Taxes and Economic Growth in the U.S. States: A Meta-Regression Analysis

by

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Abstract A key goal of economic policy-makers is economic growth. Tax policy is frequently mentioned as an important determinant of economic growth. However, estimates of the effect of taxes on economic growth vary widely in the research literature. This paper uses a procedure called "meta-regression analysis" (MRA) to study estimates from previous studies to better understand why they report different findings. By empirically controlling for these differences in study characteristics, I can potentially identify "policy signals" beneath the "noise" of alternative empirical designs. I analyse 939 individual estimates of the effects of state-level taxes on state-level economic growth in the US drawn from 27 primary studies. All the studies use similar growth and tax variables, but differ in important specification and estimation features. This study focuses on the US because each state sets an independent tax policy, while sharing a common legal and cultural framework. This makes it easier to assume that other factors that affect economic growth are being held constant. I find no evidence for publication bias or evidence of any overall significant adverse tax-growth effect. However, personal income tax, corporate income tax and property tax have a larger positive growth impact compare to other types of taxes.

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1 Introduction

A fundamental goal of economic policymakers is to encourage economic growth. Tax policy is considered one of the principal determinants of state economic growth to achieve this goal. Most economists would agree that some taxes and some government expending are essential for economic growth, but economic theory and empirical evidence to date is unclear on where the negative economic effects of increasing taxes start to outweigh the positive effects of increasing state spending.

On the one hand, high tax rates can reduce economic growth because they reduce the incentive to work hard, invest, and spend. On the other hand, taxes are necessary to fund investments in infrastructure, provide public goods and correct market failures or externalities. Understandably, the effect of tax policies on economic growth has been the focus of numerous academic studies. This is especially true regarding US states. The reason being that, the American states have many common features such as language and their legal systems, but within this set of common institutional features, each state sets an independent tax policy. This provides 50 “laboratories” to evaluate the consequence of different tax policies. However, no consensus exists among these studies about whether taxes enhance or retard economic growth in the US.

While some empirical studies find that state and local taxes have a measurable and consistently adverse impact on state economic growth, other studies reach the opposite conclusion. Many more are mixed, ambivalent, or show any adverse impacts are small (Mazerove, 2013).

From a theoretical point of view, there are competing theories about what determines economic growth. Some subscribe to Keynesian, or demand side factors, others to Neoclassical, or supply-side factors, while yet others subscribe to some mixture of the two or something entirely unique (McBride, 2012).

From an empirical point of view, most studies try to figure out the true relationship between taxes and economic growth by considering various model specifications. There are several difficulties investigating the true relationship between taxes and economic growth. These include how to measure tax variables accurately, whether to aggregate different types of taxes or decompose them into their constituent parts, and which variables should be included in the model to control for spending and borrowing. Regardless of which model specifications are applied, it is not meaningful to evaluate the effect of tax or expenditure changes in isolation: both the sources and the uses of funds must be considered.

Given the diversity of findings on the effect of taxes on state economic growth, I conduct a meta-regression analysis (MRA) on existing studies on the impact of taxes on economic growth. The technique of meta-analysis was first applied in medical science to synthesize the results from experiments or clinical trials, and is increasingly popular in social science and specifically in economics. This approach allows us to integrate the results obtained from the previous body of work and thus uncover the potential sources of variation by showing which study characteristics play more important role than the others in the empirical results.

A systematic review of existing studies produces 939 regression estimates derived from 27 empirical studies. The studies include both published and unpublished research over the period 1991 to 2014. The distribution of the results is as follows: 10 percent of the estimates are positive and statistically significant, 27 percent are positive and statistically insignificant, 25 percent are negative and statistically significant and 38 percent of the estimates are negative and statistically insignificant. This wide variation in empirical findings is one of the primary reasons as to why policymakers have difficulty in formulating policies when considering their impact on economic growth.

The studies estimating the effect of tax on economic growth differ greatly in terms of the data and methodology used. I account for 43 aspects of studies and estimates including the type of tax (e.g., sales, income, etc.); how taxes are measured (e.g., marginal, statutory, effective); inclusion of controls; publication status; estimation methodology; an allowance for dynamic effects; length of the sample; and state composition of the sample. I find no evidence for publication bias and an overall zero effect of tax on economic growth.

The remainder of this paper is structured as follows. Section 2 provides a brief review of theoretical issues and also a discussion about how studies have dealt with the measurement of tax rates. Section 3 briefly discusses the related literature on the topic. Section 4 provides an overview of the data collection procedure and discusses the descriptive statistics. Section 5 discusses the methodology and analyses the meta-regression results. The study ends with a conclusion.

2 Taxes and Economic Growth

There are some potential problems regarding research on the true relationship between taxes and economic growth. First, the net effect of tax on growth is theoretically uncertain and depends on both the structure of the tax and also the structure of its financing. The second problem is due to the difficulty of measuring tax accurately.

2.1 Theoretical Issues

Traditional exogenous growth theory, developed by Solow and Swan (1956), predicts that while fiscal policy and changes in tax rates specifically affect economic growth in the short run, there is no long run relationship between the two. Turning to endogenous growth theory, the relation between fiscal policy and growth becomes more uncertain.

The effects of taxes on economic growth depend theoretically on the level of taxes and what tax revenues are spent on, as well as empirically on comparisons based on empirical estimates of the actual linkage between fiscal structure and economic growth. In 1985, Helms developed an innovative approach to including fiscal variables in his empirical work. He formulated a budget equation for the jurisdiction in question, in his case, the state. For state and local governments combined, the budget deficit (or surplus) is equal to the sum of all state and local revenue sources (denoted by subscript i) less the sum of state and local spending on various functions (denoted by j):

$$Deficit(surplus) = \sum REV(i) - \sum EXP(j)$$

Helms then included all but one of the revenue and expenditure items in the empirical equation for economic growth in the states.

To test the predictions of endogenous growth models with respect to the structure of both taxation and expenditure, Kneller, Bleaney, and Gemmell (1999) classify elements of the government budget into one of four categories: distortionary (tax on income and property) or non-distortionary (taxes on consumption) taxation, and productive or non-productive expenditures (see Appendix B for these classifications).

Thus, the net growth effect of simultaneous state and local taxes and spending changes on a state's economy is ambiguous depending upon the relative magnitudes of the parameters.

2.2 Measurement Issues

One of the main sources of the variation of findings of empirical studies might be due to different measures of tax rates, so the main question is how to measure tax rates accurately. Unfortunately, economic theory provides no clear answer to this question. As a result, two different approaches are considered in empirical work. The first approach is to distinguish between overall taxes and various categories of taxes. While the former measures the total tax burden, the latter measures the effect of different types of tax such as personal income taxes, corporate income taxes, property taxes, sales taxes and other taxes.

Another approach is to distinguish taxes based on definition: the average tax rate and the marginal tax rate. Average tax rates are defined as the ratio of total state and local taxes receipts to state personal income. Engen and Skinner (1992) and Easterly and Rebelo (1993) showed that average tax rates are strongly correlated with public spending. Marginal tax rates are defined as the additional taxes paid when personal income rises by a small amount. For example, for a personal income tax, the marginal tax rate describes a person’s tax bracket and shows how much taxes are paid on the last dollar earned from working and investing. Since economic decisions depend on the marginal tax rate, this measure is more appropriate for investigating the effect of taxes on growth. However, marginal tax rates are not easily observable and empirical work often has to make use of average tax rates as an alternative, average tax rates being calculated by dividing total tax revenues by GDP.

3 Review of Empirical Studies

A significant amount of research has been devoted to estimating the effect of tax policies on economic growth, mainly because most policymakers put great emphasis on structuring tax policy to be conducive to economic development. Nevertheless, the general picture that emerges from the empirical literature is that the empirical evidence is inconclusive.

