Taxes and Economic Growth in OECD Countries:
A Meta-Regression Analysis

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Abstract

The impact of fiscal policy, particularly tax policy, on economic performance has been a centre of attention for decades now. Despite a large body of research on the topic, no consensus exits within the academic community and the empirical evidence has so far been mixed. Considering 713 comparable estimates of growth effect of taxation in OECD countries derived from 42 studies, this study aims to answer the following questions by applying meta-analysis regression (MRA): (Q1) What is the overall, mean effect of taxes on economic growth? (Q2) Are some taxes (e.g., personal income, corporate income) more distortionary than others (e.g., value-added tax)? (Q3) Is there empirical evidence to support the conventional wisdom that "distortionary taxes" used to fund "unproductive expenditures" are especially harmful for economic growth? (Q4) What are the factors causing researchers to encounter different or even contradictory results? My results suggest that there is no statistical evidence of overall adverse tax-growth effect. However, some taxes seem more distortionary than others. Finally, 36 different aspects of study design have been codified to explain heterogeneity observed in the existing literature.

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1 Introduction

The effect of taxes on economic activity is one of the more highly contested areas in macroeconomics. Although a large body of research has examined the effect of taxes on economic performance, no consensus exists about whether aggregate tax increases enhance or retard economic growth nor if specific types of tax are less growth-retarding than others. While theory may not provide enough guidance on the ultimate effect of taxes on growth, the empirical results are even more scattered and make any concrete conclusion difficult to draw if not impossible.

Let's first see why there is no clear a priori theoretical prediction about the effects of taxes on economic growth. In the neoclassical growth model introduced by Solow (1956) fiscal variables such as taxes and spending may have transitional effects on output levels but they have no impact on the rate of economic growth in the long run. The steady-state growth rate is driven by the exogenous factors such as rate of technical progress and population growth. But the types of endogenous growth models introduced by Barro (1990) and King and Rebelo (1990) predicted that the long run growth will be affected by productive expenditures and distortionary taxation. As taxes have no permanent effects on per capita GDP growth in the neoclassical model most researchers assume that the endogenous growth model better explains growth.

Like the theoretical literature, empirical studies provide ambiguous results on the growth effect of tax policy. This is clearly shown in Figure 1. This is due in part to the lack of a uniform frame of reference. The difficulty in finding robust evidence of the effect of taxes on growth may be explained by several methodological choices such as what countries to include, how to measure taxes and economic performance, problems with omitted variables, particularly the exclusion of different types of expenditures, differences in the inclusion of control variables, selection of estimation methods, and so on. Given the divergent specifications used in the literature on the one hand it could suggest that the ability of a tax to affect growth is very sensitive to a range of institutional and economic endowments and constraints. It is hardly surprising that conflicting results have emerged.

Figure 1 The reported tax-growth effect do not converge

Notes: The figure depicts the median estimated coefficients corresponding to the effects of taxes on economic growth reported in individual studies. The horizontal axis measures the year paper published or the last draft appeared. The line shows the linear fit.

Since the literature lacks any visible patterns, a possible alternative is to use narrative literature reviews to discuss the reasons for the heterogeneity observed in the results. However, these suffer from a couple of shortcomings: (i) they reflect the reviewers' points of view and can be varied from one reviewer to another, so are not replicable (ii) bias might be an inherent part of these reviews (iii) there are usually no clear inclusion criteria, so any conclusions cannot be generalized (iv) at best, reviews serves as a simple aggregation of the number of studies proponent and/or opponent of a specific relationship and most importantly they cannot provide clear and concrete guidance to the policymakers and other researchers concerning the relationship in the question. To overcome the above-mentioned shortcomings and in order to provide a clear picture of the large body of existing research investigating the effects of taxes on economic growth in OECD countries, I apply a meta-regression analysis (MRA). An MRA is a quantitative method of research review of existing literature in order to solve conflicting theoretical and/or empirical findings on the research question. One advantage of an MRA is that disentangles various factors causing the conflicting results among researchers (Stanley, 2001). Meta-analysis has traditionally been used in the medical sciences to synthesize the results of clinical trials but is now beginning to be used in the social sciences, and particularly in economics.

In order to conduct my meta-study, I undertook a comprehensive search on the primary research question regardless of the type of publication. I coded the 713 estimates extracted from a sample of 42 comparable studies on the topic. This paper uses this dataset to answer the following questions: (Q1) What is the overall mean effect of taxes on economic growth? (Q2) Are some taxes (e.g., personal income, corporate income) more distortionary than the others (e.g., a value-added tax)? (Q3) Is there empirical evidence to support the conventional wisdom that "distortionary taxes" used to fund "unproductive expenditures" are especially harmful for economic growth? (Q4) What are the factors causing researchers to attain widely divergent or even contradictory results? More than 40 different aspects have been codified to explain the conflicting findings of the existing studies.

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

2 Theoretical and Empirical Reviews

2.1 Theory

The neoclassical growth model introduced by Solow (1956) predicts that fiscal policies such as taxation and expenditures may have transitional effects on output levels but not the long run growth rate. The long run growth is determined by technical progress and population growth which are exogenous factors to the model. It is worth mentioning that several extensions of the neoclassical growth model have been used to incorporate the role of taxation and public expenditure in long-term economic growth.

The endogenous growth models introduced by Barro (1990) and King and Rebelo (1990), which have been extended by other scholars in recent years, have challenged the traditional neoclassical growth model and provides a mechanism through which taxes and public expenditures can determine both the output level and, the steady state growth rate.

Based on the results from endogenous growth theory, Helms (1985) emphasizes that in order to evaluate the true effect of tax or expenditure on growth, both sides of the budget including the sources and uses of funds must be taken into consideration. Otherwise, studying isolated effects would result in inaccurate inferences. He 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.

Kneller et al. (1999) demonstrates the importance of a complete specification of the government budget constraint (GBC) and emphasizes that studies not accommodating the government budget constraint and its components (expenditures, revenues, deficits) suffer from substantial biases of the estimated coefficients. The problem arises because other non-tax components of budget constraint such as expenditure can also affect growth (Tanzi and Zee, 1997). Helms (1985) followed by Kneller et al. (1999) make a distinction between different categories of public finances: distortionary[1] (e.g., personal income, corporate income) versus non-distortionary taxation (e.g., value-added tax), and productive (e.g., expenditures on infrastructure) versus unproductive expenditures (e.g., welfare expenditure)[2].

