Performance of tax simplification around the world: A panel frontier analysis

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Abstract

A complex tax system may affect the ease of doing business in a specific country through rising fixed cost and the opportunity cost of taxpayers' time, thus constituting a barrier to foreign direct investment and entrepreneurship. This study observes the tax competitiveness in its tax complexity dimension, by covering 88 countries over timespan 2005–2016 and proposing the panel data nonparametric frontier method [1,2] for the model without explicit output (hereafter, panel data DEA-WEO). A thorough view on tax simplification performance was conducted by measuring the efficiency (both contemporaneous and long-run analysis), which allows producing a ranking, and examining the productivity change of these tax systems. Findings show the uptrend of tax systems' relative efficiency through years, from 31.2% (2005) to 52.6% (2016), along with an increasing convergence of the tax simplification trend. Switzerland was found to be the most efficient country, considering long-run performance; however, Norway appeared to have the most feasible practice and model in the segment. It was also found that the average productivity progress of tax simplification for both periods, 2006–2011 and 2011–2016, was 27.7% and 19.6%, respectively. The robustness analysis finds the positive impact of some macro environment-related factors on tax simplification performance, consolidating and validating the tax competitiveness insight of these tax systems.

1. Background

Governments throughout the world are confronted by the vast global competition affecting new business creation and investment attraction, which is used as the main driver for tax revenue collection to finance operations, particularly under high government budget deficits. Entrepreneurs and investors feel unsatisfied and discouraged from participating in the formal economy; and they may even forego chasing opportunity altogether when encountering highly complex tax systems. Therefore, tax complexity has increasingly drawn the concern of academia and policymakers and has gradually become the core part of tax system reform all over the world. A complex tax system increases the costs of administration and requires compliance with many tax obligations [3]. Tax complexity may affect the ease of doing business in a particular country, through rising fixed cost and the opportunity cost of taxpayers' time. As such, this constitutes a barrier to foreign direct investment and entrepreneurship (see, for example [[4], [5], [6], [7]], among others).

Besides, in the economic downturn, namely, the 2008 Global Financial Crisis, the tax revenue could collapse considerably more than the tax base, which in turn might jeopardise the government fiscal balance [8]. Taxpayers' filing and reporting compliance seem to be impaired during the bad time as it is found to be negatively correlated with the unemployment rate (see, e.g., Ref. [9]. The extant literature shows that tax compliance risk is highly likely countercyclical [10], so that government initiatives and assistance for taxpayers in terms of tax administration are of utmost importance during the crisis [11]. For example, Brondolo argues that measures to support taxpayers, such as accelerating tax refunds, improving information systems for better communication, and reforming legal framework to facilitate administration prove to succeed in many countries.

A complex tax system may cause a tax gap as a result of the taxpayers' unintentional avoidance of taxes and tax corruption problems. Tax complexity causes compliance to suffer, and it was found the most important determinant of tax evasion [12] or non-compliance [13,14]. Contrariwise, it can be argued that a less complex tax system might increase the efficiency of tax revenue collection [15]. More importantly, a simplified, well-designed tax system can also eliminate unnecessary tax expenditure and relieve the economic agents of the burden of complex tax administration. This can help the growth of businesses and, ultimately, the growth of overall investment and employment [16], which will contribute to economic development nationally and internationally. For these reasons, tax simplification has become a worthwhile topic and a common goal amongst policymakers.

Measuring and monitoring the level of tax complexity was an important step towards tax simplification [17]; it was, however, perceived as an obstacle (Morris and Qiao, 2011). In literature, there have been diverse measures of tax complexity – a multidimensional concept meaning different things to different people –, and no universally accepted overall measures have been proposed. In this study, we follow [15,18] to measure tax simplification using the two sub-indicators of paying taxes (as an indicator of measuring the ease of doing business) i.e. time to comply (taxtime) and number of payments (taxpay).1 The premise is that "the lower the time taken to comply with the tax system and the fewer the number of payments, the easier it is for businesses to comply with their tax paying obligations" [18]. These two variables were also used in Refs. [[5], [6], [7]] to reflect tax complexity.

