




Drivers of the Tax Effort: Evidence from a Large Panel

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Abstract

This paper assesses the drivers of tax effort in a sample of 122 countries from 1980 to 2017, using both the Bird and Frank indices to measure tax effort. Our focus is on five blocks of determinants—namely, economic, fiscal, openness, structural, and political. We find that tax effort is influenced by all blocks, although results differ per income group. Tax effort in advanced economies is driven by all blocks of drivers except political variables, while openness, structural, and political blocks prevail in developing economies. There is no consistency regarding the determinants across the four regions (Latin America, Africa, Europe, and Asia). We also find that, during the first two decades under analysis, tax effort is mainly associated with both higher levels of countries' tax revenues and the role of the agricultural sector in the economy. However, from 1999 onwards, the determinants are mainly driven by left-wing governments and the economic and fiscal blocks of variables. Our results are robust for a battery of sensitivity and robustness tests. Taken together, our findings point to the existence of heterogeneous impacts, which implies that policies resulting in improvements in the level of tax effort can affect countries in diverse ways.

Keywords Tax effort · Fiscal policy · Economic development

JEL Classification H21 · O10 · O40

Introduction

There is a longstanding debate regarding the drivers of tax revenues and tax effort (Gupta 2007). Tax effort can be defined as an index of the ratio between the share of actual tax collection in gross domestic product and taxable capacity—with tax capacity being “*the predicted tax-to-gross domestic product ratio that can be estimated empirically, taking into account a country's specific macroeconomic, demographic, and institutional features, which all change through time*” (Le et al. 2012).

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Countries worldwide have been concerned with tax revenues and fiscal constraints (Arellano and Bai 2017). On the one hand, strong pressure exists on government spending, both for social expenditure on services such as education, health, and pensions (Jimenez 2017) and for public investment, with particular emphasis on addressing infrastructure gaps (Bacchiocchi et al. 2011; Sarmiento and Renneboog 2016). On the other hand, increasing attention is being paid to the sustainability of public finances, particularly in contexts of low economic growth (Afonso and Jalles 2012). All this has led to governments attaching increased importance to raising revenues. Nevertheless, a high fiscal burden can be perceived as an obstacle to economic development and growth (Afonso and Jalles 2014). Accordingly, increasing tax revenues without a high level of tax effort is considered an essential element of fiscal policy. As a result, understanding the drivers of tax effort is of great relevance, particularly for policy makers.

The literature on the drivers of tax effort has focused mainly on the economic and demographic aspects. However, other blocks of drivers should also be given due weight. The issue of the determinants of a country's tax effort are not well-understood in the extant literature—in particular, which determinants prevail in a large panel covering numerous countries over an extended period. Most studies have concentrated on the economic determinants (Frank 1959; Bird 1964; Lotz and Morss 1967; Balh 1971; Chelliah et al. 1975; Berry and Fording 1997; Piancastelli 2001; Rivero 2001; Gupta 2007; Bird et al. 2008; Fenochietto and Pessino 2013) while giving only scant attention to the role of other blocks of determinants. Our specific aim is to clarify these issues and close the knowledge gap. As in previous studies, we use a comprehensive list of determinants of tax efforts (Balh 1971; Chelliah et al. 1975; Mertens 2003; Balh 2004; Gupta 2007; Grigorian and Davoodi 2007; Bird et al. 2008; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013; Aki-toby et al. 2020). Unlike prior studies, we allow the five blocks of drivers to operate simultaneously in explaining tax effort, and our sample setting is unique; in that we cover a large panel of 122 countries over a 38-year period.

From an economic point of view, the main drivers of tax effort are GDP growth and GDP per capita (Frank 1959; Bird 1964; Rivero et al. 2001; Gupta 2007), although gross domestic income is also perceived as relevant (Lortz and Morss 1967; Chelliah et al. 1975; Piancastelli 2001). In both the economic and demographic cases, countries with a higher level of development tend to have higher taxation and tax effort levels. Furthermore, a higher contribution of agriculture to GDP tends to reduce the tax capacity (Balh 1971; Chelliah et al. 1975; Piancastelli 2001). Economies with a higher level of openness—that is, with more trade—tend to have lower levels of tax effort (Gupta 2007; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013). In addition, a better institutional environment, such as low corruption and adherence to the rule of law, tends to improve tax performance and reduce the tax burden (Bird and Martinez-Vasquez 2008).

Our data covers a large panel of 122 countries from 1980 to 2017 and is sourced from the OECD database, the World Economic Forum, the IMF World Economic Outlook (WEO), and the World Bank's World Development Indicators (WDI). Unlike other studies (Bahl 1971; Piancastelli 2001; Mertens 2003; Gupta 2007), a key feature of our research is the inclusion of two alternative measures of tax



effort (the Frank and Bird indices) that correct for purchasing power and disposable income, for the largest available number of countries (122) and years (38). Our focus is on five blocks of determinants—namely economic, fiscal, openness, structural, and political. We constructed our baseline specification by using the standard fixed-effects model for each block of determinants from which we later dropped any insignificant variables from the full specification of determinants. This parsimonious process set our benchmark specification, which was narrowed down to geographical region (Latin America, Africa, Europe, and Asia), income group (advanced economies, and developing economies), and time period (1980 to 1998, and 1999 to 2017).

Overall, tax effort is influenced by all groups of determinants, although the results differ per income group. Tax effort in advanced economies is driven by all blocks of drivers, with the exception of political variables, which are not relevant. However, the three blocks of openness, structural, and political issues prevail in developing economies. Consistency is also absent from the drivers of tax effort across the four regions. Conversely, and in contrast to all other regions, tax effort in Africa is not associated with the economic, fiscal, and openness drivers. Over the period from 1980 to 1998, the level of tax effort is mainly associated with higher levels of a country's tax revenues and the contribution of the agricultural sector to GDP. In the period after that the determinants of tax effort are mainly driven by left-wing governments and by the economic and fiscal blocks of determinants. The results are robust to a large number of robustness checks.

The remainder of this paper is organized as follows. Section 2 presents the literature review. Section 3 develops the conceptual framework underlying the empirical model. Section 4 discusses the data and presents some stylized facts, and Sect. 5 discusses the econometric results. The last section concludes and earmarks a number of critical policy implications.

Literature Review

The OECD defines tax revenues as “*the revenues collected from taxes on income and profits, social security contributions, taxes levied on goods and services, payroll taxes, taxes on the ownership and transfer of property, and other taxes. Total tax revenue as a percentage of GDP indicates the share of a country's output that is collected by the government through taxes.*” The tax burden is measured by considering total tax revenues received as a percentage of GDP (Sarmiento 2018). However, countries have different tax capacities that vary with their level of GDP, income, openness to trade, and institutional quality (Gaspar et al. 2016). Tax capacity is measured as the predicted tax-to-gross GDP ratio that a country can support, considering its specific macroeconomic, demographic, and institutional characteristics (Le et al. 2012). We can assess tax effort as a derivative of tax revenues and tax capacity. Tax effort is, therefore, the ratio between tax revenues as a percentage of GDP and the tax capacity. It is important to note that a simple comparison of tax revenues as a share of GDP can be misleading because it ignores differences in tax capacity across the countries in question (Mertens 2003). That is to say, the ratio does not



take into account the effort required to produce the income captured in GDP (Bird 1964). Other ratios adjust for differences in population and personal income (Frank 1959) and differences in disposable income (Bird 1964).

The main studies on tax effort are summarized in Table in the Appendix. Studies have evolved into more complex and comprehensive studies based on the seminal works of Frank (1959) and Bird (1964)—they were the first to define tax capacity and tax effort. Most studies use a data sample of several countries for an extended period. For example, Lotz and Morss (1967) used 72 countries to assess tax capacity. For the period from 1963 to 1965, Tanzi (1968) used data from the USA, Canada, and European countries. Balh (1971) used a similar period (1966–1968) but concentrated on 49 low-income studies. Chelliah et al. (1975) also used 47 low-income countries drawing data from the 1969 to 1971 period. More recent studies include Rivero et al. (2001) that used 14 European countries with data ranging from 1967 to 1995, and Mertens (2003) that analyzed the ten central and eastern European countries from 1992 to 2000. Worldwide country analyses (using both developed and less developed countries) have been provided by Piancastelli (2001), Gupta (2007), Bird et al. (2008), Pessino and Fenochietto (2010), and Fenochietto and Pessino (2013).

Studies on tax effort are mainly divided into two large groups: (1) those that compare and evaluate tax effort across several countries, most of which use a cross section of data, ignoring time variation although some use a sample period (Pessino and Fenochietto 2010; Fenochietto and Pessino 2013); and (2) those that analyze the potential drivers of tax efforts. Of these, we can divide the main drivers of tax effort into tax, income, economic structure, population, and institutional environment. Table in Appendix summarizes the main drivers of tax effort, authors, expected effect on tax effort, and the main findings related to each driver. Table A2 in Appendix shows that tax effort determinants can be divided into five large blocks—namely economic, fiscal, open economy, structural, and political.

GDP and GDP per capita are used to measure the economic drivers of tax effort, with some authors (Lotz and Morss 1967; Chelliah et al. 1975) using GDI (Gross Domestic Income) and GDP per capita instead. In addition, Tanzi (1968) used personal income (total and per capita). More developed countries—measured as countries with a high GDP or GDI per capita—tend to have a higher level of tax revenues, primarily due to a higher level of expenditure (mainly social expenditure on pensions, health, and education). Nevertheless, tax effort accounts for purchasing power and disposable income, depending on the measure implemented.