2.2 Empirical

Given the theoretical issues discussed earlier, empirical studies have been experiencing the evolutionary development. As the role of tax policies was neglected in the traditional neoclassical growth model, most studies that pre-dated the endogenous growth model couldn't meet the inclusion criteria and so are automatically dropped from the sample. However, a large body of empirical studies have been inspired by the extended versions of neoclassical and endogenous growth models involving fiscal policy. There are two distinct strands of literature among those studies considering the role for taxation as a determinant of economic growth: studies in which the complete specification of the government budget constraint is taken into account and studies ignoring the government budget constraint. One of the main sources of variation amongst empirical results might be explained by alternative measures of the dependent variable as well as the key independent variable (or focal predictor).

[1] Distortionary taxes are those distorting investment decisions (Barro, 1990)
[2] The list of details on the public finance classification is available in Appendix B.

2.2.1 Economic Performance Measurements

While the growth rate of GDP is the most widely used measure of an economy's performance in the empirical literature, other economic indicators such as the employment ratio, unemployment rate, and private investment as a share of GDP have been also considered as other alternatives. These alternatives have also been used to check the robustness of findings. In order to avoid the "apples and oranges" critique of meta-analysis, I only retain the estimates applying GDP as dependent variable, whether expressed as level, as a nominal value, as a variation or growth rate, or as a per capita variable.

2.2.1 Tax Measurements

One of the main challenges empirical studies involving taxation face is to identify accurate tax measures which correspond to tax rates applied in the theoretical models (Mendoza et al., 1997). Since economic decisions depend on the marginal effective tax rate, this measure is more appropriate for investigating the growth effects of tax. However, marginal effective tax rates are not observable and there is no obvious estimate of them. Thus, several proxies have been proposed in the literature. While the most commonly used proxy for tax burden is the ratio of tax revenue to GDP, this specification creates a potential collinearity with government expenditures (Easterly and Rebelo, 1993). The other available alternatives are average effective tax rates and statutory tax rates. These are more sophisticated measures. The last two measures are believed to perform better as opposed to the former in capturing the complexity of the tax system.

Another common school of thought among researchers following Barro (1990) and Kneller et al. (1999) highlights the importance of applying the disaggregated structure of taxation compared to the aggregated total tax burden in order to make a clear distinction between distortionary versus non-distortionary taxes, or direct versus indirect taxes. In particular, some studies even go further and consider the effect of various types of tax separately (e.g., personal income taxes, corporate income taxes etc.)

3 Data

Like all the empirical studies, data is required for a meta-study. However, rather than using normal economic data, the database of a meta-regression analysis consists of published and non-published studies then code with the characteristics of them used to explain the discrepancies among the results. The empirical literature typically employs a basic econometric model that relates a dependent variable, Y_{it}, measuring economic growth for country i at time t, to a vector of explanatory variables, X_{it}. Included in X_{it} are variables measuring taxes. The relationship between Y_{it} and X_{it} can be represented by the following specification:

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

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

This study considers 713 estimates derived from 42 papers, including both published and unpublished studies, which examine the relationship between taxes and economic growth. This selection is the result of a comprehensive search including an extensive electronic search as well as a complementary manual search.

One of the main characteristics of meta-studies is that they involve an exhaustive search in order to collect as many papers as possible on the relevant research question. Conducting such a comprehensive search requires several steps. The first step is to define a search query. The keywords considered in the present study are "tax OR fiscal policy" AND "economic growth" AND "OECD countries"[3]. The above-mentioned key terms were searched in various electronic search engines such as EconLit, Google Scholar, JSTOR, Web of Science, Scopus, Repec, Ebsco and ProQuest. As there might be a couple of relevant studies that I may not have come across in my keyword searches, a manual search is also undertaken. The primary search yielded 303 papers. After reading the abstracts and the conclusions of all studies, further checking are applied to those studies considering the growth effect of tax in OECD countries. In an attempt to collect more studies, I wrote an email along with the bibliography of all the papers I had initially collected to the prominent authors who have at least one paper in the research area. The letter asked for some help in identifying new scholars, such as PhD students, working on the same area as well as any other papers that we were not aware of and so not reported in the bibliography. Checking backward citations and forward citations of each paper is the next step. Then I had checked all the publications of the authors identified in the previous stages.

The collection of papers was then refined according to the three following inclusion criteria:

First, the study must investigate the growth effects of taxes, so the dependent variable (response variable) is economic growth. As explained earlier, various indicators of economic

[3] The list of all keywords is available in the appendix B.

growth have been applied in the literature. Thus, in order to have comparable estimates, the focus of this study is GDP expressed either as a level, variation or growth rate or in per capita terms. The main explanatory variable (focal predictor) is at least one measure of taxes. The tax variables can be expressed as the total tax burden, or as disaggregated structure of taxation.

Second, the countries targeted for the study are OECD countries[4]. This means any papers which includes OECD countries, even if only EU15, G7, and EU members included.

As a last refinement I only keep the papers that provide standard errors for their estimates or that provide statistics from which the standard errors can be computed for their estimates. Literature reviews and most theoretical studies are excluded from my sample. Additionally, I only consider papers released in English. I limited my search to the studies released prior to and including 13th January 2016. My final dataset consists of 713 estimates derived from 42 comparable studies.

Once I had my raw dataset I then coded the various aspects of the estimates encompassed in the final studies. This results in an MRA database. More than 30 variables reflecting each study's context which may explain the discrepancies of the estimated results have been codified. All relevant estimates available in the original studies have been collected. The oldest study in my sample is from 1993 and the most recent is from 2015. In order to avoid any errors, all the coding process has been done by two separate coders independently with a careful reconciliation of any discrepancies or inconsistencies. The search and data coding procedure followed the recently published MAER-NET protocols (Stanley et al., 2013).

The next step after coding is to analyse the data. To do so I need to have a standardized measure of association between the focal predictor and the response variable, such as effect size which is comparable measure of a relationship. Several different effect sizes are available in meta-analysis research such as estimated elasticities, regression coefficients, partial correlation coefficients, and Fisher's Z-transformed partial correlation coefficients (see Hunter and Schmidth, 2004). In this study, I compare the results derived from two different effect sizes. First, I use the partial correlation coefficient widely applied in economics and finance MRA. Then, I apply the regression coefficients. While the former refers to statistical effect, the latter indicates economic effect.

[4] The list of OECD countries is available in Appendix C.

