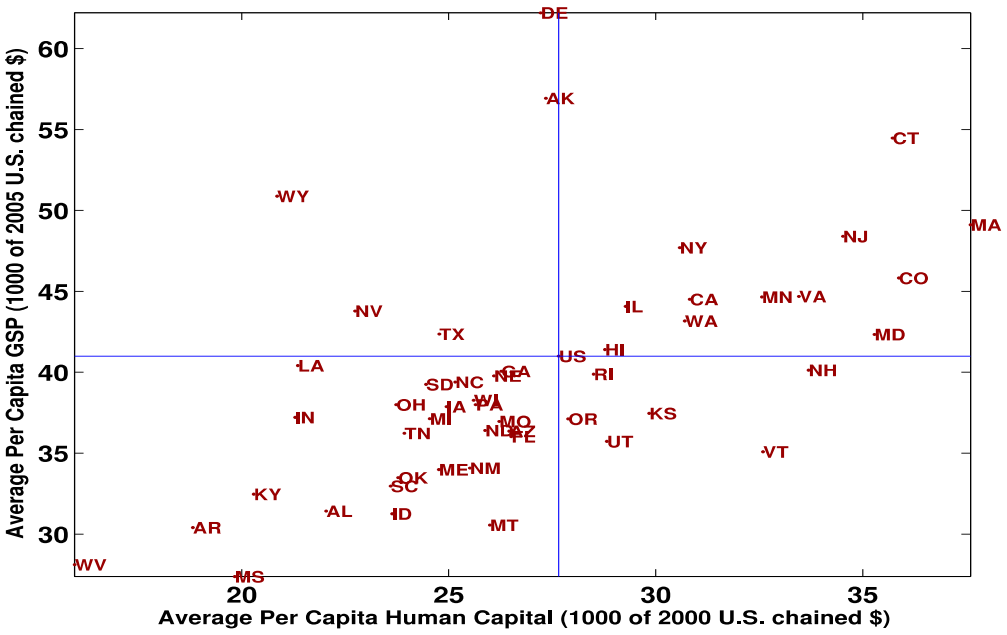

Figure 4: Per capita human capital and Gross State Product in U.S. States

Massachusetts is the richest and West Virginia is the poorest state in terms of per capita human capital in U.S. In the growth theory literature, a broader notion of capital includes human capital and it is an accepted fact that there exists a positive relationship between human capital and output. The data plotted confirm this prediction that there is positive correlation with human capital and output.

2.5 Taxes and Growth across U.S. States

Before looking at the empirical effects of taxes on U.S. states economic growth, this section presents an overview of state and local taxation for the period 1996-2005. Rigorously, when economists are talking about the distortionary effects of taxes, they are really talking about marginal tax rates. Marginal tax rates are defined as the additional taxes paid when the tax base rises by a small amount. For a personal income tax, the marginal tax rate describes shows how much taxes are paid on the last dollar earned from working and investing. But because information to construct state marginal tax rates is not easily available, a variety of tax measures including nominal tax rates, ratios of tax revenue to tax base and estimated

marginal and average tax rates has been used in the literature.[5]