Studies summarizing different empirical studies in the form of a narrative review can shed a light on the research question. The two examples of such a review are summarized by Bartik (1992) and Wasylenko (1997).

Bartik examines 84 econometric studies conducted since 1979 which assess the impact of state and local taxes on economic growth in the U.S. He concludes that the long run elasticity of business activity with respect to state and local taxes is between -0.10 and -0.6 for studies focusing on intermetropolitan or interstate business economic activity and between -1.0 and -

3.0 for intrametropolitan areas. Although Bartik's study is a comprehensive narrative review on the topic, it suffers from not controlling for a variety of study characteristics that may have influenced the measured elasticity.

Wasylenko begins with a review of issues associated with the design and estimation of economic activity as a function of tax policy. He concludes that the magnitude (and even direction) of the effects of tax policy on development are scattered. Wasylenko reports a wide range of tax elasticities, from -1.54 to 0.54, which depend primarily on the data used as the dependent variable (particularly micro-versus aggregate-level data), methodology, and time period of analysis. However, the median tax elasticity in each of the dependent variable categories is negative and generally small. For example, studies that specify gross state product as the dependent variable (most relevant to the current study as discussed below) report a median tax elasticity of -0.07. That is, given a 1% increase in some tax parameter, gross state product declines by only 0.07 percent.

While conventional narrative reviews can be quite insightful, they suffer from several limitations. A systematic review differs from conventional narrative reviews by conducting an exhaustive search. At best, conventional narrative reviews serve as vote-counts of the number of studies that find a significant effect versus those that do not. Moreover, systematic reviews are distinguished from conventional narrative reviews in that they require all research results be included and identified through an explicit and comprehensive search strategy. Finally, what makes meta-regression analysis more attractive than conventional narrative review is that a meta-regression analysis can also identify omitted variables and add new and relevant information unavailable to the original study (Stanley, 2012).

Due to the shortcoming discussed, narrative reviews have been replaced by systematic reviews and meta-analyses specifically. The two examples of such studies (MRA) are discussed as follows.

Phillips and Goss (1995) are the first to conduct a meta-analysis of the effect of state and local taxes on economic growth in the U.S. They re-examine the 84 of studies reviewed by Bartik to derive more precise estimates and to determine the importance of the inclusion and omission of key variables. They conclude that most differences in analytical technique (other than the inclusion of public services) do not lead to substantial differences in results, with the possible exception of failing to control for fixed effects.

The meta-analysis by Nijkamp and Poot (2004) departs from the previous one in several important ways. First, they conduct a meta-analysis on the more general topic; the impact of fiscal policies on long-run growth. They examine 93 published studies yielding 123 observations about the relationship between economic growth and one of five types of fiscal policies: (i) government consumption, (ii) tax rates, (iii) defence, (iv) education expenditures, and (v) public infrastructure. Second, while previous study examines tax-growth studies at the states level, this study considers studies both in developed and developing countries. They conclude that tax-funded spending on both education and infrastructure are positively associated with long-run economic growth. In contrast, tax-funded spending on defence is generally associated with a negative impact on economic growth.

4 Data

Like all empirical analysis, data is required for meta-regression analysis (MRA). However, MRA needs its own database created by conducting an exhaustive search and collecting the most relevant and comparable studies. The empirical literature typically employs a basic econometric model that relates a dependent variable, Y_{st} measuring economic growth for state s at time t, to a vector of explanatory variables, X_{st}. Included in X_{st} are variables measuring state-level taxes. The relationship between Y_{st} and X_{st} can be represented by the following specification:

$$Y_{st} = f(X_{st}) + \varepsilon_{st} ,$$

where ε_{st} is assumed to be an identically and independently distributed error term.

A preliminary search of the literature using the keywords combination "state and local taxes and state economic growth" was independently conducted through several online databases and search engines including EconLit, Google Scholar, JSTORE, RePEc, SSRN, Ebsco, Social Science Citation Index, Scopus and so on. Additionally, an extensive manual search was also performed to identify additional articles. There are no restrictions on the thoroughness of the search conducted, so in addition to peer-reviewed journals all unpublished papers including dissertations, reports and working paper series were searched. All articles identified as potentially eligible were reviewed in detail to ensure that the criteria for inclusion were met. I also conducted both backward and forward citation searching.

As mentioned earlier, numerous studies have examined the relationship between taxes and economic growth. However, a meaningful meta-analysis requires comparable original studies and the inclusion/exclusion selection criteria are designed to fulfil this requirement. Thus, to be included in the data set, a study must meet following criteria.

1. Reported econometric estimates: Studies providing sufficient statistical information to calculate the effect sizes such as regression coefficient, standard errors, and t-values/p-values (in my case partial correlation coefficient) are included. Studies that fail to report the necessary results are not included. Thus, many reports including government reports and also narrative reviews such as state of art are excluded from the dataset.
2. Economic growth as the dependent variable: Various variables such as the unemployment rate or the level of income are commonly considered as proxies for economic performance in the literature. Including either GSP growth or PCPI growth as the dependent variable is another restriction.
3. At least one measure of taxes as the explanatory variable: There are various types of taxes including sales taxes, personal income taxes, corporate income taxes, property taxes, tax burden, average income tax , other taxes, marginal income tax and tax rates ,so one or more measure of state-level taxes as an independent variable is crucial.
4. Region: Since there are 50 U.S. states plus District of Columbia in United States, including at least 44[1] contiguous states in each original study is essential.

Once all papers through the search strategy explained above have been collected, a list of all prominent authors who have worked on tax-growth effect and their contact details was prepared. I sent them a letter explaining the research and the inclusion criteria attached with the bibliography of all papers collected, I ask them if they happen to know any other papers not available in my bibliography or any new or unknown scholars such as PhD students working on the same area.

In the end I am left with 27 comparable studies, which report 939 empirical estimates (all studies are in English prior to and including April 2014). The search and data coding procedure followed the recently published MAER-NET protocols (Stanley et al., 2013).

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1. The reason why less than 50 states are considered is that outlier states such as Alaska and Hawaii and also the District of Columbia were excluded from sample in most studies due to several reasons such as the limited labour mobility of these states (Alaska and Hawaii), construction of a pipeline and receiving a substantial portion of tax revenue in the form of severance taxes (Alaska) and also for not being a state and idiosyncratic (District of Columbia).

The next step after collecting the studies is to calculate effect sizes for each study. Effect sizes are comparable measures of a relationship. Several different effect size statistics are available such as estimated elasticities, regression coefficients, partial correlation coefficients, and Fisher's Z-transformed partial correlation coefficients (see Hunter and Schmidt, 2004). In this study I use partial correlation which is a statistical measure of the directional strength of the association between taxes and economic growth, holding other variables constant. This means that for a study to be included in the meta-analysis it had to report information on sample size and a regression coefficient or another statistic which could be converted to partial correlations, such as standard errors or t-statistics.

Due to the inconsistency in the use of measurement units of regression variables in the literature, all estimates were converted into a common and comparable measure called a partial correlation coefficient (PCC). The partial correlation coefficient can be calculated as:

$$r = \sqrt{\frac{t^2}{t^2+df}}$$

where t and df denotes the t-statistic and degrees of freedom, respectively. The standard error of the partial correlation is given by:

$$V(r) = \sqrt{\frac{1-\mathrm{r}^2}{df}}\,.$$

While the partial correlation coefficient (r) is easy to calculate and is comparable across studies, it suffers from three shortcomings:

1. It contains a very small downward bias.
2. It is truncated and censored ($-1 \leq r \leq 1$).
3. The variance of r depends on its value.

