TAXES AND GROWTH – LATEST EMPIRICAL SURVEY

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Abstract

This paper closely investigates tax revenues in developed economies whereas the focus is set on the tax composition rather than the volume of taxes collected by the government. The aim of this study is to provide an up-to-date empirical survey of tax composition in 23 developed economies and its impact on income per capita growth. The benefit of this study is an extended dataset, which covers annual data of the period 1970-2016. Considering different dynamics in tax collection in this entire period among countries, the pool mean group (PMG) estimator is used to distinct long-run coefficients from short-run coefficients which are unique for each individual country. This can provide relevant results for a not entirely homogenous panel of units – developed countries. This procedure helps distinguish distortionary tendencies of each tax category in terms of influence on the income per capita.

Keywords

Income Per Capita, OECD Members, Pool Mean Group, Tax Composition, Tax Categories

I. Introduction

The role of government varies in each country based on their policies and areas of focus. The scope of government is an important factor of this role which can be also quantified with the overall funds needed for government to properly operate – the government budget. The main source of income for this budget are taxes collected from all economic subjects inside the economy. More taxes collected means more resources available for government to provide public goods and services for its citizen, and to conduct their public policies. Sounds simple enough, however the reality is much more complicated.

Government does not need to use collected revenues as efficiently as the private sector. Public goods and services might supplant private production, hence directly compete with the private sector. Bigger government in term of a larger public budget needs additional manpower in form of public servants to control, operate and redistribute these public funds. These public employees could be working in private sector or run their own business but instead they have to manage public funds. All these arguments are against large public sectors because of inefficiency and futility. There is also one ever bigger problem with large governments and it is the revenue collection itself.

Taxes are the primary tool for revenues collection of governments in developed economies world-wide. As said, more taxes collected, more resources for government but there is a huge downside. Taxes are collected from all economic subjects – households and firms. Paying taxes is obligatory and create negative distortions influencing a decision-making of any subject. One would expect the more taxes collected, the more distortions are created, or their effects deepened. The reality might not be so obvious because of the tax composition. Taxes are collected in many forms, such as income taxes (both personal and corporate), property taxes or consumption taxes. Each tax has a different effect on the payer even if the sum of taxes is the same. These effects, when aggregated to an entire economy, can limit economic activity and slow down economic growth.

The importance of the distinction of these effects is part of motivation behind my research. The aim of this paper is to provide the up-to-date empirical analysis of tax composition and how it can influence growth of income per capita. The main reason behind this study is to provide baseline model

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estimation, which is used for comparison in the future research. Benefit of this study, in view of the previous literature, is the latest dataset, which covers almost fifty-year period of 1970-2016. I used this dataset for 23 developed economies, which are also member states of OECD. The PMG method of estimation is used to obtain coefficient results for all countries. This approach has many benefits but also some limitations which will be discussed further in the text.

Structure of this article is as follows. Chapter 2 offers main previous scientific literature on this topic. Chapter 3 contains data and methodology explanation, descriptive statistics, model derivation and others. Chapter 4 shows empirical results in baseline model with coefficient commentary. Chapter 5 concludes.

II. Previous Empirical Literature

Many authors used some sort of regression analysis in order to determine effects of overall taxation on economic growth in the early studies. I can emphasize studies of Barro (1990), Agell et al. (1997) or Dar and AmirKhalikhali (2002). All these studies provide some empirical evidence in term of relationship between tax revenue and economic growth. All the mentioned studies showed a negative relationship between both variables.

There are studies which tried to quantify effects of individual tax categories on the GDP or income growth using the government budget constraint approach. This approach has many forms. One of the most known is annual budget balance equality. You need to use all tax categories together with expenditure categories and budget balance to estimate impact of each tax category. This is done in Kneller et al. (1999). They distinguished two main tax categories, which were distortionary and non-distortionary taxes and performed analysis on the 22 OECD countries in period 1970-1995. Distortionary taxes were mostly income taxes while non-distortionary were property and consumption taxes. They, however, assumed neutrality of non-distortionary taxes due to economic growth. Their result showed a positive effect of shifting taxation from distortionary towards non-distortionary taxes. In my recent review study, (Zimčík; 2017) I have found the assumption of non-distortionary taxes neutrality to be too strong and incorrect. Empirical review showed also a negative effect of non-distortionary taxes increases for the same countries but in period 1995-2016.