The fiscal determinants are mainly per capita taxes, taxes as a percentage of GDP, and the total amount of tax revenues. Most authors (Frank 1959; Bird 1964; Tanzi 1968; Rivero et al. 2001) found evidence that a higher level of tax revenues and tax collection increases the pressure on taxpayers, leading to a higher tax effort. Higher tax revenues increase the numerator of the leading tax effort measure (Bird 1964), while decreasing the denominator irrespective of whether GDP remains the same. However, as more developed countries tend to have a large tax capacity due to their strong and richer economies as evidenced by a larger GDP, this effect can reduce the tax effort.

Openness of the economy is also a relevant block in tax effort. A higher level of trade tends to reduce the tax effort. This is due to several factors: (1) a larger



volume of exports generates higher profits and creates more employment, which in turn lead to greater tax revenues; (2) in most cases, imports are taxed more; (3) trade liberalization leads to an improvement in customs procedures and also greater tax revenues (Keen and Simone 2004; Agbeyegbe et al. 2006). Nevertheless, Baunsgaard and Keen (2010) found a weaker relationship in low-income countries, even though they discovered a positive and significant relationship between trade and revenue in high-and middle-income countries.

The economic structure of a country is also related to its capacity to collect taxes and consequently influence the tax effort (Piancastelli 2001). Studies show that countries with a greater participation of agriculture in GDP tend to have a higher tax effort (Balh 1971; Chelliah et al. 1975; Mertens 2003; Gupta 2007). Agriculture tends to be rudimentary and has a predominance of small farmers—especially in less developed countries (Fenochietto and Pessino 2013). This means that the majority of the economic agents involved are less prone to pay their fair share of taxes and that the tax authority finds it more difficult to collect these revenues (Rajaraman 2004). As a result, the tax burden is shared by other sectors to a large degree (Rajaraman 2004). In less developed countries, the agriculture share of tax revenues is lower than the percentage of GDP and, consequently, tax performance is weaker (Akitoby et al. 2020). On the contrary, mining and industry tend to reduce the tax effort (Pessino and Fenochietto 2010; Fenochietto and Pessino 2013). In the case of mining, the high level of revenues—especially during a commodity price boom—tends to be highly taxed, which generates revenues. This, in turn, enables tax authorities to reduce the tax burden on other sectors.

Population also has a role in the level of tax effort. Balh (2004) found evidence that countries with a faster-growing population tend to have a low level of tax effort, and Bird et al. (2008) also found evidence of such an effect. Nevertheless, it is important to appreciate that countries with a growing population tend to be low-income countries and, therefore, the low level of tax effort could be more related to this factor.

Finally, the institutional quality of the country is a crucial aspect in determining the level of tax effort. Countries with a better institutional framework—which is reflected in low corruption, a stronger commitment to the rule of law, and higher levels of government efficiency—tend to be characterized by less tax effort (Grigorian and Davoodi 2007; Gupta 2007; Bird et al. 2008; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013). On the whole, these authors argue that a higher level of informal economy and tax evasion leads to a higher tax effort. The ability of a large proportion of taxpayers to evade their tax obligations naturally leads to the tax burden being shared by a reduced number of agents. Authors such as Bird et al. (2008) argue that in the case of low-income countries, improving government institutions is the best route to improving their tax collection because such an improvement provides a better level of development than natural resources. The authors also claim that high-income countries have greater potential to enhance their tax performance because they have better institutions. Despite this, some studies in the literature place emphasis on the repercussions that result from the lack of administrative capacity to enforce taxation in developing countries (Bird 1989, 2004).



Conceptual Framework and Empirical Strategy

Conceptual Framework

To implement our analysis, we compute two measures of tax effort based on the seminal works of Frank (1959) and Bird (1964). The two measures are still relevant today, despite recent attempts to define more comprehensive indices by also including economic development and the degree of openness (Lotz and Morss 1967), foreign trade (Bahl 1971), the intensity in the use of specific taxes (Bahl 1972; ACIR 1988), and frontier production possibilities (Aigner et al. 1977). Frank (1959) proposed a “tax sacrifice” measure, which captures the effects of differences in population and personal income. In Eq. (1), the measure of tax effort begins with the tax burden in the numerator and then accounts for the ability to pay taxes:

$$\text{Frank}_{it} = \left[\frac{\left(\frac{T}{Y} \right)}{\left(\frac{Y}{P} \right)} \right] \times 100 \quad (1)$$

where T is tax revenues, Y is the gross national product, and Y/P scales the gross national product by population (P).

The first studies on the topic computed the “tax burden” solely as T/Y without taking account of the level of economic development. Frank (1959) aimed to overcome this limitation and introduced a “tax burden” measure that adjusted for per capita purchasing power. Later, Bird (1964) asserted the need to adjust the measure to improve international comparisons of the tax burden, adding that the numerator in Frank’s measure failed to consider the effort required to produce the income. In addition, Bird (1964) challenged Frank’s inclusion of gross national product rather than gross domestic product—which better assesses performance in open economies. Nevertheless, the formulation of Bird’s index changed only the numerator part. The measure was first labeled as “tax sacrifice.” Since then, it has evolved into the “tax effort” measure that we highlight in this study (Reddy 1975; Ahmad and Stern 1989; Bird et al. 2008). The index proposed in this research uses disposal income to compute tax effort:

$$\text{Bird}_{it} = \left[\left(\frac{T}{Y - T} \right) \div \left(\frac{Y}{P} \right) \right] \times 100 \quad (2)$$

Empirical Strategy

We empirically investigate the impact of different blocks of drivers on two alternative measures of tax effort computed for the largest available number of countries and years. This means that our unbalanced panel sample includes xx countries from 1980 to 2017. The analysis is further narrowed by geographical region (Latin America, Africa, Europe, and Asia), income group (AE—advanced economies, and DEV—developing economies, including EME—emerging market economies, and



LICS—low-income countries), and time period. The following reduced-form equation is estimated using ordinary least squares (OLS) initially:

$$y_{it} = \beta_1 + \beta_2 y_{it-1} + \beta_3 \text{eco}_{it} + \beta_4 \text{fis}_{it} + \beta_5 \text{open}_{it} + \beta_6 \text{stru}_{it} + \beta_7 \text{pol}_{it} + \eta_i + \mu_t + \varepsilon_{i,t} \quad (3)$$

where the y_{it} dependent variable denotes tax effort (from either the Frank Index or the Bird Index) in the country i and time t , and y_{it-1} is the lagged dependent variable included in the dynamic model later on (cf. robustness section). eco_{it} , fis_{it} , open_{it} , stru_{it} , and pol_{it} are the blocks of drivers that correspond respectively to the economic, fiscal, open economy, structural, and political economy determinants of the tax burden. Building on previous research (Frank 1959; Rivero 2001; Tanzi 1968; Bird 1964); Balh 1971; Gupta 2007; Bird et al. 2008; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013), eco_{it} specifically includes the following variables: log of real GDP per capita; growth in real GDP; and the output gap (measured as the gap between potential and real GDP). In turn, fis_{it} includes tax revenues and the country's fiscal balance, both as a percentage of GDP. The openness of economies (open_{it}) is captured by trade openness (measured as exports plus imports as a percentage of GDP), fiscal openness (measured by the World Bank as the commitments and implementation of fiscal transparency actions), and exchange rate stability. The block of structural drivers (stru_{it}) includes the log of population density, the share of the agricultural sector in the economy, and the Gini index. To conclude, pol_{it} includes a variable to capture the political orientation of the government (Left), the political timing (Horizon), the degree of political fragmentation (Cohesion), and government accountability—see below for details. Most of the variables that comprise the different blocks are derived and adapted from those used in previous analyses. They are described in both Section 2 and in Annex Table A1.

These control variables enter with a one-year lag in order to minimize reverse causation issues. The η_i and μ_t coefficients denote the country-specific effects to capture time-invariant unobserved factors and the time effects controlling for common shocks (such as the global business cycle) that could affect fiscal conditions across all countries in a given year. $\varepsilon_{i,t}$ is an idiosyncratic error term that satisfies the standard assumptions of zero mean and constant variance. To account for possible heteroskedasticity, robust standard errors are clustered at the country level.

The Data

Tax Burden Indices

Figures 1a, b illustrate the level of tax effort worldwide, ranked from 0 to 30. While most advanced economics lie within the 0 to 1 range, Europe shows greater variability, especially when looking at the Bird Index. This measure captures the effort to produce income, and it shows that of the southern European countries (Belgium, France, Italy, Portugal, and Spain), Belgium and France exhibit above average values. The Baltic countries and some countries in the Balkans underperform. Asia shows no relevant variability in tax effort levels.