For the three reasons mentioned above, the partial correlation coefficient (r), is transformed into the Fisher's (Z_r) as follows:

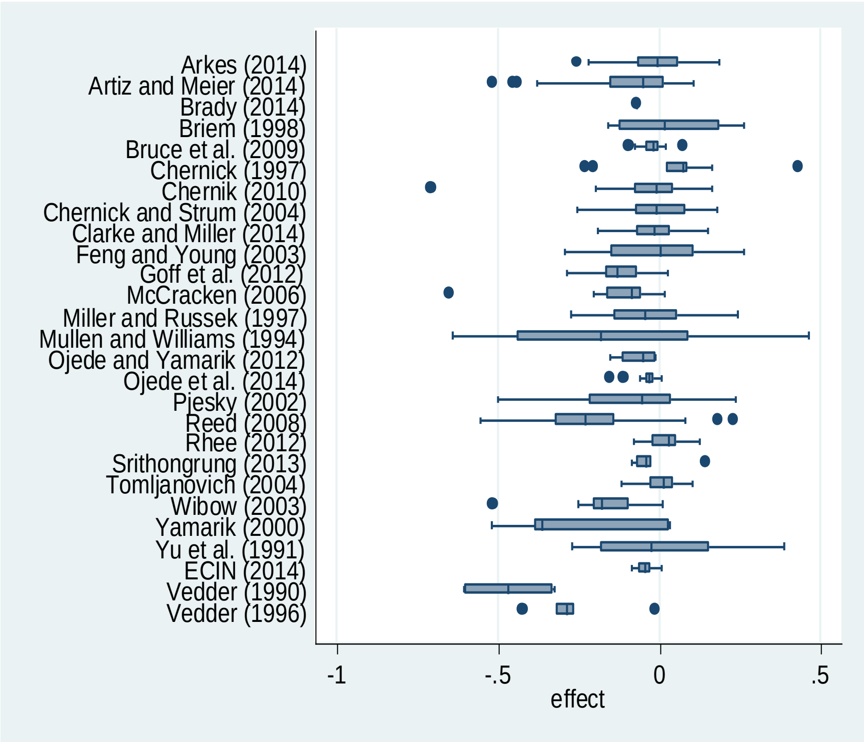
$$Z_r = 0.5\ln[(1+r)/(1-r)]$$

And so the variance is:

$$V[Z_r] = 1/(n-3)$$

Figure 1 depicts the within and between-study dispersion in the partial correlation coefficients of tax-growth estimates reported in the 27 studies examined in this meta-analysis. It is clear that the literature is highly heterogeneous, both between and within studies. MRA will help us to formally trace the source of this heterogeneity.

Figure 1 Variability in the estimated tax-growth effects across individual studies



The distribution of the reported estimates is illustrated in Figures 2 and 3 in the form of a funnel plot, which is a common method to detect publication selection (Sutton et al. 2000). A funnel graph is a scatter diagram of effect sizes (here partial correlation coefficients and Fisher's Z transformation of the correlation) versus some measure of its precision, which is best measured by the inverse of the standard error ($1/SE_i$).

As can be seen from the funnel plots in Figures 2 and 3 they are fairly symmetric. Although the distribution of the studies to the left side of the funnel seems relatively more concentrated, there is no clear asymmetry in the funnel graph.

Figure 2 Funnel plot, partial correlations of the effect of taxes on economic growth

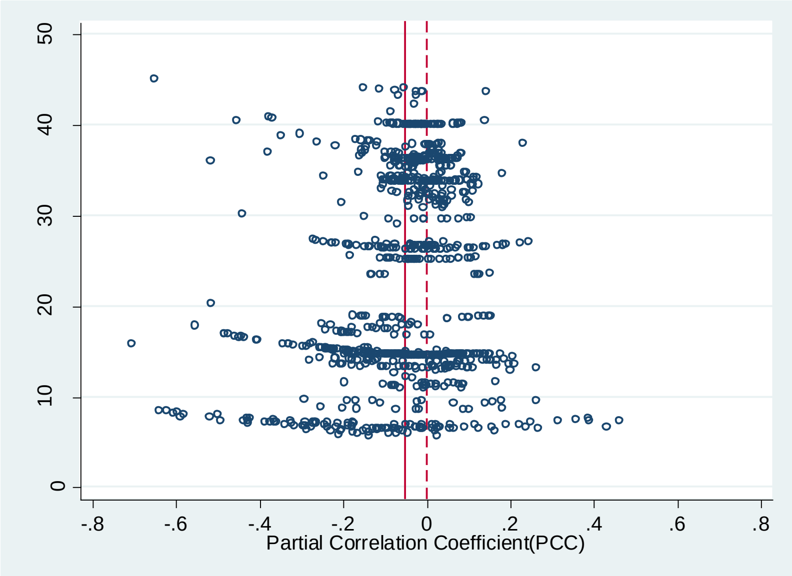
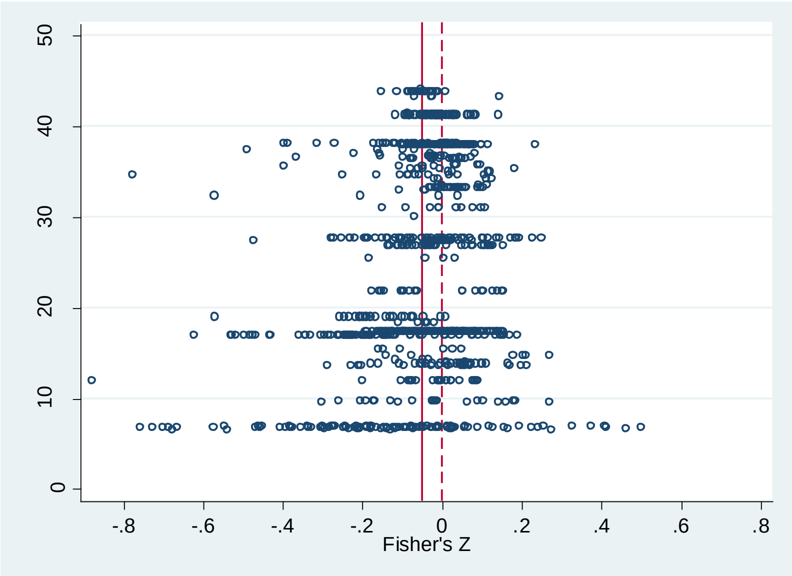


Figure 3 Funnel plot, Fishers Z-transformed partial correlations of the effect of taxes on economic growth



Moderator variables are constructed to capture and to explain differences in the reported estimates derived from the original studies. The potential moderator variables included in the MRA, together with their respective means and standard deviations are defined in Table 1. Eleven classes of explanatory variables are considered.