Second approach, also counting as the government budget approach, is the tax revenue neutrality. This approach counts share of the sum of all tax categories and the overall tax revenue to be exactly one. Authors usually distinguish tax categories based on the OECD classification. This classification in empirical studies allows creation of ranking system to sort taxes based on their distortionary effects on economic growth. Arnold (2008) from his analysis constructed sequence, which demonstrated that income taxes adversely affect GDP per capita and CIT had more negative effect than PIT. Consumption taxes indicated positive effects and property taxes had even higher effects. Arnold (2008) infers that most positive effect on GDP per capita has recurrent tax on immovable property. Other authors did not find evidence for this order sequence.

Xing (2011) examined the results in Arnold (2008) and presented some doubts about his ranking system. In Xing´s analysis shifts in overall tax revenues towards property taxes were indeed accompanied with higher income level per capita. However, increase of tax revenues from production taxes, corporate and personal income taxes were associated with lower per capita income in the long run. Xing (2011) did not find any proof to prioritize personal income taxes over corporate ones or favoring consumption taxes over any income taxes as in Arnold (2008).

Datasets in both studies were quite similar. Arnold (2008) tested 21 OECD countries in period 1971-2004 while Xing (2011) used data from 17 OECD countries in period 1970-2004 for his research. All presented studies represent the key scientific literature in the line of research.

III. Data and Methodology

My dataset contains observations from 23 OECD countries. I chose these developed countries for two reasons. First, they are only countries to have data available for such extended timeframe. Second,

and this is why I chose only the most developed countries, there are too many differences among countries in case of their taxation and fiscal policy. Differences are even bigger comparing developed and developing countries. Selection of only developed countries was made, especially, to ensure smallest differences as possible for panel estimation. Estimation is based on model similar to the one in Xing (2011) and is shortly presented in next subsection.

The model originates from a Solow model (1956) augmented with human capital, which has form of Cobb-Douglas production function as in Xing (2011). Overall product *Y* in period *t* is then given as:

$$Y_t = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta} \tag{1}$$

K and *H* are physical and human capital, respectively. *A* is the current level of technology and *L* is labor force. α and β depict partial elasticities of output to physical and human capital, respectively. Following equations shows path ways of these variables:

$$\begin{aligned} y &= k^{\alpha} h^{\beta} \\ \dot{k} &= s^k y - (g + n + d)k \\ \dot{h} &= s^h y - (g + n + d)h \\ \dot{L} &= nL \\ \dot{A} &= gA \end{aligned} \tag{2}$$

where all small letters *y*, *k*, *h* designate quantities for effective unit of labor force. s^k and s^h are shares of physical and human capital investment into output, *g* quantifies the exogenous technological change, *n* is labor force growth rate and *d* is rate of physical and human capital depreciation. With few mathematical adjustments we can derive the steady states for variables h^*, k^* which are:

$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{g + n + d} \right)^{\frac{1}{1-\alpha-\beta}}$$

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{g + n + d} \right)^{\frac{1}{1-\alpha-\beta}} \tag{3}$$

Output per effective worker in the steady state y^* can be derived from first equation in (2) and both in (3) as:

$$y^* = (k^*)^{\alpha} + (h^*)^{\beta} = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{g + n + d} \right)^{\frac{1}{1-\alpha-\beta}} (h^*)^{\beta} \tag{4}$$

Taken eq. (4) into logarithm form makes:

$$ln\, y^* = \frac{\alpha}{1-\alpha} ln\, s_k + \frac{\beta}{1-\alpha} ln\, h^* - \frac{\alpha}{1-\alpha} ln(g + n + d) \tag{5}$$

We can use transition dynamics as in Xing (2011) to express eq. (6) as:

$$\frac{d\, ln\, y_t}{dt} = -\lambda (ln\, y_t - ln\, y^*) \tag{6}$$

where $\lambda = (1-\alpha-\beta)(g+n+d)$ and the transition path of output is then:

$$ln\, y_t - ln\, y_{t-s} = -\varphi(\lambda)(ln\, y_{t-s} - ln\, y^*) \tag{7}$$

Putting eq. (5) into eq. (7) we obtain basis for error correction model as in Arnold (2008). I extended the model with vector of tax structure variables. The resulting equation used for estimation has following form:

