Hacienda Pública Española/Review of Public Economics 237-(2/2021): 85-109

https://dx.doi.org/10.7866/HPE-RPE.21.2.4

The Sinful Side of Taxation: Is it Possible to Satisfy the Government Hunger for Revenues While Promoting Economic Growth?*

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Received: October, 2019
Accepted: May, 2020

Abstract

This study evaluates both linear and non-linear relationships between individual taxes' revenues and real *per capita* growth. The analysis is carried out for all the OECD countries over the period 1980-2015, using panel data techniques to assess the short –and long– run effects of taxation on economic growth. With the exception of taxes on individual income, we find evidences of non-linear relationships between other sources of taxation and economic growth, which consequently supports the existence of the optimisation in GDP terms of threshold values between economic growth and tax components' revenues. In summary, the results provide a certain degree of support regarding the application of a policy focused on raising certain taxes, expressed as a percentage of GDP, without harming economic growth.

Keywords: Economic growth, Tax systems, Fiscal policy, Optimal taxation.

JEL Classification: E62, H21, O47.

1. Introduction

Few events are as impactful on economic and social interactions as is the tax phenomenon. Taxation is indeed a crucial input on individual and collective decision-making processes. It not only grounds several ideological and political economy perspectives but also it minimizes the conflict between individual liberty and the imperative of the common good,

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* The opinions expressed herein are those of the author and do not necessarily reflect those of his employers. Any remaining errors are the author's sole responsibility. The author acknowledge financial Support from FCT - Fundação para a Ciência e Tecnologia (Portugal), national funding through research grant UIDB/05069/2020.

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through state financing (Musgrave, 1992). Moreover, there is a variety of examples where we can observe the overall phenomena that have arisen from the taxation topic, namely from the constant tension that exists between the appropriation of income and wealth generated by private economic agents through taxation, and the need to finance government expenditure (Alves, 2018). From this tension derives what we might label as micro-macroeconomics duality problem. In fact, from a microeconomic point-of-view, taxation is a subtraction of income which has been obtained from the individual effort, both by individuals and firms, and considering a static perspective of reality; on the other hand, the overall effect of taxation, *i. e.*, in a dynamic perspective, should be revised to assess the truly effects of taxation on economic agents in both short and long-term.

Optimal taxation have been a recurring debate on Economics and its results have been revisited over time. Tax revenues are raised from income wealth of private sector, and are redistributed and allocated through public spending. In addition, and disregarding the nature of the efficiency level of government expenditures, the money raised by taxation is not taken out of the economy. Indeed, these financial resources are put into circulation and, consequently, boost several aspects of an economy, through both public consumption and investment. Therefore, and for Ramsey (1927), the concern of optimal taxation should be raising revenues to feed the ruler, while, at the same time, minimizing the effects of deadweight loss derived from the expropriation of income and wealth of the remaining economic agents. The seminal paper presented by Mirrlees (1971) develops a model to evaluate optimal tax system over individual's income, based on a static perspective of the economy. By neglecting time-varying evolution of an economy, optimal information regarding the state on individuals taste, as well as the administration costs of the government on levying taxes, the main contribution of Mirrlees (1971) is the discussion about the skills distribution and income-leisure preferences of individual on optimal tax design. Moreover, while the jointly optimal tax model developed in Chamley (1986)-Judd (1985) proclaims that capital taxes should be set to zero in the long-run, which is contradicted by the recent results obtained in the recent analysis made in Straub and Werning (2019) (other valuable contributions on optimal taxation could also be found in Werning (2007), Golosov *et al.* (2011), Farhi and Werning (2013) and Sargent *et al.* (2017), and others).

As discussed, financial resources resulting from taxation are constantly being reintroduced in the economic circuit by government spending, which have recognizing important results over economic competition, namely when governments try to correct market externalities through public policies. In order to conduct those policies, the equality and efficiency notions naturally emerge when public authorities have to decide how to tax. These concepts, which are usually concurrent, must consider when public authorities decide how to raise taxes. In fact, as Okun (2015) refers, there is a need to transfer money from the richest strata society to the poorest one. However, the author is aware of the inefficiency effects that may occur from this process, due to the bureaucratic public administration costs, as well as the incentives that can emerge from decreasing labour supply for the most fortunate individuals in the society; moreover, this last group is more incentive to base their spending in tax-deductible expenditures. In that sense, and quoting Okun (2015), "High tax rates are followed by attempts of ingenious men to beat them as surely as snow is followed by little boys on sleds". Therefore, we can expect these emerging inefficiencies to be somehow offset by what we assume to be productive expenditures that can overall foster economic growth. Otherwise, it seems legit to admit that public authorities would not allow to deduct those expenditures. Furthermore, and as highlighted in Berggren *et al.* (2015), an institutional perspective must consider when economists analyse government size burden. In fact, the different sociological adherence to political regimes can influence the efficiency degree of governments and, therefore, explain the observed government burden levels across countries. As the authors mention, a higher perceived legitimacy is related with higher adherence to public policies and, in that sense, tax burden is less impactful; however, the same established legitimacy can alienate individuals from economic debate, making interest groups to have a higher power when deciding regarding to political decision making process (this reflection is also reached in Alves, 2018).

Through all this reflection, we may wonder what are the real effects of the overall economy and its dynamics. Therefore, we propose to study if tax effects always present linear impacts over social life or, on the other hand, if there are evidences of a non-linear impact of tax revenues on economic development. In the empirical research developed, we evaluate linear and non-linear tax sources revenues and their effects on both short- and long-term economic growth, for the period between 1980 and 2015, and we identify optimal values of taxation that governments should consider when stimulating economic growth. To sum up, and besides of providing new insights on this topic, we believe this analysis also provides important clues for governments regarding optimal tax design. The rest of this empirical research is organised as follows: Section 2 provides a literature review of the related theoretical viewpoints and empirical studies on this topic; Section 3 presents the methodology, the data, and its sources; Section 4 highlights the empirical results; and Section 5 summarises our conclusions.

2. Literature Review

The existing literature on the linkage between both short- and long-run tax composition effects on economic growth is quite abundant. However, and as reflected in Bergh and Henrekson (2011), the vast literature that have been emerging supplied a set of different results on the role of the state, whether they analysed the revenue or spending sides. Notwithstanding the literature survey of these authors, which points out a negative impact between 0.5% and 1% by each 10% increase in government size, they also conclude that higher tax burden countries show an economic growth above the average. Their explanation relates to the collection of higher amount of taxes with a consequent set of policies that improve the general welfare and, therefore, promote economic performance[1]. Yet, Dalena and Maggazzino (2012) have shown different paths of public finance trajectories for the Italian case for more than one century. The authors conclude that while "Tax-and-Spend" and "Spend-and-Tax" arguments present and adherence to liberal and interwar periods, respectively, the "Fiscal Synchronization" public finance argument is conciliatory with the second-half period of twentieth century. However, and despite the public arguments these authors found, Maggazzino and Mutascu (2019) show that fiscal sustainability in the long-run seems to be ensured in Italy. In addition, Brady and Maggazzino (2018) provide new results for fiscal sustainability paths for EU28. Although they find three countries' clusters regarding public finance balanced path, it seems that PIIGS countries show the worst path, since government expenditures tend to grow faster than tax collection.