Table 1 Potential explanatory variable for Meta-Regression Analysis

Variable	*Description*	*Mean*	*SD*
Partial correlation	Partial correlation coefficient between taxes and economic growth. The response variable.	-0.05	0.14
Standard error	Standard error of partial correlation used to correct publication selection bias.	0.06	0.04
Fisher's Z	Fisher's Z – transformed partial correlation.	-0.05	0.15
Standard error	Standard error of Fisher's Z (to correct publication bias).	0.05	0.04
Publication characteristics			
Journal	=1, if the estimate comes from a study published in a peer-reviewed journal.	0.39	0.49
PubYear	The year study was published.	2008.9	6.68
Economic Growth measures			
GSP	=1, if GSP growth is used as DV in the original studies.	0.24	0.43
PC-GSP	=1, if per capita GSP growth is used as DV.	0.12	0.33
PCPI	=1, if PCPI growth is used as DV.	0.56	0.50
PI	=1, if PI growth is used as DV. (Omitted category)	0.08	0.27
Tax variables measures			
PI-Tax	=1, if personal income tax is used.	0.26	0.44
CO-Tax	=1, if corporate income tax is used.	0.10	0.30
SA-Tax	=1, if sales tax is used.	0.10	0.30
PR-Tax	=1, if property tax is used.	0.08	0.27
OT-Tax	=1, if other taxes are used.	0.11	0.31
Overall tax	=1, if the overall tax (no decomposition) is used. (Omitted category)	0.35	0.48
Other tax specification-General			
Marginal	=1, if the marginal form of tax is used.	0.20	0.40
Differenced	=1, if the differenced form of tax is used.	0.15	0.36
Num-Tax	The number of tax variables in the estimation.	3.15	2.11
ETR	=1, if the tax variable in estimation is effective tax rate as opposed to a statutory tax rate.	0.69	0.46
Other tax specification-Lagged form			
First-Lag	=1, if the first lagged form of tax is used.	0.28	0.45
More-Lag	=1, if the second/more lagged form of tax is used.	0.06	0.23
No-Lag(current)	=1, if no lag is used.(Omitted category)	0.66	0.47
Other tax specification-Predicted tax effect based on "theory"			
Pred-Neg	=1, if the theoretical prediction of the coefficient is negative.	0.07	0.26
Pred-Pos	=1, if the theoretical prediction of the coefficient is positive.	0.03	0.17
Pred-Ambiguous	=1, if the theoretical prediction of the coefficient is ambiguous. (Omitted category)	0.89	0.31
Control variables characteristics-General			
HLK	=1, if at least 2 of 3 control variables (K, L, H) are included.	0.25	0.44
FE	=1, if the state fixed effects is considered in estimation.	0.69	0.46
Initial-Inc	=1, if initial level of output (convergence theory) is included.	0.44	0.50
Lag-DV	=1, if lagged dependent variable is included.	0.26	0.44
Control variables characteristics-Standard Error Calculation			
SE-HAC	=1, if both heteroskedasticity and autocorrelation standard error are considered.	0.34	0.47
SE-HET	=1, if heteroskedasticity standard error is considered.	0.09	0.29
SE-OLS	=1, if OLS standard error is considered. (Omitted category)	0.57	0.49

Table 1 Potential explanatory variables for Meta-Regression Analysis (continued)

Variable	*Description*	*Mean*	*SD*
	Data Characteristics		
CSTS(Panel data)	=1, if panel data as opposed to cross-sectional data is used.	0.89	0.31
Interval	The time interval "between observations" from the same state used in the primary studies.	4.91	7.03
Num-Years	The length of sample time period.	27.05	8.78
AvgYear	The average year of data used in the primary studies.	1989.07	7.80
	Estimation characteristics		
GLS	=1, if Generalized Least Squares estimator is used.	0.42	0.49
GMM	=1, if Generalized Method of Moments estimator is used.	0.06	0.24
TSLS	=1, if Two-Stage Least Squares estimator is used.	0.04	0.20
OLS	=1, if OLS estimator is used. (Omitted category)	0.47	0.50
	Region(US States) characteristics		
None	=1, if all the states are included.	0.09	0.29
AK	=1, if Alaska is excluded.	0.19	0.39
DC	=1, if District of Columbia is excluded.	0.17	0.38
AKHIDCOthers	=1, if states including (AK, HI, DC, others) are excluded.	0.06	0.23
AK, HI, DC	=1, if states including (AK, HI, DC) are excluded. (Omitted category)	0.48	0.50

Note: The grouped variables include all possible categories and the omitted categories are in parentheses.

5 The Meta-Regression Methodology

The most basic approach to estimating the mean tax-growth effect involves regressing comparable estimated effect ($effect_{ij}$) between taxes and state economic growth upon a constant and an error term:

$$effect_{ij} = \alpha_0 + v_{ij} \quad (1)$$

Where $effect_{ij}$ is the *i*th estimated effect from the *j*th study and v_{ij} is the random error. Equation (1) assumes that the reported effects of taxes on state economic growth vary randomly around a central effect α_0. Hence, α_0 is the MRA estimate of the mean tax-growth effect, after allowing for random sampling error. A test of $H_0: \alpha_0 = 0$ is a test for whether there is a real effect between taxes and economic growth, where the magnitude of α_0 informs us about the size of the effect.

One of the main concerns in the MRA approach is publication selection bias. This might happen because studies reporting statistically insignificant results or coefficients with wrong signs based on relevant theories are less likely to be published. Thus, the sample will not be a representative of the population of studies. Publication selection bias is detected as a statistically significant relationship between an effect and its standard error. In the absence of publication bias, there should be no relationship between an estimate and its standard error. The standard test for this is to estimate FAT-PET MRA:

$$effect_{ij} = \alpha_0 + \alpha_1 SE_{ij} + \varepsilon_{ij} \tag{2}$$

where SE_{ij} is the estimate's standard error. MRA model (2) accommodates selective reporting through the $\alpha_1 SE_{ij}$ term. The idea is that studies with smaller samples and thereby larger standard errors, SE_{ij}, will be required to engage more intensively in selection through remodelling, resampling, and further estimation in order to achieve statistical significance. The term $\alpha_1 SE_{ij}$ is a rough approximation to the amount of publication bias. The funnel-asymmetry test (FAT) is the conventional way to detect whether or not there is publication selection bias: $H_0: \alpha_1 = 0$ (Egger et al., 1997; Stanley, 2008).

Tables 2-1 and 2-2 report the basic FAT-PET MRA results. Heteroskedasticity is always an issue for meta-regression analyses, because the original estimates, which are the dependent variable, come from very different datasets with different sample sizes and different estimation techniques. Thus, some version of weighted least squares (WLS) should always be employed. Furthermore, authors in this literature typically report multiple estimates; therefore, estimates within the study cannot be assumed to independent from one another. To account for these data complexities, Tables 2-1 and 2-2 report WLS estimates that adjust for this within-study dependence, through cluster-robust standard errors and random-effects unbalanced panels. As can be seen in Table 2-1 (DV=PCC) and also Table 2-2 (DV=Fisher's Z), regarding publication selection bias, the results are mixed. There is no statistical evidence of publication selection bias in almost all cases except WLS (RE) without considering study fixed effects (see FAT in Table 2-1). However, I find evidence of publication selection bias as shown in Table 2-2, both WLS (RE) with and without considering study fixed effects (see FAT in columns 3 and 5).

On the one hand, as can be seen later in the multiple meta-regression analysis, the preferred general-to-specific approach removes the standard error variable from the meta-regression. On the other hand, differences in quality can lead to heterogeneity in effect estimates and unless properly captured, the heterogeneity can wrongly be perceived as publication bias.

Thus, there might be possible publication bias, but most likely what is really being picked up here is effect heterogeneity and in general the presence of publication selection bias won't be supported once the various dimensions of the research are considered.

A valid method to identify whether there is a genuine empirical effect remaining after accommodating and filtering potential reporting bias is to test $H_0: \alpha_0 = 0$ (Stanley, 2008). Among 939 estimates of tax-growth effect, there is no evidence of a genuine nonzero effect (see PET in both Tables 2-1 and 2-2). However, the simple WLS estimates for either measure of economic growth (PCC or Fisher's Z) represent a statistical signal of an adverse effect (see column 1 of Table 2-1 and Table 2-2). The magnitude of this adverse effect, -0.03, is small.

Table 2-1 FAT-PET MRA (DV=PCC)

Variables	**(1) WLS(FE)**	**(2) FAT-PET (FE)**	**(3) FAT-PET (RE)**	**(4) FAT-PET (FE)**	**(5) FAT-PET (RE)**
Intercept: $\hat{\alpha}_0$	-0.03*	-0.01	-0.01	0.02	0.01
(PET)	(-2.27)	(-0.30)	(-0.35)	(0.81)	(0.93)
$SE_{ij}: \hat{\alpha}_1$	-	-0.66	-0.70*	-0.77	-0.52
(FAT)		(-1.12)	(-2.19)	(-0.94)	(-1.28)
Study FE	*NO*	*NO*	*NO*	*YES*	*YES*
Adjusted R^2	0	0.01	0.02	0.17	0.24
n	939	939	939	939	939
Standard Error	0.11	0.11	0.13	0.10	0.11

Note: The dependent variable is the partial correlation coefficient between taxes and economic growth.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). Columns 1 and 2 report estimates of Eq. (1) and (2). Columns 3 and 4 consider study fixed effects. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.