$$\Delta \ln y_{i,t} = -\phi_i \left(ln\, y_{i,t-1} - \alpha_1 ln\, s_{i,t}^k - \alpha_2 h_{i,t} - \alpha_3 n_{i,t} - \sum_{j=6}^{m} \alpha_j\, TAX_{i,t} \right) + \beta_{1,i} \Delta ln\, s_{i,t}^k$$

$$+\beta_{2,i}\Delta h_{i,t} + \beta_{3,i}\Delta n_{i,t} + \sum_{j=6}^{m} \beta_{j,i}\,\Delta TAX_{i,t} + \gamma_i + \delta_i + \varepsilon_{i,t} \quad (8)$$

where *TAX* stands for vector of tax structure indicators containing overall tax revenue with a combination of tax share indicators. This model restricts all long-run coefficients to be common across countries ($\alpha_1, \alpha_2 \ldots \alpha_m$) and allow short-run coefficient for each country ($\beta_1, \beta_2 \ldots \beta_m$). ϕ_i is the convergence rate which has distinct values for every nation. γ_i are coefficient for time effect dummy which is explained down further. δ_i is country-specific intercept and $\varepsilon_{i,t}$ represent error term with assumed normal distribution.

This setting was first described in Pesaran et al. (1999) as the pool mean group (PMG) estimator. It offers a middle way in panel estimation between mean group estimator and fixed-effect estimator. PMG estimates cointegration form of autoregressive distributed lag (ARDL) model and allows intercepts, short-run coefficients and cointegration terms to differ across unit cross-sections. We than assume long-term coefficients to be same for all countries. Reason for this approach is nature of cross-section units which are OECD member states and we can anticipate a certain degree of homogeneity in these most developed countries.

Empirical results in the next section are only for the long-run coefficients because there is no interest in different short-run dynamics among countries. Focus is rather set on the long-run effects of tax structure on economic growth.

My unique dataset contains annual data from 23 OECD countries[2] and period 1970-2016. To my knowledge it is the most recent and the most comprehensive dataset used in panel study concerning tax structure with total of 1081 observations. All variables are listed and shortly explained below. Table 1 also contains descriptive statistics for these variables together with data source.

The dependent variable (*y*) is the real GDP per capita with constant purchasing power parity in US dollars. Variable to approximate physical capital is gross fixed capital formation in percent of nominal GDP (*inv*). Human capital is extremely difficult to measure. Proxy variable I used is the human capital index from the Penn World Table 9.0 (*hc*). This index is constructed based on years of schooling and an assumed rate of return to education. Growth rate of labor force is approximated with the rate of population growth (*n*).

Tax structure is derived from shares of individual tax quotas on the overall tax revenue quota. Overall tax revenue quota is overall sum of collect taxes in portion to nominal GDP (*total_rev*). Distinction of tax categories is based on the OECD methodology. Taxes on income, profits and capital gains (1000) can be distinguished into two main groups. Taxes on income, profits and capital gains of individuals (1100) and Taxes on income, profits and capital gains of corporates (1200). Taxation of labor also consists of the social security contribution (2000) and Taxes on payroll and workforce (3000) in some countries. All these taxes have form of direct taxes on income whether it is income of individuals, households or corporations. Variable (*direct*) sums up all previous taxes and put them in ratio to overall tax revenues. Variable (*indirect*) sums up all taxes that are considered indirect, in meaning that they do not relate to incomes but rather to consumption. This covers Taxes on property (4000) and Taxes on consumption and others (5000+6000).[3] All tax variables originate from OECD Tax Statistics.

Estimation does not only cover these two main tax categories (*direct and indirect*) but four tax groups in particular. First is Personal income tax (*PIT*) that is share of sum of 1100+2000+3000 to overall tax revenues. Second is corporate income tax (*CIT*) which is basically share of category 1200.

[2] List of countries in alphabetical order: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

[3] Time dummy variable (*cr*) is used in estimation as fixed regressors and covers time period 2008-2010 to filter for the global economy crisis. This, however, does not affect the long-term growth, so coefficient for (*cr*) is listed as short-term coefficient and is not located in table 2.

Consumption taxes (*consume*) consists of categories 5000+6000 share. Property taxes (*property*) are the last share category and consists of 4000. Using only one of these tax shares together with overall tax revenue shows effect the tax neutral change of the specific tax share on the long-term economic growth. This is more visible in table 2 with empirical results in the next chapter. This procedure measures a change in single tax share which is offset with change in all other tax shares, so the overall tax revenues remain the same.