3.1 Partial Correlation Coefficients

Due to inconsistencies of measurement units of regression variables available in the literature, most meta-analysts prefer to convert all estimates into a common and comparable measure called partial correlation coefficients (PCC).A partial correlation coefficient 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 regression coefficients, or any other statistics through which the partial correlation coefficients can be calculated. These can include standard errors or t-statistics. The partial correlation coefficients can be calculated as:

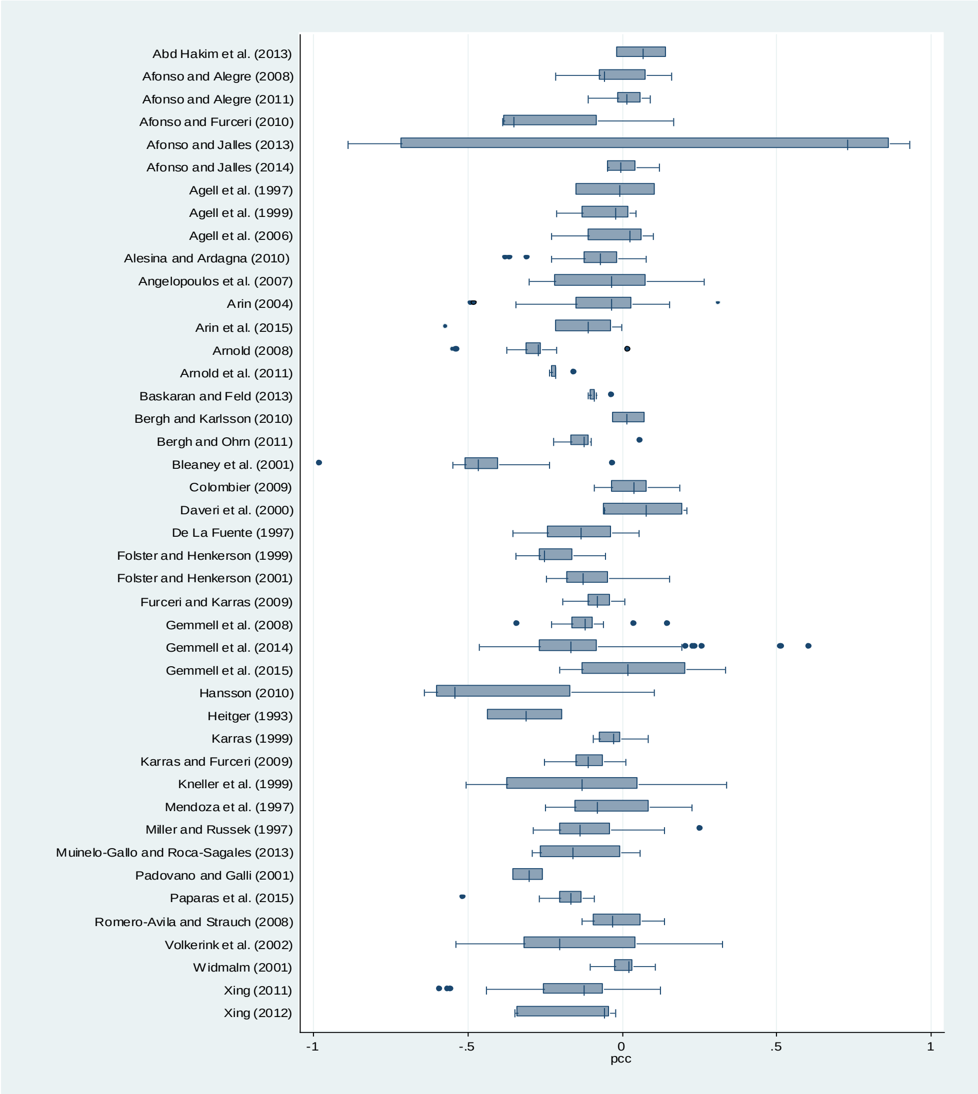
$$r = \sqrt{\frac{t^2}{t^2+df}}$$

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

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

Figure 2 depicts a box plot of partial correlation coefficients of the growth effect of taxes reported in the 42 primary studies examined in this meta-analysis. As can be seen there is heterogeneity both within and between studies. However, it seems there is a tendency among scholars to report the effect close to zero. MRA will help us to formally trace the source of this heterogeneity.

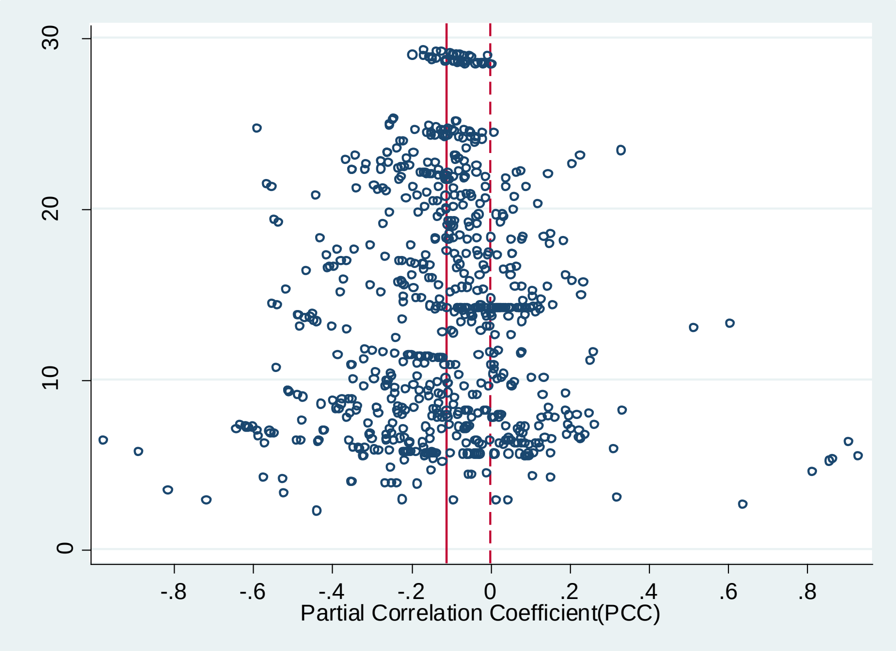
Figure 2 Variability in the estimated tax-growth effects across individual studies



The distribution of the reported estimates is illustrated in Figure 3 in a form of a funnel plot. The funnel plot is a scatter diagram of effect sizes (here partial correlation coefficients) versus some measure of their precision, typically the inverse of the standard error$(1/SE_i)$. It can be used as a simple visual tool to identify if there is any publication selection bias available in the literature (Stanley and Doucouliagos, 2010). It can also illustrate the position of the average growth effect of tax. This is calculated here as the weighted average using each estimate's precision as the weight.