Several studies that analyse different timespans and countries' samples, usually within OECD countries' members, are unanimous regarding the negative effect of taxation distortionary impact on economic growth (Cashin, 1995, Kneller *et al*., 1999, Bleaney *et al*., 2001, and Gemmell *et al*., 2007). For instance, in an analysis of a sample of 14 EU countries for a period between 1990 and 2006, Benos (2009) found that distortionary taxation has a negative impact on economic growth rates, where capital, income, and wealth taxation are included,. Furthermore, and in line with these conclusions, Acosta-Ormaechea and Yoo (2012) found that changing the tax composition in favour of income taxes is negatively related with long-term growth rates; this effect is even clear for social security contributions and personal income taxes. Contrary to similar studies, these authors' findings highlight that it is preferable to shift taxation from income to property taxes, rather than to change from income to consumption taxation. Moreover, Arnold *et al*. (2011), while examining tax policy changes required for a sustainable transition from short-term to the long-term economic growth for a set of 21 OECD countries and covering more than 30 years' time span, also reached to a similar conclusion –economic growth can be promoted by progressively increasing towards consumption and property taxation, compensated by reduction in income taxation.

Afonso and Furceri (2010) report that indirect tax revenues present negative and significant effects on growth for both EU and OECD countries between 1970 and 2004, while direct taxes show no impact on economic performance, evidencing a lower degree of distortion when compared to indirect taxes. In addition to these results, the authors did not find a concave relationship between taxes and growth. A similar result is also achieved in a previous study from Karras and Furceri (2009), where the authors address the tax-growth relation for 19 European countries during a 39-year period (1965-2003). While they found that taxes present a negative impact between 0.5% and 1% increase in overall taxation, consumption taxes seem to be the most detrimental source of taxation for growth. Yet, Zimcík (2016) also evidences a negative correlation between production taxes and economic performance.

On the other hand, Fölster and Henrekson (2001) analyse the growth-tax linkage during the 1970-1995 period for a sub-sample of OECD countries, founding results of no support tax effects on growth. Although their results are robust under extreme bound analyses, when the authors consider other geographies, such as Hong Kong, Singapore, and Taiwan, the conclusions show a significantly negative impact of taxation on economic performance. Moreover, and by decomposing tax revenues into several tax components for 155 countries during a 39-year period, Afonso and Jalles (2014) also evidence a non-significant effect of each tax component on growth. Tosun and Abizadeh (2005) evaluated tax structure and its effects on growth on 24 OECD countries over the last two decades of the twentieth century, founding that the tax items that are most positively responsive to a change in *per capita* GDP are personal and property taxes, while taxes on payroll and on goods and services decrease their importance. In fact, for 23 OECD countries and for 5-year periods between 1970 and 2000, Angelopoulos *et al*. (2007) develop a competitive decentralised equilibrium model to study the growth-government revenues nexus, and state that capital and corporate income tax rates are positively related to growth. However, these results seem to be contradicted by Afonso and Alves (2015), who found that capital and profit taxation is detrimental for growth. The conclusion of these last authors is corroborated by a previous study conducted in

Arnold (2008), which assesses how tax structures influence growth dynamics for 21 OECD countries between 1971 and 2004. The author concludes that, besides the fact that income taxes, in particular those levied on firms, are detrimental for growth, the priority should be to tax property and consumption, as these taxation sources are growth enhancing. De Witte and Moesen (2010) resort to a non-parametric data envelopment analysis to assess a concave relationship between growth and government size, computing an average value of 42% for optimal tax burden over the economy.

Lastly, the study conducted by Xing (2012), which assesses tax revenues composition and *per capita* growth, found that several empirical papers on tax-economic growth present a non-robust econometric result under different heterogeneity hypotheses across the several samples of countries, both in the short and the long term.

Therefore, and given the panoply of literature on the effects of taxation on several economic aspects, it is scarce, as mentioned in this section, the studies on optimal levels of taxes, namely the levels of each tax component, and the existence of tax thresholds. Accordingly, our study aims to contribute to the above-mentioned literature with new insights regarding the link of taxation-economic growth.

3. Methodology and Data

In our analysis we consider a neoclassical growth model, represented by an aggregate production function of the type $Y = F(T)$, *i.e.*, the economic output is a function with a taxation structure represented, generically, by the set T, as expressed in Equation (1):

$$g_{i,t} = \alpha_{i,t} + \beta_{0,i,t} y_{i,t-1} + \sum \beta_{n,i,t} \tau_{n,i,t} + \beta^{j}_{n,i,t} x^{j}_{i,t} + \nu_i + \eta_t + \varepsilon_{i,t}, j = 1,2, t = 1, \ldots, T, i = 1, \ldots, N \quad (1)$$

where $g_{i,t}$ is the real *per capita* GDP growth rate, $y_{i,t-1}$ illustrates the one-lag real *per capita* GDP, $\tau_{n,i,t}$ represents the revenue of each tax item n, in GDP term, $x^{j}_{i,t}$ is an independent variable belonging to the first or second sets of control variables j, ν_i, and η_t are the country and time-specific effects, respectively, $\varepsilon_{i,t}$, reflects an unobserved zero mean white noise-type column vector satisfying the standard assumptions, and lastly, $\beta_{n,i,t}$ are the estimated coefficients to assess the impact of each variable on growth, while t and i are the time and country indices, respectively.

In order to assess possible non-linearity effects of tax items on economic performance, we then add an additional squared term for each tax item, as expressed in the following equation:

$$g_{i,t} = \alpha_{i,t} + \beta_{0,i,t} y_{i,t-1} + \sum \beta_{1,n,i,t} \tau_t + \sum \beta_{2,n,i,t} \tau_t^2 + \beta_j x^{j}_{i,t} + \nu_i + \eta_t + \varepsilon_{i,t},\ t = 1, \ldots, T,\ i = 1, \ldots, N \quad (2)$$

By deriving Equation (2), we obtain Equation (3), which represents the combined effect of increasing tax items revenues on economic growth:

$$\frac{\partial g_{i,t}}{\partial(\tau_{n,i,t})} = \frac{\partial\left(\alpha_{i,t} + \beta_{0,i,t}y_{i,t-1} + \sum \beta_{1,n,i,t}\tau_{n,i,t} + \sum \beta_{2,n,i,t}\tau_{n,i,t}^2 + \beta_i x_{i,t}^j + \nu_i + \eta_t + \varepsilon_{i,t}\right)}{\partial(\tau_{n,i,t})} \quad (3)$$

Each tax item threshold, $\tau_{n,i,t}^*$, is subsequently computed by equalising Equation (3) to zero, as shown in Equation (4),

$$0 = \beta_{1,n,i,t} + 2\beta_{2,n,i,t}\tau_{n,i,t}^* \Leftrightarrow \tau_{n,i,t}^* = \frac{-\beta_{1,n,i,t}}{2\beta_{2,n,i,t}} \quad (4)$$

Consequently, if the results evidence a significant negative signal for $\beta_{2,n,i,t}$, it means that there is a concave relationship between a tax item and the economic performance, and it implies a maximum value of taxation raised in an economy that promotes economic growth. On the other hand, a positive significant coefficient leads to an inverse conclusion; a positive $\beta_{2,n,i,t}$ means a convex relationship and, in economic terms, a tax item value that minimizes economic growth. Therefore, in the results section, when we obtain non-linear relations, we retrieve these conclusions from the statistical significance of both linear and squared terms and, to differentiate between maximum and minimum optimal levels, we highlight these coefficients.