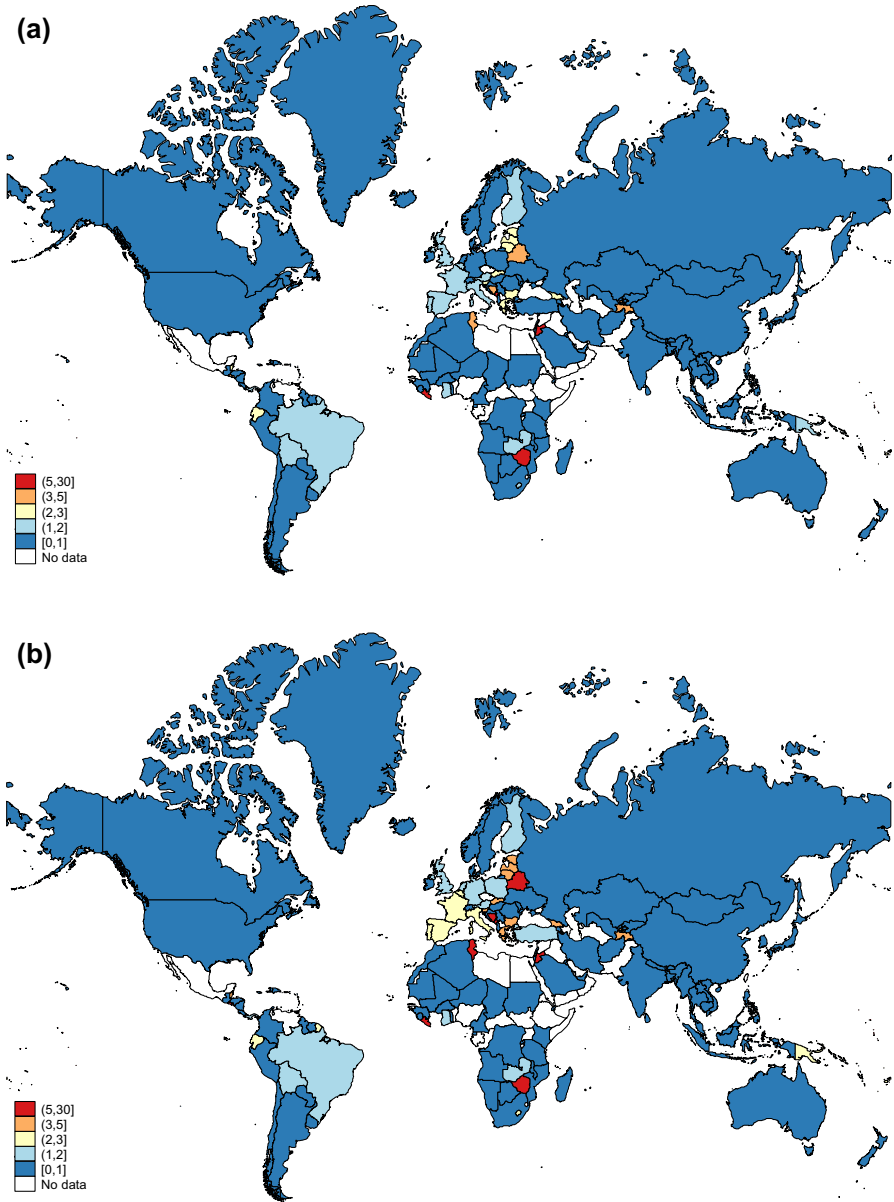


Fig. 1 a Tax Burden across the world, 2017 (using the Frank Index) b Tax Burden across the world, 2017 (using the Bird Index)

Figure 2 illustrates the evolution of both indexes since 1980. The gap has decreased consistently over the years, although a visual inspection highlights a considerable drop in the interquartile range gap. However, the gap between the advanced and the developing economies was not similar (see Fig. A4 in Appendix).



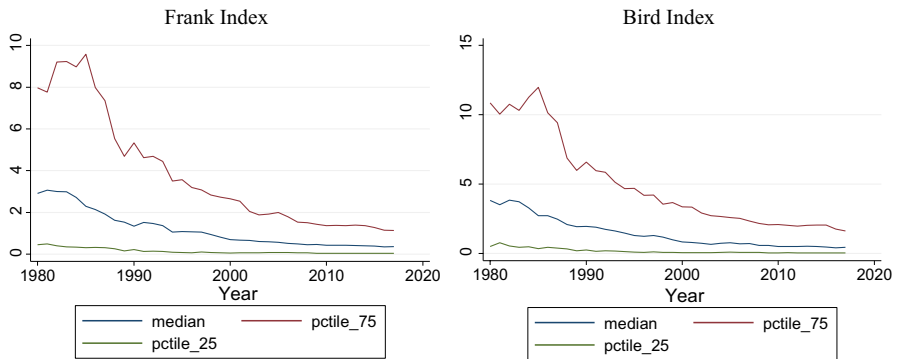


Fig. 2 Evolution of the Frank and Bird indices over time, all countries *Note:* Interquartile range, plotting the median and first and third quartile of the respective distributions

Figures A1, A2 and A3 in Appendix show the evolution of the Frank and Bird indices per country. Interestingly, Japan presents an inversion of the tax effort trend within the group of advanced economies. When looking at emerging market economies (EME) and low-income countries (LCIS), more distinct patterns can be observed. In Fig. 3, we report the distribution of the Frank and Bird indices, which shows that the dispersion is significantly greater for developing economics.

Political and Institutional Drivers

To test the role of political and institutional variables in driving the tax burden, as discussed in the previous sub-section, we propose an approach that relies on a principal component analysis (PCA), with variables grouped around three political dimensions—namely ideology, electoral proximity, and political strength. Data on political economy variables were retrieved from the Database of Political Institutions (DPI) (Cruz et al. 2018).

Ideology

This dimension captures whether a ruling government is left wing or not. The DPI original “chief executive party orientation (execrlc)” value takes three discrete values: 1 for right-wing parties, 2 for centrist parties, and 3 for left-wing parties. We define “left” as taking the value 1 if “execrlc” takes the value 3, and 0 otherwise.

Electoral Proximity

This dimension takes into account the time available to policy makers before forthcoming elections. Politicians facing elections can have higher or lower incentives to implement certain tax reforms, depending on the tax area, vested interests, and constituency voting patterns. We use three variables to compute the proximity to



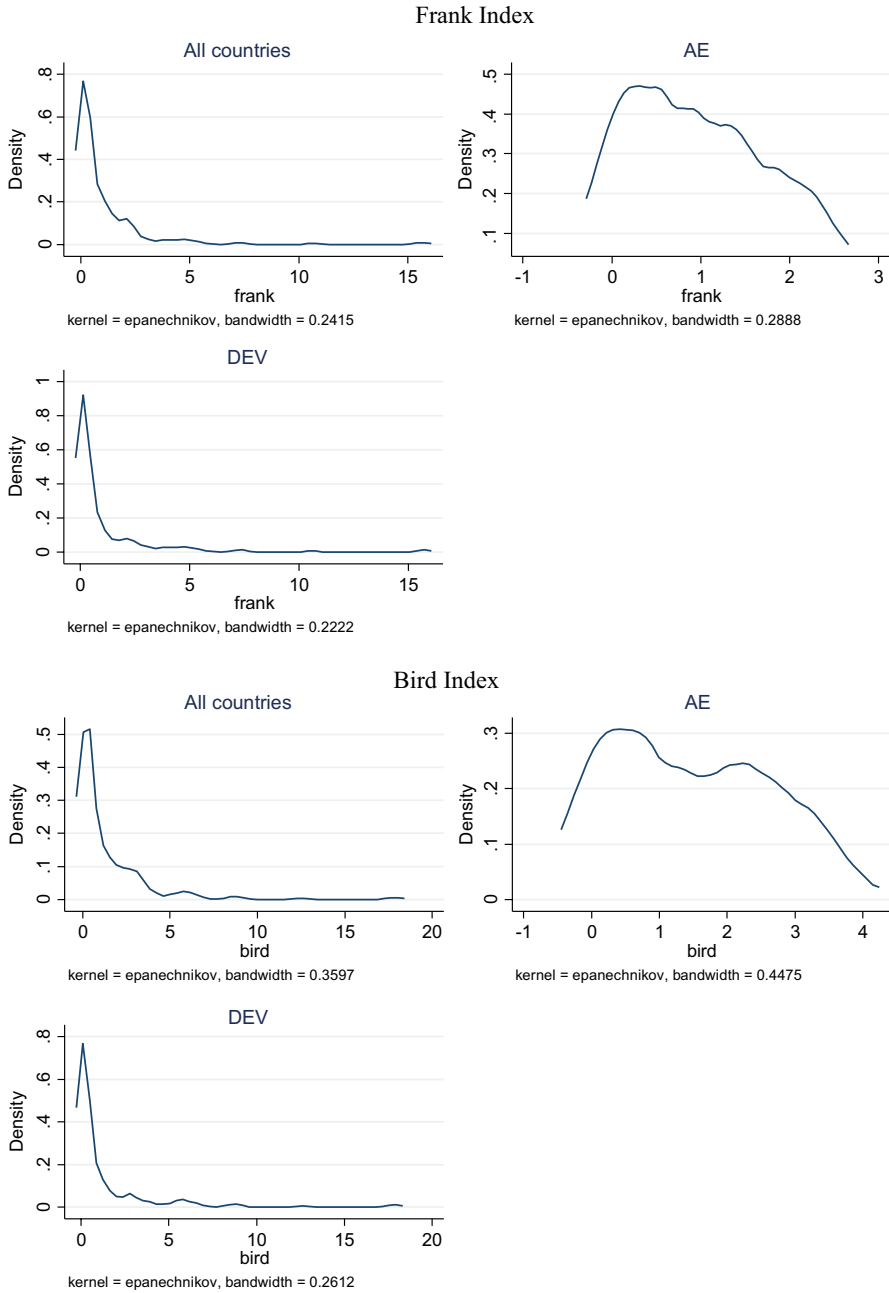


Fig. 3 Distribution of the Frank and Bird indices by income group, 2017



elections PCA. A higher electoral proximity is associated with a longer length of time in office for the party of the chief executive, a greater number of years in office of the chief executive, and a higher number of elapsed years from the current term. The first principal component is retained because this factor explains 60% of the variance in the standardized data (see Table A3).

Political Strength

This represents a dimension that captures the number of political actors participating in fiscal decisions, which typically tend to exhibit conflicting demands. These actors could be parties in government (or in opposition), interest groups, or, more generally, veto players. Strong governments are those that operate in less fragmented political environments. We use four variables to compute the strength of PCA, where greater political strength is associated with a large parliamentary majority, executive control of all houses, and a weak opposition. This strength is measured by a larger number of parliamentary seats and a superior share of the votes held by the ruling government. Only the first principal component is retained because it explains more than 54% of the variance in the standardized data (see Table A3).

Political Accountability

This is the dimension that considers the institutional context in which fiscal policy decisions are made. Politicians tend to be more responsive to citizens' demands and more accountable to voters for the promises they make when they operate in contexts typified by greater transparency, better governance, and a larger number of mechanisms designed to monitor their activities objectively. In such contexts, politicians operating in institutional contexts with greater accountability are associated with greater fiscal discipline and lower promise gaps. We use four variables to compute the accountability of PCA. A higher accountability index is associated with a stronger voice and greater accountability, with superior regulatory quality, more government effectiveness, and less corruption. Only the first principal component is retained (see Table A3).