As can be seen, there is a fairly wide distribution of results, with the majority of the results being negative. While the Funnel plot in Figure 3 appears to be fairly symmetrical, only formal statistical tests can provide sufficient proof of this. The meta-average is illustrated as the solid vertical line suggesting that there is a negative effect of tax on economic growth.

Figure 3 Funnel plot, partial correlation coefficients of the effect of taxes on economic growth



Notes: Each data point represents a single estimate of the effect of taxes on economic growth. The dash line indicates the position of zero effect. The solid line indicates the value of the weighted average partial correlation.

3.2 Regression Coefficients

The regression coefficients are the measure of association between the focal predictors and the dependent variables, holding other factors constant (ceteris paribus), in each regression. There are ideal measures for effect size as they refer to economic effect rather than statistical effect. However, they are not independent of units of measurements, so they are not comparable unless one makes sure the studies use the same scale (Stanley and Doucouliagos, 2013). The main advantage of this measure compared to the others is that the coefficients as well as the standard errors can be derived directly from the regressions and no further adjustments are required. For the sake of comparison, all the measurement units available in the primary studies have been checked. In order to have consistent measurement units, the required modification has been performed.

3.3 Moderator variables

Moderator variables are constructed to capture and explain differences in the reported estimates derived from the original studies. Table 1 lists potential moderator variables (eleven classes) collected from individual studies, their description, and their summary statistics including mean and standard deviation and also the mean weighted by the inverse of the number of estimates per study. As can be seen in Table 1, study characteristics common across primary studies have been divided into eleven classes.

Table 1 Potential explanatory variable for Meta-Regression Analysis

Variable	Description	Mean	SD	WM
Partial correlation	Partial correlation coefficient between taxes and economic growth (First response variable).	-0.11	0.21	-0.11
Standard error	Standard error associated with partial correlation used to correct publication selection bias.	0.10	0.06	0.10
Reg-coefficients	Estimated coefficients, the effect of tax on economic growth, ceteris paribus (Second response variable).	-0.10	0.65	-0.09
Standard error	Standard error associated with the estimated coefficients.	0.13	0.22	0.14
Publication characteristics				
Peer-reviewed	=1, if the estimate comes from a study published in a peer-reviewed journal versus not published yet.	0.65	0.48	0.75
Publication Year	The year in which the last version of study is available. (Base: 1993)	13.95	5.41	13.35
Data Characteristics				
CSTS(Panel data)	=1, if panel data as opposed to cross-sectional data is used. (Omitted category)	0.99	0.09	0.97
CS (Cross-section)	=1, if cross-section data is used.	0.01	0.09	0.03
Length	The length of sample time period.	31.3	7.45	29.58
Mid-Year	The midpoint of the sample (Base is the sample minimum: 1951)	34.2	5.22	34.3
Economic Growth measures				
GDP	=1, if GDP growth is used as DV in the original studies.	0.25	0.43	0.17
PC-GDP	=1, if per capita GDP growth is used as DV. (Omitted category)	0.75	0.43	0.83
Tax variables measures				
Labour-Tax	=1, if personal income tax is used.	0.19	0.40	0.13
Capital-Tax	=1, if corporate income tax is used.	0.12	0.33	0.08
Consumption-Tax	=1, if sales tax is used.	0.15	0.35	0.13
Other-Tax	=1, if property tax or other taxes is used.	0.02	0.09	0.01
Mixed-Tax	=1, if more than one types of tax (but not overall) are used.	0.20	0.40	0.20
Overall tax	=1, if the overall tax (not decomposition) is used. (Omitted category)	0.32	0.47	0.44
Other tax specification-General				
Marginal	=1, if the marginal form of tax is used.	0.08	0.28	0.09
Differenced	=1, if the differenced form of tax is used.	0.18	0.39	0.15
ETR	=1, if the tax variable in estimation is effective tax rate as opposed to a statutory tax rate.	0.91	0.28	0.93

Notes: SD refers to standard deviation and WM refers to mean weighted by the inverse of the number of estimates coded per study. The grouped variables include all possible categories and the omitted categories are in parentheses.

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

Variable	Description	Mean	SD	WM
Other tax specification-Predicted tax effect based on "theory"				
Prediction negative	=1, if the theoretical prediction of the coefficient is negative.	0.07	0.26	0.06
Prediction positive	=1, if the theoretical prediction of the coefficient is positive.	0.22	0.41	0.17
Prediction other	=1, if the theoretical prediction of the coefficient is ambiguous. (Omitted Category)	0.71	0.45	0.77
Control variables characteristics-General				
Investment	=1, if investment is included.	0.58	0.49	0.66
Trade Openness	=1, if trade openness is included.	0.19	0.39	0.27
Human	=1, if human capital is included.	0.42	0.49	0.51
Population Growth	=1, if population growth in included.	0.26	0.44	0.36
Employment Growth	=1, if employment growth is included.	0.38	0.49	0.34
Unemployment Rate	=1, if unemployment rate is included.	0.10	0.30	0.11
Inflation	=1, if inflation rate is included.	0.13	0.34	0.22
Initial income	=1, if initial level of output (convergence theory) is included.	0.55	0.50	0.68
Lag-DV	=1, if lagged dependent variable is included.	0.19	0.39	0.15
FE	=1, if the country fixed effects is considered in estimation.	0.83	0.38	0.76
Control variables characteristics-Standard Error Calculation				
SE-HAC	=1, if both heteroskedasticity and autocorrelation standard error are considered.	0.16	0.48	0.15
SE-HET	=1, if heteroskedasticity standard error is considered.	0.25	0.43	0.45
SE-OLS	=1, if OLS standard error is considered. (Omitted category)	0.59	0.49	0.57
Short-run, Medium and Long-run effect				
Short-run	=1, if the coefficient reported refers to short-run effect. (Omitted category)	0.69	0.46	0.74
Medium-run	=1, if the coefficient reported is the cumulative effect.	0.07	0.25	0.05
Long-run	=1, if the coefficient reported is long-run effect.	0.24	0.43	0.41
Estimation characteristics				
GLS	=1, if Generalized Least Squares estimator is used.	0.15	0.36	0.11
OLS	=1, if OLS estimator is used. (Omitted category)	0.69	0.46	0.64
Endogeniety	=1, if estimator corrects for endogeneity, e.g. 2SLS, 3SLS, or GMM.	0.16	0.37	0.24
Region characteristics				
OECD	=1, if OECD countries are examined. (Omitted category)	0.79	0.41	0.87
EU-15	=1, if countries included in EU-15 are examined.	0.06	0.25	0.08
G-7	=1, if countries included in G-7 are examined.	0.11	0.32	0.02
EU-member	=1, if EU-members are examined.	0.04	0.19	0.02

Notes: SD refers to standard deviation and WM refers to mean weighted by the inverse of the number of estimates coded per study. The grouped variables include all possible categories and the omitted categories are in parentheses.