The model is estimated for the period between 1980 and 2015, and for the following OECD countries: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), South Korea (KOR), Latvia (LVA), Luxembourg (LUX), Mexico (MEX), the Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR) and United States (USA).

Our database consists of several data sources. GDP is based on purchasing-power-parity *per capita* GDP (*realgdppc*), in thousands. Data on growth rate (*realgdppcgr*), general government structural balance in percentage of GDP (*capb*), general government gross debt-to-GDP ratio (*debt*), and share of total government expenditures in percentage of GDP (*totexp*) is taken from the World Economic Outlook of the International Monetary Fund. The financial information on taxes on income, profits and capital gains of individuals (*taxinc*), taxes on income, profits, and capital gains of companies (*taxfirms*), social security contributions (*ssc*), taxes on payroll and workforce (*taxpayroll*), taxes on property (*taxprop*), taxes on goods and services (*taxvat*), gross fixed capital formation growth rate (*gfcfgr*), current account balance in percentage of GDP (*current*), long-term interest rates (*ltir*), average hours actually worked (*avg*), and unemployment rate in percentage of active population (*unem*) had the *OECD.Stats* database as its source.

From the Government Finance Statistics, we used data of public spending, based on the classification of the functions of government, *i.e.*, government expenditures on general public services (*pubser*), on defence (*def*), on public order & safety (*pubor*), on economic affairs (*eco*), on environment protection (*env*), on housing & community amenities (*hou*), on health (*hea*), on recreation, culture, & religion (*cul*), on education (*edu*), and on social protection (*socpro*).

In addition, the data on old age dependency ratio as a percentage of active population (*ageratioold*), total fertility rate (*fertility*), GDP percentage of household final consumption expenditure (*hconsggdp*), land area in squared km (*landarea*), and total life expectancy at birth in years (*lexpectancy*) is taken from the World Development Indicators (WDI).

Lastly, population in millions (*pop*) and the total factor productivity at constant national prices (*rtfpna*) are based on Feenstra *et al*. (2015), while the liquid liabilities-to-GDP ratio (*llgdp*) information was collected from the International Financial Statistics (IFS) data, from the International Monetary Fund. Table 1 presents the summary statistics for each variable used in our econometric specifications.

Table 1
SUMMARY STATISTICS OF THE VARIABLES SET FOR ECONOMIC GROWTH REGRESSIONS, 1980-2015

	realgdppc	*taxinc*	*taxfirms*	*ssc*	*taxpayroll*	*taxprop*	*taxvat*
Mean	24.448	8.82	2.806	8.345	0.369	1.745	10.588
Std dev	14.313	4.635	1.5	4.981	0.728	1.003	3.046
Max	101.054	26.78	12.594	19.173	5.661	7.334	18.73
Min	2.184	0.873	0.261	0	0	0.074	2.979
Obs.	1195	1106	1106	1137	1137	1137	1137
Median	21.698	8.532	2.533	8.862	0	1.593	10.892
Skewness	1.426	1.14	2.045	-0.162	2.773	0.564	-0.36
Kurtosis	3.689	2.053	7.128	-1.085	9.192	0.075	-0.15
IQR	32.252	11.071	3.337	12.512	0.311	2.55	12.361
CV	0.585	0.526	0.534	0.597	1.976	0.575	0.288
Range	98.870	25.907	12.333	19.173	5.661	7.26	15.751
	gfcfgr	*current*	*ltir*	*avg*	*unem*	*capb*	*debt*
Mean	3.314	-0.578	6.211	1797.237	7.349	-2.588	55.728
Std dev	8.917	5.565	3.429	249.343	3.835	3.295	35.901
Max	45.119	16.467	22.498	2911	27.467	6.003	242.113
Min	-47.761	-23.201	-0.069	1361.7	1.854	-18.676	3.664
Obs.	1164	727	854	986	741	860	943
Median	3.214	-1.073	5.367	1783.9	6.776	-2.266	48.27
Skewness	-0.015	0.047	0.966	1.248	1.777	-0.878	1.565
Kurtosis	3.261	1.277	0.89	3.242	4.976	1.543	4.262
IQR	7.61	2.6	8.117	1906.75	8.839	-0.374	70.778
CV	2.691	-9.622	0.552	0.139	0.522	-1.273	0.644
Range	92.88	39.668	22.567	1549.3	25.613	24.679	238.449

(*Continued*)

	totexp	*pubser*	*def*	*pubor*	*eco*	*env*	*hou*
Mean	42.621	6.703	1.681	1.698	4.76	0.689	0.756
Std dev	9.657	2.274	1.333	0.44	1.763	0.346	0.44
Max	68.436	16.701	8.851	3.761	25.28	1.758	5.411
Min	14.244	2.98	0	0.815	1.307	-0.284	-0.083
Obs.	977	585	586	585	585	583	585
Median	43.202	6.287	1.376	1.643	4.475	0.681	0.696
Skewness	-0.404	0.972	2.623	0.777	4.755	0.21	2.935
Kurtosis	0.048	1.023	7.922	2.018	42.369	0.518	23.116
IQR	49.546	7.917	1.763	1.951	5.239	0.869	0.94
CV	0.227	0.339	0.793	0.259	0.37	0.502	0.582
Range	54.192	13.721	8.851	2.946	23.974	2.042	5.494
	hea	*cul*	*edu*	*socpro*	*llgdp*	*pop*	*rtfpna*
Mean	5.901	1.176	5.394	15.562	72.91	33.531	0.941
Std dev	1.686	0.57	1.08	4.708	48.689	52.235	0.123
Max	9.123	3.63	8.116	26.18	399.114	319.449	1.539
Min	0.379	0.248	3.021	5.44	6.865	0.228	0.472
Obs.	585	585	585	585	1139	1173	1173
Median	6.172	1.113	5.389	16.046	63.178	10.385	0.975
Skewness	-0.885	1.422	0.128	-0.001	2.933	3.186	-0.425
Kurtosis	0.638	3.829	-0.634	-0.82	11.78	11.883	1.632
IQR	7.076	1.413	6.221	19.054	82.569	46.492	1.014
CV	0.286	0.484	0.2	0.303	0.668	1.558	0.131
Range	8.744	3.381	5.095	20.74	392.249	319.221	1.067
	ageratioold	*fertility*	*hconsggdp*	*landarea*	*lexpectancy*		
Mean	20.094	1.793	56.382	1014.986	76.316		
Std dev	5.519	0.499	7.069	2412.040	3.934		
Max	42.653	4.836	79.551	916.192	83.844		
Min	6.641	1.076	29.918	2.590	58.692		
Obs.	1260	1260	1174	1220	1260		
Median	20.171	1.72	56.38	241.930	76.734		
Skewness	-0.171	2.023	-0.233	2.834	-0.753		
Kurtosis	0.473	6.207	0.8	6.313	0.91		
IQR	23.766	1.96	60.858	410.340	79.185		
CV	0.275	0.278	0.125	2.376	0.052		
Range	36.011	3.76	49.633	9159.330	25.152		

Notes: For reasons of parsimony, the results of *realgdppc* and *landarea* variables are expressed in thousands of USD and squared *km*, respectively.