Table 2-2 FAT-PET MRA (DV= Fisher's Z – transformed partial correlation)

Variables	**(1) WLS(FE)**	**(2) FAT-PET (FE)**	**(3) FAT-PET (RE)**	**(4) FAT-PET (FE)**	**(5) FAT-PET (RE)**
Intercept: $\hat{\alpha}_0$	-0.03*	0.002	-0.01	0.03	0.03
(PET)	(-2.30)	(0.11)	(-0.05)	(1.19)	(1.73)
$SE_{ij}: \hat{\alpha}_1$	-	-0.96	-0.88***	-1.32	-1.03**
(FAT)		(-1.57)	(-2.65)	(-1.32)	(-2.06)
Study FE	*NO*	*NO*	*NO*	*YES*	*YES*
Adjusted R^2	0	0.02	0.04	0.17	0.24
n	939	939	939	939	939
Standard Error	0.11	0.10	0.13	0.10	0.11

Note: The dependent variable is the Fisher's Z – transformed partial correlation.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). Columns 1 and 2 report estimates of Eq. (1) and (2). Columns 3 and 4 consider study fixed effects. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.

As can be clearly seen from the funnel plot in Figures 2 and 3, there is substantial heterogeneity among the reported tax-growth effects even in the most precise estimates. The use of different datasets, different control variables, and different estimators all produce wide heterogeneity in reported estimates. MRA can be used to explore the source of this heterogeneity in reported tax-growth effects.

To accommodate for heterogeneity equation (2) can be expanded:

$$effect_{ij} = \alpha_0 + \alpha_1 SE_{ij} + \sum \beta Z_{ij} + \varepsilon_{ij} \quad (3)$$

The term Z is a vector of moderator variables, which is defined as explained variation in reported estimates.

Tables 5 and 6 (see Appendix C) provide the main results of my meta-regression analysis. Table 3 represents a summary of all results reported in the Table 5-1, 5-2, 6-1 and 6-2 (column 4 only). Various classes of heterogeneity are analysed. I start off with a general meta-regression model by including all 36 moderator variables; the first two columns report the general model based on equation (3). I then apply a general-to-specific (GETS) modelling procedure. In this model selection approach, the least statistically significant variables are removed, one at time, until only statistically significant variables remain. The statistically significant variables are the core coefficients. The last two columns report results derived from applying a general-to-specific modelling strategy to the results reported in first two columns.

Table 3 Multiple Meta-Regression Analysis, a comparison

DV	**PCC**	**Fisher's Z**	**PCC**	**Fisher's Z**
Variables	**FE (Specific)**	**FE (Specific)**	**RE (Specific)**	**RE (Specific)**
Constant	-0.115*** (-3.24)	-0.023 (-0.78)	-0.088 (-1.28)	0.082*** (2.78)
Journal	-	-	-	-
PubYear	-	-	-	-
GSP	-	-	-	-
PC-GSP	0.045*** (2.64)	0.035*** (2.58)	-	-
PCPI	0.047* (1.83)	-	-	0.033* (1.72)
PI-Tax	0.086*** (5.29)	0.081*** (7.20)	0.077*** (3.72)	0.085*** (4.02)
CO-Tax	0.100*** (3.00)	0.093*** (3.46)	0.108*** (4.36)	0.114*** (4.46)
SA-Tax	-	-	-	-
PR-Tax	0.045*** (3.31)	0.038*** (4.72)	0.045*** (3.87)	0.049*** (3.93)
OT-Tax	-	-	-0.038*** (-2.77)	-0.034** (-2.28)
Marginal	-0.084*** (-5.74)	-0.088*** (-5.49)	-0.115*** (-3.42)	-0.117*** (-3.36)
Differenced	-	-	-0.054*** (-3.22)	-0.048** (-2.19)
Num-Tax	-	-	-	-
ETR	-0.094*** (-6.16)	-0.077*** (-5.96)	-0.083*** (-4.94)	-0.095*** (-5.29)
First-Lag	-	-	-	-
More-Lag	0.018** (2.21)	-	-	-
Pred-Neg	-	-	-	-
Pred-Pos	-	-	-	-
HLK	-	-	-0.041** (-2.44)	-0.045** (-2.13)
FE	-	-	-0.049*** (-2.87)	-0.040* (-1.91)
Initial-Inc	-	-	-0.041** (-2.32)	-0.041* (-1.89)
Lag-DV	-	-	0.078*** (3.11)	0.058** (2.27)

Table 3 Multiple Meta-Regression Analysis, a comparison (continued)

DV	**PCC**	**Fisher's Z**	**PCC**	**Fisher's Z**
Variables	**FE (Specific)**	**FE (Specific)**	**RE (Specific)**	**RE (Specific)**
SE-HAC	-	-	-	-
SE-HET	-	-	-	-
CSTS	-	-	0.134** (2.45)	-
Interval	-0.011* (-1.83)	-	-	-
Num-Years	0.003*** (4.14)	0.001* (1.74)	-	-
AvgYear	-	-	-	-
GLS	-0.049** (-2.21)	-	-0.069*** (-2.68)	-0.080*** (-2.99)
GMM	-0.046*** (-4.10)	-0.033*** (-2.94)	-0.063*** (-3.95)	-0.054** (-2.41)
TSLS	-	-	-	-
None	-	-	-	-
AK	-	-	0.112*** (4.40)	0.102*** (3.36)
DC	-	-	-	-
AKHIDCOthers	-0.085** (-2.42)	-	-	-
Standard Error	1.142 (1.38)	-0.661 (-1.46)	0.564 (1.53)	-0.472 (-1.48)
NO.Observations	939	939	939	939
NO. Studies	27	27	27	27
Adjusted R^2	0.223	0.170	0.256	0.245

Note: The dependent variables for the first and third columns are partial correlation coefficients. However, the dependent variables for the second and fourth columns are Fisher's Z – transformed.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimates of Eq. (3); all columns report a general-to-specific modelling approach (review of the last columns in previous tables). WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively (This Table represents a summary of all results reported in the Table 5-1, 5-2, 6-1 and 6-2 (column 4 only)).

Based on the results as shown in the tables, most of the variables included in the multivariate regression are statistically insignificant. This is mainly because these variables having no effect at all on the reported PCC or Fisher's Z and partly because of the presence of multicollinearity, which is a common problem in MRA.

In the fixed effects model it is assumed that all studies come from a population with a fixed average effect size, meaning that all studies are assumed to share a common tax-growth effect. Accordingly, the observed effect size is assumed to vary from one study to another because of (1) random sampling error and (2) systematic differences due to their different research processes (within study variation). In contrast, in the random effects model, the assumption is that studies were drawn from populations that differ from each other in ways that could affect the treatment effect (Borenstein et al., 2007). In this case, the effect size will vary due to sampling error (the fixed effects model), systematic differences due to the research process, and also due to random differences between studies (between study variations). This model is more appropriate if the source of differences between studies cannot be identified. The results derived from random effects and fixed effects are quite different in this study. This suggests that the apparent heterogeneity in the reported results is of the random effects kind.

Not surprisingly, almost all moderator variables have the same influence in either partial correlation coefficients or Fisher's Z. However, none of them indicate a representative genuine tax effect on growth, because this effect depends on several factors. The most important characteristics which can explain heterogeneity amongst the reported effects are the main focus of the ensuing discussion.

