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Article

Tax determinants revisited: An unbalanced data panel analysis

Journal of Applied Economics

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Suggested Citation: Castañeda Rodríguez, Víctor Mauricio (2018) : Tax determinants revisited: An unbalanced data panel analysis, Journal of Applied Economics, ISSN 1667-6726, Taylor & Francis, Abingdon, Vol. 21, Iss. 1, pp. 1-24,
<https://doi.org/10.1080/15140326.2018.1526867>

This Version is available at:

<https://hdl.handle.net/10419/314037>

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To cite this article: Víctor Mauricio Castañeda Rodríguez (2018) Tax determinants revisited. An unbalanced data panel analysis, *Journal of Applied Economics*, 21:1, 1-24, DOI: [10.1080/15140326.2018.1526867](https://doi.org/10.1080/15140326.2018.1526867)

To link to this article: <https://doi.org/10.1080/15140326.2018.1526867>



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ARTICLE



Tax determinants revisited. An unbalanced data panel analysis

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ABSTRACT

Quantitative research on taxation is important to test which variables affect it and hence to identify strategies in order to boost tax revenue or change its composition. Albeit research on this topic is not recent, many authors have focused on developed countries, whereas others have avoided including variables that are available recently, for example many governance indicators. This paper contributes to the matter by expanding the dataset with a relevant sample of countries, variables, and time observations. Using a dataset that covers over 138 countries and a 40-year period (1976–2015) we estimate static and dynamic models, although the results generally keep unchanged. In addition, and according to the coefficients significance, some variables as the following influence taxation and/or its composition: Agriculture's share in gross domestic product, financial intermediation, natural rents, education, population share above 65 years, quality of government, and democracy.

ARTICLE HISTORY

Received 8 August 2016

Accepted 1 February 2018

KEYWORDS

Tax determinants; tax revenue; tax structure; developed and developing countries

1. Introduction

Quantitative research on taxation is important in order to be able to test which variables affect it and identify strategies to boost tax revenue and finance public expenditure. In addition, it is a useful tool to evaluate if a country collects enough taxes according to its tax capacity, which is the idea behind the tax effort literature (see e.g., Piancastelli, 2001).

However, taxation involves an exchange relationship between citizens and government, so the total tax revenue and its composition are affected not only by economic factors, but also by social and political ones. Therefore, to understand why some countries get a better tax performance, i.e., some states collect higher revenues and have a more redistributive structure than others, it is necessary to consider potential factors that may affect how taxpayers perceive that relation, for instance the political and government institutions (Baskaran & Bigsten, 2013; Bird, Martinez-Vazquez, & Torgler, 2008).

Recent literature has found *inter alia* that democratic regimes can better afford direct taxes and tax revenue (Mahdavi, 2008), which implies that democracy can be interpreted as a dictatorship of the poor and middle classes because their preferences for

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redistribution are taken into account in the collective choice (Acemoglu & Robinson, 2006). Likewise, findings in the same line arise when media becomes freer and citizens are informed effectively about the politicians' actions.

Nonetheless, there are other factors which have been more extensively studied. Some economic features, for example, affect the tax boundaries, which is the case of agriculture's share in gross domestic product (GDP) and GDP per capita (GDPP), but the list of possible tax determinants includes also demographic and socioeconomic variables (e.g., population density and education). Indeed, many variables should be considered in any quantitative study which tries to explain countries' tax dynamics.

But when many variables are used, the number of available observations falls notably in data panel analysis, which is the traditional approach applied in quantitative studies, due to missing data for some periods or countries, especially those which are far behind at the time or are at low development levels, respectively. Additionally, taking into account many regressors may generate multicollinearity. In consequence, it is necessary to implement some strategies to tackle the aforementioned problems.

This paper, in addition to consider some methodologies to face difficulties such as those mentioned above, not only studies tax revenue (as percentage of GDP) but also taxes on income, profits and capital gains (TR_IP&C) and taxes on general consumption of goods and services (TR_G&S). Additionally, and despite it is usual that empirical studies consider only central governments figures (e.g., Bird et al., 2008), which provides an incomplete picture of public finance for federal states,¹ we take into account general government data when it is available. Then, we include a dummy to indicate if tax variables are observed for central or general government level.

We aim at considering whether some determinants affect tax structure in a certain way, for example increasing direct taxation (i.e., TR_IP&C). Albeit there are several studies which have tried to explain the trends followed by tax structure and revenue (see, e.g., Agbeyegbe, Stotsky, & WoldeMariam, 2006; Gupta, 2007; Kenny & Winer, 2006; Le, Moreno-Dodson, & Bayraktar, 2012; Mahdavi, 2008), this paper includes a large sample of countries (developing and developed ones) and at the same time increases the number of observations and takes into account the possible tax performance persistence (i.e., we include dynamic models).

Taxation depends on many variables, in particular history and institutions matter (Castañeda-Rodríguez, 2012; Sokoloff & Zolt, 2007), so countries with a common history can exhibit similar characteristics in their tax systems. For instance, developed countries tend to collect higher tax revenue and have a more redistributive structure than developing ones. Nevertheless, many authors focus only on developed (Angelopoulos, Economides, & Kammas, 2012) or on developing states (Agbeyegbe et al., 2006; Gupta, 2007; Mahdavi, 2008).

Therefore, this paper includes a large sample of different economies (e.g., in the one hand Qatar, and on the other hand Burundi) in order to examine whether signs and significance levels are robust under country grouping. For this, we apply a multiple imputation (MI) method, a simulation-based approach for analyzing incomplete data. This method replaces missing information with multiple simulated values in order to

¹Indeed, tax revenues could be underestimated for countries with higher subnational taxes such as Brazil, Argentina and India.

complete the data. The MI method does not try to predict missing values but to deal with missing data in a way that allows valid statistical inference (Rubin, 1996). Consequently, the number of observation rises notably; we get an average of 30 observations per country. We consider also the potential existence of a path dependence process in taxation by estimating system Generalized Method of Moments (GMM) models, following the Arellano and Bover (1995) methodology.²

This paper is organized as follows. In Section 2, we survey determinants of taxation as suggested by the literature and announce theoretical expected signs. We later we briefly describe in Section 3 our data, and present econometric issues. In Section 4, the main results are summarized and discussed. And, the final Section 5 presents policy recommendations and concludes.

2. Review of theoretical determinants of taxation

There are a lot of empirical studies which model tax revenue (in some cases in conjunction with other dependent variables), for example Profeta, Puglisi, and Scabrosetti (2013), Le et al. (2012), Dioda (2012), Mahdavi (2008), Bird et al. (2008), Cetrángolo and Gómez-Sabaini (2007), Gupta (2007), Mulligan, Gil, and Sala-i-Martin (2004), and Piancastelli (2001). However, all of them do not present the same results because they depend, for example, on included regressors and econometric methods.

Indeed, it is important to eschew misspecification issues when a quantitative approach is adopted. Therefore, we briefly review the tax determinant literature in order to construct an expected relationship table, including new variables, as a referent for our empirical study. Several economic, demographic, social, and political factors are discussed below.

It is usual to find that the GDPP, the proxy for economic development) is positively related to the tax revenue (for an exception, see Bird et al., 2008). A higher economic development suggests a lower average citizens' resistance to pay their taxes, because of their lower money's marginal utility and a greater proportion of them who surpass an exempt income level. In addition, a high rate of economic growth and a sizeable GDPP favor state capacity to collect taxes (see e.g., Besley & Persson, 2009) and are related to greater tax bases (e.g., consumption and income) (Muibi & Sinbo, 2013).