Table 1 shows all the descriptive statistics. Dependent variable (*y*) took form of a natural logarithm. This monotonic transformation helps smooth individual time-series for better comparison across countries. You can notice that in econometric equation (8) dependent variable is first difference of ln(*y*) so it approximates a growth rate of the real GDP per capita. The unweighted average value for 23 countries is 1.9 percent of annual growth rate. Share of total tax revenue to nominal GDP is 31.7 percent on average for 23 OECD countries. Interesting point is the division of this share between direct and indirect taxes. Direct taxes are around two third of all tax revenues while indirect taxes are only third on average. Looking at more specific distinction, personal income tax is the primary source of revenues followed by consumption taxes and then corporate income taxes with property taxes to have the smallest contribution.

Table 1 Descriptive statistics of dependent and independent variables[4]

Variable	Mean	Standard deviation	Minimum	Maximum	Source
ln y	10.274	0.405	8.826	11.422	OECD Statistics
ln inv	3.137	0.168	2.444	3.638	World Bank Database
hc	2.952	0.497	1.311	3.734	Penn World Table 9.0
n	0.667	0.607	-0.886	3.800	World Bank Database
total_rev	0.333	0.080	0.091	0.495	OECD Tax Database
direct	0.631	0.073	0.353	0.770	OECD Tax Database
indirect	0.368	0.073	0.230	0.647	OECD Tax Database
PIT	0.543	0.079	0.265	0.726	OECD Tax Database
CIT	0.085	0.046	0.006	0.294	OECD Tax Database
property	0.060	0.033	0.008	0.214	OECD Tax Database
consume	0.307	0.078	0.128	0.566	OECD Tax Database

Source: Author´s calculation

IV. Empirical Results

I present results of PMG estimation in this section. Eq. (8) is used for estimation with cointegration form of ARDL (1,1,1,1,1) model.[5] This represents a usage of lagged dependent and independent variables as regressors with separation of long-run coefficient same for all countries and short-run coefficient which can differ among them. Table 2 contains estimation results but only the long-run coefficients.

They should evaluate effects of tax structure only on the long-term economic growth. We are not interested in short-term fluctuations, which has different paths in individual countries.

Coefficient results in table 2 are categorized into 7 columns. Column number (1) contains control variables only. Columns (2) and (3) show aggregated results for direct and indirect tax shares, respectively. Columns (4) – (7) have results for individual tax shares. Table 2 also offers the mean convergence rate of short-run coefficients which is, as expected, negative and statistically significant.

[4] All statistics are round up to three decimal point. Share of direct and indirect must be equal to one. Share of the last four variables must be equal to one as well. Small discrepancies are due to rounding numbers.

[5] This form was chosen based on the information criteria testing. Form (1,1,1,1,1) has the smallest value for Akaike Info Criterion.

Bottom low shows number of observation. As you can see, the panel contained missing values, especially for (*PIT*), (*CIT*) and (*consume*).

I can predict signs of coefficients based on the macroeconomic theory and previous literature. Proxies for both physical and human capital should have positive signs while, population growth should have negative sign. Prevailing opinion about overall taxation predicts a negative sign for the overall tax quota because increase of this quota is associated with higher tax burden. Certain consensus among economists credits bigger distortionary effects to direct taxes. Following this, I assume a negative sing in column (2) for direct taxes and contrary to that, a positive sign in column (3) for indirect taxes. Assumption of individual tax shares coefficient is rather tricky. Previous studies in chapter 2 contained some contradiction. However, I can, at least, assume more distortionary effects of CIT and PIT because they are part of direct taxes.

Table 2 – Long run coefficients of PMG estimation[6]

Dependent variable (*d_ln y*)

LR coefficients only

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln inv	-0.23	0.65**	0.70**	0.23***	0.53***	0.65***	1.33**
	(-1.49)	(2.49)	(2.45)	(2.71)	(7.16)	(4.95)	(1.98)
hc	0.32**	0.03	0.02	0.50***	0.54***	0.28**	-0.44
	(2.23)	(0.08)	(0.05)	(4.57)	(6.65)	(2.03)	(-0.51)
n	-0.21***	-0.27***	-0.29**	-0.14***	-0.12***	-0.29***	-0.38*
	(-3.71)	(-2.58)	(-2.47)	(-3.65)	(-4.56)	(-4.43)	(-1.70)
total_rev		0.72	0.68	-0.15	0.67**	1.55***	1.26
		(0.95)	(0.85)	(-0.43)	(2.01)	(2.74)	(0.91)
direct		-5.15***					
		(-3.03)					
indirect			5.49***				
			(2.86)				
PIT				-2.79***			
				(-6.49)			
CIT					1.90***		
					(3.71)		
property						0.97	
						(0.88)	
consume							8.68*
	0.37***	0.29***	0.15***				(1.80)