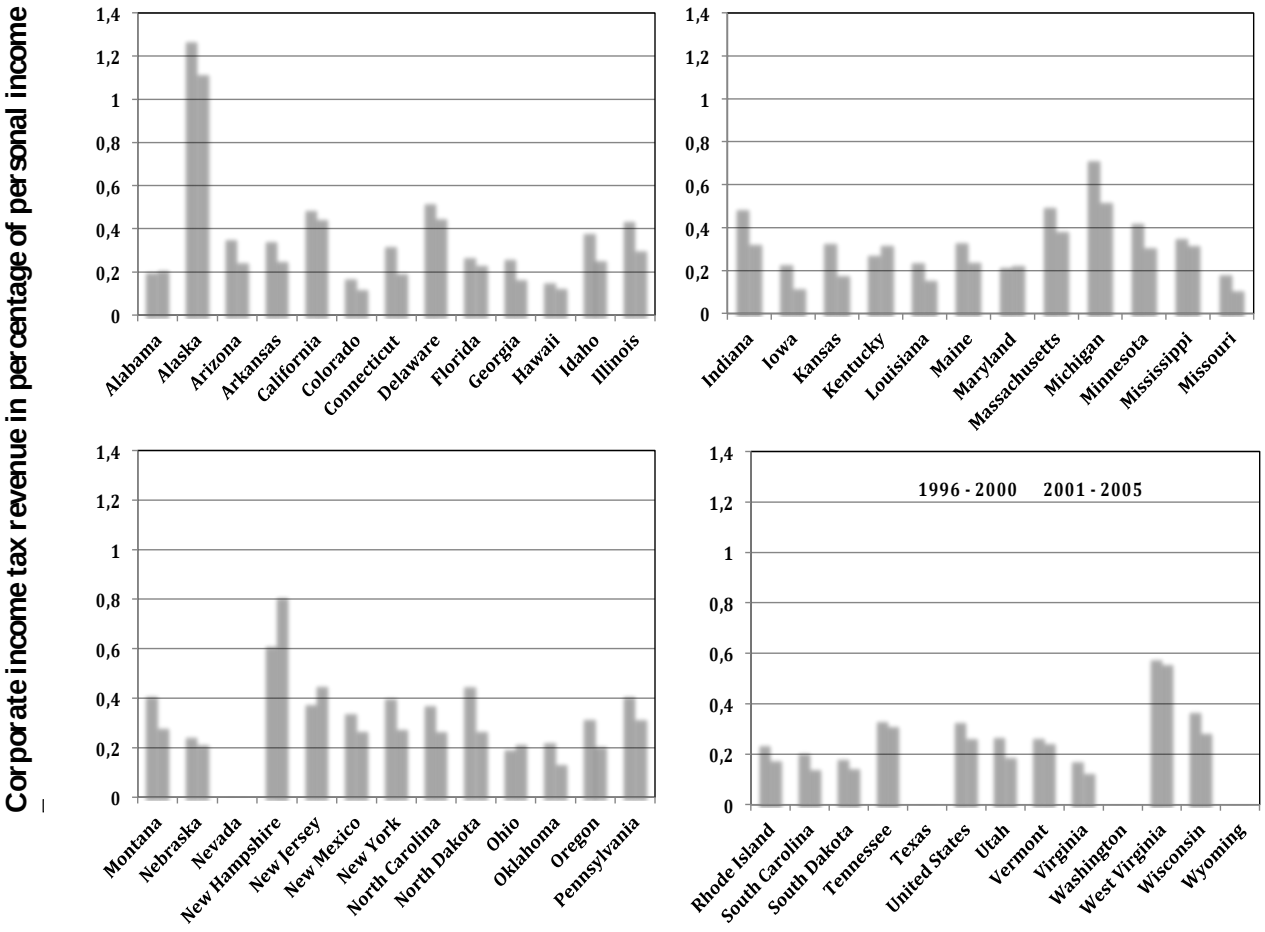

Figure 5: Evolution of state-level corporate income tax rate

Tax burden is by far the most commonly employed measure of state taxation in the literature, and can be seen as the *effective average tax rate*.[6] We follow this literature and use average tax rates as our measure of taxes. In contrast to most studies related to the tax effects on economic growth at subnational level which consider only one measure of taxes, we distinguish three different taxes: individual income tax, corporate income tax and general sales tax. These types of taxes are those, which are used in the vast majority of U.S. states. Moreover, we split the sample into two intervals 1996−2000 and 2001−2005 to gain more insight about the tax rates. Thus, we define the average income tax rate (respectively the

[5] Newman (1983), Benson and Johnson (1986), Yamarik (2000) and Reed (2008) used various tax measures.
[6] Helms (1985), Mofidi and Stone (1990), Mullen and Williams (1994).

average corporate income tax rate) for a given period as the ratio of total state and local individual income tax receipts averaged over the period to the average state personal income over the period. Figures 5, 6 and 7 plot respectively the average corporate income, individual income and general sales tax rate for U.S. states.