We consider also financial intermediation as a potential tax determinant under the assumption that tax administration would identify more easily tax evasion when financial corporations report citizens' transactions, for example. More even, it has been pointed out by Levine, Loayza, and Beck (2000) that financial intermediation influences economic growth and therefore tax bases. Nevertheless, it is worth to point out that including this variable demands taking into account several complementary measures. We will return on this issue in the empirical section.

Likewise, international trade (measured as the sum of exports and imports in relation to GDP) implies a need to replace external taxes (e.g., tariffs) for internal and easy-to-collect ones, especially the VAT (Muibi & Sinbo, 2013), because of its comparatively low administrative cost (Ghura, 2002). Nevertheless, that kind of reforms requires some conditions such as a relative institutional strength and domestic economic development to compensate the loss of external tax base, which explains the

²This method allows including time-invariant regressors such as legal origin, which would disappear in difference GMM.

findings of Baunsgaard and Keen (2010), who point out that the success in this task depends on the economic development level.

Conversely, other economic factors such as the share of agriculture in GDP and inflation are usually associated negatively with tax revenue and its components. The agricultural sector is difficult to tax, particularly in developing countries, because of self-consumption, underreporting and special tax treatments (exemptions and deductions), so the findings of Agbeyegbe et al. (2006) and Gupta (2007) are reasonable. Similarly, inflation is a substitute instrument of taxation and a signal of state weakness, which explains Ghura's (2002) and Mahdavi's (2008) results.

Nevertheless, the associations between potential determinants of taxation and tax variables (e.g., tax revenue) are not always clear cut. For instance, Gupta (2007) points out that international aid (i.e., disbursements of loans made on concessional terms and grants) is positively related to tax revenue for low income countries,³ whereas other authors (see Benedek, Crivelli, Gupta, & Muthooru, 2014; Mahdavi, 2008) find the opposite relation in any case. To this respect, Mahdavi (2008) states that foreign aid displaces TR_IP&C (as % of GDP). The lack of certain conclusion on international aid's effects can be explained theoretically. For example, and although foreign aid implies a relaxation of government's budget constraint in the short run, aid-financed projects at the long run must generate additional expenditures such as operational costs, which may demand tax increments. Thus, the links between taxation and international aid depend on how much a government lasts to adjust its tax system to finance the rise in expenditures and on the instability of aid flows.

In addition, fiscal deficit and public – and publicly guaranteed – debt suggest the need for future funding and hence higher tax revenue (Muibi & Sinbo, 2013), albeit empirically the findings are inconclusive (see e.g., Dioda, 2012; Mahdavi, 2008). However, we include the total debt service (i.e., the public expenditure for the payment of interests and principal) as a proxy of the aforementioned variable, basically because we have more observations for the latter, which favors dataset size.

Moreover, natural resources abundance creates opportunities for rent-seekers when the state lacks strong institutions. Under those conditions, corruption can emerge and the government budget constraint can be relaxed, which discourages *inter alia* citizens' political control by virtue of what CEPAL (2013) names unnecessary reciprocity, which affects the renewal and deepening of fiscal pact. Nonetheless, rents for natural resources turn out to be another tax source, so collection may grow when commodity prices rise and the respective tax base is not exempted. Moreover, tax structures may change; high natural rents tend to boost income taxes rather than consumption taxes.

Regarding demographic variables, it is important to highlight that theoretical relationships with taxation are unclear. Population density and the extent of urbanization may foster taxation when citizens' concentration reduces the administrative cost of collection and auditory (Dioda, 2012), so it could discourage evasion. Nevertheless, it is reasonable too that population density and urbanization generate scale economies in the provision of public goods and reduce the needs of public funding (Alesina & Wacziarg, 1998).

³Nevertheless, Gupta et al. (2004; cited by Gupta, 2007) find that when international aid, represented in grants, is used to pay current consumption expenditures, then domestic revenue mobilization falls.

Likewise, there are different hypotheses that relate population aging and taxation. On one hand, some authors suggest that population aging demands a rise of public social expenditure (e.g., Dioda, 2012) and hence tax revenue, although this result can be explained also by the higher old-age people's tax morale (Castañeda-Rodríguez, 2017; Torgler & Schaltegger, 2005). On the other one, Mahdavi (2008) states under the life-cycle theory that retired people dissave and work less, so tax structure would change and income tax revenue decreases.

Another variable that has been considered by the specialized literature is the female labor force participation, which boosts revenue by labor and sales taxes especially (see Mahdavi, 2008). A higher female participation in labor force represents an increase in taxable labor income and consumption since housewives, on the other hand, work usually without receiving a payment. Moreover, several studies have found that women exhibit greater tax morale than men and pay more attention to ethical considerations (Torgler & Schaltegger, 2005), so the former are more likely to comply with their taxes.

Regarding cross-cutting factors such as education, they affect taxation in diverse ways. For instance, higher education levels are related positively to tax morale (Castañeda-Rodríguez, 2017; OECD, 2013; Torgler & Schaltegger, 2005) because high-educated people can recognize more easily the importance of government's intervention, or because they usually earn higher wages and therefore display a lower marginal utility of money (whereby it is necessary to control for economic variables). Nevertheless, educated people, especially who are involved in economic-administrative and legal careers, may be aware about loopholes that favor tax evasion and elusion. Empirical results show that the first effect outweighs the second one and hence education boosts tax revenue, especially from income or property taxes, which are reported deliberately.

However, taxpayer decisions not only depend on individual features (e.g., education), but also on external (framework) factors such as government's legitimacy. Bird et al. (2008) point out that state legitimacy is essential to increase taxes (either through direct or indirect ones), so other cross-cutting factors such as corruption and democracy's extension have been included into the recent literature due to higher data availability. It is well known that tax compliance not only depends on enforcement strategies (i.e., high detection probabilities and fine rates), but also on other socioeconomic variables related to the psychic cost that a taxpayer would bear if he (she) fails to conform to social norms (Cullis, Jones, & Savoia, 2012). Consequently, when corruption is the rule rather than the exception, citizens may decide to evade more easily, not only because the potential economic cost would be lower, but also because they would not be cognizant about the use given to the public funds (Castañeda-Rodríguez, 2015). The above supports a negative association between corruption and tax variables (Bird et al., 2008; Le et al., 2012; Tanzi & Davoodi, 2000).

Meanwhile, the political economic literature on democracy highlights a double link between the latter and economic development, in particular fiscal outcomes. Acemoglu and Robinson (2006) establish that markets can prosper only under a framework that enforces contracts without distinctions, and hence provides warranties, liberties, and democratic practices. In addition, democratic regimes must favor higher income taxes and public spending than autocratic regimes (Boix, 2003), since redistribution is an

important objective under democracy when free voters can express their preferences and politicians in office are monitored.

In line with the above, the political regime affects the way and extent to which tax reforms are implemented and delimits tax objectives, and hence democracy can boost domestic tax revenue via citizen empowerment and higher tax morale (Ehrhart, 2012). However, some issues such as the role played by vested interests and insufficient financial sector development can hinder that outcome, which explains the findings of Mulligan et al. (2004) and Profeta et al. (2013).

Political institutions are also a key issue for taxation because depending on power relations between agents (i.e., taxpayers and state), citizens may exhibit different compliance rates (Castañeda-Rodríguez, 2015). Taxation as a component of a social contract needs to be validated continuously, which in turn is more likely when the government is seen as legitimate by a majority. Therefore, political features such as representativeness, accountability, and transparency stimulate tax revenue (Bräutigam, Fjeldstad, & Moore, 2008).