3.3.1 Publication characteristics

A first feature of estimates is the basic type of publication. Most meta-analyses conducted in economics only consider peer-reviewed or published literature due to the general belief that those studies have a higher quality compared to the other outlets, since they are going through a refereeing process. To see whether published studies yield different results once all other aspects have been controlled for, a dummy variable is included. A number of authors investigating the effect of taxes on economic growth have noted that early empirical studies examining this relationship report ambiguous results due to shortcomings in terms of both the theory and also data availability. To account for such differences, I include the publication year as a continuous variable. Thus, a paper published in a peer-reviewed journal has the publication year coded. Otherwise, I code the year in which the latest version of the study is available. It is worth mentioning that if there are various versions of a paper (e.g., published, working paper, conference paper), this study has heavily relied on the published version. However, the extra relevant estimates not include in the published version have been added in order to have a comprehensive collection and to avoid publication bias.

3.3.2 Data characteristics

Second, I collect information on data characteristics as the structure of data sets can vary. However, due to the regional criteria considered, (OECD countries) the options available are reduced to cross section data or panel data. No need to mention that most studies apply panel data as this data set can offer more sample variability than cross sectional data as well as more degrees of freedom which improve the efficiency of economic estimates. A corresponding dummy variable is included to see whether or not these data sets yield systematically different results. The variable length measures the length of the sample period covered in the primary studies. A longer time period allows researcher to control for business cycle effects. It also allows them to focus on long term growth. I finally control for the age of the data by including a variable reflecting the midpoint of the sample.

3.3.3 Economic growth measures

As mentioned earlier, studies investigating the growth effect of taxes have measured economic growth differently. In order to have comparable studies, I have only considered the studies with GDP as the response variable. Thus, the two most popular growth indicators GDP and also per capita GDP, are included.

3.3.4 Tax variable measures

As explained earlier, one of the main concerns in the tax-growth literature is to find a suitable tax variable to measure tax-growth effects. While some recent studies divide the tax variables into two groups, distortionary taxes and non-distortionary taxes, there are studies that predict that not only the aggregated total tax but also the disaggregated tax structures may be important for growth. Thus, we control for all above-mentioned cases to see whether it yields any systematic differences in the results. To do so, five types of tax including labour tax, capital tax, consumption tax, property tax, and other taxes based on the OECD classification of taxes have been taken to account. However, as the number of estimates reporting property and other taxes are too small compared to the others, these two taxes are combined together in the "other taxes" category. There is also a category for studies using the aggregated total tax burden. It is worth noting that once a study does not consider standard forms of tax categories (e.g., aggregate taxes or disaggregated taxes) and instead divide the taxation into distortionary and non-distortionary taxes it cannot fall into one of the current categories. On the one hand, it contains more than one type of taxes. On the other hand, not all is included. In order to control for this aspect, mixed taxes category has been added. No need to mention that non-distortionary taxation is considered as a consumption tax.

3.3.5 Other tax specification (General)

I control for other tax specifications such as whether or not they are applied in a marginal form or a differenced form. I also control for effective tax rates versus statutory tax rates, since these two proxies are believed to be better proxies for the total tax burden as they take into account the complexity of tax structures (Angelopoulos et al., 2007).

3.3.6 Other tax specification (Predicted tax effect based on "theory")

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 Kneller, Bleaney and Gemmell (1999). One of the classes coded in the Table 1 is "Predicted tax effect based on theory". This category is aimed to predict the net effect of tax on economic growth by considering both distortionary and non-distortionary taxes and also productive and unproductive expenditure.

Table 2 Growth effect of taxes and expenditure

<table>
<tr><th colspan="2" rowspan="2">Finance by increase in:</th><th colspan="3">Tax increases to finance increase (reduce) in expenditure (deficit)</th></tr>
<tr><th>Productive</th><th>Unproductive</th><th>Deficit</th></tr>
<tr><td rowspan="2">Taxes</td><td>Distortionary</td><td>+ / -</td><td>-</td><td>+ / -</td></tr>
<tr><td>Non-distortionary</td><td>+</td><td>0</td><td>+</td></tr>
</table>

Source: Gemmell (2009)

3.3.7 Control variables characteristics (General)

Most previous studies have tried to control for variables known as growth determinants. In an attempt to follow a standard framework applicable in growth literature, I include variables such as labour, physical and human capital, with or without other macro variables (unemployment rate inflation, trade openness, convergence effect, etc.). However, depending on the channels through which taxes might affect economic growth the control variables have been used interchangeably.

The variable initial income indicates whether the growth specification includes the value of GDP at the start of the period, as suggested by convergence theory. The inclusion of country fixed effects is common in cross-section and panel studies as it can take into account country specific effects such as culture and social norms.

3.3.8 Control variables characteristics (Standard error calculation)

Three different categories are considered regarding how the original studies calculated the standard errors. The OLS standard errors represent the primary studies not corrected for nonspherical errors. However, HET and HAC are those corrected for nonspherical errors. The former corrects for heteroskedasticity and the latter corrects for both heteroskedasticity and serial correlation.

3.3.9 Short-run, medium and long-run effects

Given the availability of data for longer period (more than 30 years) and also the great development in methodologies applied (e.g., Structural Vector Autoregressive (SVAR)), there is a tendency amongst empirical studies to examine the long run impact of tax policy on GDP. Thus, the studies investigating the growth impact of tax can be divided into short, medium and long-run categories.

3.3.10 Estimation characteristics

Various estimators are available in the literature but keeping a record of all of them makes the inferences difficult if not impossible. I thus consider four common estimators: OLS, GLS, GMM and 2SLS. Since endogeneity is a concern in the literature that is associated with interactions between government budgets and economic conditions, I control for this case by adding a dummy variable. It takes the value of one if the study is applying either GMM or 2SLS and zero otherwise.