To estimate the coefficients, we apply panel data techniques by using (*i*) OLS, (*ii*) OLS-Fixed Effects (FE) to deal with unobserved effects, (*iii*) Generalised Method of Moments (GMM) to deal with endogeneity problems, and lastly (*iv*) Robust Least Squares (RLS) to retrieve robust results and to deal with possible outliers' observations. With the exception of RLS, we estimate the coefficient by resorting to white diagonal covariance matrix assumption, in order to assume a residual heteroscedasticity.

In complement to the application of each tax component, we use two sets of control variables: the first econometric specification includes $realgdppc_{-1}$, *gfcfgr*, *current*, *ltir*, *avg*, *unem*, *capb*, *debt* and *totexp* variables; the second econometric specification considers $realgdppc_{-1}$, *pubser*, *def*, *pubor*, *eco*, *env*, *hou*, *hea*, *cul*, *edu*, *socpro*, *llgdp*, *lpop*, *rtfpna*, *ageratioold*, *fertility*, *hconsggdp*, *landarea*, and *lexpectancy* variables.

Lastly, and in order to estimate both short- and long-term effects of taxation, we estimate Equations (1) and (2) by making use of the annual growth rate and a 5-year average economic growth, respectively. However, it is important to mention that we only assess possible tax thresholds for each tax item when we obtain both statistical coefficients for both linear and square term items regressors, with a significant level of at least 10%.

4. Empirical Analysis

4.1. Short-run effects of taxation on economic growth

For both econometric specifications, as addressed in the previous section, estimations from Equations (1) to (8) are based on the first set of control variables, while the ones from Equations (9) to (16) are based on the second set.

When the first set of control variables is used, the results presented in Table 2 show that there is always a β-convergence process through the negative and significant signal represented in the real *per capita* GDP. In addition, growth of investment (*gfcfgr*) and long-term interest rates evidence an expected signal for the economic growth dynamics when their coefficients are statistically significant. On one hand, government expenditures seem to be detrimental for growth, which is consistent with Afonso and Jalles' (2016) findings. At the same time, the structural budget balance and the government debt-to-GDP ratio appear to present an expected negative relationship related with economic growth (see, for example, the conclusions presented in Afonso and Alves (2015)).

Looking in detail for the different tax sources' revenues effects on economic performance, and for the estimations without the square term (of Equations (1), (3), (5) and (7)), we conclude that only an increase in tax revenues from individual income presents a positive effect on growth, while the other tax sources do not evidence consistent effects on economic growth. In fact, the econometric regressions show both positive and negative tax revenues effects on GDP, depending on the econometric technique under analysis.

Table 2

LINEAR AND NON-LINEAR SHORT-RUN IMPACT RESULTS OF TAXATION STRUCTURE ON ECONOMIC GROWTH DYNAMICS FOR EQUATION (1)

	OLS		OLS-FE		GMM		RLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ln(realgdppc_{-1})$	-0.000^{**}	-0.000^{***}	-0.000^{***}	-0.000^{***}	-0.000	-0.000^{***}	-0.000^{***}	-0.000^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.097	0.037	-0.017	0.221	-0.008	-0.176	0.159^{***}	0.134^{*}
	(0.063)	(0.122)	(0.146)	(0.250)	(0.077)	(0.165)	(0.043)	(0.081)
$taxinc^2$		0.004		-0.012		0.007		0.003
		(0.004)		(0.009)		(0.004)		(0.003)
taxfirms	0.063	0.557^{***}	-0.337^{**}	0.318	-0.010	0.173	0.085	0.631^{***}
	(0.080)	(0.200)	(0.163)	(0.312)	(0.087)	(0.315)	(0.06)	(0.170)
$taxfirms^2$		-0.050^{***}		-0.058^{***}		-0.016		-0.052^{***}
		(0.017)		(0.020)		(0.029)		(0.015)
ssc	0.173^{***}	0.655^{***}	-0.903^{***}	-2.950^{**}	0.095	0.525^{***}	0.241^{***}	0.647^{***}
	(0.059)	(0.108)	(0.205)	(1.258)	(0.064)	(0.124)	(0.036)	(0.082)
ssc^2		-0.03^{***}		0.086^{*}		-0.027^{***}		-0.024^{***}
		(0.006)		(0.052)		(0.006)		(0.005)
taxpayroll	0.042	1.006^{***}	-0.711^{**}	0.496	-0.052	0.587	0.111	0.974^{***}
	(0.118)	(0.276)	(0.356)	(0.540)	(0.127)	(0.382)	(0.103)	(0.270)
$taxpayroll^2$		-0.283^{***}		-0.266^{***}		-0.157		-0.252^{***}
		(0.076)		(0.096)		(0.105)		(0.081)
taxprop	0.103	0.111	-0.685^{*}	-2.196	0.058	0.449	0.156^{*}	-0.335
	(0.115)	(0.473)	(0.374)	(1.576)	(0.122)	(0.601)	(0.092)	(0.388)
$taxprop^2$		-0.062		0.321		-0.114		0.065
		(0.099)		(0.288)		(0.120)		(0.087)
taxvat	0.097	0.272	-0.783^{***}	-1.862	0.067	-0.124	0.109^{**}	-0.033
	(0.082)	(0.250)	(0.294)	(1.132)	(0.096)	(0.357)	(0.050)	(0.184)
$taxvat^2$		-0.009		0.048		0.008		0.008
		(0.013)		(0.043)		(0.018)		(0.009)
gfcfgr	0.302^{***}	0.295^{***}	0.181^{***}	0.182^{***}	0.347^{***}	0.327^{***}	0.282^{***}	0.275^{***}
	(0.028)	(0.029)	(0.031)	(0.029)	(0.050)	(0.050)	(0.011)	(0.010)

(*Continued*)

	OLS		OLS-FE		GMM		RLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
current	-0.019	-0.039	-0.098**	-0.071	-0.059	-0.089	0.029	0.006
	(0.037)	(0.042)	(0.043)	(0.048)	(0.049)	(0.055)	(0.018)	(0.018)
ltir	0.007	0.047	-0.269***	-0.258**	-0.017	0.027	-0.012	0.039
	(0.059)	(0.065)	(0.104)	(0.111)	(0.097)	(0.113)	(0.041)	(0.043)
avg	0.000	-0.001	-0.006***	-0.009***	0.000	-0.002	0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
unem	0.013	0.002	-0.084*	-0.084*	0.016	0.006	0.011	0.023
	(0.036)	(0.039)	(0.045)	(0.045)	(0.043)	(0.048)	(0.025)	(0.025)
capb	-0.068	-0.051	0.082	0.042	0.060	0.118	-0.099**	-0.091**
	(0.065)	(0.074)	(0.075)	(0.071)	(0.092)	(0.115)	(0.040)	(0.040)
debt	-0.007*	-0.006	0.023***	0.033***	-0.003	-0.005	-0.008***	-0.008***
	(0.004)	(0.004)	(0.009)	(0.011)	(0.005)	(0.006)	(0.003)	(0.003)
totexp	-0.103*	-0.120*	-0.091	-0.085	-0.033	-0.027	-0.135***	-0.163***
	(0.057)	(0.061)	(0.069)	(0.069)	(0.068)	(0.083)	(0.030)	(0.030)
Tax thresholds								
taxinc	—	—	—	—	—	—	—	—
taxfirms	—	5.57%	—	—	—	—	—	6.07%
ssc	—	10.92%	—	**17.15%**	—	—	—	13.48%
taxpayroll	—	1.78%	—	—	—	—	—	1.93%
taxprop	—	—	—	—	—	—	—	—
taxvat	—	—	—	—	—	—	—	—
R^2	0.63	0.651	0.834	0.844	0.624	0.641	0.462	0.476
DW-statistic	1.432	1.492	1.518	1.554	1.472	1.507	n. a.	n. a.
Obs.	525	525	525	525	491	491	525	525