Along with the above variables, government effectiveness as well as the strength and impartiality of legal system influence the taxpayer's perception about the tax system fairness. For instance, when judicial officers pursue their own economic interests and therefore take biased decisions, taxpayers have an opportunity to reduce their fiscal obligations by paying bribes, which discourages other citizens since they may perceive the tax system as unfair. Thus, a strong and approved judicial system hampers evasion, especially of income taxes which are reported consciously.

Meanwhile, political instability (e.g., a likely coup) implies an opportunity for potential evaders, who would not be fined if the tax administration office suffers drastic changes in its structure or powers. Some indexes elaborated by the World Bank under the Worldwide Governance Indicators project can be considered, for example the Political Stability Index that measures "perceptions of the likelihood that the government in power will be destabilized or overthrown by unconstitutional or violent means" (Kaufmann, Kraay, & Mastruzzi, 2010, p. 4).

In addition, political ideology has attracted attention as a potential tax determinant, but results remain inconclusive. Some researchers state that political ideology matters since left-wing parties are more willing to increase tax revenue (Messere, 1993), albeit it can be achieved through capital and income taxes (Angelopoulos et al., 2012; Messere, 1993; Swank & Steinmo, 2002) or via consumption taxes (Pommerehne & Schneider, 1983). Nevertheless, other authors do not carry out significant associations (see Ashworth & Heyndels, 2002⁴), which is reasonable since a party may try "[...] to moderate its appeal in order to maximize its chances of electoral success" (Jackman, 1986, p. 142),⁵ or because the approval of any legal initiative is generally the product of a political and economic negotiation in which many factors take place.

Furthermore, taxation is a field in which the past matters since fundamentals such as institutions can be inherited from settlers (see Sokoloff & Zolt, 2007). The colonial legacy sets up the institutional framework that a country adopts and consequently

⁴These authors study tax turbulence's determinants. Therefore, they do not find evidence that partisan preferences imply tax changes.

⁵It follows the median voter theorem.

affects its capabilities to levy taxes on certain tax bases such as labor income and wealth. Dioda (2012, p. 25) points out that “British colonialism left behind relatively efficient institutions able to collect taxes, with a formal labor market and a modern fiscal system [...],” which is coherent with the research of Sokoloff and Zolt (2007) who argue that colonial taxation in Latin America was determined partially by an extractive economic model and hence this region has depended on mobile bases since the eighteenth century, whereas United States and Canada relied since the beginning on local property and labor taxes due to a more extended land ownership.⁶

The legal origin also determines which judicial guarantees are given to the citizens, and hence affects citizens’ intrinsic motivations to pay taxes because how reciprocal is the state-citizens relation matters when a taxpayer judges a tax system as legitimate or illegitimate. To this regard, the common law (or English) tradition was originated as an effort to limit the power of the sovereign and protect the citizens’ rights while, on the other hand, the socialist legal system had the objective of maintaining the state’s power and its competence to extract resources. Given that English common law limits corruption (see Bird et al., 2008) and suggests a fairer treatment for citizens, this feature may boost higher tax compliance and therefore higher tax revenue, especially from income taxes which are more visible for taxpayers (Liu & Feng, 2015), as opposed to a socialist legal system. We use the data provided by La Porta, López de Silanes, Shleifer, and Vishny (1999) for five legal origins: the French, German, and Scandinavian legal systems, in addition to those aforementioned. Nonetheless, legal origin and colonial heritage are correlated. For instance, English common law code prevails in English and Australian colonies whereas Dutch, Spanish, French, Portuguese, and Belgian colonies rely traditionally on the French commercial code. Consequently, and in order to avoid redundant data or multicollinearity, we include only legal origin to capture historical and institutional roots of taxation.

This section has shown that tax performance depends not only on regulations but also on the taxpayers’ behavior and particular circumstances in which the tax law is enforced. Consequently, Figure 1 classifies the tax determinants into four groups that embody theoretical literature. Nonetheless, some factors are in “grey areas”; for instance, natural resources shape partially the economic framework and influence politicians’ decisions on tax issues.

3. Data description and empirical methodology

In order to control for financial intermediation effects we consider the financial system’s capacity to create payment mechanisms through broad money, since it includes demand and saving deposits in addition to the sum of currency outside banks. Additionally, we capture the financial system strength by incorporating three series, domestic credit to private sector as a whole and the respective sums provided by both, financial sector and banks.

Given the high correlations between the aforementioned four variables, since they fall into the range [0.53, 0.95], we decided to use the first two principal components

⁶This helps to explain why Latin American countries generally have had inequitable tax systems and levy low taxes at the subnational level.

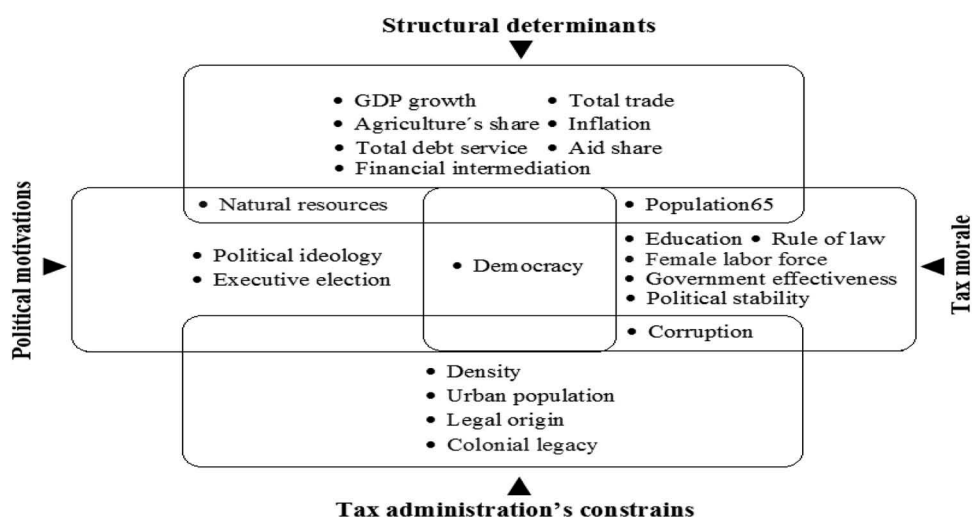


Figure 1. A preliminary classification of tax determinants.

Source: Authors' own elaboration.

Table 1. Principal components analysis.

	Component	Eigenvalue	Difference	Proportion	Cumulative
Component	Financial_int1	3.084	2.577	0.771	0.771
	Financial_int2	0.507	0.142	0.127	0.898
	Financial_int3	0.365	0.321	0.091	0.989
	Financial_int4	0.044		0.011	1.000

Source: Own authors' calculation. Observations: 6795; the respective components were named as: Financial_int1, Financial_int2, Financial_int3, and Financial_int 4.

which account for 89.8% of the total variance (Table 1), in order to reduce the loss of degrees of freedom for estimation purposes. The first component is related to the financial system strength while the second one is associated with broad money (Table 2).

Likewise, for simplicity and in order to reduce multicollinearity problems, we gather corruption, government effectiveness and the rule of law into one. It is the Indicator of Quality of Government constructed by the Political Risk Service group, which assesses three components of the International Country Risk Guide (ICRG): corruption within the political system; the strength and impartiality of the legal system, together with the popular observance of the law; and bureaucracy quality.