Focusing on business taxes, taxtime and taxpay capture all three taxes (corporate income tax, labour tax, and consumption tax). Plots 1(a) and 1(b) of Fig. 1 show the steady downtrend of tax complexity across countries over the observed period, 2005–2016. The average number of payments decreased from 37.4 per year in 2005 to 18.5 per year in 2016. Time-to-comply with these payments in 2016 is about 64% of the hours in 2005, which is equivalent to a total reduction of 150 h per year. This remarkable improvement in tax simplification can also be observed in panels 1(c) and 1(d), where data on two years, namely 2005 and 2016, is directly contrasted. Grey circles, representing pairs of total hours and payments, appear to be more compact in plot 1(d) than those in plot 1(c), indicating a convergence tendency towards the benchmarking countries (empirical frontier) over the timespan 2005–2016. This trend has been seen for a number of years, reflecting a continued focus by many governments in developing efficient systems for tax collection (Paying Taxes Report [19], p.6).

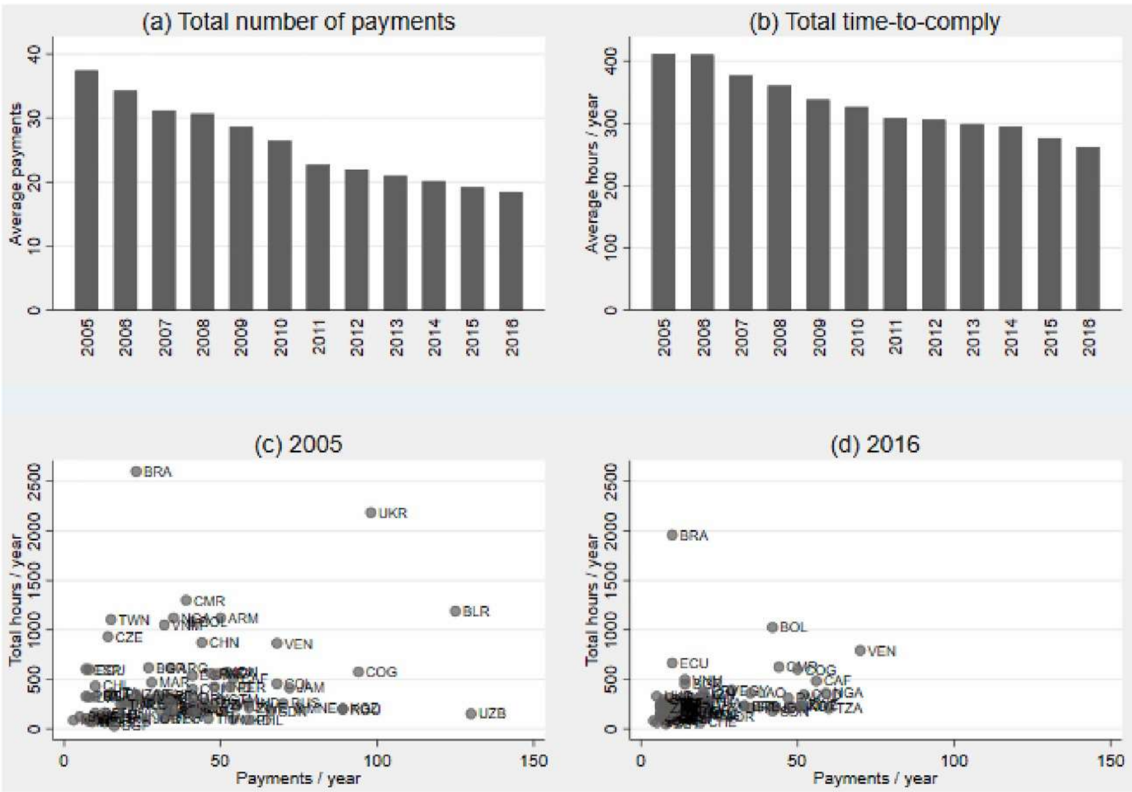


Fig. 1. Illustration of tax compliance burden. Source: Paying Taxes Reports (PwC & World Bank).

In the existing literature, a number of studies were found to cover the impacts of tax complexity on tax cost, notably Refs. [13], [14], [17], [20], [21], [22], [23], [24], [25]; among many others. Other authors discussed the relationship between complex tax systems and lower taxes, including Refs. [12], [26], [27], [28]; etc. Also, some articles controversially studied the link between tax complexity and higher taxes, for example, Refs. [29,30]. Nonetheless, empirical research on the performance evaluation of tax simplicity across countries, which is an essential component of the tax complexity framework, appears not to have received thorough attention.