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1%, respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Table 3
LINEAR AND NON-LINEAR SHORT-RUN IMPACT RESULTS OF TAXATION STRUCTURE ON ECONOMIC GROWTH DYNAMICS FOR EQUATION (2)

	OLS		OLS-FE		GMM		RLS	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$ln(realgdppc_{-1})$	-0.000^{***}	-0.000^{***}	-0.001^{***}	-0.001^{***}	-0.000^{***}	0.000^{***}	0.000^{***}	0.000^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.307^{***}	0.279^{**}	0.177	0.075	-0.002	0.153	0.189^{***}	0.110
	(0.08)	(0.136)	(0.129)	(0.298)	(0.114)	(0.186)	(0.064)	(0.117)
$taxinc^2$		0.003		0.002		-0.003		0.005
		(0.005)		(0.010)		(0.007)		(0.005)
taxfirms	0.172^{**}	0.304	0.237	0.373	-0.081	-0.693	0.069	0.338
	(0.087)	(0.265)	(0.153)	(0.375)	(0.138)	(0.501)	(0.091)	(0.267)
$taxfirms^2$		-0.022		-0.014		0.052		-0.031
		(0.021)		(0.026)		(0.043)		(0.024)
ssc	0.374^{***}	0.989^{***}	-0.452^{*}	-0.365	0.192	0.592^{**}	0.283^{***}	0.750^{***}
	(0.078)	(0.199)	(0.241)	(0.839)	(0.120)	(0.273)	(0.060)	(0.184)
ssc^2		-0.035^{***}		-0.004		-0.022		-0.028^{***}
		(0.010)		(0.031)		(0.014)		(0.009)
taxpayroll	0.492^{***}	1.490^{***}	-0.394	0.601	0.136	0.176	0.294^{*}	0.904^{**}
	(0.176)	(0.451)	(0.359)	(0.801)	(0.205)	(0.583)	(0.153)	(0.440)
$taxpayroll^2$		-0.298^{**}		-0.245^{*}		0.036		-0.180
		(0.138)		(0.138)		(0.184)		(0.134)
taxprop	0.838^{***}	1.748^{***}	-0.008	-0.921	1.212^{***}	1.858	0.523^{***}	0.734
	(0.229)	(0.503)	(0.185)	(0.908)	(0.385)	(1.331)	(0.176)	(0.456)
$taxprop^2$		-0.191^{**}		0.112		-0.156		-0.057
		(0.074)		(0.113)		(0.317)		(0.081)
taxvat	0.394^{***}	1.006^{***}	0.127	1.341^{*}	0.390^{**}	0.436	0.286^{***}	0.844^{***}
	(0.138)	(0.383)	(0.185)	(0.686)	(0.197)	(0.677)	(0.090)	(0.321)
$taxvat^2$		-0.027		-0.048^{*}		0.000		-0.028^{**}
		(0.018)		(0.028)		(0.032)		(0.014)

(*Continued*)

	OLS		**OLS-FE**		**GMM**		**RLS**	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
pubser	-0.514***	-0.589***	-0.325**	-0.369***	-0.417***	-0.490***	-0.464***	-0.489***
	(0.085)	(0.082)	(0.127)	(0.138)	(0.157)	(0.147)	(0.068)	(0.071)
def	-0.271	-0.395*	0.018	0.055	-0.156	-0.189	-0.207	-0.349**
	(0.188)	(0.211)	(0.369)	(0.388)	(0.254)	(0.274)	(0.143)	(0.157)
pubor	-1.083**	-1.600***	0.658	0.693	-1.277*	-1.379*	-0.638	-1.069**
	(0.496)	(0.542)	(0.828)	(0.868)	(0.741)	(0.792)	(0.422)	(0.456)
eco	-0.186	-0.175	0.015	0.014	-0.601	-0.717	-0.145**	-0.109
	(0.137)	(0.129)	(0.058)	(0.054)	(0.465)	(0.515)	(0.067)	(0.068)
env	-1.728***	-1.242*	-1.233	-1.171	-1.905**	-0.997	-1.842***	-1.303**
	(0.646)	(0.692)	(0.909)	(0.942)	(0.967)	(1.168)	(0.470)	(0.506)
hou	-0.444	-0.574	0.281	0.300	-0.350	-0.085	-0.354	-0.457
	(0.433)	(0.453)	(0.318)	(0.331)	(0.795)	(0.962)	(0.274)	(0.280)
hea	-0.224*	-0.177	0.390*	0.401*	0.108	0.142	-0.226**	-0.176
	(0.125)	(0.129)	(0.230)	(0.230)	(0.197)	(0.239)	(0.105)	(0.110)
cul	-1.255***	-0.983**	0.016	0.400	-1.084**	-1.132*	-0.754**	-0.491
	(0.435)	(0.457)	(0.693)	(0.756)	(0.537)	(0.637)	(0.341)	(0.370)
edu	-0.281	-0.439**	-1.072**	-1.126**	0.035	-0.162	-0.227	-0.315*
	(0.190)	(0.207)	(0.441)	(0.435)	(0.281)	(0.399)	(0.177)	(0.191)
socpro	-0.343***	-0.311***	-0.597***	-0.595***	-0.136	-0.086	-0.240***	-0.204***
	(0.071)	(0.076)	(0.144)	(0.152)	(0.090)	(0.119)	(0.051)	(0.058)
llgdp	0.011**	0.009	0.037***	0.037***	0.004	0.008	0.008**	0.006
	(0.005)	(0.005)	(0.012)	(0.012)	(0.007)	(0.009)	(0.004)	(0.005)
ln(*pop*)	-0.264	-0.267	17.701***	16.495***	-0.452	-0.624	-0.254	-0.234
	(0.217)	(0.223)	(4.657)	(5.217)	(0.368)	(0.468)	(0.155)	(0.165)
rtfpna	7.767***	7.326***	10.797***	9.666***	-3.100	-1.415	8.489***	7.472***
	(2.318)	(2.305)	(2.859)	(3.086)	(3.415)	(3.452)	(1.708)	(1.818)

(*Continued*)