Table 2. Eigenanalysis of the Correlation Matrix.

Variable	Components			
	Financial_int1	Financial_int2	Financial_int3	Financial_int4
Broad money	0.438	0.896	0.075	-0.029
Domestic credit to private sector	0.479	-0.300	0.820	0.092
Domestic credit provided by financial sector	0.541	-0.261	-0.330	-0.729
Domestic credit provided by banks	0.535	-0.201	-0.462	0.678

Source: Own authors' calculation based on World Bank data.

Table 3 gives a quick overview of the yearly dataset after multivariate and logistic imputation, which covers 138 countries and the period 1976–2015. Nevertheless, the number of observations varies from country to country and hence the dataset is an unbalanced panel data. We used as regular variables (not imputed and applied as

Table 3. Summary statistics of the data.

Variable	Measure	Source	Obs.	Mean	Std. Dev.	Min	Max
Tax revenue (TR)	Percentage of GDP	IMF	105,851	15.895	6.922	0.000	47.208
(1) Tax revenue from income, profits and capital gains (TR_IP&C)			105,823	5.678	4.375	0.000	29.330
(2) Tax revenue from goods and services (TR_G&S)			105,822	6.637	3.701	0.000	20.956
Indicator of tax progressiveness (ITP). It is the difference between (1) and (2)		Authors using IMF	105,819	−0.959	4.350	−17.596	20.887
Log_GDPP	Natural logarithm of GDPP at constant US dollars of year 2000	WDI	105,851	8.044	1.367	5.077	11.311
Financial_int1	Percentage of GDP		105,851	0.062	1.386	−3.643	4.499
Financial_int2			105,851	−0.025	0.287	−0.938	0.811
International trade			105,851	69.954	32.920	0.167	179.906
Agriculture's share in the Economy			105,851	17.318	12.056	0.000	46.987
Inflation	Percentage		105,851	15.746	51.486	−18.109	1096.678
Total debt service	Percentage of GNI		105,750	5.434	5.553	−12.996	73.283
Aid share	Percentage of GDP	IMF	105,851	5.118	7.144	−11.999	29.967
Natural resources rents		WDI	105,851	5.318	6.399	0.000	29.893
Education	Age Standardized Education Per Capita	IHME	105,851	5.641	3.086	0.31	14.92
Density	(Logarithm of the number of people per sq. km of land area)	WDI	105,851	3.995	1.365	0.372	7.477
Urban population	Percentage of total population		105,851	48.254	22.670	3.491	99.244
Population65	Percentage of population aging 65 and above		105,851	6.065	4.130	1.058	22.410
Female labor force	Percentage of total labor force		105,851	39.284	8.709	4.930	59.931
Quality of government	It ranges from 0 to 1. Higher values correspond to better outcomes	ICRG	105,851	0.522	0.189	0.001	1.000
Democracy	It is scaled from 0 (least democratic) to 10 (most democratic)	Freedom House	105,851	6.253	3.079	0.000	10.000
Political stability	The vast majority of scores lie between −2.5 and 2.5). Higher values correspond to better outcomes)	WGI	105,771	−0.163	0.905	−3.530	3.632
Left	Dummy variable	DPI	105,849	0.281	0.449	0.000	1.000
Center			105,849	0.086	0.280	0.000	1.000
Executive election			105,851	0.106	0.308	0.000	1.000
G_Government	Dummy that equals 1 if tax variables are observed at the general government level, and zero otherwise	IMF	105,851	0.345	0.476	0.000	1.000

Notes: IMF (International Monetary Fund); WDI (World Development Indicators-World Bank); IHME (Institute for Health Metrics and Evaluation-University of Washington); ICRG (International Country Risk Guide); WGI (Worldwide Governance Indicators-World Bank); DPI (Database of Political Institutions – World Bank).

regressors) those with more observations in the original dataset (i.e., Log GDPP, International trade, Inflation, Education, Density, Urban population, Population65, Democracy and legal origin dummies). It is worth to note that although the basic statistics did not change significantly (not shown here), the average number of observations per country rose up from 9 to 30.⁷

The multivariate imputation method applies an iterative Markov chain Monte Carlo technique to assign missing values (Schafer, 1997) while the logistic method depends on logistic regressions. Those techniques allow us to tackle the lack of complete data, which is evident in the original sample,⁸ and make more equal the distribution of observation into country-groups. These methods do not try to predict missing values but to deal with this difficulty in a manner that allows valid statistical inference (Rubin, 1996).

Regarding the above, the imputation does not solve the missing data problem, but it fills empty cells with possible values through a stochastic process. Although an alternative is replacing missing values for the means of the set of observed data, it leads to biased variances (Rubin, 1996). It suggests fixing a certain number of rounds in order to construct several “complete” bases that include probable values for missing data, which are finally combined to calculate a mean estimator and standard error (Rubin, 1996).

Albeit there are different techniques such as the multivariate imputation by chained equations (MICE) and the multivariate normal regression, each one with weaknesses and strengths (see Schafer, 1997), Table 3 is based on the last since its outputs (imputed values) incorporate the uncertainty associated with estimates by implementing previously the expectation maximization algorithm.

Before proceeding with regressions, we should take into account the nature of the data and choose the appropriate econometric technique to cope with usual problems such as temporal or cross-country correlation and heteroscedasticity. On one hand, tax variables frequently appear to respond to changes in certain factors (e.g., the economic cycle). For instance, many Latin American countries during the nineties and under economic crisis increased notably their tax revenue by using general taxes on goods and services (Castañeda-Rodríguez, 2012); on the other hand, as Gupta (2007, p. 15) states, “revenue performance tends to be highly persistent over time.” Due to the above facts, this empirical section includes static and dynamic panel data estimations.

Fixed (FE) and random (RE) effects are the two more common static panel data specifications, but one should contrast in any case for assumptions such as homoscedasticity and not cross-country or serial correlations. In addition, to choose between RE and FE one should reject the pooled ordinary least square estimator that ignores the data’s panel structure. Therefore, we applied the Breusch and Pagan Lagrange multiplier test and the *F*-test under the null hypothesis that all country dummies are zero, respectively. The results favor both RE and FE estimates.⁹ However, the Hausman test favored the FE estimator. In a following step, the modified Wald test for groupwise heteroscedasticity, the Breusch-Pagan LM test of independence and the Wooldridge test for autocorrelation suggested that fundamental econometric assumptions were not met.

⁷The number of observations per variable reported in Table 3 is greater than 105,000 since 30 imputations were added. Indeed, this value is the total number of observations in the data panel throughout the 30 imputations.

⁸Indeed, regressions include around 36 countries when they are run on the original dataset.

⁹*p*-values for both tests were 0.000, therefore null hypotheses were rejected.

Therefore, we applied the Panel Corrected Standard Errors (PCSE) model set up by Beck and Katz (1995).

In synthesis, we firstly estimated four models following the structure defined in Equation (1):

$$TV_{it} = \alpha_i + \sum_{k=1}^K \beta_k X_{kit} + \varepsilon_{it}, \quad (1)$$

in which a particular tax variable (e.g., tax revenue) for a pair it (country-year) depends on a set of factors $((X_k))$, including country-specific characteristics. For its part, α_i is a dummy variable equal to one for the country i and there are $k : 1, \dots, K$ explanatory variables, those presented in the previous section, so X_{kit} is the k th variable for the pair it .