Table A3 in Appendix lists the corresponding factor loadings and uniqueness of the PCAs, which can be interpreted as follows in this example: in the case of political strength, the resulting factor appears to mostly describe the margin of the majority and control of all houses, as indicated by their lower uniqueness.

Given that PCA is based on the classical covariance matrix, which is sensitive to outliers, we take a preliminary step by basing it on a robust estimation of the covariance (correlation) matrix. A well-suited method is the minimum covariance determinant (MCD), which considers all subsets containing $h\%$ of the observations and estimates the variance of the mean on the data of the subset associated with the smallest covariance matrix determinant—for which we implement Rousseeuw and Van Driessen's (1999) algorithm. After re-computing the same indices with the MCD version, we broadly obtain similar results, which 5that outliers are not driving our factor analysis.



Empirical Results

Baseline

As a baseline, we estimate Equation (1) using the standard fixed-effects model and start with a specification that includes only macroeconomic variables in Column (1) of Table 1 as a reference point. We then present parsimonious specifications with alternative blocks of drivers organized by topic and enter them independently into Specifications (2) to (6). Specification (7) includes all blocks of drivers placed together in a single regression. While these results demonstrate a relatively consistent picture, we consider the model in Column (8)—which was obtained from dropping insignificant variables from Specification (7) one at a time—as our benchmark specification.

The dependent variables in Tables 1 and 2 are the Frank index and the Bird index, respectively. The results are very similar for the two proxies of tax effort, although with one exception. The Gini index is associated with higher tax effort for the Frank index but is not relevant for the Bird index. In fact, the latter differs in the way it accounts for the effort to produce income, thus making the measure of income inequality not relevant in explaining tax effort. We observe that countries with higher tax as a percentage of GDP and a higher fiscal balance experience higher tax effort. This result is consistent for both measures of tax effort and with the role of tax effort in achieving fiscal consolidation.

The results suggest the existence of higher tax effort for more open economies, which are more sensitive to exchange rate fluctuations. The works of Lotz and Morss (1967), Balh (1971), Chelliah et al. (1975), Mertens (2003), and Bird et al. (2008) all contended that openness exerts a negative effect on tax effort, although some other studies suggested the opposite effect, which is arguably due to import taxes (Gupta 2007; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013). Consistent with Bird et al. (2008), tax effort increases population density, although the level of income can shape this relationship, as discussed below.

Increasing real GDP is associated with higher tax effort. However, contrary to most empirical evidence (Frank 1959; Gupta 2007; Pessino and Fenochietto 2010; Fenochietto and Pessino 2013), real GDP per capita appears to drive down countries' tax efforts. Bird et al. (2008) asserted that more developed countries have a greater tax capacity. Accordingly, this supports our decision to narrow the analysis to geographical region and income group in the section that follows.

Collectively, results suggest a more prominent role in explaining a country's tax effort for economic, fiscal, and political drivers. A country's tax effort decreases as the real GDP per capita increases, which is expected considering the nature of the tax effort measure. Indeed, an increase in the prosperity of an economy based on its economic growth is likely to lead to increased tax revenue (Castro and Camarillo 2014), although at a more reduced pace. Regarding the fiscal block of determinants, our results demonstrate that those fiscal balances are triggers for a greater effort in collecting taxes, in order to fund government spending from the revenues collected (Tanzi 1989). The positive effect on tax



Table 1 Baseline: Frank Index—OLS

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Real GDP (log)	3.9552*** (0.588)						6.6160* (3.641)	
Real GDP pc (log)	- 8.1783*** (0.787)						- 10.4814*** (3.720)	- 4.6661*** (0.496)
Real GDP growth	4.5236*** (1.431)						0.3803 (1.275)	1.9768* (1.133)
Inflation rate	2.1349 (1.846)						- 0.7948 (1.733)	
Output gap	0.0514*** (0.015)						0.0169 (0.013)	0.0411*** (0.012)
Growth forecast	- 0.0203 (0.043)						0.0176 (0.029)	
Tax pc (log)		- 2.8826*** (0.421)					- 0.3541 (0.276)	
Tax (%GDP)		0.0526*** (0.015)					0.0338*** (0.010)	0.0285*** (0.007)
Public debt (%GDP)		- 0.0193*** (0.004)					- 0.0001 (0.002)	
Fiscal balance (%GDP)		- 0.0185 (0.012)					0.0288*** (0.009)	0.0173*** (0.007)
Trade openness			0.7225*** (0.204)				0.4351 (0.287)	0.3269* (0.198)
Terms of trade			0.1360 (0.129)				- 0.4027 (0.269)	



Table 1 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial openness			- 1.2281*** (0.219)				- 0.0391 (0.194)	0.6297*** (0.181)
Exchange rate stability			- 1.2070*** (0.208)				- 0.5413** (0.210)	- 0.3849** (0.151)
Monetary independence			0.3984* (0.226)				0.0842 (0.148)	
Financial crises			- 0.0385 (0.191)				0.0807 (0.112)	
Population density (log)				- 6.0174*** (2.198)			2.7629 (3.225)	5.4213*** (0.737)
Labor force (log)				4.5871*** (1.083)			- 0.2166 (0.876)	
Agriculture (%GDP)				0.0863*** (0.032)			- 0.0320 (0.047)	0.0752*** (0.028)
Services (%GDP)				- 0.0089 (0.022)			- 0.0135 (0.020)	
Gini (disp.inc)				9.5888*** (2.232)			1.2246 (2.127)	4.0867** (1.774)
Left					- 0.1010** (0.040)	0.0089 (0.026)	- 0.0699*** (0.022)	- 0.0175 (0.020)
Horizonl					- 0.3027*** (0.061)	- 0.0248 (0.048)	0.0645 (0.047)	- 0.2766*** (0.064)
Cohesion					0.2595 (0.196)	- 0.1924 (0.338)	1.1737*** (0.420)	0.5741* (0.327)



Table 1 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Accountability						- 1.2853*** (0.256)	- 0.0842 (0.227)	
Observations	1709	1376	3466	1913	2518	1383	649	1162
R-squared	0.7865	0.7735	0.6954	0.7636	0.7274	0.8813	0.9235	0.8997

The dependent variable is the Frank index. Robust standard errors are in brackets. The outliers are excluded—namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

Table 2 Baseline: Bird Index—OLS

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Real GDP (log)	6.6362*** (0.808)						8.3178 (5.483)	
Real GDP pc (log)	-12.5423*** (1.123)						-14.4502*** (5.557)	-6.6941*** (0.727)
Real GDP growth	5.8019*** (1.841)						1.2386 (1.927)	2.8943* (1.625)
Inflation rate	2.5859 (2.181)						-0.5998 (2.589)	
Output gap	0.0657*** (0.020)						0.0313 (0.021)	0.0594*** (0.017)
Growth forecast	-0.0061 (0.052)						0.0133 (0.045)	
Tax pc (log)		-3.8572*** (0.573)					-0.2698 (0.418)	
Tax (%GDP)		0.0897*** (0.023)					0.0516*** (0.015)	0.0458*** (0.010)
Public debt (%GDP)		-0.0242*** (0.005)					0.0000 (0.003)	
Fiscal balance (%GDP)		-0.0253 (0.016)					0.0456*** (0.014)	0.0298*** (0.009)
Trade openness			0.8051*** (0.255)				0.5977 (0.433)	0.4753* (0.289)
Terms of trade			0.0851 (0.143)				-0.5569 (0.416)	



Table 2 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial openness			- 1.7570*** (0.282)				- 0.1332 (0.294)	0.7644*** (0.245)
Exchange rate stability			- 1.5190*** (0.260)				- 0.7912** (0.317)	- 0.6843*** (0.209)
Monetary independence			0.5640* (0.299)				0.1196 (0.225)	
Financial crises			- 0.0640 (0.243)				0.0783 (0.166)	
Population density (log)				- 6.1792** (2.956)			4.7866 (4.856)	8.1081*** (1.067)
Labor force (log)				5.8131*** (1.460)			- 0.0638 (1.328)	
Agriculture (%GDP)				0.0967** (0.040)			- 0.0720 (0.072)	0.0714* (0.038)
Services (%GDP)				- 0.0185 (0.029)			- 0.0165 (0.030)	
Gini (disp.inc)				10.4189*** (3.047)			0.1712 (3.306)	3.7901 (2.492)
Left					- 0.1333** (0.053)	0.0247 (0.036)	- 0.0962*** (0.034)	- 0.0208 (0.028)
Horizonl					- 0.3925*** (0.081)	- 0.0242 (0.064)	0.0787 (0.071)	- 0.3501*** (0.082)
Cohesion					0.3604 (0.248)	- 0.1537 (0.429)	1.7809*** (0.647)	0.9297** (0.472)



Table 2 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Accountability						- 1.7098***	- 0.0465	
Observations	1709	1376	3466	1913	2518	(0.347)	(0.332)	1162
R-squared	0.8077	0.7639	0.6871	0.7525	0.7108	1383	649	0.8968

The dependent variable is the Bird index. Robust standard errors are in brackets. The outliers are excluded, namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively



effort aligns with the extant literature (Frank 1959; Bird 1964; Tanzi 1968 or Rivero et al. 2001). From an economic point of view, the relevance of the political driver on a country's tax effort is surprising. Left-wing governments are keener to implement redistributive policies (Piketty 1995) that are funded with a higher tax burden. Moreover, taxation is likely to be more progressive in the majority of countries that have left-wing parties in government (Andersson 2022).