	OLS		**OLS-FE**		**GMM**		**RLS**	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
ageratioold	-0.079	-0.079	0.166*	0.105	-0.184**	-0.215**	-0.018	-0.014
	(0.062)	(0.064)	(0.098)	(0.103)	(0.080)	(0.089)	(0.038)	(0.039)
fertility	-0.802	-0.743	-7.314***	-6.709***	-3.567***	-3.417***	-0.011	0.391
	(0.846)	(0.876)	(1.419)	(1.482)	(1.139)	(1.252)	(0.618)	(0.650)
hconsggdp	-0.060	-0.051	-0.147*	-0.116	-0.090	-0.080	-0.085**	-0.070*
	(0.043)	(0.044)	(0.085)	(0.088)	(0.070)	(0.085)	(0.035)	(0.036)
landarea	0.000	0.000**	0.000	0.000	0.000	0.000*	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lexpectancy	-0.258**	-0.288**	-0.837***	-0.744**	-0.072	-0.032	-0.302***	-0.338***
	(0.109)	(0.117)	(0.316)	(0.328)	(0.144)	(0.163)	(0.066)	(0.073)
Tax thresholds								
taxinc	—	—	—	—	—	—	—	—
taxfirms	—	—	—	—	—	—	—	—
ssc	—	14.13%	—	—	—	—	—	13.39%
taxpayroll	—	2.50%	—	—	—	—	—	—
taxprop	—	4.58%	—	—	—	—	—	—
taxvat	—	—	—	13.97%	—	—	—	15.07%
R^2	0.392	0.411	0.798	0.801	0.285	0.271	0.305	0.313
DW-statistic	1.273	1.263	1.195	1.212	1.386	1.403	n. a.	n. a.
Obs.	536	536	536	536	500	500	536	536

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Additionally, when we evaluate the existence of non-linear relationships between the several tax revenues and their impact on growth (estimations from Equations (2), (4), (6), and (8)), we achieve some tax thresholds. In particular, when we conclude that there is an average maximum value of 5.82% for taxes levied on firms' income, the share of taxes that we suggest should be levied on firms to efficiently boost economic growth. The same conclusion is found for taxes on payroll and workforce, where we reach an average maximum of 1.86% of revenues over GDP for this tax item. Furthermore, we also obtain an average maximising GDP growth rate value of 11.37% for social security contributions (Equations (2), (6) and (8)). However, it is important to mention that for this source of taxation, our results show a minimising effect on growth of 17.15%, which means that raising social security revenues until that value will reduce economic growth rates.

Moving now to Equations (9) to (16), which show the results of Equations (1) and (2) by using the second set of control variables as mentioned above, we are able to conclude that government spending, by function of government, is generally negative to growth, as is also evidenced in previous research. The same negative effect on growth is also found for life expectancy. In contrast to these results, an increment of monetary supply and of total factor productivity appears to improve real economic growth. Still, an increase of household consumptions presents a negative impact on growth, although the statistical coefficients obtained evidence a marginal impact (less than 0.15% on economic growth per unit increase in household consumption).

When we evaluate possible tax-to-growth thresholds using the second set of control variables, we also obtain several optimising values. The results achieved show average growth-maximising values of 13.76% for social security contributions, while evidencing maximum values of 2.50% and 4.58% for taxes on payroll and on property, respectively. Additionally, a threshold of 14.52% on average is found for tax on goods and services. Comparing to the results of previous research, we conclude that there are no significant differences between the regression results using the first or the second set of control variables. The results are presented in Table 3.

4.2. Long-run effects of taxation on economic growth

With regards to the long-term relationship between taxation structure and economic growth, we also compute our main equations using both sets of variables. However, and in order to evaluate the taxation items impacts on long-term growth, we make use of the 5-year average economic growth rates. The long-term results are shown in Tables 4 and 5, for the first and second sets of control variables, respectively.

Regarding the first set of control variables with linear relationships of taxes with growth (Equations (1), (3), (5) and (7)), we verify the same positive impact of investment growth on long-run economic performance just as in the short-run analysis. The same conclusions are reached for the impacts of government spending. However, and in accordance with the short-run results, government debt growth and fiscal consolidation, through the structural budget balance, show, in general, a negative relation with *per capita* long-term growth. However, the results show a positive link between certain tax items and growth, namely social security contributions and taxes on payroll. For the remaining tax sources, the results obtained cannot be summarised as having a unique impact of growth, as different signals are obtained depending on the econometric specifications.

Table 4
LINEAR AND NON-LINEAR LONG-RUN IMPACT RESULTS OF TAXATION STRUCTURE ON ECONOMIC GROWTH DYNAMICS FOR EQUATION (1)

	OLS		OLS-FE		GMM		RLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(realgdppc$_{-1}$)	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.035	-0.007	-0.203***	-0.302*	0.058	-0.029	0.073***	-0.020
	(0.043)	(0.072)	(0.078)	(0.178)	(0.062)	(0.109)	(0.027)	(0.052)
taxinc^2		0.002		0.003		0.005*		0.004**
		(0.002)		(0.006)		(0.003)		(0.002)
taxfirms	-0.009	0.113	0.043	0.394***	0.002	0.458**	0.028	0.180*
	(0.041)	(0.119)	(0.073)	(0.148)	(0.054)	(0.186)	(0.037)	(0.107)
taxfirms^2		-0.017*		-0.029***		-0.049***		-0.015
		(0.010)		(0.009)		(0.018)		(0.010)
ssc	0.078*	0.385***	-0.170	0.103	0.107	0.497***	0.142***	0.373***
	(0.041)	(0.064)	(0.120)	(0.498)	(0.054)	(0.087)	(0.022)	(0.052)
ssc^2		-0.020***		-0.014		-0.024***		-0.015***
		(0.003)		(0.021)		(0.004)		(0.003)
taxpayroll	0.023	0.506***	0.219	0.470	0.091	0.683**	0.115*	0.381**
	(0.070)	(0.184)	(0.151)	(0.322)	(0.094)	(0.265)	(0.063)	(0.171)
taxpayroll^2		-0.141***		-0.082		-0.162**		-0.066
		(0.048)		(0.058)		(0.070)		(0.051)
taxprop	0.060	0.469	-0.726***	-1.766**	-0.026	-0.057	0.196***	0.445*
	(0.076)	(0.290)	(0.272)	(0.846)	(0.088)	(0.378)	(0.057)	(0.245)
taxprop^2		-0.138**		0.232		-0.042		-0.076
		(0.065)		(0.142)		(0.080)		(0.055)
taxvat	-0.006	0.499***	-0.406***	-0.852***	0.018	0.378**	0.060*	0.256**
	(0.056)	(0.152)	(0.119)	(0.324)	(0.071)	(0.181)	(0.031)	(0.117)
taxvat^2		-0.026***		0.022		-0.018**		-0.011*
		(0.007)		(0.014)		(0.008)		(0.006)
gfcfgr	0.044***	0.040***	0.031***	0.029***	0.094***	0.079***	0.023***	0.021***
	(0.012)	(0.011)	(0.009)	(0.009)	(0.028)	(0.026)	(0.007)	(0.007)

(*Continued*)