3.3.11 Region characteristics

The focus of this study is OECD countries. Although OECD countries are regarded as fairly homogenous, it includes some developing countries like Turkey. The presence of such developing countries suggests that democracy and institutional structure may matter in the results found. Since a couple of studies have noted the results might be sensitive to the countries included in the analysis, various country grouping are coded. For example the EU countries may differ from the rest of OECD countries in terms of their fiscal policies. Thus, I control for different regional differences and include four dummies. The reference category for this group of dummy variables is estimation for the OECD countries.

4 The Meta-Regression Methodology

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

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

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 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 $\text{H}_0: \alpha_0 = 0$ 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 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:

$$effect_{ij} = \alpha_0 + \alpha_1 SE_{ij} + \varepsilon_{ij} \qquad (2)$$

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: $\text{H}_0: \alpha_1 = 0$ (Egger et al., 1997; Stanley, 2008).

The PET estimate suffers from a downward bias when there is a true non-zero effect, so the bias can be reduced by applying a non-linear estimator that replaces $SE_{ij}$with SE_{ij}^2 (Stanley and Doucouliagos, 2012). This model is known as precision effect estimate with standard error (PEESE):

$$effect_{ij} = \alpha_0 + \alpha_1 SE_{ij}^2 + \varepsilon_{ij} \qquad (3)$$

Table 3 and Table 4 report the basic FAT-PET and PEESE MRA. 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; and so estimates within the study cannot be assumed to independent from one another. To account for these data complexities, Table 3 reports WLS estimates that adjust for this within-study dependence, through cluster-robust standard errors. Column 1 and 4 report the results of estimating EQ. (1), for partial correlation coefficients and regression coefficients as the response variables, respectively. While the former reports a statistically significant negative effect of tax on economic growth in OECD countries, the latter represents no statistical evidence of such a relationship (see the PET coefficient). Columns 2 and also 5 report the results based on the EQ. (2).

There is no statistical evidence of publication selection bias once the response variable is PCC (see the FAT coefficient). This result confirms my visual inspection of the funnel plot. However, once the response variable is changed to regression coefficients there is a clear evidence of publication bias. This negative and significant coefficient implies that there is selection bias towards the studies reporting negative tax effect on growth. As a result, the PET coefficient reported in column 5 is now less than before but still insignificant. Columns 3 and 6 report the PEESE results based on EQ. (3). As can be seen these results are very close to column 1 and 4. On the first half of the panel, once the response variable is PCC, there is no need to report the PEESE estimate as there is no publication selection bias. In contrast, there is a symptom of publication selection bias based on the results reported on the second half of the panel (see the PET coefficient in column 5). It is noteworthy that as long as the PET coefficient fails to find sufficient evidence of an empirical effect there is no need for PEESE estimation. All the results reported in Table 3 are based on the “Fixed Effects” (FE) estimator. This estimator is not to be confused with the fixed effects estimators associated with panel data. In the fixed effects model it is assumed that all studies come from a population with a fixed average effect size. This means 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 process (within study variation).

Table 3 FAT-PET and PEESE MRA (Fixed Effects)

Response variables:	Partial Correlation Coefficients (PCC)			Regression Coefficients (Bhat)		
		FAT-PET	PEESE		FAT-PET	PEESE
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept ($\hat{\alpha}_0$)	-0.109***	-0.104***	-0.108***	-0.007	-0.001	-0.007
(PET)	(-6.63)	(-3.68)	(-5.80)	(-1.49)	(-0.74)	(-1.49)
Standard error ($\hat{\alpha}_1$)		-0.090			-1.519***	
(Selection bias, FAT)		(-0.24)			(-5.13)	
Standard error Squared			-0.355			-1.346
(PEESE)			(-0.25)			(-1.31)
Number of observations	713	713	713	713	713	713
Number of studies	42	42	42	42	42	42
Adjusted R^2	0	-0.001	-0.001	0	0.25	0.01

Notes: The dependent variables are partial correlation coefficients as well as regression coefficients of growth effect of tax. Figures in brackets are t-statistics using standard errors robust to data clustering at the study level. Columns 1, 2, and 3 respectively report estimates of EQ. (1), (2) and (3) when the dependent variable is PCC. Columns 4, 5 and 6 report estimates of EQ (1), (2) and (3) but for Bhat as a dependent variable.

In contrast, the random effects model assumes that studies were drawn from populations that differ from each other in ways that could affect the treatment effect (Bronestein et al., 2007). In this case, the effect size will vary due to sampling error (the fixed effects model), systematic differences due to 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. Table 4 reports the same estimates as before but considering the random effects estimator. In this table, we fail to find any sufficient evidence of an empirical effect either on the first half of the panel associated with PCC as the response variable or on the second half associated with Bhat. While the first half of the panel does not confirm the presence of publication selection bias, I find clear evidence of publication bias in the second half. This result is confirmed once I conduct multiple MRA.

Table 4 FAT-PET and PEESE MRA (Random Effects)

Response variables:	Partial Correlation Coefficients (PCC)			Regression Coefficients (Bhat)		
	WLS (1)	FAT-PET (2)	PEESE (3)	WLS (4)	FAT-PET (5)	PEESE (6)
Intercept ($\hat{\alpha}_0$)	-0.111***	-0.094	-0.105***	-0.066***	-0.007	-0.064***
(PET)	(-6.63)	(-1.22)	(-3.27)	(-4.03)	(-0.74)	(-3.93)
Standard error ($\hat{\alpha}_1$)		-0.106			-1.052***	
(Selection bias, FAT)		(-0.22)			(-2.83)	
Standard error Squared			-0.226			-0.483
(PEESE)			(-0.22)			(-0.66)
Number of observations	713	713	713	713	713	713
Number of studies	42	42	42	42	42	42
Adjusted R^2	0	-0.001	-0.001	0	0.07	0.003

Notes: The dependent variables are partial correlation coefficients as well as regression coefficients of growth effect of tax. Figures in brackets are t-statistics using standard errors robust to data clustering at the study level. Columns 1, 2, and 3 respectively report estimates of EQ. (1), (2) and (3) when the dependent variable is PCC. Columns 4, 5 and 6 report estimates of EQ (1), (2) and (3) but for Bhat as a dependent variable.

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

$$effect_{ij} = \alpha_0 + \alpha_1 SE_{ij} + \sum \beta Z_{ij} + \varepsilon_{ij} \tag{4}$$

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

Table 5 provides the main results of multivariate meta-regression analysis. Various classes of heterogeneity coded in this study allow me to observe the causes of heterogeneous findings on the growth effect of taxes in the empirical literature. I start off with a general meta-regression model by including all 36 moderator variables (the results are not reported here).