Literature on performance evaluation has exhibited, in addition to other parametric methods, the popular usage of nonparametric approach for measuring the comparative efficiency. Data Envelopment Analysis (DEA) has been a common choice since its introduction by Charnes, Cooper and Rhodes [24],2 where it was used to convert inputs into outputs for a Decision–Making Unit (DMU). The traditional DEA models have been developed for the general case of multiple inputs and multiple outputs; however, in some real applications inputs or outputs are implicit and not directly considered. Recently, the greater application of a single constant input DEA model (known as model without explicit inputs, DEA-WEI) or single constant output DEA model (known as model without explicit outputs, DEA-WEO) has been utilised in the various areas of static performance evaluation, where all variables have a natural role of input or output (for examples, see Refs. [[31], [32], [33], [34]]. The DEA-WEI has been primarily used for measuring the outcomes of units using index indicators in performance evaluation of business, human development, health service, etc. On the other hand, the DEA-WEO has drawn the concern and has been used for resource usage measuring. This approach is similar to what has been known in part of literature as "Benefit-of-the-Doubt (BoD) model", which has defined the assessment seeking to only aggregate outputs for constructing the composite indicators [[35], [36], [37], [38], [39], [40]]; and [41]; among others).

Although, this literature on DEA-WEO has been rather scarce, the economic significance of this model application seems apparent and has begun to catch the interest of academia and policymakers (see Refs. [42,43]; for an assessment of the performance of 139 different alternatives for long-term asset financing at Czechia financial institutions). In the case of tax systems, procedures largely determine the resources that taxpayers (economic agents) use to maintain tax compliance. This is the tax cost imposed on taxpayers when starting or doing business, which is certain and unavoidable, but optimisable (or minimisable, in this case). Therefore, it is undeniable that the more these resources are saved, the more the social deadweight loss is decreased.

In this study, we examine the tax system procedures of 88 countries from various income groups, over 12 years (2005–2016), using the nonparametric frontier approach. In order to observe the tax competitiveness of the countries, in the tax simplification dimension, we have utilised the data envelopment analysis (DEA) model without explicit output (DEA-WEO) to analyse the tax administrative burden (taxpay and taxtime) for minimising the compliance costs. Besides the contemporaneous efficiency measurement, we derived the panel data DEA model (first proposed by Ref. [1]; and then extended by Ref. [2], conditional on WEO context for the long-run performance analysis. The rankings were applied using a state-of-the-art algorithm by Ref. [42]; and the measure of productivity change with Malmquist index was adapted from Ref. [34] and used to complement the performance evaluation. Moreover, the robustness analysis was conducted to explore some potential determinants of tax competitiveness. As a result, we have identified the top-ranked peers to set the benchmarks, the potentials for tax systems to improve, and the implications for policymakers to base our analysis on.

Our findings suggest that the tax systems' relative efficiency has been generally increased throughout the years, from 31.3% (2005) to 52.6% (2016), with an increasing integration of the tax simplification trend. The number of efficient units occupies around 4.5%–10.2% of the studied sample. The time-invariant long-run performance indicates the difference among groups. The average score reached 28.7% for the full sample. Switzerland was found to be the only efficient system. Furthermore, the year-on-year evolution of time-variant performance, over the timespan 2005–2016, signifies the uptrend in tax system simplification in each group of countries. It also highlights the general conclusion that Norway had the most feasible practice and model (appearing 600 times in reference sets), followed by Ireland (433 times), Singapore (388 times), and Switzerland (273 times). Moreover, the results of the rankings demonstrate that, on the one hand, the top ranks belong to the expected, classified countries, such as Switzerland, Singapore, New Zealand, Norway and Estonia. This reflects the mature tax systems, simplified effective administrative burden and the effective employment of electronic platform between the tax authorities and taxpayers in these advanced economies. Contrarily, Brazil is acknowledged as a typical case of tax complexity. It achieved the bottom rank over the 12 years, which was caused by burdensome compliance procedures. Another aspect that should be of concern is the productivity change measure of tax simplification. The averages of 27.7% and 19.6% signify the productivity progress for the 2006–2011 and 2011–2016 periods, respectively. Despite the existing inefficient performances during these years, China and the Ukraine had recorded achievements in tax procedure simplification, leading to the highest productivity progress of 327.4% and 318.5% respectively. In addition, the positive impact of some macro environment-relevant variables on tax simplification measure helps validating the general situation of tax competitiveness across countries. Correspondingly, in an average country, the increase in institutional quality, and development of information technology is found to facilitate the performance of tax procedure simplification, resulting in the rise of tax competitiveness.