The different measures of economic growth and taxes may be an important source of variation in empirical results. In Table 3, there are three growth variables included in the PCC-FE specification (GSP, PC-GSP, and PCPI) and the omitted variable is (PI). Positive coefficients on PC-GSP and PCPI indicate that the partial correlations associated with these specific growth variables report larger effect than the partial correlations associated with personal income growth. Five tax variables (PI-Tax, CO-Tax, SA-Tax, PR-Tax, and OT-Tax) are included in the PCC-FE specification. Overall-Tax is the omitted variable in this specification. Positive and significant coefficients on PI-tax, CO-Tax, and PR-Tax means that the partial correlations associated with these specific tax variables are slightly greater than the partial correlations associated with overall tax. Studies considering the marginal form of tax, on average, have slightly lower partial correlation coefficients than those not taking that to account. Studies applying effective tax rates as opposed to statutory tax rates have slightly lower partial correlation coefficients, on average. Taking more than one lag for tax variables in the study results in slightly greater partial correlation coefficients than those considering the current period. As far as the estimation methodology is concerned, both GLS and GMM imply slightly lower partial correlation coefficients compared to OLS. Both Interval and Num-Years are study characteristics that affect the size of tax correlations. However, the effect is quite small. Finally, studies excluding Alaska, Hawaii, and District of Columbia in conjunction with excluding other states have slightly lower partial correlation coefficients than those that just exclude Alaska, Hawaii and District of Columbia. A similar summary of the results and interpretation of them occurs when the dependent variable is Fisher's Z transformed.

As mentioned earlier, it is not meaningful to evaluate the effect of tax or expenditure changes in isolation: both the sources and the uses of funds must be considered. This point has been demonstrated by Helms (1985) and is followed by Kneller, Bleaney and Gemmell (1999). One of the classes coded in Table 1 is "Predicted tax effect based on theory". By considering both distortionary/ non-distortionary taxes and also productive /unproductive expenditure, the class "Other tax specification-Predicted tax effect based on "theory" " was aimed to predict the net effect of tax on economic growth.

Table 4 Growth effect of taxes and expenditure

Net Effect		Public Spending	
		Productive	Unproductive
Taxes	Distortionary	Positive/negative	Negative
	Non-distortionary	Positive	Positive/negative

While I try to control for the aspect mentioned above, I cannot find any evidence to confirm this hypothesis.

6 Conclusion

The impact of state and local taxes on economic growth has been an enduring question. The importance of this issue is reflected by the large number of empirical studies devoted to the issue. However, the general picture that emerges from the empirical evidence is rather inconclusive and heterogeneity in the estimates seems apparent. This provides a reason to conduct a systematic analysis of the empirical literature to see if there are any dominant results.

The findings of 27 empirical studies were analysed by applying meta-regression analysis. The variation in reported estimates can be explained by study-specific factors such as the way taxes have been measured, whether a study has been published or not, the time period covered by the original studies, the states excluded from the analysis, the econometric methods applied, and so on.

Using two different measures of effect size (PCC and Fisher's Z) and same moderator variables for 939 tax-growth estimates, the main results of the analysis can be summarized as follows:

First, I cannot find statistical evidence that the literature on taxes and economic growth suffers from a publication bias for either measure of effect size (PCC or Fisher's Z).

Second, the MRA results indicate no evidence of a practically meaningful adverse overall effect of taxes on economic growth. The average partial correlation of tax on growth is almost zero. This study identifies several research dimensions that can explain why different studies are getting different results on the same research question.

The main important characteristics that can explain variation across studies regarding the above impact are the different measures and types of taxes, the different measures of economic growth, the different econometric methodologies used, the presence or absence of lags, whether marginal or effective forms of taxes are used, and which the of the 50 U.S. states are omitted in the studies. However, three types of taxes including personal income tax, corporate income tax and property tax play important role in economic growth than others.

The conclusions that emerge from the present review are obviously not the whole story about tax effectiveness. Tax policy, though important, is only one of the determinants of economic growth. Finally, the central contribution of this study is to identify the most relevant study characteristics that explain heterogeneity in the effect and can be applied to improve research design of further empirical research.

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Appendix A: Empirical studies included in the MRA

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Appendix B:

Theoretical aggregation of functional classifications

Theoretical classification	Functional classification
Distortionary taxation	Taxation on income and profit
	Social security contributions
	Taxation on payroll and manpower
	Taxation on property
Non-distortionary taxations	Taxation on domestic goods and services
Other revenues	Taxation on international trade
	Non-tax revenues
	Other tax revenues
Productive expenditures	General public services expenditure
	Defense expenditure
	Educational expenditure
	Health expenditure
	Housing expenditure
	Transport and communication expenditure
Unproductive expenditures	Social security and welfare expenditure
	Expenditure on recreation
	Expenditure on economic services
Other expenditures	Other expenditures (unclassified)

Note: functional classifications refer to the classifications given in the data source.

Source: Kneller, Bleaney, and Gemmell (1999)

Appendix C:

Table 5-1 Multiple Meta-Regression Analysis, WLS (FE)

Variables	(1) General	(2) General	(3) Specific(G-to-S)	(4) Specific(G-to-S)
Constant	2.359	4.758	0.040***	-0.115***
	(0.55)	(1.44)	(3.01)	(-3.24)
Journal	-0.001	-0.006	-	-
	(-0.04)	(-0.25)		
PubYear	-0.0002	-0.0005	-	-
	(-0.10)	(-0.22)		
GSP	0.046	0.042	-	-
	(1.50)	(1.32)		
PC-GSP	0.089**	0.078**	0.046**	0.045***
	(2.20)	(1.99)	(2.31)	(2.64)
PCPI	0.086***	0.083***	0.044*	0.047*
	(2.73)	(2.63)	(1.75)	(1.83)
PI-Tax	0.069**	0.079**	0.074***	0.086***
	(2.44)	(2.41)	(4.86)	(5.29)
CO-Tax	0.080*	0.092**	0.088***	0.100***
	(1.87)	(2.06)	(2.68)	(3.00)
SA-Tax	0.010	0.023	-	-
	(0.33)	(0.63)		
PR-Tax	0.027	0.038	0.034***	0.045***
	(1.00)	(1.24)	(2.90)	(3.31)
OT-Tax	-0.044*	-0.033	-0.021**	-
	(-1.74)	(-1.11)	(-1.98)	
Marginal	-0.083***	-0.081***	-0.086***	-0.084***
	(-3.78)	(-3.76)	(-5.35)	(-5.74)
Differenced	-0.023	-0.031	-	-
	(-1.17)	(-1.41)		
Num-Tax	0.005	0.002	-	-
	(1.07)	(0.48)		
ETR	-0.090***	-0.091***	-0.103***	-0.094***
	(-3.58)	(-3.90)	(-5.93)	(-6.16)
First-Lag	-0.001	-0.003	-	-
	(-0.10)	(-0.26)		
More-Lag	0.016	0.018	0.020**	0.018**
	(1.07)	(1.23)	(2.15)	(2.21)
Pred-Neg	-0.001	-0.005	-	-
	(-0.06)	(-0.41)		
Pred-Pos	-0.036	-0.038	-	-
	(-1.44)	(-1.50)		
HLK	-0.001	0.0005	-	-
	(-0.04)	(0.02)		
FE	-0.021	-0.024	-	-
	(-1.30)	(-1.44)		
Initial-Inc	-0.044	-0.037	-0.058***	-
	(-1.36)	(-1.20)	(-2.96)	
Lag-DV	0.014	0.020	-	-
	(0.44)	(0.66)		

Table5-1 Multiple Meta-Regression Analysis, WLS (FE), (continued)