As it was mentioned above, the models represented by Equation [1] were estimated through PCSE since the hypothesis contrasts suggest that $\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$, $\exists k/\sigma_k^2 \neq \sigma^2$ and $\exists i \neq j/E((\varepsilon_{it} - \bar{\varepsilon})(\varepsilon_{jt} - \bar{\varepsilon})) \neq 0$.¹⁰ Although Feasible Generalized Least Squares allows dealing with heteroskedasticity and both contemporaneous and serial correlation, PCSE was preferred because the former produces incorrect (and overconfident) standard errors, especially for small samples (Beck & Katz, 1995).

Nevertheless, some tax variables tend to persist, as suggested by serial correlation, which motivates including alternatively the lag of the dependent variable in the right side of Equation [1], even though it can give rise to autocorrelation. Additionally, some determinants can be endogenous for different reasons, particularly because causality may run in both directions; as extended corruption may lead to poor tax performance, in turn low taxation can limit funding for well-functioning institutions and control of corruption (Baskaran & Bigsten, 2013; Bird et al., 2008).¹¹ Last but not least, it is important to control for time-invariant country features and to keep in mind that our panel dataset has a short time dimension ($T = 40$) with respect to the cross-section dimension ($N = 138$).

To deal with the aforementioned issues, we turn to dynamic models. Taking into account that the difference GMM proposed by Arellano and Bond (1991) does not provide acceptable coefficients under heteroscedasticity and excludes time-invariant regressors (e.g., legal origin) (Brañas-Garza, Bucheli, & García-Muñoz, 2011), we adopt a system GMM estimator (see Arellano & Bover, 1995) that works with the level equation (Equation [2]) and employs the difference of the lagged dependent variable (ΔTV_{it-1}) as instrument of TV_{it-1} . Moreover, and according to Benedek et al. (2014, p. 9), “the resulting system-GMM estimator has much better finite sample properties in terms of bias and root mean squared error than that of the difference-GMM estimator.”

$$TV_{it} = \alpha_i + \lambda TV_{it-1} + \sum_{k=1}^K \beta_k X_{kit} + \varepsilon_{it} \quad (2)$$

We control for measurement errors and outliers observations by including only those which belong to a reasonable range and comply with logical restrictions.¹²

¹⁰ ε and σ and terms represent errors and standard deviations, respectively.

¹¹ The same applies to other explanatory variables such as the growth of GDP and inflation.

¹² For instance agriculture's share and tax revenue, both as percentages of GDP, should be greater or equal than zero.

4. Results

4.1. Main results

Table 4 displays static and dynamic estimations applying the aforementioned techniques and using available information after multivariate normal imputation.

Dynamic models (the last four columns, Table 4) include three rows which show Arellano-Bond tests for first differences and the Hansen test (the latter to verify the instruments' validity). Disturbances exhibit serial correlation of order 1 in differences, because of the addition of the dependent variable lag as a regressor in the Equation (2) and errors do not present serial correlation of order 2 (1) in differences (levels) at a 99% level of significance. Additionally, instruments appear to be valid statistically since the null hypothesis that residuals are not correlated with instruments is not rejected by the Hansen test.

But it is important to take into account that unit roots can lead to spurious relation in panel analysis, as in the univariate case. Hence we applied some panel unit root tests in order to check the stationarity of series. For this purpose, we considered two alternatives: the Im, Pesaran and Shin (IPS henceforth) test, which is based on the Dickey-Fuller procedure and allows for heterogeneous intercepts and slopes; and the Fisher test that is asymptotically optimal and non-parametric (Maddala & Shaowen, 1999). According to the Table 5, there are three variables that appear to be non-stationary: Log_GDPP, Financial_int1 and Education, the last two according to the IPS test only.

The next step is to test the existence of at least one cointegration relationship between, on one hand, each of our endogenous variables and, on the other hand, Log_GDPP, Financial_int1 and Education. The task is to find out if there are long-run relations between the aforementioned factors in order to avoid concerns about spurious correlations. Therefore, we use the panel cointegration test suggested by Pedroni (1999), which considers seven test statistics (four panel statistics and three group statistics) and estimates residuals from a hypothesized cointegrating regression. Table 6 shows that at least 6 out of 7 statistics (depending on the tax variable that is considered) reject the null hypothesis of non cointegration at 5% of significance level, and hence we can rely on the estimates provided in Table 4.

In any case, the Online Appendix 1 includes the respective estimations reported in Table 4 but replacing Log_GDPP, Financial_int1 and Education with their first differences. Nevertheless, our results keep unchanged in general, although the coefficients related to these new variables turn out to be statistically insignificant. In addition, and for robustness check purposes, we used other datasets.

One of them in the result of imputing original data applying the MICE method, which is based on the assumption that the probability of a value is missing depends only on observed values. Fortunately, the violation of this assumption does not distort significantly the imputation outputs (Dong & Peng, 2013). This procedure considers several regressions in which each variable with missing data is modeled conditional upon the other variables in the data (Azur, Stuart, Frangakis, & Leaf, 2011).

Table 4. Determinants of taxation (PCSE and dynamic specifications).

Method		PCSE			System GMM			
Model	1	2	3	4	5	6	7	8
Dependent variable (DV)								
Lag DV								
Log_GDPP	-0.451	0.515***	-1.093***	1.722***	0.124*	0.272***	0.175**	0.173***
Financial_int1	0.227**	0.212***	0.029	0.203***	-0.398	0.326	-0.992***	1.395***
Financial_int2	0.374	-0.212	0.204	-0.339*	0.413	-0.125	0.242	0.217*
International trade	0.018***	0.006***	0.003**	0.003	0.015**	0.005*	0.003	-0.220
Agriculture's share	-0.142***	-0.040***	-0.039***	0.001	-0.135***	-0.035**	-0.037***	0.002
Inflation	-0.000*	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	0.003
Total Debt Service	0.023	-0.003	0.008	-0.013	0.038*	-0.002	0.010	0.000
Aid share	-0.024*	-0.003	-0.036***	0.039**	-0.016	0.001	-0.040***	-0.013
Natural resources rents	-0.047***	0.014	-0.048***	0.077***	-0.049	0.016	-0.041***	0.042***
Education	0.386***	0.079	0.307***	-0.216***	0.249	0.032	0.255**	0.070***
Density	-0.905***	-0.530***	0.027	-0.530***	-0.708***	-0.358**	0.024	-0.158
Urban population	-0.076***	-0.026***	-0.009	-0.014*	-0.058***	-0.017	-0.008	-0.417**
Population65	0.417***	0.189***	0.341***	-0.182***	0.337**	0.106	0.268***	-0.012
Female labor force	0.102***	0.073***	-0.004	0.086***	0.098***	0.071***	-0.003	-0.165
Quality of government	5.347***	3.878***	1.434**	2.970***	3.104	4.109***	0.683	3.700**
Democracy	0.180***	0.067*	0.089**	-0.018	0.177*	0.055	0.073	-0.007
Political Stability	-0.184	-0.276**	0.035	-0.355***	-0.025	-0.332**	0.112	-0.427**
Left	0.373	0.165	0.141	-0.052	0.388	0.017	0.263	-0.239
Center	-0.269	-0.150	-0.026	-0.164	-0.407	-0.120	0.009	-0.153
Lag (Executive election)	-0.000	-0.037	-0.051	-0.022	-0.020	-0.043	-0.022	-0.035
English	1.942***	2.209***	-0.739*	2.805***	1.423	1.402**	-0.424	1.965**
French	1.950***	1.295***	0.329	0.785	1.519	1.023	0.439	0.562
German	-1.487	0.628	-2.848***	3.178***	-2.209	0.165	-2.077	2.004
Scandinavian	10.304***	6.697***	3.233***	3.296***	9.671***	4.989**	2.669**	2.780
G_Government	1.041*	0.589**	0.951***	-0.429	1.192	0.443	1.177***	-0.447
Constant	13.151***	-3.479**	11.368***	-16.614***	11.960***	-3.511*	10.225***	-14.425***
Number of observations	4404	4288	4338	4384	4404	4260	4320	4377
r ²	0.465	0.438	0.3647	0.192				
Arellano-Bond test for AR(1)					0.000	0.000	0.000	0.000
Arellano-Bond test for AR(2)					0.970	0.877	0.442	0.398
Hansen test of overid. restrictions					0.110	0.114	0.099	0.116