Sensitivity

We performed sensitivity analyses by income group (Table 3), geographical location (Table 4), and time period (Table 5). The results of the sensitivity analysis by income group show that there are only two consistent determinants of tax effort: real GDP per capita and population density. The results for other economic and fiscal drivers of the tax effort remain similar to the base case for advanced economies. The relevance of the agricultural sector in developing economies increases the tax effort. However, this association is negative for advanced economics, which is explained by the role of the agricultural sector on output per capita. Overall, the tax effort in advanced economies is driven by all the blocks of drivers, except for political variables. However, in developing economies, the level of tax effort is influenced by the openness, structural, and political blocks of drivers.

The sample is further narrowed in Table 4 to geographical location—namely Latin America, Africa, Europe, and Asia. Overall, there is no consistency in the drivers of tax effort across the four regions. Tax effort in African countries is not associated with economic, fiscal, and openness drivers. African countries exhibit lower tax efforts with higher density populations in the case of countries governed by left-wing parties and also for countries with a prominent agriculture sector in the economy. Latin American countries share similarities with African countries, although the Gini index and the economic and fiscal blocks of drivers need to be added to those cited above for African countries. The Gini index plays a role in the tax efforts of regions where there is a concentration of countries with greater inequality. In fact, the Gini index is only relevant to the Latin American region. The inequality index is highly concentrated above 40 for most Latin American countries, whereas it is not uniform throughout the African region and is relatively low in most countries of all other regions.

The Europe and Latin America regions share most economic drivers, although with opposing associations—namely increase in GDP per capita, lower real GDP growth, and smaller output gap are all associated with lower tax efforts in Europe, although they are higher in Latin America. The block of fiscal variables is relevant in explaining variability in tax efforts in the Asia region, together with financial openness and the contribution of the agriculture sector.

Table 5 shows the results for two time periods—1980 to 1998 and 1999 to 2017. The decision to formulate two periods was based on two considerations. First, it allowed us to split the sample into two periods of equal length—18 years each. In addition, these periods represent dissimilar economic growth. Second, in 1999, the eurozone was formed from 19 countries, which later led to the creation of the euro



Table 3 Sensitivity: Frank and Bird Indices—OLS by income group

Specification	(1)	(2)	(3)	(4)
Dependent variable	Frank	Frank	Bird	Bird
Income group	AE	DEV	AE	DEV
Variables				
Real GDP pc (log)	− 7.0596*** (0.605)	− 2.4031*** (0.557)	− 10.3648*** (0.910)	− 3.2610*** (0.727)
Real GDP growth	3.9041*** (1.051)	− 0.2315 (1.818)	5.0267*** (1.620)	0.0003 (2.512)
Output gap	0.0598*** (0.013)	− 0.0039 (0.015)	0.0874*** (0.020)	− 0.0004 (0.020)
Tax (%GDP)	0.0386*** (0.007)	0.0065 (0.027)	0.0612*** (0.010)	0.0197 (0.034)
Fiscal balance (%GDP)	0.0364*** (0.007)	0.0041 (0.016)	0.0570*** (0.010)	0.0115 (0.022)
Trade openness	1.1718*** (0.224)	− 0.4094 (0.349)	1.7528*** (0.338)	− 0.5588 (0.480)
Financial openness	− 0.0304 (0.124)	1.4028*** (0.318)	0.0239 (0.201)	1.5797*** (0.422)
Exchange rate stability	− 0.5887*** (0.153)	− 0.0788 (0.246)	− 1.0110*** (0.232)	− 0.1445 (0.332)
Population density (log)	7.6925*** (0.664)	4.7012*** (1.198)	11.4558*** (0.993)	6.2270*** (1.681)
Agriculture (%GDP)	− 0.1077** (0.046)	0.0947*** (0.030)	− 0.1969*** (0.070)	0.1138*** (0.041)
Gini (disp.inc)	− 0.0867 (1.606)	2.9377 (2.176)	− 1.2200 (2.550)	2.2388 (2.995)
Left	− 0.0052 (0.018)	0.0048 (0.048)	− 0.0085 (0.028)	0.0154 (0.061)
Horizon1	0.0260 (0.035)	− 0.5319*** (0.094)	0.0401 (0.054)	− 0.6789*** (0.119)
Cohesion	0.5232 (0.373)	1.2183** (0.562)	0.9799* (0.577)	1.6006** (0.759)
Observations	688	474	688	474
R-squared	0.9256	0.9259	0.9230	0.9219

The dependent variable is the either the Frank index or the Bird index. The robust standard errors are in brackets. The outliers are excluded, namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

currency. The single currency market has yielded certain benefits: improved price stability; economic stability and growth; a more significant influence on the global economy; and enhanced firm competitiveness (Georgieva et al. 2014; Hutson and



Table 4 Sensitivity: Frank and Bird Indices—OLS by geographical region

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Frank	Frank	Frank	Frank	Bird	Bird	Bird	Bird
Region	Latin America	Africa	Europe	Asia	Latin America	Africa	Europe	Asia
Variables								
Real GDP pc (log)	0.8971** (0.396)	2.0296 (1.237)	- 7.3616*** (0.673)	- 0.2055 (0.189)	1.2520** (0.528)	3.5767* (1.955)	- 11.0858*** (1.004)	- 0.1753 (0.260)
Real GDP growth	- 2.7187* (1.394)	- 2.1839 (2.829)	3.4479*** (1.223)	- 0.4214 (0.470)	- 3.7043* (1.955)	- 3.9181 (4.438)	4.5904** (1.864)	- 0.5763 (0.676)
Output gap	- 0.0366*** (0.014)	- 0.0155 (0.029)	0.0629*** (0.014)	- 0.0036 (0.007)	- 0.0528*** (0.019)	- 0.0303 (0.044)	0.0946*** (0.021)	- 0.0028 (0.010)
Tax (%GDP)	0.0824*** (0.032)	- 0.0139 (0.015)	0.0330*** (0.007)	- 0.0192** (0.008)	0.1436*** (0.046)	- 0.0208 (0.023)	0.0515*** (0.011)	- 0.0297*** (0.012)
Fiscal balance (%GDP)	- 0.0114 (0.013)	0.0044 (0.012)	0.0347*** (0.009)	0.0135*** (0.004)	- 0.0144 (0.018)	0.0102 (0.018)	0.0546*** (0.013)	0.0245*** (0.007)
Trade openness	- 0.0925 (0.246)	0.2009 (0.268)	1.1795*** (0.320)	- 0.0577 (0.063)	- 0.1484 (0.341)	0.2324 (0.424)	1.6575*** (0.483)	- 0.0559 (0.094)
Financial openness	- 0.3195 (0.230)	0.0242 (0.310)	0.1257 (0.152)	0.4145*** (0.151)	- 0.5258* (0.316)	- 0.1025 (0.494)	0.2434 (0.238)	0.5576*** (0.211)
Exchange rate Stability	0.2835 (0.232)	- 0.4221 (0.398)	- 0.8098*** (0.150)	0.0110 (0.069)	0.3740 (0.316)	- 0.7343 (0.647)	- 1.2901*** (0.225)	0.0005 (0.109)
Population density (log)	- 2.2734*** (0.790)	- 5.9368*** (1.622)	8.0483*** (1.011)	- 0.3829 (0.308)	- 2.7240** (1.114)	- 7.1459*** (2.587)	11.5598*** (1.518)	- 0.5931 (0.439)
Agriculture (%GDP)	- 0.0563*** (0.019)	- 0.0581* (0.032)	- 0.0196 (0.057)	0.0199*** (0.007)	- 0.0790*** (0.027)	- 0.0914* (0.050)	- 0.0721 (0.089)	0.0237** (0.010)
Gini (disp.inc)	12.2224*** (2.109)	4.4996 (3.023)	2.0634 (2.125)	0.0876 (0.949)	15.1202*** (2.894)	6.9319 (4.939)	1.5744 (3.380)	- 0.0852 (1.398)



Table 4 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Left	- 0.0491* (0.026)	- 4.7953** (1.680)	- 0.0400* (0.023)	0.0029 (0.017)	- 0.0448 (0.034)	- 5.4869* (2.688)	- 0.0555 (0.036)	0.0078 (0.025)
Horizon1	0.0312 (0.057)	- 0.2162** (0.091)	0.0251 (0.045)	- 0.0168 (0.014)	0.0444 (0.078)	- 0.3675** (0.146)	0.0279 (0.068)	- 0.0168 (0.021)
Cohesion	0.4228 (0.344)	2.7674* (1.481)	1.1379** (0.451)	- 0.2556* (0.134)	0.5929 (0.475)	4.5485* (2.366)	1.7111** (0.690)	- 0.3516* (0.193)
Observations	206	49	571	136	206	49	571	136
R-squared	0.9753	0.9984	0.9228	0.9681	0.9682	0.9980	0.9188	0.9665

The dependent variable is either the Frank index or the Bird index. The robust standard errors are in brackets. The outliers are excluded, namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively



Table 5 Sensitivity: Frank and Bird Indices—OLS by time period

Specification	(1)	(2)	(3)	(4)
Dependent variable	Frank	Frank	Bird	Bird
Time period	1980– 1998	1999– 2017	1980– 1998	1999– 2017
Variables				
Real GDP pc (log)	0.0246 (1.408)	– 3.9766*** (0.530)	0.3646 (1.970)	– 5.6642*** (0.769)
Real GDP growth	– 2.3432 (1.710)	2.6107*** (0.859)	– 3.5873 (2.373)	3.6983*** (1.197)
Output Gap	– 0.0355* (0.021)	0.0218** (0.011)	– 0.0571** (0.028)	0.0326** (0.015)
Tax (%GDP)	0.0400*** (0.015)	0.0086 (0.007)	0.0569*** (0.020)	0.0180* (0.010)
Fiscal balance (%GDP)	– 0.0088 (0.014)	0.0108** (0.005)	– 0.0117 (0.019)	0.0203*** (0.007)
Trade openness	0.7552 (0.558)	– 0.1248 (0.200)	0.7493 (0.728)	– 0.1305 (0.300)
Financial openness	0.0950 (0.223)	0.0179 (0.166)	0.1789 (0.324)	– 0.0788 (0.238)
Exchange rate stability	– 0.2105 (0.202)	– 0.1652 (0.161)	– 0.4142 (0.287)	– 0.2968 (0.227)
Population density (log)	– 4.0539 (2.878)	6.1490*** (0.842)	– 5.5306 (3.832)	8.8226*** (1.218)
Agriculture (%GDP)	0.3023*** (0.063)	0.0239 (0.018)	0.3491*** (0.082)	0.0076 (0.025)
Gini (disp.inc)	3.1376 (3.408)	1.9428 (1.675)	4.1789 (4.562)	1.1211 (2.402)
Left	0.0228 (0.035)	– 0.0473*** (0.017)	0.0146 (0.054)	– 0.0632** (0.025)
Horizon1	– 0.1370* (0.083)	– 0.0591 (0.049)	– 0.1582 (0.112)	– 0.0730 (0.068)
Cohesion	– 0.5606 (0.454)	0.9931*** (0.326)	– 0.5085 (0.671)	1.4063*** (0.467)
Observations	249	913	249	913
R-squared	0.9870	0.9308	0.9864	0.9253

The dependent variable is the either the Frank index or the Bird index. The robust standard errors are in brackets. The outliers are excluded, namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

O’Driscoll 2010; Beetsma and Giuliodori 2010; Ferrando et al. 2019). During the first period, the tax effort is mainly associated with a higher level of tax revenues per country and the role of the agricultural sector in the composition of GDP. Turning to



the next two decades, drivers differ significantly as the economic and social development of countries evolve. In this new situation, determinants of tax effort are now mainly driven by the economic and fiscal blocks of variables. The growth in GDP is associated with higher tax effort, although it is offset by the prosperity of economies measured by per capita GDP. The relevance of left-wing governments emerged in the second period—which acts as a determinant of decreasing tax effort.

Robustness

We began the empirical analysis with the standard fixed-effects model, which provided consistent and robust results. However, the model represented by Equation (1) is the reduced-form version, which therefore renders it impossible to make causal statements, or even quantify the clean effects of certain drivers on the tax burden. Adding covariates partly corrects for these biases. However, endogeneity can still arise from other omitted variables (unobserved heterogeneity and selection effects), measurement errors in variables, and reverse causality (simultaneity). Since causality can run in both directions, some of the right-hand-side regressors can be correlated with the error term. However, due to the potential for the existence of endogeneity and the persistence of tax burden indices, we checked the sensitivity of our baseline results by estimating the static model with the two-stage least squares (2SLS) estimator. We used lagged regressors as instruments (up to two lags), which are validated by the Kleibergen-Paap and Hansen statistics.¹ Furthermore, we used the system generalized method of moments (GMM) approach developed by Arellano and Bover (1995) and Blundell and Bond (1998) to estimate the dynamic version of our model—even though the GMM system approach is a very demanding estimator, especially when using a limited number of unbalanced observations. The system GMM approach involves constructing two sets of equations—one with first differences of the endogenous and pre-determined variables instrumented by suitable lags in their own levels, and the other with the levels of the endogenous and pre-determined variables instrumented with suitable lags of their own first differences. We apply the one-step version of the GMM system estimator to ensure the robustness of the results, as the standard errors from the two-step variant of the GMM system method are known to be downward biased in small samples.

The use of all available lagged levels of the variables in the GMM estimation leads to a proliferation in the number of instruments, which reduces the efficiency of the estimator in finite samples and can potentially lead to over-fitting. A further issue is that the use of many instruments significantly weakens the Hansen J test of over-identifying restrictions and, therefore, the detection of over-identification is harder when it is most needed. Conversely, however, restricting the instrument set

¹ When looking at the diagnostic statistics to assess the validity of the instrumental variable strategy, the under-identification test *p*-values generally reject the null that the different equations are under-identified. In addition, the Hansen test statistics reveal that the instrument sets contain valid instruments (i.e., instruments that are uncorrelated with the error term, and those that the excluded instruments have correctly excluded from the estimated equation).



too much results in a loss of information that, in turn, leads to imprecisely estimated coefficients. Accordingly, the estimation of such models involves a delicate balance between maximizing the information extracted from the data, on the one hand, and guarding against over-identification, on the other. To this end, we follow the strategy suggested by Roodman (2009) to deal with the problem of weak and excessively numerous instruments. We also validate the GMM system identification assumptions by applying a second-order serial correlation test for both the residuals and the Hansen J test for the over-identifying restrictions. The values reported for AR(1) and AR(2) in the respective tables are the p-values for the first-and second-order autocorrelated disturbances in the first-differenced equation. As expected, we find evidence of high first-order autocorrelation but no evidence of significant second-order autocorrelation. Similarly, the Hansen J test result indicates the validity of internal instruments used in the dynamic model estimated using the GMM system approach.

Finally, we consider the mean group (MG) estimator (Pesaran and Smith 1995) and the pooled mean group (PMG) estimator (Pesaran et al. 1999). Both the MG and PMG are appropriate for analyzing dynamic panels that have both large time and cross section dimensions. Furthermore, they have the advantage of accommodating both the long-run equilibrium and the possibly heterogeneous dynamic adjustment process. These estimators allow us to correct for the potential bias that could result from estimating tax buoyancy coefficients when using standard fixed-effects models in the presence of non-stationary error terms. Imposing parameter homogeneity would introduce bias into the estimating equation.

Results for the robustness analysis using the entire sample are given in Table 6, which contrasts with the results in Tables 1 and 2. The role of real GDP per capita in shaping countries' tax efforts is reinforced in all estimations as documented by Bird et al. (2008), although the results are contrary to other studies (Frank 1959; Gupta 2007; Pessino and Fenochietto 2010; Pessino and Fenochietto 2013). We also observe that fiscal balances increase countries' tax efforts, as in the baseline estimation. The battery of robustness tests yields better clarification on the influence of the Gini index in explaining tax efforts, although it is now robust across the two dependent variables used in our study.

Conclusion and Policy Implications

In this paper, we evaluated the determinants of tax effort in a large sample of 122 countries over 38 years from 1980 to 2017. In contrast to other studies (Bahl 1971; Piancastelli 2001; Mertens 2003; Gupta 2007), a key feature of our research is the inclusion of two alternative measures of tax effort (the Frank and Bird indices) that correct for purchasing power and disposable income. The focus of our analysis is on five groups of determinants—namely economic, fiscal, openness, structural, and political. We began our analysis by looking at the entire sample. Next, we narrowed the analysis by geographical region (Latin America, Africa, Europe, and Asia), income group (advanced economies, and developing economies), and time period (1980 to 1998, and 1999 to 2017).



Table 6 Robustness: Frank and Bird Indices—alternative estimators, all countries

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable	Frank	Frank	Frank	Frank	Frank	Bird	Bird	Bird	Bird	Bird
Estimator	TOLS	Diff-GMM	Sys-GMM	MG	PMG	TOLS	Diff-GMM	Sys-GMM	MG	PMG
Variables										
Real GDP pc (log)	-4.5922*** (0.185)	-2.9200** (1.119)	-0.5595*** (0.084)	-2.6130*** (0.973)	-1.2872** (0.559)	-6.7203*** (0.262)	-4.4252*** (1.615)	-0.8230*** (0.121)	-3.7618*** (1.815)	-2.0038*** (0.939)
Real GDP Growth	3.1778*** (0.674)	1.4969 (1.744)	3.1020 (2.432)	1.1317 (0.872)	0.3646 (0.296)	4.7780*** (0.955)	2.0097 (2.483)	4.5113 (3.394)	1.4531 (1.361)	0.3780 (0.553)
Output Gap	0.0344*** (0.007)	0.0325 (0.022)	0.0418 (0.029)	0.0162* (0.009)	-0.0064 (0.010)	0.0505*** (0.011)	0.0432 (0.033)	0.0648 (0.042)	0.0266* (0.014)	-0.0183 (0.017)
Tax (%GDP)	0.0215*** (0.006)	0.0067 (0.022)	-0.0017 (0.029)	0.0310** (0.013)	0.0356 (0.023)	0.0340*** (0.009)	0.0224 (0.032)	-0.0074 (0.043)	0.0503*** (0.022)	0.0630* (0.037)
Fiscal Balance (%GDP)	0.0141** (0.007)	-0.0130 (0.014)	-0.0272 (0.031)	0.0115** (0.005)	0.0121 (0.012)	0.0241*** (0.009)	-0.0135 (0.021)	-0.0368 (0.043)	0.0230*** (0.008)	0.0365* (0.022)
Trade Openness	-0.0165 (0.145)	-0.7702* (0.437)	-1.0264*** (0.381)	0.1544 (0.159)	0.3066 (0.272)	-0.0271 (0.205)	-1.1078* (0.644)	-1.6181*** (0.528)	0.1953 (0.250)	0.5036 (0.498)
Financial Openness	0.5020*** (0.115)	-0.4786 (0.417)	-1.2144** (0.549)	-0.7123** (0.357)	-0.2169* (0.134)	0.5546*** (0.163)	-0.6730 (0.570)	-1.8303** (0.787)	-0.9221 (0.609)	-0.4030* (0.245)
Exchange Rate Stability	-0.3210*** (0.109)	0.0324 (0.196)	-0.2422 (0.542)	0.0596 (0.071)	0.3058** (0.142)	-0.6291*** (0.155)	-0.0354 (0.312)	-0.2958 (0.777)	0.0489 (0.113)	0.4787** (0.214)
Population Density (log)	4.4313*** (0.368)	1.0192 (3.352)	0.1535 (0.118)	-4.6124 (2.968)	-0.3347 (0.754)	6.5138*** (0.521)	2.8126 (4.477)	0.2675 (0.176)	-6.5249 (5.146)	0.0140 (1.177)
Agriculture (%GDP)	0.0498*** (0.015)	0.1240** (0.053)	0.0555 (0.065)	0.0058 (0.016)	0.0346 (0.036)	0.0379* (0.021)	0.1852** (0.081)	0.0740 (0.093)	0.0139 (0.028)	0.0721 (0.064)
Gini (disp.inc)	4.1043*** (1.235)	10.6360** (4.731)	-2.0022 (2.135)	-1.4397 (1.120)	-0.6764 (0.430)	3.5108** (1.749)	16.5095** (6.929)	5.4346* (3.177)	-2.4869 (1.877)	-0.8501 (0.698)