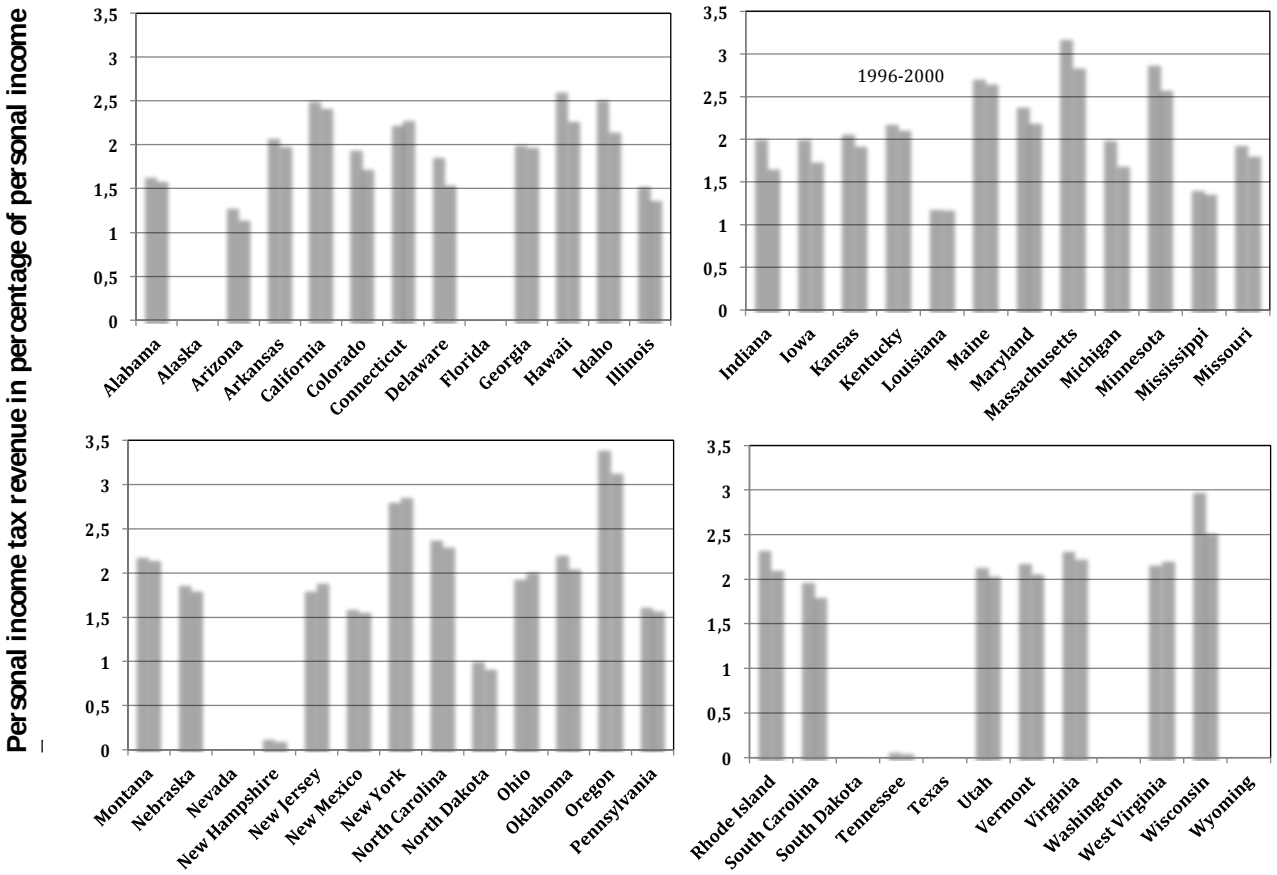

Figure 6: Evolution of state-level personal income tax rate

Comparing tax rates over the period 1996−2000 with those in 2001−2005, it appears that average tax rate decreased for some states, remain unchanged for some others while a last category of states increased their tax rates. Overall evolution of average effective tax rates show that states have reduced income taxes and increased sales taxes. For instance, with the exception of Kentucky, New Hampshire, New Jersey for corporate income tax, figure 5 shows that average corporate income tax rates decrease in all U.S. states over the sample period. This observation also holds true for the individual income tax with the exception of Connecticut, Louisiana, New Jersey, New York, Ohio and West Virginia. On the other hand,

with the exception of eight states,[7] almost all states increase their sales tax rates over the sample period.