Notes: Significance levels: *0.05 ≤ p < 0.10, **0.01 ≤ p < 0.05, *** p < 0.01. We use STATA 13 for estimating the respective models. Arellano-Bond tests for first differences and the Hansen test were calculated under the 30th (the last) imputation.

Table 5. Panel unit root tests.

Null hypothesis: all panels have unit root			
Test	IPS test		Fisher test
	Wald statistic	p-Value	p-Value
TR	-2.077	0.019	0.000
TR_IP&C	-3.696	0.000	0.000
TR_G&S			0.000
ITP	-1.577	0.057	0.000
Log_GDPP	1.493	0.932	1.000
Financial_int1	0.565	0.714	0.012
Financial_int2	-0.269	0.394	0.000
International trade	-2.969	0.002	0.000
Agriculture's share	-4.631	0.000	0.000
Inflation	-7.318	0.000	0.000
Total Debt Service	-2.942	0.002	0.000
Aid share	NA	NA	0.000
Natural resources rents	-1.503	0.066	0.000
Education	NA	NA	0.655
Density	-19.258	0.000	0.000
Urban population	-91.106	0.000	0.000
Population65	-3.699	0.000	0.000
Female labor force	-18.340	0.000	0.000
Quality of government	NA	NA	0.000
Democracy	NA	NA	0.000
Political Stability	-5.893	0.000	0.000

Notes: These estimates were obtained using the STATA code `xtunitroot`. NA appears when there was an insufficient number of time periods to compute the Wald statistic.

Table 6. Pedroni cointegration tests.

Dependent variable	TR	TR_IP&C	TR_G&S	ITP
Test				
Panel ν -statistic	-1.597*	-1.724**	-1.204*	-1.350*
Panel ρ -statistic	-0.614	-1.851**	-1.606*	-2.307**
Panel t -statistic: (non-parametric)	-8.469***	-10.460***	-9.845***	-10.330***
Panel t -statistic (<i>adf</i>): (parametric)	-7.997***	-8.300***	-9.431***	-9.441***
Group ρ -statistic	2.909***	2.563***	1.997**	-2.203**
Group t -statistic: (non-parametric)	-9.015***	-9.405***	-9.336***	-8.536***
Group t -statistic (<i>adf</i>): (parametric)	-7.972***	-8.071***	-8.682***	-7.663***

Notes: All Pedroni's test statistics can be compared to the $N(0,1)$ distribution. Hence, ***, **, and * indicates rejection of the null hypothesis of non cointegration at 1%, 5%, and 10% levels of significance, respectively.

We deal with missing data applying also interpolation, which replace missing values with previous or following nonmissing values considering different approaches and methods. In particular, each one of the variables with missing data was interpolated based on other "complete" factors (e.g., the logarithm of GDPP) assuming linear relations and using an inverse distance weighting, so the observable values that are nearest have the highest weight.¹³

The alternative estimations based on the aforementioned imputed datasets appear in Online Appendix 2. Although there are many imputation methodologies, we show here a sample of them, those that match with the original dataset features. For instance, Full Information Maximum-Likelihood is another method that estimates parameters using all the information generated by the incomplete dataset, but it is especially useful for structural equation models.

¹³It was performed using the Stata's `mipolate` command.

4.2. Discussion of the results

It is noteworthy that our four endogenous variables exhibit in general a path dependence process according to the statistical significance of their lags in our estimations (models 5–8, [Table 4](#)), disregarding the imputation method applied. Nevertheless, taxation is affected also by exogenous shocks, e.g. socioeconomic changes (models 1–4, [Table 4](#)), although our principal results remain unchanged. Therefore, we will consider henceforth the PCSE estimations, for their simplicity.

Coming into discussion, the logarithm of GDPP appears to influence tax structure but without effect on the total tax burden, which is a particular finding. This variable is positively (negatively) associated with income taxes (consumption taxes), and hence countries with a higher GDPP tend to have a more progressive tax system. It goes in line with public finance statistics (see e.g., the OECD database) and helps to explain differences in tax structure between the OECD members and the Latin American countries, for example (Cetrángolo & Gómez-Sabaini, 2007). The above is reasonable if one remembers that GDPP is a proxy of government's performance and its capacity to implement policies in matters such as taxation (see Besley & Persson, 2009).

Regarding the principal components that were included to capture the financial intermediation effect, our results indicates that the greater the financial intermediation in terms of total credit provided to privates, the higher are total tax revenue and income taxes. The financial sector provides valuable information for tax control purposes given its records of economic transactions (which hampers evasion). For instance, tax administrations have better auditing tools when consumers pay their purchases by credit (e.g., credit cards), and hence it is more difficult that sellers underreport incomes. Additionally, financial sector favors economic growth (Levine et al., 2000) and likewise tax bases; albeit our findings indicate that it is especially true for income taxes.

Our results indicate also that commercial liberalization has implicated a replacement of external tax sources for internal bases, but it does not mean a change in favor of a higher dependence on indirect taxes. This research further stresses that fiscal reforms have not disregarded income taxes, so there is no evidence of a “race to the bottom” effect associated with the globalization phenomenon (Castañeda-Rodríguez, 2016). Even more, the estimates by country-groups show that developing countries have reached a higher tax revenue after trade openness, which is contrary to the highlighted by Baunsgaard and Keen (2010).

Regarding the agriculture's share, it is related negatively to tax revenue, what is one of the most common findings in the literature. This sector is difficult to tax, particularly when there is a large number of subsistence farmers (Gupta, 2007), and its high risk exposition supports preferential tax treatments (e.g., agricultural goods can be taxed at zero rate for VAT). Likewise, the correlation coefficients between inflation and total tax revenue (models 1 and 5, [Table 4](#)) show the former can relax the demands for tax revenue in the short-run, what implies that governments may pass over the taxes and inflation joint inefficiencies, contrary to the stated by Poterba and Rotemberg (1990).

In addition, our results suggest that international aid seems to generate fiscal laziness, since aid-receiving countries can end up depending on grants to the point of relaxing tax collection (Broms, 2011), which is aligned with many other studies (e.g.,

Mahdavi, 2008). Additionally, Table 4 indicates that the decrease of consumption taxes related to natural rents are not offset by the increase of income taxes, although it should be restated for developing countries in accordance to the estimates by country-groups.¹⁴

Meanwhile, education boosts consumption taxes (e.g., VAT) and tax burden; probably by its role in taxpayers' tax morale. This socioeconomic variable is associated with a greater recognition of public intervention and therefore a better attitude toward taxes (Castañeda-Rodríguez, 2015; OECD, 2013). Nonetheless, given the country-groups analysis (Online Appendix 3), this factor is particularly important in developing nations, likely because their relative low educational coverages imply higher marginal effects when the average number of years of educational attainment rises.