Table 6 (continued)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Left	0.0072 (0.031)	0.0278 (0.109)	0.1241 (0.140)	- 0.0122 (0.013)	- 0.0206 (0.024)	0.0190 (0.044)	0.0339 (0.150)	0.1608 (0.199)	- 0.0285 (0.025)	- 0.0320 (0.041)
Horizon1	- 0.3810*** (0.065)	- 0.0190 (0.123)	0.1572 (0.144)	0.1335 (0.117)	- 0.0650** (0.033)	- 0.4878*** (0.093)	- 0.0347 (0.176)	0.2296 (0.212)	0.2003 (0.165)	- 0.1284** (0.063)
Cohesion	1.0367** (0.432)	0.2150 (0.505)	- 0.5532 (1.192)	0.0098 (0.340)	- 0.3329 (0.352)	1.6446*** (0.611)	0.2324 (0.739)	- 0.8186 (1.632)	0.0253 (0.598)	- 0.6222 (0.611)
Observations	1129	1100	1184	901	901	1129	1100	1184	901	901
R-squared	0.5559					0.5684				

The dependent variable is either the Frank index or the Bird index. The robust standard errors are in brackets. The outliers are excluded, namely the top 5% of the Frank and Bird indices distributions, respectively. Country and time fixed effects are included but are omitted for reasons of parsimony. The constant term is omitted. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively

Our main findings are summarized as follows. Tax effort is influenced by all groups of determinants, although the results differ per income group. All blocks of groups of determinants explain the tax effort in advanced economies—except the block of political variables—while, in developing economies, the level of tax effort is mainly influenced by the open structural and political blocks of drivers. Overall, there is no consistency in the drivers of tax effort across the four regions. Economic and fiscal determinants are relevant for Europe and Latin America, although in opposite directions. Conversely, none of the economic, fiscal, and openness drivers determines tax effort in Africa. The relevant determinants for African regions are the density of population, the weight of the agricultural sector, and political drivers.

Determinants of tax effort also differ according to each time period. On the one hand, tax effort is mainly associated with higher levels of countries' tax revenues and the role of the agricultural sector in the GDP during the first period (1980–1998). However, on the other hand, in the second period, the relevance of left-wing governments emerged as a determinant of decreasing tax effort, together with the relevance of the economic and fiscal blocks of variables.

Our findings have four main policy implications. First, tax effort is a relevant measure of fiscal policy, but it has limitations. It is easy to collect and provide a simple overview of tax trends over countries. However, countries with different levels of development and income should be considered with caution. The best solution is to consider the impact of each block of determinants mainly in the same income group. Second, in the case of high-level income countries, as all blocks of determinants are relevant, countries should have a holistic view of their tax system. In addition, high-income countries have the potential to improve their tax efficiency by improving their institutions. Third, if countries outside the high-level income group want to take full advantage of their tax revenues, then they need to consider changes in their openness and in the structural aspects of their economy. Fourth, political and institutional drivers are becoming increasingly more relevant.

Future research should consider a finer decomposition of the tax burden, using the Frank index approach by tax category (personal, corporate, goods, and services). Another avenue of research that could usefully be pursued is the economic (and distributional) consequences of big increases in the tax burden—defined as a binary variable that could take the value 1 if the annual change in the index is larger than each country's time-series average plus one standard deviation. This would identify years of major country-specific tax shocks.

Appendix

See Figs. 4, 5, 6 and 7.





Fig. 4 Country-time evolution of the Frank and Bird Indices, Advanced Economies



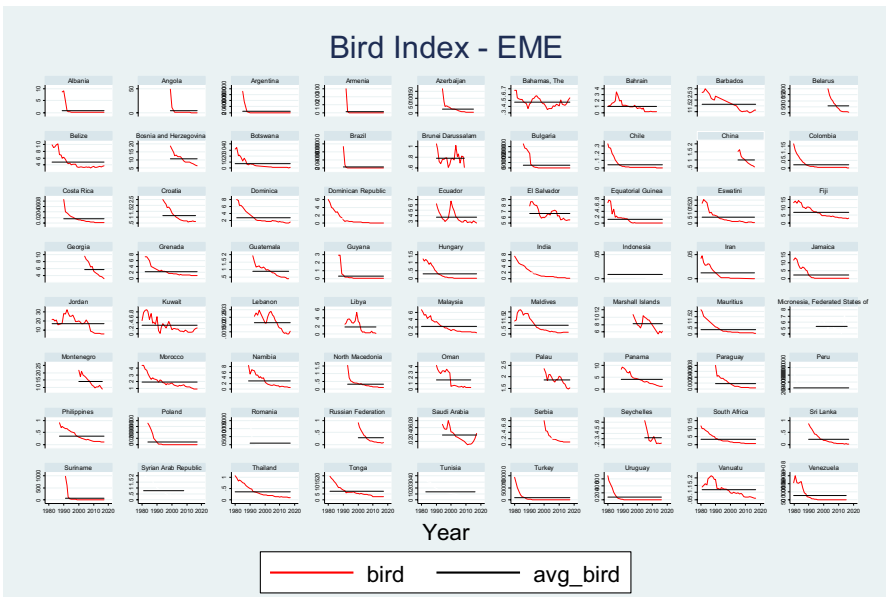
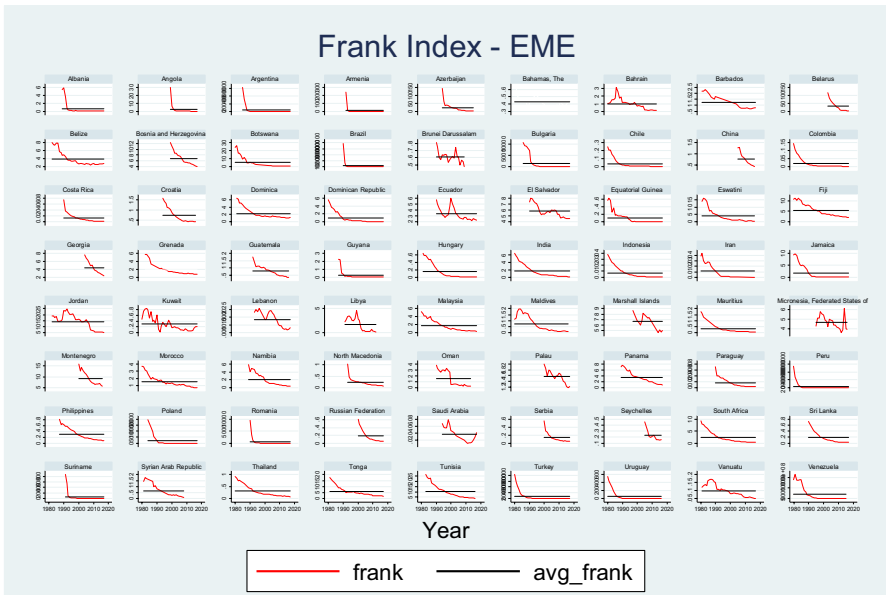


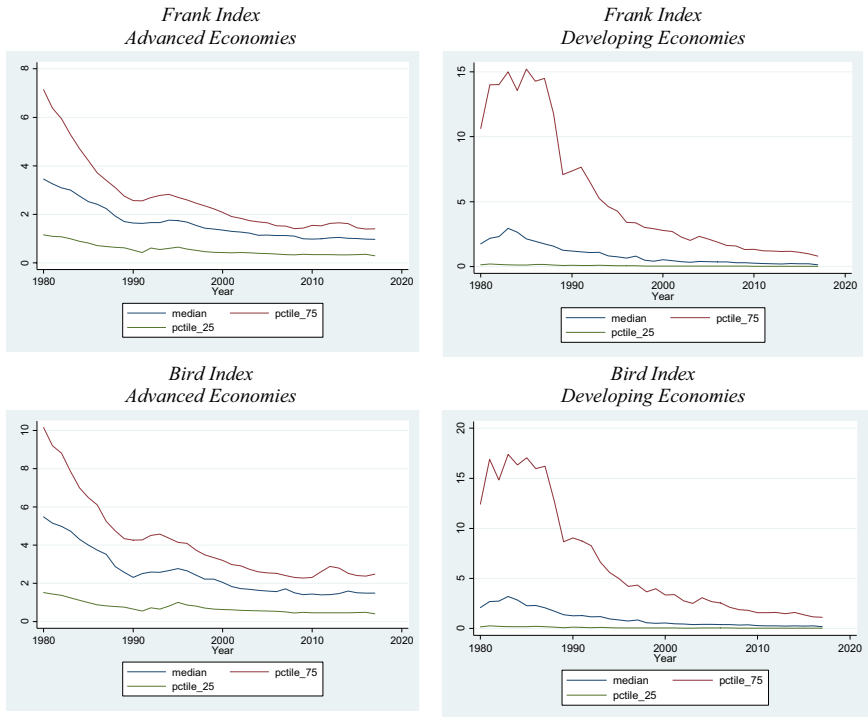
Fig. 5 Country-time evolution of the Frank and Bird Indices, Emerging Market Economies





Fig. 6 Country-time evolution of the Frank and Bird Indices, Low-Income Countries





Note: Interquartile range, plotting the median and the first and third quartiles of the respective distribution.