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 called the core coefficients. All the columns in Table 5 report the results derived from applying a general-to-specific modelling strategy considering both Fixed Effects and Random Effects models.

Table 5 Multiple Meta-Regression Analysis, a comparison

Variables	Partial Correlation Coefficients (PCC)		Regression Coefficients (Bhat)	
	Specific (FE)	Specific (RE)	Specific (FE)	Specific (RE)
Constant	-0.397*** (-5.85)	-0.099 (-1.00)	-0.084*** (-3.56)	-0.090*** (-3.07)
Standard Error		-1.061** (-2.59)	-0.907*** (-3.09)	-0.87*** (-2.77)
Publication characteristics				
Peer-reviewed			0.082*** (4.46)	0.078*** (3.46)
Publication Year	0.010*** (2.76)			
Data Characteristics				
CS (Cross-section)		0.158** (2.54)		0.037** (2.38)
Length				
Mid-Year				
Economic Growth measures				
GDP				
Tax variables measures				
Labour-Tax				
Capital-Tax	0.108*** (3.49)	0.115*** (2.99)	0.019*** (3.36)	0.037** (2.42)
Consumption-Tax		0.106*** (4.25)	0.036*** (4.09)	0.078*** (3.72)
Other-Tax	0.056** (2.63)			
Mixed-Tax	-0.096*** (-3.33)	-0.113*** (-3.56)	-0.013* (-1.80)	-0.054* (-1.76)
Other tax specification-General				
Marginal	0.038* (1.86)			
Differenced	-0.089** (-2.70)			
ETR	0.234*** (5.37)	0.165*** (3.47)		
Other tax specification-Predicted tax effect based on "theory"				
Prediction negative		-0.069* (-1.78)	-0.035*** (-4.56)	
Prediction positive	0.144*** (4.65)			

Notes: The response variables for the first two columns are partial correlation coefficients and for the last two columns are regression coefficients. t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimate of EQ (4); general to specific modelling approach is applied for model selection. WLS is used for all estimations using the inverse variance (precision squared) as a weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level respectively.

Table 5 Multiple Meta-Regression Analysis, a comparison (Continued)

Variables	Partial Correlation Coefficients (PCC)		Regression Coefficients (Bhat)	
	Specific (FE)	Specific (RE)	Specific (FE)	Specific (RE)
Control variables characteristics-General				
Investment				
Trade Openness		0.063** (2.06)		
Human	-0.081** (-2.25)			
Population Growth	-0.061* (-1.99)		-0.028* (-1.76)	
Employment Growth		0.090*** (4.15)	0.054*** (5.27)	0.061*** (4.00)
Unemployment Rate			0.062*** (3.70)	0.091*** (3.74)
Inflation		-0.070* (-1.95)		
Initial income				
Lag-DV				
FE			-0.051*** (-4.83)	-0.049*** (-3.23)
Control variables characteristics-Standard Error Calculation				
SE-HAC			0.063*** (3.51)	0.054* (1.87)
SE-HET	0.046** (2.35)			
Short, Medium and Long-run effect				
Medium-run			0.033* (1.70)	
Long-run	-0.085*** (-2.72)	-0.068** (-2.59)		
Estimation characteristics				
GLS			-0.045** (-2.24)	-0.055** (-2.48)
Endogeniety				
Region characteristics				
EU-15			0.054*** (4.11)	0.072* (1.96)
G-7		0.038** (2.18)	0.181*** (5.21)	0.187*** (5.94)
EU-member	-0.037*** (-3.12)			

Notes: The response variables for the first two columns are partial correlation coefficients and for the last two columns are regression coefficients. t-statistics are reported in parentheses using standard errors robust to data clustering (clustered at the study level). All columns report estimate of EQ (4); general to specific modelling approach is applied for model selection. WLS is used for all estimations using the inverse variance (precision squared) as a weight. ***, **, and * denote statistically significant at the 1%, 5%, and 10% level respectively.

Based on the results shown in the last table, most variables included in the multivariate regression are statistically insignificant, so they do not appear as core variables. This is mainly because these variables might not potentially affect the magnitude of the reported PCC or regression coefficients and partly because of the presence of multicollinearity a common problem in MRA. Interestingly enough, the results derived from random effects are quite close to the fixed effects results once the dependent variable is regression coefficients. However, that is certainly not the case once the dependent variable is partial correlation coefficients. The MRA models reported in Table 5 incorporate several key variables which can explain the heterogeneity of the results. While the results reported based on PCC help to explain which characteristics can play more important role in explaining the heterogeneity of results, the regression coefficients do a better job providing some insights into the research questions. Thus, the focus of the ensuing discussion is the regression coefficients results reported on the last two columns.

Although the FAT results provided in previous sections regarding publication bias have been mixed, the results reported here reveal a significant selection bias. The publication selection coefficient (coefficient on SE) is statistically significant and negative implying that there is selection for negative tax-growth effects. Published papers report greater coefficients compared to the unpublished papers. Studies applied to cross-section data report higher coefficients compared to the panel data. One possible explanation is that cross-section studies over long time spans may fail to capture the growth effects of tax due to endogenous policy determination. It suffers from low degrees of freedom and less sample variability. The results on the tax variable measures are clear cut. As expected, the coefficient for distortionary taxes (mixed taxes) in primary studies shows a negative sign in all meta-regressions as compared to studies employing overall taxes. It is, however, not statistically different from zero in all specifications. Consumption taxes, representing non-distortionary taxes in the original studies, on the other hand, reports a positive sign compared to the benchmark study. But these are still close to zero.

Regarding the public finance discussion about the net effect of tax on economic growth, I can find evidence to support the prediction based on theory. However, that refers to negative prediction and not the positive one. Studies controlling for exogenous growth factors such as population growth, employment growth and the unemployment rate, on average, report greater coefficients as opposed to ones not controlling for those variables. Studies correcting for nonspherical errors report higher coefficients compared to those which didn’t apply any correction and just report the OLS standard errors. While endogeneity doesn't seem an important issue, studies applying Generalized Least Square estimators reporting more negative coefficients compare to the OLS.

The last part of the table confirms the fact that structural differences between countries do matter in the growth process. It can also confirm that the OECD may not be homogenous country grouping and the commingling of information from those countries may lead to flawed conclusions. For example, the EU countries may differ from the rest of the OECD countries in terms of fiscal policies. As can be seen the EU15 and G7 countries report greater coefficients compared to the rest of the OECD countries.