Findings for density and urbanization support the point of Alesina and Wacziarg (1998), so scale economies appear to foster a more efficient public provision of goods and services (i.e., increasing health coverage in 20% could require that funding grows 15%) and then a proportional lesser demand of revenue. While the literature usually includes demographic factors due to their potential effects on the administrative and enforcement costs, so positive associations can be found for density and tax burden (Dioda, 2012; Gupta, 2007); our results state that what happens with public expenditure matters since demands for tax revenue can go down.

The percentage of population age 65 and above and the female participation in the labor force, both considered usually by the tax morale theory (Castañeda-Rodríguez, 2015), show the expected correlations. For example, female participation in the labor force is associated positively with the tax burden and the revenue from income taxes (models 1, 2, 5 and 6, Table 4), which is supported by many economic and social reasons. Indeed, empirical works on tax morale suggest that females are more tax compliant than males (Casal, Kogler, Mittone, & Kirchler, 2016; Torgler & Schaltegger, 2005), and hence a higher women's participation in economy favors taxation. Additionally, when women get access to the formal sector they gain a wage that is base for direct taxes, unlike when they stay as housewives.

Now, if we review the institutional and political framework, it is worth noting that those countries that present better outcomes in corruption control, law and order, and bureaucracy quality (features which are captured as a whole by the Indicator of Quality of Government provided by the PRS Group's ICRG) exhibit also a higher tax burden, especially thanks to the revenue from income taxes (models 1, 2, 5, and 6, Table 4). It is reasonable that a government that applies high administrative standards in order to enforce law and control corruption will boost tax compliance too. Likewise, this positive relationship is found for democracy extension, what supports the Mahdavi's (2008) results.

The last result could be explained by both, direct and indirect taxes. It implies that taxpayers are more reluctant to evade taxes in general, not only those reported consciously, when the tax law is reformed under a democratic process in which citizens have voice and vote, at least indirectly. Nevertheless, this finding changes partially when the dataset is split into country-groups (Online Appendix 3), so more democratic

¹⁴For instance, in countries which are highly dependent on natural resources, their tax systems have been tied to the commodities cycle. Therefore, natural rents and tax revenue are positively associated in poor states. In 2014 natural rents explained 10.63% of GDP in average for poor-countries, while this number was 6.06% in rich countries.

developing countries exhibit a greater collection by indirect taxes especially, which contrasts with the Dioda (2012) findings.

As a common feature, countries with higher levels of taxation tend to have a relevant share of their populations over 65-year old and to be democratic, which would increase taxpayers' willingness to comply with their tax obligations (Castañeda-Rodríguez, 2015; Torgler & Schaltegger, 2005). Figure 2 depicts the aforementioned relationships through the scatterplots of simple yearly averages of tax revenue vs democracy index and Population65, respectively.

Despite the above, the higher the political stability score becomes, the lower the tax revenue from income taxes. Although it was unexpected, some authors have pointed out that political variables and their effects on the tax system depend on the context (see e.g., Profeta et al., 2013). For instance, an increase in political stability may reduce demands for public spending in certain phases (Plümper & Martin, 2003) and hence the pressures to increase taxes. Even more, when this relation is analyzed in light of economic development level, it is identify that the negative association between political stability and TR_IP&C is stronger for middle and rich counties (Online Appendix 3).

Regarding legal origins, our estimates indicate *ceteris paribus* that countries that follow the Scandinavian, English or French code exhibit also higher tax revenues in basis of income taxes. In any case, the comparison is made in relation to Socialist/Communist laws. Particularly, Nordic countries (e.g., Denmark and Finland) present a high dependence on direct taxes, which is feasible when taxpayers judge as fair the state-citizens relationship thanks to social public spending and universalization programs, for example.

In addition to the above results, it is important to stress that there are other variables that appear to be insignificant, disregarding the model or imputation method. It is the case of the total debt service, the chief executive party orientation and the change in government (i.e., the lagged dummies for executive elections). It implies that changes in taxation do not appear to respond to debt funding requirements, which is logic when a government has access to new loans, so it can finance public investment with credit.

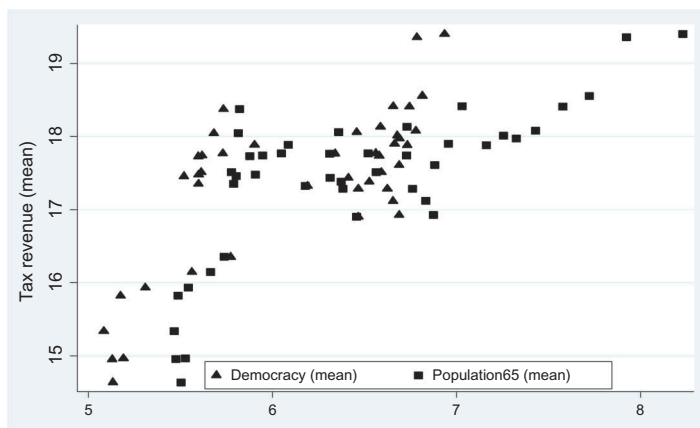


Figure 2. Tax revenue (yearly averages), democracy and percent of population over 65-year old.

Sources: World Bank and Freedom House.

Indeed, this result is rational under an economic growth scenario, but should be studied in deep when an international economic crisis occurs.

In addition, that the chief executive party orientation does not matter for tax issues shows that governments are pragmatic generally when they come to make economic decisions, unlike what other studies suggest (e.g., Angelopoulos et al., 2012). For instance, the tax reforms in Latin America during the nineties followed certain principles (i.e., a broad tax base with moderate marginal tax rates), without an apparent influence of ideological considerations (see Castañeda-Rodríguez, 2012). Additionally, our findings in relation to the executive election do not verify the electoral cycle hypothesis,¹⁵ which indicates that case studies in taxation are required since particular institutions matter.

For instance, although the aforementioned hypothesis finds support in countries such as USA, where the executive re-election is immediately allowed, other electoral rules may moderate that effect (e.g., not reelection). Indeed, an incumbent government could promote tax reforms at the end of its period in order to handcuff future governments.

However, it is possible that some of our findings respond to the existence of non-linear effects, even more if we go back to some results that suggest that it may exist a u-shaped relation between political variables (e.g., political stability) and taxation. Consequently, we capture the potential non-linear associations between those variables with unexpected or statistically insignificant coefficients (i.e., total debt service) and our tax variables by including the squares of the former in the PCSE estimations.

Albeit the respective tables are not presented for space considerations, the coefficients associated with the new terms were not statistically significant and the models 1–4 (Table 4) initially estimated did not change notably. Our results do not seem to be dependent on non-linear effects. Political variables such as the chief executive party orientation were not included in these control estimations since they are dummies.

Even if we have shown how some results change when the dataset is split into country-groups, a question that emerges from this empirical approach is how much our results depend on the sample (i.e., on which countries are included or on whether they are developed or developing ones). Nevertheless, when one splits the sample to include only certain nations, the number of observations falls notably, so new concerns arise about the estimates' reliability. Nonetheless, and for robustness check purposes, we classified for each year the countries according to their per capita GDP into three groups of equal size: poor, middle and rich.