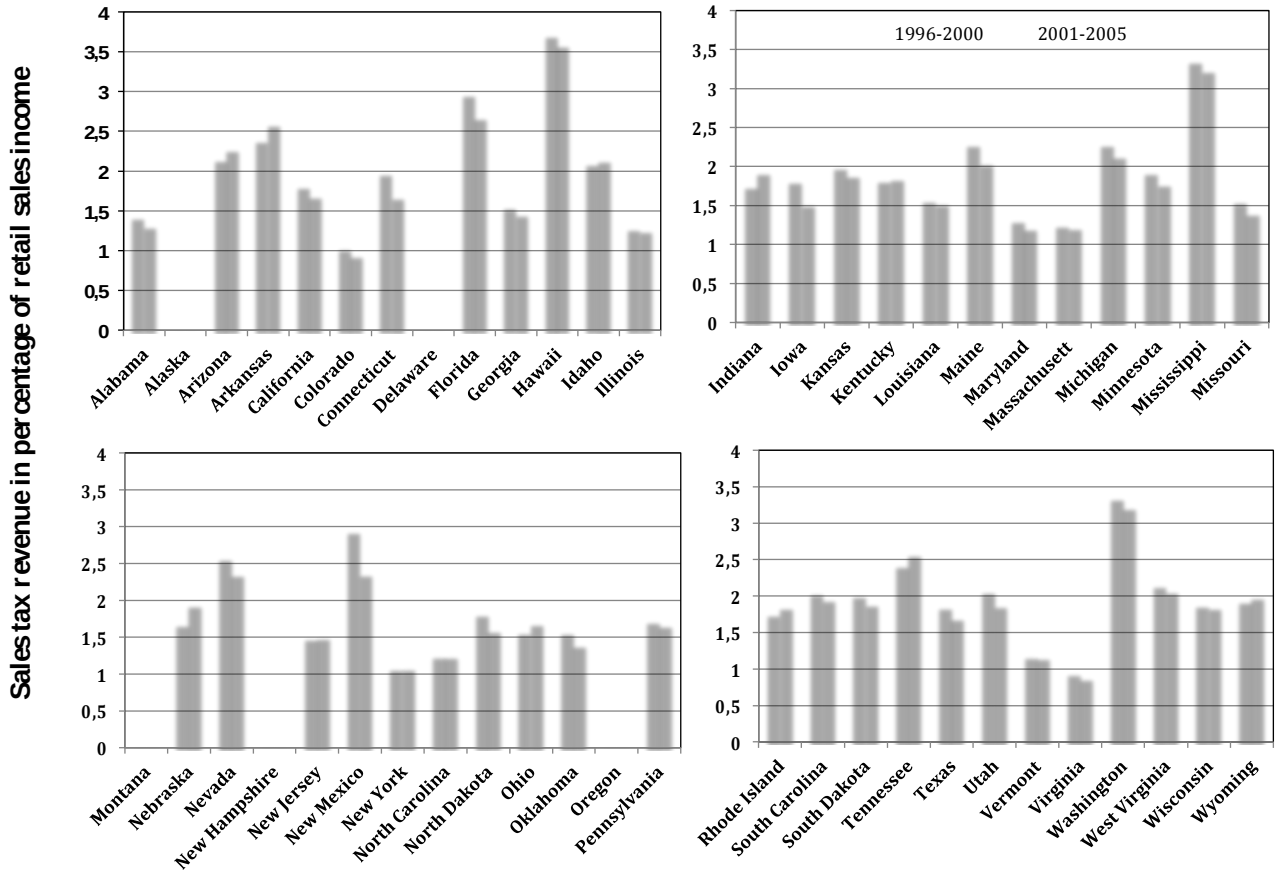

Figure 7: Evolution of state-level sales tax rate

Despite these changes in tax rates, figure 5 highlights that states' tax rates tend to be persistent over time. For instance, the set of states, which have higher average effective tax rates on corporate income, tends to remain the same over the two sub periods. The observation holds true if we consider individual income tax or general sales tax (see charts 6 and 7). To assess this persistence of tax rates, table 1 presents in column 1 the correlation of average tax rates over the sub periods.