	OLS		**OLS-FE**		**GMM**		**RLS**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
current	0.024	0.010	-0.027	-0.027	-0.020	-0.033	0.020*	0.000
	(0.015)	(0.017)	(0.020)	(0.021)	(0.022)	(0.025)	(0.011)	(0.012)
ltir	-0.006	0.003	-0.091*	-0.098*	0.074	0.149*	0.058**	0.080***
	(0.045)	(0.049)	(0.052)	(0.054)	(0.073)	(0.082)	(0.025)	(0.027)
avg	0.001**	0.000	-0.001	0.000	0.000	-0.001	0.001***	0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
unem	0.002	-0.026	-0.110***	-0.104***	0.005	-0.010	-0.008	-0.026
	(0.029)	(0.028)	(0.036)	(0.037)	(0.035)	(0.037)	(0.015)	(0.016)
capb	-0.084**	-0.059	0.073	0.066	-0.075	-0.065	-0.066***	-0.041
	(0.037)	(0.039)	(0.048)	(0.047)	(0.070)	(0.080)	(0.025)	(0.026)
debt	-0.018***	-0.016***	0.016***	0.020***	-0.012***	-0.011**	-0.015***	-0.015***
	(0.003)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
totexp	-0.036	-0.037	0.024	0.020	-0.069	-0.091	-0.077***	-0.071***
	(0.041)	(0.042)	(0.048)	(0.046)	(0.056)	(0.061)	(0.018)	(0.019)
Tax thresholds								
taxinc	—	—	—	—	—	—	—	—
taxfirms	—	—	—	6.79%	—	4.67%	—	—
ssc	—	9.63%	—	—	—	10.35%	—	12.43%
taxpayroll	—	1.79%	—	—	—	2.11%	—	—
taxprop	—	—	—	—	—	—	—	—
taxvat	—	9.60%	—	—	—	10.50%	—	11.64%
R^2	0.390	0.440	0.781	0.788	0.288	0.343	0.338	0.359
DW-statistic	0.433	0.472	0.804	0.848	0.749	0.770	n. a.	n. a.
Obs.	525	525	525	525	491	491	525	525

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Table 5
LINEAR AND NON-LINEAR LONG-RUN IMPACT RESULTS OF TAXATION STRUCTURE ON ECONOMIC GROWTH DYNAMICS FOR EQUATION (2)

	OLS		OLS-FE		GMM		RLS	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$ln(realgdppc_{-1})$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	-0.042	-0.030	0.108	0.075	-0.033	-0.087	-0.001	-0.008
	(0.031)	(0.058)	(0.068)	(0.160)	(0.048)	(0.085)	(0.028)	(0.049)
$taxinc^2$		0.000		-0.001		0.003		-0.001
		(0.002)		(0.006)		(0.003)		(0.002)
taxfirms	-0.022	0.102	0.169**	0.312*	-0.020	0.065	-0.012	-0.095
	(0.049)	(0.128)	(0.072)	(0.173)	(0.070)	(0.200)	(0.040)	(0.111)
$taxfirms^2$		-0.020**		-0.012		-0.014		-0.009
		(0.010)		(0.012)		(0.017)		(0.010)
ssc	-0.023	0.225***	-0.059	0.471	-0.014	0.324***	0.048*	0.308***
	(0.031)	(0.078)	(0.115)	(0.492)	(0.053)	(0.106)	(0.027)	(0.076)
ssc^2		-0.016***		-0.023		-0.020***		-0.020***
		(0.004)		(0.019)		(0.005)		(0.004)
taxpayroll	0.063	0.138	0.428**	1.047**	0.099	0.484**	0.103	0.028
	(0.056)	(0.165)	(0.193)	(0.405)	(0.065)	(0.234)	(0.067)	(0.183)
$taxpayroll^2$		-0.024		-0.170**		-0.107		0.018
		(0.048)		(0.076)		(0.073)		(0.056)
taxprop	0.275***	0.774***	-0.149	-1.142	0.438**	1.195**	0.251***	0.988***
	(0.094)	(0.245)	(0.155)	(0.697)	(0.184)	(0.505)	(0.078)	(0.190)
$taxprop^2$		-0.102***		0.130		-0.194		-0.125***
		(0.039)		(0.082)		(0.118)		(0.034)
taxvat	-0.129**	0.470***	0.089	0.702**	-0.064	0.642**	-0.011	0.466***
	(0.056)	(0.161)	(0.093)	(0.339)	(0.071)	(0.292)	(0.040)	(0.133)
$taxvat^2$		-0.027***		-0.024*		-0.032**		-0.023***
		(0.007)		(0.014)		(0.013)		(0.006)

(*Continued*)

	OLS		**OLS-FE**		**GMM**		**RLS**	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
pubser	-0.129***	-0.164***	-0.063	-0.111	-0.167**	-0.206***	-0.142***	-0.183***
	(0.040)	(0.039)	(0.069)	(0.071)	(0.076)	(0.074)	(0.030)	(0.030)
def	-0.106	-0.127	0.160	0.197	-0.101	-0.199*	0.027	-0.046
	(0.080)	(0.084)	(0.184)	(0.198)	(0.115)	(0.113)	(0.063)	(0.065)
pubor	0.059	-0.403*	-0.089	-0.087	-0.015	-0.487	-0.392**	-0.574***
	(0.214)	(0.207)	(0.407)	(0.408)	(0.288)	(0.311)	(0.186)	(0.189)
eco	0.004	0.012	0.076	0.075	0.117	0.156	-0.059**	0.046
	(0.059)	(0.054)	(0.057)	(0.051)	(0.270)	(0.269)	(0.030)	(0.028)
env	-1.740***	-1.428***	-2.512***	-2.423***	-2.193***	-1.801***	-1.026***	-0.642***
	(0.278)	(0.286)	(0.448)	(0.458)	(0.504)	(0.525)	(0.207)	(0.210)
hou	0.039	-0.101	0.007	0.039	0.136	-0.227	0.121	0.124
	(0.148)	(0.164)	(0.157)	(0.166)	(0.472)	(0.487)	(0.121)	(0.117)
hea	0.148**	0.165**	0.152	0.168	0.081	0.110	-0.005	0.135***
	(0.062)	(0.069)	(0.149)	(0.166)	(0.102)	(0.118)	(0.046)	(0.046)
cul	-0.304	-0.087	0.685*	0.946***	-0.409	-0.234	-0.011	-0.350**
	(0.238)	(0.248)	(0.358)	(0.356)	(0.269)	(0.296)	(0.150)	(0.154)
edu	-0.185**	-0.216**	0.103	0.046	-0.266**	-0.273	-0.121	-0.254***
	(0.083)	(0.088)	(0.199)	(0.204)	(0.119)	(0.169)	(0.078)	(0.079)
socpro	-0.008	0.018	-0.277***	-0.280***	-0.024	-0.012	-0.026	0.048**
	(0.028)	(0.030)	(0.081)	(0.083)	(0.038)	(0.042)	(0.022)	(0.024)
llgdp	0.001	-0.000	0.007	0.006	0.002	0.002	0.001	-0.003
	(0.002)	(0.002)	(0.006)	(0.006)	(0.003)	(0.003)	(0.002)	(0.002)
ln(*pop*)	-0.223**	-0.187*	11.093***	9.345***	-0.184	-0.103	-0.162**	-0.282***
	(0.099)	(0.108)	(2.465)	(2.689)	(0.174)	(0.216)	(0.068)	(0.069)
rtfpna	-0.001	-0.364	4.635***	3.597**	-0.796	-1.320	1.041	0.808
	(1.047)	(1.076)	(1.558)	(1.617)	(1.322)	(1.370)	(0.753)	(0.756)

(*Continued*)