Online Appendix 3 presents models 1–4 (reported in Table 4), re-estimated by groups. As can be seen, our findings are robust in general since they keep unchanged to the data splitting, although there are some cases that deserve attention. For instance, the first component for financial intermediation is especially significant for poor and middle-income countries, which indicates that financial strength can favor notably tax collection when institutions are in low or intermediary development stages. Indeed, tax authorities may enforce the laws more easily in rich countries (Besley & Persson, 2009), so other tax administration instruments for reducing the tax gap become less important.

¹⁵It stresses that reforms are more likely to be approved in the first months of a new administration.

Furthermore, associations between tax revenue and government quality become stronger as richer countries are considered. A possible reason for this is that taxpayers respond better to public administration outcomes when they have covered fundamental needs such as health and education access. In another case, citizens will prefer to avoid taxes if this action allows them to enhance their life quality.

Likewise, our results suggest that international aid is harmful particularly for poor-countries since it can replace tax revenue. As it has already been treated, when states lack of institutional capacity, it is difficult that they invest the “unearned” income (i.e., international aid) in a productive way, so they end up depending on multilateral institutions or wealthy countries instead of their citizenry (Broms, 2011).

As it has been pointed out by Moss, Pettersson, and Van de Walle (2006, p. 14):

[...] If donors are providing the majority of public finance and governments are primarily accountable to those external agencies, then it may simply not be possible to also expect a credible social contract to develop between the state and its citizens.

Then, it follows that international aid provided to developing countries should include certain conditions that favor investment in institutional building and government accountability, for example. It is a required step to tackle tax evasion and boost tax revenue.

Finally, the effect of Population65 on taxation is notable in “rich” nations, which can be due to their relative lower informality levels. Tax morale literature has found that age is associated positively with the intrinsic motivation to pay taxes (Torgler & Schaltegger, 2005) and it is suggested from psychology that elderly people are more sensitive to the threats of sanctions for immoral actions. Nevertheless, this intention will turn into action more likely if aging people have payment capacity, a condition difficult to meet in developing countries according to their pension coverage (Figure 3).

A reader could wonder how much our findings change for the MI process. Although the number of observations for each model boils down to about 259 when the original dataset is considered, many correlation-signs keep unchanged (but statistical significances vary). Since our estimations include numerous regressors, missing data for any of them implies a notably reduction of available observations in our original dataset and therefore a lack of statistical confidence; hence imputation process turns out to be central for our purposes. Nonetheless, the Online Appendix 4 presents the respective estimations based on the original (unimputed) dataset.

Albeit many of our findings keep unchanged, it is important to comment that some variables such as Log_GDPP, education and government quality are affected. Indeed, the respective coefficients become negative, in particular when PCSE estimates are taken into account. However, these results are biased since the sample includes especially developed countries and the number of observations is small.

5. Conclusions

This study considers an unbalanced panel data set that includes a large sample of countries, both developed and developing ones, and a period of 40 years (1976–2015). It was built in order to find out what long-term variables (i.e., economic, social, political and cultural factors) influence taxation and explain differences in tax performance. We

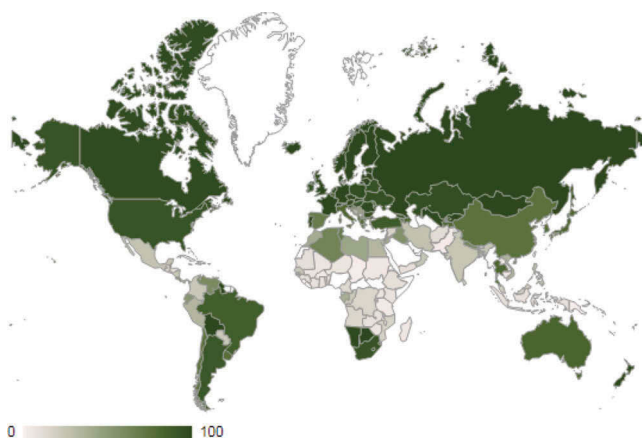


Figure 3. Share of population above pensionable age who receive a pension.

Source: International Labour Organization (2014).

establish that taxation, taking into account total tax burden and revenues from consumption and income taxes in addition to a progressiveness index, follow a path dependence process according to the significance of the lags. It suggests that taxation depends deeply on both the past and structural factors, such as economic context and dynamic from other public income sources (e.g., inflation).

Indeed, our study is compatible with an important strand of literature that supports that taxation depends partially on economic structure; factors such as agriculture's share (as percentage of GDP) and natural rents are significant and influence effectively taxation. For instance, tax burden tends to be low in those countries in which agriculture's share is high. Among other cases, Eritrea, Ethiopia and Sierra Leone in 2010 presented agricultural shares greater than 45% of their GDP but their tax revenues were lower than 12.5%.

The above recommends implementing complementary policies in order to favor taxation on agriculture. For example, public investments in the sector modernization, inclusion of minimum tax bases and cadastral update. These policies may foster sector's productivity and enhance its tax control.

On the other hand, our general – without sample splitting – estimations show that there are some irrelevant “tax determinants,” despite the abundant literature that take them into account; this is the case of total debt service (a proxy of public debt). Nevertheless, when the sample is split into three groups (i.e., poor, middle and rich countries), it helps us to identify that some effects are particular for nations that share similar attributes (e.g., their development level). Indeed, government quality is related positively to tax burden especially in rich countries, which indicates that signals of fairness in the State-citizens relation and efficient public administration are core tools to motivate tax compliance and hence increase revenue when taxpayers have previously cover fundamental needs (e.g., health and education access).

In addition, this research highlights the importance of considering the two sides of the public budget, revenue and public expenditures. For instance, political stability may reduce demands for public spending (Plümper & Martin, 2003) and therefore tax

revenue. Otherwise, it would be difficult to support a negative correlation between political stability and taxation since the first can be studied also as a promoter of tax morale. Likewise, this perspective allows us to explain a negative association between density or urban population on one side, and taxation on the other one.

Taxation is a field in which different agents act, what requires to consider not only the roles played by tax administrations or economic factors that enforce or shape tax laws, but also other features that influence taxpayers' behavior. Therefore, our empirical work also tests some hypotheses extracted from the tax morale theory since it is rational that those factors which boost intrinsic motivation to pay taxes likewise affect tax collection (see Cummings, Martinez-Vazquez, McKee, & Torgler, 2009). Indeed, this study finds that government quality fosters tax burden and direct and indirect taxes, likewise democracy does.

Additionally, the financial system strength, related to Financial_int1, seems to favor tax burden, especially from income taxes. Indeed, financial records of transactions facilitate tax control since tax administrations can trace transaction more easily and verify if corresponding incomes were reported, for example. Nevertheless, this determinant is especially significant for poor and middle-income countries, according to the regressions which were run after the data splitting. On the other hand, tax authorities may enforce the laws more easily in rich countries (Besley & Persson, 2009) and hence "other" tax administration instruments for reducing the tax gap (e.g., financial information) become less important.

Therefore, increasing tax revenue requires not only tax reforms that change tax rates or bases, or introduce more tax penalties to deter evasion, but also the taxpayers' perception on the state must be considered. In consequence, expanding education coverage (including tax education too), enhancing state intervention and strengthening institutions are challenges to be overcome in order to increase voluntary tax compliance and tax revenue, a pending task in regions such as Latin America and Sub-Saharan Africa. Nevertheless, this requires continuity in policy implementation since these strategies last a long time to produce any effect.

Disclosure statement

No potential conflict of interest was reported by the author.

Notes on contributor

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