It shows that the correlations of average tax rates over the subintervals are positive and very high. Correlations of average tax rates over 1996–2000 range from 0.96 for corporate income tax to 0.99 for Individual income. This fact can be partially explained by the relative short time period covered by the study. The rank correlation of states' tax collections across

[7] Iowa, Maine, Michigan, Missouri, California, Connecticut, New Mexico and Utah.

time periods is also high (column 2 of table) but lower than the correlation of tax rates over periods. This suggests that despite the high persistence of tax rates, average tax rates were enough variable to affect the rank order. So, variation in tax rates may be good candidates for shocks that cause growth rates to vary over the subintervals.

Table 1: Correlation

Type of tax	Autocorrelation		Correlation GSP-tax	
	Tax rate	State rank	Contemporaneous	Delayed
Corporate Income	0.98	0.95	-0.31	-0.27
Individual Income	0.96	0.91	-0.30	-0.31
General sales	0.99	0.96	0.14	0.13

Table 1 presents, in column 3 and 4, the correlations of GSP with contemporaneous and lagged tax rates. It appears that corporate income and general sales tax rates are negatively correlated with per capita real GSP for U.S. states, while there is a positive correlation between individual income tax rates and per capita real GSP. Compared to columns 1 and 2, columns 3 and 4 show that correlation with GSP are around one third of the rank or tax autocorrelation. This fact holds true when we consider either contemporaneous or lagged tax rates. Moreover contemporaneous and lagged correlation coefficients are of the same order. This fact can be explained in part by the high persistence of tax rates. The negative correlation of corporate income and general sales tax with real per capita GSP is consistent with the theoretical prediction that higher tax rates dampen economic growth. While the interpretation of the negative correlation is easy in economic growth theory, the positive correlation of personal income tax rate with per capita GSP is not expected. In fact, it is difficult to distinguish between the influence on growth of initial GSP and taxes. For instance, let assume that positive correlation occurred only because of convergence, i.e. growth rate are negatively correlated to initial GSP, and that individual income taxes have negative growth effects. Since initial GSP is negatively correlated with subsequent growth, taxes and GSP may be positively correlated indirectly through convergence for spurious reasons. On the other hand, suppose that there is no convergence but that individual income

taxes have negative growth effects. In this case, the positive correlation between taxes and GSP would imply negative correlation between growth and initial GSP (again spuriously) through the tax effects. These simple correlations above suggest that a relationship between taxes and growth may exist. We put this hypothesis to test, using Barro[8] regressions in the next section.

3 Econometric Analysis

3.1 Empirical Specification

The main problem in empirical work on the effect of taxes on growth consists in isolating the tax effects from the effects of other variables that may affect solely growth rates or both growth rates and tax rates. For example, variables characterizing initial income impact the rate of convergence, but may also influence taxes. Changes in non-tax government policies may also affect economic growth. So, we have to separate changes in the marginal tax rate from changes in other government policies. The growth literature deals with the latter issue by either holding all spending and transfers constant or keeping revenues fixed. In this study, we address explicitly these issues as follow. Firstly, as discussed above, initial GSP may affect economic growth and we control for potential correlation between growth rate and initial GSP in our regression. Secondly as shown in graph 3, GSP is positively correlated with physical capital and may affect economic growth. A third variable we control for is human capital. In fact the stock of human capital is a determinant of creation of news ideas, which contribute to productivity growth. A fourth issue comes from the fact that taxes may directly influence economic growth through at least two channels. First, they can influence the accumulation of human and physical capital. Second they may affect the way physical capital, human capital, and other resources are allocated by distorting individual behavior. We suspect that some studies have found insignificant effects of sub-national taxes on economic growth because they ignore some other state financial variables. Moreover it is known that there is a trade-off between taxes and public expenditures. On one hand, high taxes decrease after tax return on capital and labor. Since factors are much more mobile

[8] See Barro and Sala-i Martin (1992), Barro (1996) and Barro and Sala-i Martin (1991) for further details.