Fig. 7 Evolution of the Frank and Bird Indices over time, by income group *Note:* Interquartile range, plotting the median and the first and third quartiles of the respective distribution

See Tables 7, 8 and 9.



Table 7 Literature review

Author	Country/region	Period	Methodology	Dependent variables	Explanatory variables	Main conclusions
Frank (1959)	USA	1953–1957	Frank index	Frank index (tax effort)	Per capita taxes Tax as % of GDP Tax revenues GDP GDP per capita	Methodology used to understand the main determinants of tax effort. Compares tax effort across different States.
Bird (1964)	USA, Canada, Europe, and Latin America	1962	Bird index	Bird index (tax effort)	Tax revenues GDP per capita GDI	Low-income countries tend to have higher tax effort. More robust results than the Frank index, by using GDI instead of GDP.
Lotz and Morss (1967)	72 countries		Lotz–Morss equation	Tax capacity	GDI GDI per capita Economy openness	Low-income countries tend to have higher tax effort. Tax capacity limits tax revenue in low-income countries.
Tanzi (1968)	USA, Canada, and Europe	1963–1965	Tanzi equation	Tax effort $\frac{T}{Y} = f(Y')$	Tax revenue Personal income (Y') Personal income per capita (Y'')	Compares the tax effort of other countries with the US.
Bahl (1971)	49 low-income countries	1966–1968	OLS	Tax effort $\left(\frac{T}{Y}\right)$	Agriculture and mining as % of GDP Exports/Imports GDP	A greater share of agriculture in GDP reduces tax capacity, as opposed to mining.
Chelliah et al. (1975)	47 low-income countries	1969–1971	Linear regressions	Tax effort	GDI per capita Economy openness Agriculture and mining as % of GDP	Despite the general increase in tax ratios in developing countries, the average level of taxation is still lower than that in developed countries. The differences between developing and developed countries are more significant if total taxes are defined by including social security contributions.

Table 7 (continued)

Author	Country/region	Period	Methodology	Dependent variables	Explanatory variables	Main conclusions
Berry and Fording (1997)	USA (State level)	1960–1991	Time series regressions	Tax effort index: $\frac{T}{T_{potential}}$	GDI GDI per capita	A change in the index over time indicates a difference in the State tax effort in relation to the national effort.
Rivero et al. (2001)	14 EU countries	1967–1995	Convergence of tax effort in EU	Tax effort (β convergence) $\left[\beta = \frac{1}{T} \log \left(\frac{d_i}{h_i} \right) \right]$	Tax revenues as % of GDP Population GDP	Considerable convergence in the EU between 1967 and 1974, but lower convergence between 1984 and 1995 (with a divergence between 1974 and 1984). This tax convergence contributed to better monetary integration.
Piancastelli (2001)	75 countries	1985–1995	Stochastic model	Tax effort $\left(\frac{T}{Y} \right)$ Also uses Loiz-Morss and Tanzi equations	GDI per capita Economy openness Industry as % GDP Agriculture and mining as % of GDP Degree of literacy	Both GDP per capita and trade increase tax effort. Agriculture share increases tax effort in medium and low-income countries.
Mertens (2003)	Ten Central and Eastern European (CEE)	1992–2000	OLS	Tax effort $\left(\frac{T}{Y} \right)$ Also uses Loiz-Morss and Tanzi equations	Industry as % GDP Agriculture and mining as % of GDP Imports as % of GDP	Substantial variations in tax effort among CEE countries. Agriculture share increases tax effort.



Table 7 (continued)

Author	Country/region	Period	Methodology	Dependent variables	Explanatory variables	Main conclusions
Gupta (2007)	105 countries	1980–2004	OLS fixed effects and endogeneity models	Tax revenues as a % of GDP	GDP per capita Economy openness Foreign aid Corruption Agriculture and mining as % of GDP	Several factors increase revenues: GDP growth, the share of agriculture in GDP, and trade openness along with foreign aid. Several institutional factors decrease revenues potential: more corruption and political instability. Countries that depend on taxing goods and services as their primary source of tax revenue tend to have poorer revenue performance. Countries that place greater emphasis on taxing income, profits, and capital gains perform better.
Bird et al. (2008)	121 countries	1998–2000	OLS 2SLS	Tax share as % of GDP	GDP per capita Population growth Economy openness Corruption Voice and accountability Agriculture and mining as % of GDP	Better institutions improve tax performance. Tax effort is determined to a significant extent by extending the conventional model of tax effort. This is achieved by showing that not only do supply factors matter, but also that demand factors such as corruption, voice, and accountability are also important.



Table 7 (continued)

Author	Country/region	Period	Methodology	Dependent variables	Explanatory variables	Main conclusions
Fenochietto and Pessino (2013)	96 countries	1991–2006	Stochastic Frontier Models	Ratio between actual revenue and tax capacity	GDP per capita Economy openness Income distribution Inflation Levels of education Corruption Agriculture and mining as % of GDP	Countries should analyze the efficiency of their tax effort before implementing new taxes or increasing the rate of the existing ones. A positive and significant relationship exists between tax revenue as a percentage of GDP and the level of development (per capita GDP), trade (imports and exports as percentage of GDP), and education (public expenditure on education as a percent of GDP). A negative relationship exists between tax revenue as a percentage of GDP and inflation (CPI), income distribution (GINI coefficient), the ease of tax collection (agricultural sector value-added as a percentage of GDP), and corruption.

This table presents the main literature on tax efforts. In the tax effort calculations, T stands for taxes, and Y stands for GDP. IT is total income tax revenue. GDI stands for gross domestic income. GDP stands for gross domestic product. Openness economy is calculated as the sum of exports and imports divided by tGDP. Corruption is an index measured by the World Bank (ranging from 0 = worst, to 100 = best). Voice and accountability is an index that is measured by the World Bank, which considers perception of democracy, freedom of expression, association, and media (ranging from 0 = worst, to 100 = best)



Table 8 Main drivers of tax effort

Main driver	Authors	Results on tax effort (+/-; n.s; n.a)	Main findings
Economic determinants			
GDP	Frank (1959)	+	More developed countries have higher tax revenues, mainly due to large expenditures on social functions.
	Balh (1971)	+	
GDP per capita	Rivero (2001)	n.a	More developed countries tend to have a higher tax effort.
	Frank (1959)	+	Nevertheless, more developed countries also have more tax capacity than less developed ones, which can reduce the effect on tax effort.
	Bird (1964)	+	
	Gupta (2007)	+	
	Bird et al. (2008)	-	
	Fenochietto and Pessino (2013)	+	
GDI	Bird (1964)	+	
	Lotz and Morss (1967)	+	
GDI per capita	Berry and Fording (1997)	n.a	
	Lotz and Morss (1967)	+	
	Chelliah et al. (1975)	+	
	Berry and Fording (1997)	n.a	
	Piancastelli (2001)	+	
Personal income (total and per capita)	Tanzi (1968)	n.a	
Fiscal determinants			
Per capita tax	Frank (1959)	+	A higher level of tax revenues naturally leads to an increase in tax effort, although tax capacity can mitigate tax effect.
	Frank (1959)	+	
Tax % GDP	Rivero (2001)	n.a	
	Frank (1959)	+	
Tax revenues	Bird (1964)	+	
	Tanzi (1968)	n.a	



Table 8 (continued)

Main driver	Authors	Results on tax effort (+/-; n.s; n.a)	Main findings
Other determinants (open economy, structural and political)			
Openness economy	Lotz and Morss (1967)	-	A more-open economy (i.e., more exports and imports as a % of GDP) tends to have less tax effort.
	Balh (1971)	-	However, some studies show the opposite effect, mainly due to taxes on imports.
	Chelliah et al. (1975)	-	
	Piancastelli (2001)	+	
	Mertens (2003)	-	
	Gupta (2007)	+	
	Bird et al. (2008)	-	
	Fenochietto and Pessino (2013)	+	
Agriculture as % GDP	Balh (1971)	+	Studies are consensual that countries with a higher share of agriculture in GDP tend to have more tax effort.
	Chelliah et al. (1975)	+	This is mainly the effect of agriculture activities—particularly in less developed countries—which tend to be more difficult to tax, leading to more tax effort in the other sectors.
	Piancastelli (2001)	+	
	Mertens (2003)	+	
	Gupta (2007)	+	
	Bird et al. (2008)	+	
	Fenochietto and Pessino (2013)	+	
Institutional environment	Gupta (2007)	-	A better institutional environment—with low corruption and a better rule of law—tends to reduce tax evasion, which leads to less tax effort.
	Bird et al. (2008)	-	
	Fenochietto and Pessino (2013)	-	

This table presents the main drivers of tax effort in the literature. In the results on tax effort, the “+” signal indicates that the variable increases the tax effort, the “-” signal shows that the variable reduces the tax effort, “n.s” means that the variable is not significant, and “n.a” indicates that the variable was used to calculate the tax effort, but no specific result regarding the variable was obtained



Table 9 Factor loadings and uniqueness

Variables	Factors			Uniqueness
	Proximity	Strength	Accountability	
Longer length of time of party in office	0.84			0.28
Higher number of years available for the chief executive in office	0.84			0.29
Years left in the current term	0.02			0.48
Margin of majority		0.88		0.21
Executive control of all houses		0.86		0.25
Government voting share		0.32		0.89
Government number of seats		0.71		0.49
Voice and accountability			0.95	0.08
Regulatory quality			0.97	0.07
Government effectiveness			0.96	0.09
Control of corruption			0.87	0.24
% explained	0.60	0.53	0.88	

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