Variables	**(1) General**	**(2) General**	**(3) Specific(G-to-S)**	**(4) Specific(G-to-S)**
SE-HAC	-0.025	-0.023	-	-
	(-0.92)	(-0.75)		
SE-HET	-0.044	-0.038	-	-
	(-0.80)	(-0.66)		
CSTS	-0.013	-0.015	-	-
	(-0.18)	(-0.20)		
Interval	-0.005	-0.013*	-	-0.011*
	(-1.13)	(-1.80)		(-1.83)
Num-Years	0.002	0.003***	-	0.003***
	(1.34)	(2.54)		(4.14)
AvgYear	-0.001	-0.002	-	-
	(-0.41)	(-0.90)		
GLS	-0.070***	-0.066***	-0.065**	-0.049**
	(-2.78)	(-2.64)	(-2.07)	(-2.21)
GMM	-0.052**	-0.056***	-0.051***	-0.046***
	(-2.46)	(-2.52)	(-4.23)	(-4.10)
TSLS	0.027	0.034	-	-
	(0.90)	(1.16)		
None	-0.041	-0.016	-0.045***	-
	(-0.98)	(-0.32)	(-2.85)	
AK	0.085**	0.081**	0.080**	-
	(2.44)	(2.42)	(2.41)	
DC	0.015	0.024	-	-
	(0.62)	(1.18)		
AKHIDCOthers	-0.069*	-0.080***	-0.068***	-0.085**
	(-1.93)	(-2.70)	(-2.50)	(-2.42)
Standard Error	-	1.508	-	1.142
		(1.55)		(1.38)
NO.Observations	939	939	939	939
NO. Studies	27	27	27	27
Adjusted R^2	0.231	0.240	0.212	0.223

Note: The dependent variable is the partial correlation coefficient between taxes and economic growth.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimates of Eq. (3); the last two columns using a general-to-specific modelling approach. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.

Table 5-2 Multiple Meta-Regression Analysis, WLS (FE)

Variables	**(1) General**	**(2) General**	**(3) Specific(G-to-S)**	**(4) Specific(G-to-S)**
Constant	2.428	2.910	0.042***	-0.023
	(0.62)	(0.86)	(2.84)	(-0.78)
Journal	-0.001	-0.011	-	-
	(-0.36)	(-0.45)		
PubYear	-0.0004	-0.0004	-	-
	(-0.18)	(-0.19)		
GSP	0.039	0.038	-	-
	(1.34)	(1.24)		
PC-GSP	0.082**	0.079*	0.029**	0.035***
	(2.07)	(1.95)	(2.22)	(2.58)
PCPI	0.073**	0.072**	-	-
	(2.41)	(2.30)		
PI-Tax	0.061**	0.064**	0.074***	0.081***
	(2.40)	(2.34)	(5.20)	(7.20)
CO-Tax	0.072*	0.076*	0.087***	0.093***
	(1.80)	(1.84)	(2.87)	(3.46)
SA-Tax	-0.0003	0.004	-	-
	(-0.01)	(0.14)		
PR-Tax	0.018	0.021	0.033***	0.038***
	(0.75)	(0.84)	(3.19)	(4.72)
OT-Tax	-0.050**	-0.046	-0.021**	-
	(-2.09)	(-1.69)	(-2.25)	
Marginal	-0.082***	-0.081***	-0.088***	-0.088***
	(-3.89)	(-3.84)	(-5.40)	(-5.49)
Differenced	-0.024	-0.025	-	-
	(-1.30)	(-1.34)		
Num-Tax	0.004	0.004	-	-
	(1.10)	(0.92)		
ETR	-0.078***	-0.079***	-0.088***	-0.077***
	(-3.13)	(-3.20)	(-6.42)	(-5.96)
First-Lag	0.0007	0.0001	-	-
	(0.06)	(0.01)		
More-Lag	0.016	0.017	0.021*	-
	(1.17)	(1.22)	(1.95)	
Pred-Neg	-0.035	-0.005	-	-
	(-1.52)	(-0.41)		
Pred-Pos	-0.035	-0.036	-	-
	(-1.52)	(-1.54)		
HLK	-0.011	-0.010	-	-
	(-0.37)	(-0.34)		
FE	-0.022	-0.022	-	-
	(-1.42)	(-1.41)		
Initial-Inc	-0.042	-0.040	-0.051***	-
	(-1.31)	(-1.25)	(-3.00)	
Lag-DV	0.018	0.019	-	-
	(0.58)	(0.62)		

Table 5-2 Multiple Meta-Regression Analysis, WLS (FE), (continued)

Variables	(1) General	(2) General	(3) Specific(G-to-S)	(4) Specific(G-to-S)
SE-HAC	-0.024	-0.024	-	-
	(-0.84)	(-0.83)		
SE-HET	-0.055	-0.053	-	-
	(-1.03)	(-0.94)		
CSTS	-0.008	-0.004	-	-
	(-0.12)	(-0.60)		
Interval	-0.005	-0.008	-	-
	(-1.12)	(-1.39)		
Num-Years	0.001	0.002	-	0.001*
	(1.01)	(1.44)		(1.74)
AvgYear	-0.0008	-0.001	-	-
	(-0.36)	(-0.49)		
GLS	-0.068***	-0.067***	-0.044*	-
	(-2.70)	(-2.63)	(-1.71)	
GMM	-0.051**	-0.052**	-0.051***	-0.033***
	(-2.34)	(-2.33)	(-4.23)	(-2.94)
TSLS	0.030	0.032	-	-
	(1.06)	(1.12)		
None	-0.047	-0.039	-0.042***	-
	(-1.20)	(-0.85)	(-3.57)	
AK	0.082**	0.081**	0.078**	-
	(2.19)	(2.17)	(2.33)	
DC	0.023	0.025	-	-
	(0.97)	(1.21)		
AKHIDCOthers	-0.074**	-0.077***	-0.050***	-
	(-2.08)	(-2.31)	(-2.20)	
Standard Error	-	0.555	-	-0.661
		(0.61)		(-1.46)
NO.Observations	939	939	939	939
NO. Studies	27	27	27	27
Adjusted R^2	0.217	0.217	0.183	0.170

Note: The dependent variable is the Fisher's Z – transformed partial correlation.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimates of Eq. (3); the last two columns using a general-to-specific modelling approach. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.

Table 6-1 Multiple Meta-Regression Analysis, WLS (RE)

Variables	**(1)** **General**	**(2)** **General**	**(3)** **Specific(G-to-S)**	**(4)** **Specific(G-to-S)**
Constant	0.876 (0.25)	2.466 (0.84)	-0.011 (-0.26)	-0.088 (-1.28)
Journal	0.009 (0.38)	0.0003 (0.01)	-	-
PubYear	-0.0008 (-0.60)	-0.001 (-0.79)	-	-
GSP	0.034 (1.30)	0.024 (0.86)	-	-
PC-GSP	0.069** (2.25)	0.049 (1.62)	-	-
PCPI	0.064*** (2.62)	0.054** (2.32)	-	-
PI-Tax	0.061*** (2.77)	0.072*** (2.89)	0.078*** (3.71)	0.077*** (3.72)
CO-Tax	0.090*** (2.82)	0.105*** (3.34)	0.106*** (4.46)	0.108*** (4.36)
SA-Tax	-0.002 (-0.10)	0.015 (0.58)	-	-
PR-Tax	0.027 (1.30)	0.040** (2.03)	0.043*** (3.64)	0.045*** (3.87)
OT-Tax	-0.062** (-2.42)	-0.050* (-1.85)	-0.038*** (-2.76)	-0.038*** (-2.77)
Marginal	-0.117*** (-2.81)	-0.109*** (-2.69)	-0.114*** (-3.35)	-0.115*** (-3.42)
Differenced	-0.032 (-1.62)	-0.043** (-2.13)	-0.047*** (-2.68)	-0.054*** (-3.22)
Num-Tax	0.0002 (0.06)	-0.002 (-0.42)	-	-
ETR	-0.076*** (-2.91)	-0.071*** (-2.96)	-0.081*** (-4.85)	-0.083*** (-4.94)
First-Lag	0.011 (1.10)	0.003 (0.30)	-	-
More-Lag	0.024 (1.40)	0.028* (1.75)	-	-
Pred-Neg	-0.004 (-0.18)	-0.008 (-0.49)	-	-
Pred-Pos	-0.045* (-1.71)	-0.049* (-1.84)	-	-
HLK	-0.051** (-2.48)	-0.043** (-2.38)	-0.045*** (-2.58)	-0.041** (-2.44)
FE	-0.044** (-2.44)	-0.046*** (-2.62)	-0.044** (-2.37)	-0.049*** (-2.87)
Initial-Inc	-0.055** (-2.05)	-0.052** (-2.11)	-0.035* (-1.83)	-0.041** (-2.32)
Lag-DV	0.039 (1.26)	0.049 (1.60)	0.067*** (2.64)	0.078*** (3.11)