between states than between countries, higher taxes will potential imply lower factor accumulation and affect economic growth. On the other hand, it is accepted in the growth literature that higher expenditures on infrastructure and education may increase labor productivity and factor accumulation by increasing return on factors. We take this trade-off into account by introducing in our regressions state total tax revenue and expenditures. We follow Helms (1985) and measure expenditures as a proportion of state personal income. Since state and local local taxes and taxes revenue form approximatively a budget identity implying (at least nearly) perfect multicollinearity, we omit public health expenditures. So the estimated coefficients of taxes and other expenditures variables are interpreted as the effect of increasing that variable through an exactly offsetting change in public health expenditure. Finally, a fifth issue is that taxes may have immediate effects on the allocation of resources. They may also have persistent effects, as the effort to smooth adjustment costs causes tax-induced reallocations of resources to be delayed into future time periods. So, we have controlled for delayed tax effects on economic growth. The general specification of our model is as follow:

$$\begin{aligned} Growth\ Rate = {} & \beta_0 + \beta_1 GSP_{1997} + \beta_2 PhysicalCapital_{2001-2005} \\ & + \beta_3 HumanCapital_{2001-2005} + \beta_4 SalesTaxRate_{2001-2005} \\ & + \beta_5 CorporateTaxRate_{2001-2005} + \beta_6 IndividualTaxRate_{2001-2005} \\ & + \beta_7 SalesTaxRate_{1996-2001} + \beta_8 CorporateTaxRate_{1996-2001} \\ & + \beta_9 IndividualTaxRate_{1996-2001} + \beta_{10} NonPublicHealthExp_{2001-2005} \end{aligned}$$

While isolating tax effects on growth require a control for several variables, coefficient estimates are often highly dependent on the particular set of variables included in the regression (Sala-i Martin et al. (2004)). To deal with this problem and have a parsimonious regression, we use selection criteria to determine variable selection. A negative correlation between initial level of GDP and growth is a well-known empirical regularity, reflecting conditional convergence in growth literature. So we expect negative coefficient on GSP1997. Economic theory provides an explanation for a negative relationship between taxes and economic growth. So coefficients on taxes are expected to be negative. The coefficients on physical and human capital are expected to be positive since we assume that output is an increasing function of inputs. The sign of the coefficient on Expenditure is ambiguous due to the trade-off between higher tax rates and infrastructure spending we

highlight above. Ordinary least squares regression analysis adjusted for White's correction is used in the regression analysis.

3.2 Estimated Coefficients and Discussion

We begin by introducing in the regressions only the contemporaneous tax variables. As expected, Column 1 of table 2 show that the coefficients for general tax rates and corporate income tax rates are significantly negative. However the coefficient for individual income tax rate is positive but insignificant.

Table 2: Regression Results

	1	2	3	4	5	6
Sales Tax	-0.12***	-0.13***	-0.13***	-0.10**	-0.10**	-0.10**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Corporate Income Tax	-5.29**	-3.91*	-5.13**	-5.16**	-4.84**	-5.90*
	(2.17)	(2.26)	(2.10)	(2.15)	(2.11)	(3.07)
Individual Income Tax	0.14	0.06	0.07	-0.03	-0.21	-0.21
	(0.68)	(0.65)	(0.71)	(0.69)	(0.71)	(0.72)
GSP 1997		-0.14				
		(0.08)				
Physical Capital			-0.04		-0.07	-0.07
			(0.05)		(0.07)	(0.06)
Human Capital 3				0.21**	0.27**	0.30**
				(0.09)	(0.12)	(0.12)
Expenditures						0.09
						(0.15)
Constant	12.82***	17.38***	15.52***	6.86*	10.34*	9.12
	(2.70)	(3.80)	(5.48)	(3.96)	(5.23)	(5.65)
Observations	50	50	50	50	50	50
Adjusted-R2	0.07	0.10	0.06	0.11	0.13	0.12

Note: *** Significant at 1%; ** Significant at 5%; and * Significant at 10%
Public Health Expenditures is not included in Expenditures

As discussed above, we control for convergence by introducing initial GSP (GSP of 1997) in the regression. Column 2 shows that the coefficient for initial GSP is negative but insignificant. This means that initial GSP has either a negative but negligible effect on growth rate, or has no effect on economic growth. This result can be explained by the fact that the sample-period is too short for convergence forces to be significant. Moreover,

adding initial GSP to the regression does not affect the sign of other coefficients. So we can consider that the sign obtained in column 1 is not spurious. We are entitled to say that higher corporate income or general sales taxes dampen economic growth while individual income tax rate does not affect growth. These results are consistent with the correlation coefficients obtained before. From now, Initial GSP has been dropped from the model since it does not affect growth rate.