5 Conclusions

The effect of taxation on economic growth has been an enduring question. Despite the large body of research devoted to the topic, the general picture that emerged from the empirical evidence is rather inconclusive. In an attempt to offer a clear picture of the large amount of research on the tax-growth effect, I conduct a meta-analysis of the effect of taxes on economic growth. Using 713 estimates from 42 studies and controlling for differences in study characteristics, I show that the available empirical evidence suggests that there is not enough evidence for any non-zero true effect of tax on economic growth. The MRA reveals a significant selection bias towards negative results.

Using two different measures of effect size (PCC and regression coefficient) and same moderator variables for 713 tax-growth estimates, the main results of the analysis can be summarized as follows:

First, there is statistical evidence that the literature on taxes and economic growth suffers from a publication bias for either measure of effect size (PCC or regression coefficient).

Second, the MRA results indicate no evidence of a practically meaningful adverse overall effect of taxes on economic growth. However, as expected, distortionary taxes have negative effects on growth compare to non-distortionary taxes. This means that public finance predicted net effect has been confirmed. This study identifies several research dimensions that can explain why different studies are reporting 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, various data structures available in cross country studies, different control variables included in the model, the different econometric methodologies used, and which group of countries are included in the studies.

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 main contributions of this study are as follows: (1) there is not enough evidence to confirm there is an overall adverse effect of taxes on economic growth (2) there is enough evidence that some taxes are more distortionary than the others (3) there is empirical evidence to support the conventional wisdom that non distortionary taxes used to fund productive expenditure are useful for economic growth and (4) 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:

Table B-1: 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)

Table B-2: List of Keywords and key terms

Keywords searched in various databases		
TAX	Economic Growth	OECD
Tax(es) /Tax rate(s)/Taxation	Economic growth	OECD countries
Tax policy(policies)	Growth	EU countries
Tax ratios	Economic indicators	G-7 countries
Tax changes	Long-term growth	High income OECD countries
Tax rate change	Long-run growth	Industrial countries
Fiscal policy(policies)		Rich countries
Tax structures/Fiscal structures		Europe
Fiscal decentralization		Cross-national study
Public finances		

Appendix C:

Table C: List of OECD Countries

ID	Country	Abbreviation	Date	EU-15	G-7	EU.Member
1	Australia	AUS	1971/07/07			
2	Austria	AUT	1961/09/29	Austria		Austria
3	Belgium	BEL	1961/09/13	Belgium		Belgium
4	Canada	CAN	1961/04/10		Canada	
5	Chile	CHL	2010/05/07			
6	Czech Republic	CZE	1995/12/21			Czech Rep
7	Denmark	DNK	1961/05/30	Denmark		Denmark
8	Estonia	EST	2010/12/09			Estonia
9	Finland	FIN	1969/01/28	Finland		Finland
10	France	FRA	1961/08/07	France	France	France
11	Germany	DEU	1961/09/27	Germany	Germany	Germany
12	Greece	GRC	1961/08/27	Greece		Greece
13	Hungary	HUN	1996/05/07			Hungry
14	Iceland	ISL	1961/06/05			
15	Ireland	IRL	1961/08/17	Ireland		Ireland
16	Israel	ISR	2010/09/07			
17	Italy	ITA	1962/03/29	Italy	Italy	Italy
18	Japan	JPN	1964/04/29		Japan	
19	Korea	KOR	1996/12/12			
20	Luxembourg	LUX	1961/12/07	Luxembourg		Luxembourg
21	Mexico	MEX	1994/05/18			
22	Netherlands	NLD	1961/11/13	Netherlands		Netherlands
23	New Zealand	NZL	1973/05/29			
24	Norway	NOR	1961/07/04			
25	Poland	POL	1996/11/22			Poland
26	Portugal	PRT	1961/08/04	Portugal		Portugal
27	Slovak Republic	SVK	2000/12/14			Slovakia
28	Slovenia	SVN	2010/07/21			Spain
29	Spain	ESP	1961/08/03	Spain		Spain
30	Sweden	SWE	1961/09/28	Sweden		Sweden
31	Switzerland	CHE	1961/09/28			
32	Turkey	TUR	1961/08/02			
33	United Kingdom	UK	1961/05/02	UK	UK	UK
34	United States	USA	1961/04/12		USA	

Appendix D:

Table D: Description of studies

ID	Study	Publication Status	Number of estimates
1	Afonso and Alegre (2011) / (2008)	Journal / Working Paper	6 / 6
2	Afonso and Furceri (2010)	Journal	6
3	Afonso and Jalles (2014) / (2013)	Journal / Working Paper	11/ 10
4	Agell et al. (1997)	Journal	3
5	Agell et al. (1999)	Journal	4
6	Agell et al. (2006)	Journal	4
7	Alesina and Ardagna (2010)	Journal	26
8	Angelopoulos et al. (2007)	Journal	36
9	Arin	Working Paper	80
10	Arnold et al. (2011)	Journal	5
11	Arnold (2008)	Working Paper	18
12	Baskaran and Feld (2013)	Journal	12
13	Bergh and Karlsson (2010)	Journal	3
14	Bergh and Ohrn (2011)	Working Paper	10
15	Bleaney et al. (2001)	Journal	19
16	Colombier (2009)	Journal	13
17	Daveri et al. (2000) / (1997)	Journal / Working Paper	3 /3
18	De La Fuente (1997)	Discussion Paper	15
19	Folster and Henkerson (2001)	Journal	7
20	Folster and Henkerson (1999)	Journal	7
21	Furceri and Karras (2009)	Working Paper	43
22	Gemmell et al. (2015)	Journal	10
23	Gemmell et al. (2008)	Working Paper	18
24	Gemmell et al. (2014)	Journal	53
25	Gemmell et al. (2011)	Journal	19
26	Hansson (2010)	Journal	23
27	Heitger (1993)	Journal	2
28	Karras and Furceri (2009)	Journal	32
29	Karras (1999)	Journal	28
30	Kneller et al. (1999)	Journal	35
31	Mendoza et al. (1997)	Journal	11
32	Miller and Russek (1997)	Journal	12
33	Muinelo-Gallo and Roca-Sagales (2013)	Journal	6
34	Padovano and Galli (2001)	Journal	2
35	Romero-Avila and Strauch (2008)	Journal	15
36	Volkerink et al. (2002)	Journal	26
37	Widmalm (2001)	Journal	6
38	Xing (2011)	Working Paper	34
39	Abd Hakim et al. (2013)	Conference Paper	2
40	Arin et al. (2015)	Working Paper	6
41	Paparas et al. (2015)	Journal	16
42	Xing (2012)	Journal	7