Table 6-1 Multiple Meta-Regression Analysis, WLS (RE) - (continued)

Variables	**(1) General**	**(2) General**	**(3) Specific(G-to-S)**	**(4) Specific(G-to-S)**
SE-HAC	-0.032	-0.033	-	-
	(-0.86)	(-0.83)		
SE-HET	-0.071*	-0.059	-	-
	(-1.96)	(-1.41)		
CSTS	0.065	0.103**	0.078*	0.134**
	(1.46)	(2.20)	(1.80)	(2.45)
Interval	-0.003	-0.007	-	-
	(-0.85)	(-1.37)		
Num-Years	0.0004	0.002***	-	-
	(0.53)	(2.64)		
AvgYear	0.0004	-0.0002	-	-
	(0.18)	(-0.10)		
GLS	-0.063***	-0.060***	-0.064**	-0.069***
	(-2.77)	(-2.84)	(-2.39)	(-2.68)
GMM	-0.038	-0.048	-0.053***	-0.063***
	(-1.03)	(-1.26)	(-2.80)	(-3.95)
TSLS	0.029	0.035	-	-
	(0.87)	(1.11)		
None	-0.065**	-0.023	-	-
	(-2.23)	(-0.60)		
AK	0.109***	0.108***	0.101***	0.112***
	(2.55)	(2.66)	(3.49)	(4.40)
DC	0.024	0.042*	-	-
	(0.88)	(1.82)		
AKHIDCOthers	-0.045	-0.057*	-	-
	(-1.35)	(-1.90)		
Standard Error	-	1.252*	-	0.564
		(1.85)		(1.53)
NO.Observations	939	939	939	939
NO. Studies	27	27	27	27
Adjusted R^2	0.266	0.276	0.251	0.256

Note: The dependent variable is the partial correlation coefficient between taxes and economic growth.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimates of Eq. (3); the last two columns using a general-to-specific modelling approach. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.

Table 6-2 Multiple Meta-Regression Analysis, WLS (RE)

Variables	(1) General	(2) General	(3) Specific(G-to-S)	(4) Specific(G-to-S)
Constant	0.583	0.691	-0.006	0.082***
	(0.17)	(0.21)	(-0.15)	(2.78)
Journal	0.012	0.009	-	-
	(0.46)	(0.36)		
PubYear	-0.0009	-0.0009	-	-
	(-0.62)	(-0.62)		
GSP	0.035	0.032	-	-
	(1.27)	(1.13)		
PC-GSP	0.070**	0.066**	-	-
	(2.21)	(2.06)		
PCPI	0.066***	0.063**	-	0.033*
	(2.58)	(2.40)		(1.72)
PI-Tax	0.063***	0.066***	0.079***	0.085***
	(2.74)	(3.00)	(3.73)	(4.02)
CO-Tax	0.093***	0.097***	0.108***	0.114***
	(2.88)	(3.14)	(4.57)	(4.46)
SA-Tax	-0.001	0.004	-	-
	(-0.05)	(0.16)		
PR-Tax	0.029	0.033**	0.044***	0.049***
	(1.34)	(1.63)	(3.64)	(3.93)
OT-Tax	-0.063**	-0.059**	-0.039***	-0.034**
	(-2.42)	(-2.20)	(-2.76)	(-2.28)
Marginal	-0.121***	-0.119***	-0.116***	-0.117***
	(-2.78)	(-2.67)	(-3.32)	(-3.36)
Differenced	-0.031	-0.033	-0.046***	-0.048**
	(-1.52)	(-1.57)	(-2.64)	(-2.19)
Num-Tax	0.0002	-0.0002	-	-
	(0.06)	(-0.06)		
ETR	-0.079***	-0.077***	-0.083***	-0.095***
	(-2.88)	(-2.89)	(-4.75)	(-5.29)
First-Lag	0.011	0.010	-	-
	(1.05)	(0.84)		
More-Lag	0.024	0.025	-	-
	(1.38)	(1.50)		
Pred-Neg	-0.004	-0.005	-	-
	(-0.18)	(-0.23)		
Pred-Pos	-0.044*	-0.045*	-	-
	(-1.72)	(-1.73)		
HLK	-0.055**	-0.052**	-0.047***	-0.045**
	(-2.46)	(-2.22)	(-2.57)	(-2.13)
FE	-0.047**	-0.047***	-0.047**	-0.040*
	(-2.50)	(-2.49)	(-2.37)	(-1.91)
Initial-Inc	-0.059**	-0.058**	-0.037*	-0.041*
	(-2.14)	(-2.15)	(-1.88)	(-1.89)
Lag-DV	0.039	0.041	0.070***	0.058**
	(1.23)	(1.29)	(2.65)	(2.27)

Table 6-2 Multiple Meta-Regression Analysis, WLS (RE) - (continued)

Variables	(1) General	(2) General	(3) Specific(G-to-S)	(4) Specific(G-to-S)
SE-HAC	-0.034	-0.035	-	-
	(-0.87)	(-0.89)		
SE-HET	-0.073**	-0.070*	-	-
	(-2.01)	(-1.73)		
CSTS	0.062	0.076	0.077*	-
	(1.37)	(1.49)	(1.78)	
Interval	-0.003	-0.004	-	-
	(-0.84)	(-0.90)		
Num-Years	0.0005	0.0009	-	-
	(0.61)	(1.08)		
AvgYear	0.0006	0.0005	-	-
	(0.28)	(0.26)		
GLS	-0.066***	-0.065***	-0.068**	-0.080***
	(-2.79)	(-2.79)	(-2.39)	(-2.99)
GMM	-0.039	-0.041	-0.055***	-0.054**
	(-1.00)	(-1.05)	(-2.77)	(-2.41)
TSLS	0.030	0.031	-	-
	(0.85)	(0.88)		
None	-0.068**	-0.057	-	-
	(-2.23)	(-1.46)		
AK	0.113***	0.113***	0.107***	0.102***
	(2.55)	(2.59)	(3.50)	(3.36)
DC	0.025	0.029	-	-
	(0.89)	(1.15)		
AKHIDCOthers	-0.045	-0.047	-	-
	(-1.32)	(-1.43)		
Standard Error	-	0.369	-	-0.472
		(0.51)		(-1.48)
NO.Observations	939	939	939	939
NO. Studies	27	27	27	27
Adjusted R^2	0.259	0.258	0.244	0.245

Note: The dependent variable is the Fisher's Z – transformed partial correlation.t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimates of Eq. (3); the last two columns using a general-to-specific modelling approach. WLS is used for all estimations, using the inverse variance (precision squared) as the weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level, respectively.