We control also for physical capital. Results are presented in column 3. The coefficient for physical capital is not significant meaning that physical capital does not affect growth rate over the period. This result can be partially explained by the fact that there is not a big differential between U.S. states endowments of physical capital. In column 4, we introduce human capital in the regression to control for the effect of education attainment on growth. Here, we consider the proportion of PCNIP 25+ with bachelor degree or above. As expected, the coefficient for human capital is positive. It indicates that higher proportion of qualified people in the labor force stimulates growth. The coefficient for individual income tax remains insignificant. Since growth model assumes that physical capital and labor are complementary inputs in the aggregate production function, we keep human capital in the model and add physical capital to control for cross effect. The results in column 5 indicate that the sign of all coefficients remain the same in comparison to column 4. However, there is an increase in the coefficient for human capital. This result shows that introducing physical capital in the regression strengthens the positive impact of human capital on economic growth. Finally in column 6, we introduce Expenditure other than public health spending in the model. The coefficient for expenditure is not significant meaning that increasing non public-health expenditure by reducing public-health expenditures does not affect economic growth. By comparing columns 5 and 6, it appears that introducing non public-health expenditure in the regression magnifies the positive effects of human capital on economic growth and exacerbates the negative effects of general sales tax and corporate income tax rates on economic growth. It also increases the coefficient, in absolute value, for all other variables while keeping their sign unchanged. The result in column 6 is the general result we used. We consider the R-squared as selection criteria and it increased from one regression to another from column 1 to column 6. Dropping initial GSP from the regression does not decrease of the R-Squared meaning that having GSP in the equation does not

improve the performance of the model.

We undertake several robustness checks presented in table 3.

Table 3: Sensitivity Analysis

	7	8	9	10	11	12	13
Sales Tax	-0.10**	-0.10**	-0.13***	0.34	-0.11**	-0.10**	
	(0.04)	(0.04)	(0.04)	(0.27)	(0.04)	(0.04)	
Corporate Income Tax	-5.35**	-5.08**	-4.52**	-4.91**	-9.85	-4.91**	
	(2.29)	(2.41)	(2.24)	(1.98)	(7.08)	(2.18)	
Individual Income Tax	0.16	0.16	0.09	-0.21	-0.38	-1.04	
	(0.65)	(0.68)	(0.67)	(0.68)	(0.79)	(2.94)	
Human Capital 1	0.24						
	(0.15)						
Human Capital 2		0.20**					
		(0.08)					
Average GSP1996 – 2000			-0.10				
			(0.08)				
Physical Capital				-0.07	-0.07	-0.06	-0.07
				(0.06)	(0.07)	(0.07)	(0.07)
Human Capital 3				0.33***	0.28**	0.26**	0.27**
				(0.10)	(0.12)	(0.12)	(0.12)
Lag Sales Tax				-0.48			-0.11**
				(0.28)			(0.04)
Lag Corp. Income Tax					4.98		-4.26*
					(6.89)		(2.12)
Lag Ind. Income Tax						0.78	-0.04
						(2.70)	(0.64)
Constant	-8.17	1.47	16.30***	9.28*	10.23*	10.33*	10.35**
	(12.18)	(5.20)	(3.95)	(5.13)	(5.21)	(5.26)	(5.02)
Observations	50	50	50	50	50	50	50
Adjusted-R2	0.10	0.14	0.07	0.17	0.12	0.11	0.13

Note: *** Significant at 1%; ** Significant at 5%; and * Significant at 10%
Public Health Expenditures is no included in Expenditures