	OLS		**OLS-FE**		**GMM**		**RLS**	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
ageratioold	-0.079^{***}	-0.077^{***}	0.109^{**}	0.066	-0.078^{***}	-0.073^{***}	-0.076^{***}	-0.113^{***}
	(0.019)	(0.020)	(0.052)	(0.055)	(0.024)	(0.028)	(0.017)	(0.016)
fertility	-0.191	-0.338	-2.388^{***}	-2.184^{***}	-0.264	-0.056	-0.607^{**}	-0.538^{**}
	(0.334)	(0.357)	(0.716)	(0.758)	(0.445)	(0.471)	(0.273)	(0.270)
hconsggdp	-0.103^{***}	-0.104^{***}	-0.078^{*}	-0.057	-0.105^{***}	-0.094^{**}	-0.053^{***}	-0.084^{***}
	(0.022)	(0.022)	(0.044)	(0.045)	(0.037)	(0.038)	(0.016)	(0.015)
landarea	-0.000^{**}	0.000	-0.000	-0.000	-0.000^{**}	0.000	0.000	0.000^{**}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lexpectancy	-0.244^{***}	-0.280^{***}	-0.251	-0.205	-0.220^{***}	-0.269^{***}	-0.215^{***}	-0.226^{***}
	(0.033)	(0.036)	(0.189)	(0.193)	(0.041)	(0.050)	(0.029)	(0.030)
Tax thresholds								
taxinc	—	—	—	—	—	—	—	—
taxfirms	—	—	—	—	—	—	—	—
ssc	—	7.03%	—	—	—	8.10%	—	7.70%
taxpayroll	—	—	—	3.08%	—	—	—	—
taxprop	—	3.79%	—	—	—	—	—	3.95%
taxvat	—	8.72%	—	25.07%	—	10.03%	—	10.13%
R^2	0.636	0.662	0.796	0.803	0.631	0.649	0.475	0.509
DW-statistic	0.537	0.570	0.808	0.839	0.545	0.598	n. a.	n. a.
Obs.	536	536	536	536	500	500	536	536

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

In the analysis of possible non-linear impacts of taxation on economic performance (Equations (2), (4), (6) and (8)), we come to similar conclusions for the control variables' effect on *per capita* growth. With regards to the existence of taxation thresholds, we obtain maximum average values of 10.80% and 10.58% for the revenues from social security contributions and for taxes on goods and services, respectively. We also reach two optimal average values of maximum tax revenues for taxes on payroll and workforce (1.95%), while property taxes appear not to present a non-linear connection with economic growth.

For the regressions in the long-run, using the second set of control variables, we obtain the following optimal maximising tax items' revenues average threshold values: 7.61% for social security contributions, 3.08% for taxes on payroll, 3.87% for property taxation, and 10.88% for consumption taxation.

Additionally, similar results for the long-run were obtained for the control variables impact on real *per capita* GDP growth, when compared to those obtained for the short-run regressions. In particular, public spending by function evidences a negative impact for economic growth. Monetary supply seems to lose statistical significance when it comes to explaining long-term growth; at the same time, total factor productivity significance is maintained, although its impact on real growth is not so high in the long-term as it is in the short-run. Lastly, household consumption, fertility rate, old-age dependency ratio, and life expectancy present the same conclusions as in the short-term analysis.

5. Conclusions

In our article we evaluated the relationship between the revenues of tax sources as a proportion of GDP and real *per capita* economic growth. This study was conducted on both short-term and long-term basis, and also assessed possible non-linear relationships between taxation and growth. The analyses conducted for all OECD countries between 1980 and 2015 used two set of control variables, in order to understand the impact of tax structure on GDP growth.

The results obtained in this study support the point-of-view that tax revenues-to-GDP thresholds exist, which translates into optimal maximising/minimising values for certain tax items' revenues, in GDP terms. In particular, and only on the short-term basis, we found optimal maximum values for taxes on firms, while social security contributions, taxes on payroll and workforce, taxes on property, and taxes on consumption present threshold values for both the short and the long-term. Furthermore, we conclude that there are no optimal threshold values for taxation of individual incomes in relation to economic growth.

Lastly, and by comparing our results with the mean values of each tax item presented in the summary statistics, we verify that the historic mean value for consumption taxes coincides with the threshold value registered for that same tax source in the long-run. In addition, we verify that there is fiscal margin to raise certain tax revenues, as a proportion of GDP, by confronting the threshold results obtained with average historic values. This would lead to a raise in government revenues without jeopardising economic performance. This supposition is valid for taxes on firms, for social security contributions (albeit this is not valid for the second econometric specification in the long-run analysis), taxes on payroll and workforce, and property taxes.

Furthermore, an additional hypothetical exercise can be made: if we sum our results for the average threshold values with the average mean of the other tax components which do not display threshold values, we can conclude that the proportion of taxation levied on GDP should be between 40.20% and 46.99%, for the short-term perspective, and between 37.07% and 39.63%, for a long-run framework, depending on the results obtained for the first and second set of control variables employed in our analysis. Considering this exercise and the mean values for total revenues (32.95%, based on OECD data), we conclude that, on average, there is fiscal margin to increase overall tax revenues as a proportion of GDP, and, consequently, to improve both the short and long-run real *per capita* economic growth (Table 6 summarises our main findings regarding average tax source threshold values).

However, we are aware that there can be several differences regarding tax-items thresholds. It derives not only from tax sociology, *i.e.* from the sociological adherence to political process decision, but also to intrinsic features of different tax systems. For instance, further researches must be aware on the progressive degree of tax systems, tax-deductions, and, in general, tax incidence specific details, in order to provide a deeper analysis on tax systems effects over economic growth, along higher timespans.

Table 6
SUMMARY OF TAX ITEMS THRESHOLD VALUES FOR *PER CAPITA* REAL GDP GROWTH RATE

	(1)		(2)		Mean
	Short-run	**Long-run**	**Short-run**	**Long-run**	
taxinc	—	—	—	—	8.82%
taxfirms	*5.82%*	*5.73%*	—	—	2.81%
ssc	**17.15%** / *11.37%*	*10.80%*	*13.76%*	*7.61%*	8.35%
taxpayroll	*1.86%*	*1.95%*	*2.50%*	*3.08%*	0.37%
taxprop	—	—	*4.58%*	*3.87%*	1.75%
taxvat	—	*10.58%*	*14.52%*	*10.88%*	10.59%

Notes: The non-bold and bold values, presented in the short-run and long-run columns express maximum and minimum optimum levels, respectively. The values expressed in *italics* represent average values.

Note

1. In addition to this analysis, we recommend Forte and Magazzino (2011) who analyse the optimal government size for EU27, covering the last four decades.

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Resumen

Este estudio evalúa las relaciones lineales y no lineales entre los diferentes impuestos y el crecimiento de la renta per cápita. El análisis se realiza para todos los países de la OCDE durante el período 1980-2015, utilizando técnicas de datos de panel que permiten evaluar los efectos a corto y largo plazo de la fiscalidad sobre el crecimiento económico. Encontramos evidencias de relaciones no lineales entre los diferentes impuestos y el crecimiento económico, con la excepción de los impuestos sobre la renta de las personas físicas. Este resultado apunta a la existencia de determinados umbrales de recaudación impositiva que permiten maximizar el crecimiento económico. Los resultados indican la existencia de espacio fiscal para aumentar determinados impuestos sin perjudicar el crecimiento económico.

Palabras clave: crecimiento económico, sistemas fiscales, política fiscal, imposición óptima

Clasificación JEL: E62, H21, O47.