[6] All coefficients and appropriate t-statistics (in parenthesis) are round up to two decimal points. The number of stars next to each coefficient represents significance level: (*) 10%, (**) 5% and (***) 1%.

constant				0.52***	0.40***	0.32***	0.08***
Mean ϕ_i	-0.03***	-0.02***	-0.02***	-0.05***	-0.06***	-0.04***	-0.01**
Observations	1045	1043	1043	1023	1023	1019	1043

Source: Author´s calculations

Control variables in column (1) are consistent with assumption with one exception. Proxy for physical capital is statistically insignificant. However, in all following regressions are coefficients for physical capital statistically significant and positive. Coefficients of control variables are consistent in majority of estimation equations (2) to (7) with few examples without statistical significance.

More interesting result are visible in these columns regarding aggregated and individual tax categories. Aggregated tax categories in column (2) and (3) are absolutely in accordance with assumptions form previous literature. Coefficient for direct taxes is negative and statistically significant. Value of coefficient (-5.15) means that a rise of direct tax share about 10 pp. leads to drop in approximated long-term economic growth by 0.515 pp.[7] Indirect taxes are positive and statistically significant. The coefficient is similar in scale with the one in column (3) for direct taxes. This is not surprising, considering that the sum of both variables is one. Change in one is offset by the same change in the other variable in order to preserve tax revenue neutral change. Such change in tax structure in favor of indirect taxes should then have a pro-growth effect, according to result in columns (2)-(3).

The division of these aggregated tax shares into individual tax categories has results in columns (4) through (7). Coefficients of personal income tax share and consume tax share, respectively, are in accordance with theory and previous assumptions. PIT coefficient is negative and statistically significant, meaning revenue neutral tax change increasing PIT share is growth prohibiting in the long-run. Promoting the consume taxes at the expanse of other taxes should have an opposite effect, according to result in column (7). Result for property taxes are inconclusive because of the statistical insignificance.

Column (5) offers an unusual result for CIT in the sense that the coefficient has a positive sign which is in contradiction with the previous estimations. However, some explanations can be provided considering the construction of tax quota and tax category 1200 especially, see Kotlán et al. (2011), Kotlán and Machová (2012) or the conclusion section.

The last remark to the empirical result is not included in the table 2. Time dummy crisis (cr) was present in short-time coefficients only. However, in all seven regressions, coefficient for this dummy was negative and significant, which should control for the global economic crisis at the end of last decade.

V. Conclusion

The aim of this paper was to provide the latest empirical review concerning possible effects of tax structure on the long-term economic growth. This was intended to achieve by using up-to-date unique dataset which contains more than thousand annual observations from 23 developed economies. Structure of taxes is an important issue because the right setting of fiscal policy can promote long-term growth without the need to raise sum of tax related revenues. This should be goal for any rational policy-maker. Results in this paper also serve as a benchmark model for additional testing to have robust and unbiased results to provide correct conclusions.

The method for estimation was PMG estimator which set assumption on homogeneity of long-run coefficients but allows short-run dynamics to differ among all cross-section units. This should ease

[7] Tax shares are used in fractions instead of percentage shares. This is the reason why a relatively high coefficient value represents a smaller effect on the dependent variable.

restrictions in case of fixed effects and because of all observed countries are the most developed countries in the world, we can assume some degree of homogeneity in term of tax structure effects.

Result showed that change in tax structure in favor of indirect taxes should resolve in a higher growth rate of GDP per capita. There was also one result, which was not expected. Increase in corporate tax share should be accompanied with higher economic growth also. This may be explained with factors behind economic growth in observed period. Founding of new firms and corporations, especially high-tech companies which were booming in this period should promote growth, while also increase the share of corporate taxes in overall tax revenues.

Results showed positive tendencies of consumption tax increase. To both preserve tax revenue neutral change and maximize the long-term economic growth, adjusting factor of the last two examples should be decrease in personal income taxes. These mostly labor income related taxes have the most distortionary effects on growth. There already make up for more than half of all tax revenues on average and additional increment in these taxes affects growth adversely.

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