Firstly, we start by using alternative measure of human capital. Results in column 7 show that the coefficient of human capital remains positive but becomes insignificant when we use the proportion of PCNIP 25+ with higher school degree or above as a proxy of human capital. This can be explained by the fact that the proportion of people with higher school degree does not vary much across U.S. states. In column 8, when we consider the proportion of PCNIP 25+ with college degree or above, the coefficient for human capital becomes significant. In other words all things equal elsewhere, a state with higher proportion of PCNIP 25+ with college degree or above experiences a higher growth rate. Furthermore, the

coefficient of the proportion of PCNIP 25+ with college degree or above in column 8 is lower than that of the proportion of PCNIP 25+ with bachelor degree or above in column 10 of table 3. This result indicates that the more qualified the labor force, the higher is the marginal contribution of human capital to growth rate.

In column 9 of table 3, we introduce the average GSP over the initial sub period 1996 – 2000 instead of initial GSP to control for the convergence effect. Again the coefficient for the initial income is not significant. This result supports our conclusion above that convergence forces are not operating over the sample period.

From columns 10 to 12, we control for delayed effects of tax rates by introducing one lag tax rate per column. Results in column 4 indicate the coefficient for contemporaneous tax rate becomes insignificant when delayed general sales tax rate is introduced in the regression. The observation holds true for contemporaneous corporate income tax rate as in column 11. In column 12, we consider delayed personal income tax rate, the sign of all coefficients remain the same as compared to the situation, where we don't control for delayed effect of individual income tax rate. In column 13, we drop all contemporaneous tax rates from the regression while introducing all the delayed tax rates. The results are qualitatively similar to what we get when using contemporaneous tax rates. More precisely, corporate income and general sales taxes rate affect negatively and significantly economic growth while individual income tax rate does not affect economic growth. In other words, delayed tax rates affect economic growth in the same way as contemporaneous tax rates. These results can be explained by the high persistence of tax rate over the sample period revealed by the correlations above. This high persistence of tax rate also partially supports the results of columns 10 to 12. For instance, if the correlation between the contemporaneous and delayed rates of a given tax rate is very high as in our case, introducing simultaneously the two variables in the regression poses the problem of multicollinearity. This may explain why the coefficients of both tax rates become insignificant when introduced simultaneously.

Overall, we find that increasing individual income tax rate to finance public health does not affect economic growth while increasing corporate income and general sales tax dampen economic growth. The observation holds true regardless to which tax rate (contemporaneous or delayed) is used. However, the high persistence of tax rates over the sub-periods may imply multicollinearity problem, which prevent from having significant effects of corporate

income and general sales tax rates when we consider both contemporaneous and delayed taxes. Moreover, highly qualified labor force stimulates growth while physical capital does not affect growth. Finally, the sample period is too short to allow convergence forces to significantly impact economic growth.

4 Conclusion

This paper focuses on a specific question: Do state and local taxes matter for sub-national economic growth? To answer this question, we explore the growth dynamics of U.S. states other the period 1997-2012. We find that cross sectional dispersion within U.S. states GSP varies widely over time. A review of the history of GSP and subnational tax policies reveals that GSP as well as tax rates are highly persistent over time. Simple correlation analysis suggests that average corporate income and general sales tax rates are negatively correlated to GSP, while personal income tax rates is positively weakly correlated with GSP. Moreover, we present evidence that educational attainment and per capita physical capital are essential and complementary in determining U.S. states' GSP. In addition, we find substantial heterogeneity in physical and human capital within U.S. states. Regression analysis is used to estimate the impact of state and local taxes on subnational economic growth. In order to isolate the impact of taxes, we control for convergence, initial condition such as physical and human capital and other government policies variables. By distinguishing between corporate income, general sales and individual income tax rates, we find a significant negative impact of higher corporate income and general sales tax rates on economic growth while individual income tax rates does not significantly affect growth rate. Our explanation is that even if changes in tax rates are expected, individuals are less likely to adjust their behavior than corporations. Moreover, educational attainment affects positively economic growth and this finding is robust to alternative education levels. However the results fail to support a significant convergence result due to the relatively small length of the period covered by the study. Our results show that the heterogeneity in physical capital endowment within U.S. states is not enough to explain differences with states' economic growth rates.

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