This study contributes to the research field in certain aspects. Methodologically, the paper extends the standard panel data DEA estimator [1,2] to apply to the model without explicit output condition. Empirically, it is the first application of panel data DEA-WEO proposal for long-run panel estimation in addition to contemporaneous analysis with cross-sectional data DEA-WEO model, to provide practical contribution results from the measuring of tax system performance. Indeed, this is a performance evaluation of tax simplification in 88 countries, over 12 years (2005–2016), addressing the implied social costs (the tax compliance costs) paid by taxpayers in order to comply with taxes. The study provides a thorough view of the tax system competitiveness of different countries, by way of evaluating efficiency and ranking, measuring the productivity changes, and examining the relevant determinants of these tax systems' competitiveness. This is, to the best of our knowledge, the first empirical application of tax performance measure with panel data frontier method conditional on the implicit output. This accounts for the synthetic assessment and analysis obtained from the combination of the different tax administrative indicators (tax payments and time to comply with taxes). Subsequently, we sought to identify the most feasible reference peers, which the other tax systems may imitate or emulate to become more efficient. Additionally, the assessment of tax simplification efforts, reflecting the level of recovery and innovation, along with the relationship between some relevant macro environment factors and tax competitiveness might assist policymakers with creating effective tax design.

The remainder of the paper is organised as follows. Section 2 deals with the conceptual framework and Section 3 discusses the methodology and estimators used for measure and computation. Section 4 is about sample, data collection, and variable selection. The results relating to performance measure for both contemporaneous and long-run analysis are presented in Section 5. Section 6 provides the country rankings, which is followed by productivity change measure in Section 7. The robustness analysis to validate the performance measure appears in Section 8. The paper finally concludes with a summary of the main findings, policy implications, and suggestions for further research.

2. Conceptual framework

The model of optimal tax administration, which was proposed by Keen and Slemrod [44], KS model, and further explained by Creedy [45], can be simplified in the plot Fig. 2 as below.Where s denotes public non-enforcement spending, and t is the tax rate which is chosen by the government for a given value of enforcement level α. The tangent point F illustrates the government optimal combination of (t,α) so that the social welfare is maximised.

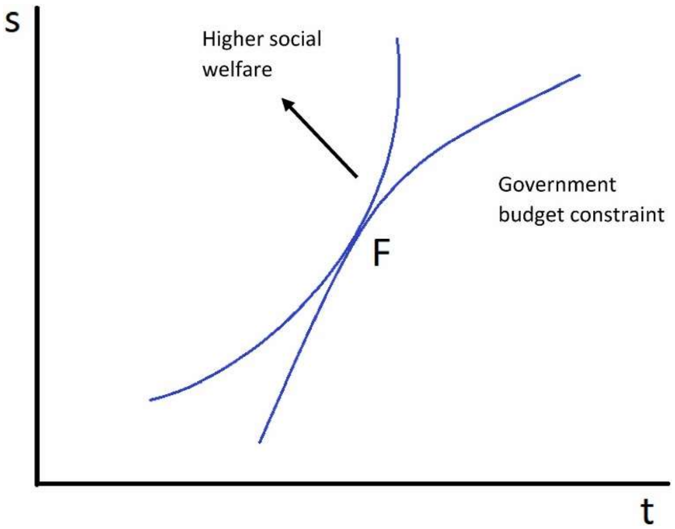


Fig. 2. Government optimal choice.

KS model considers two cases: (i) choose the optimal t given a fixed α; or (ii) set t fixed then choose the optimal α. The first case implies, for a predetermined enforcement level α, the government raises tax rate until the proportional tax revenue increases. Meanwhile, in the second case, KS derived the government choice of optimal enforcement level α as follows:

$$\varnothing = \alpha\left(\frac{\frac{c_{\alpha}}{v'} + a_{\alpha}}{tz}\right) \qquad (1)$$

It is the adjusted marginal cost-revenue ratio, in the sense that the numerator is a linear approximation to the sum of compliance and administration costs, in which $\varnothing = E(z, \alpha) = \frac{\alpha}{z}\frac{\partial z}{\partial \alpha}$ is referred to as the enforcement elasticity of tax revenue, α is tax enforcement parameter, the term $\frac{c_{\alpha}}{v'}$ represents the marginal cost of evasion (also referred to the "marginal compliance cost"), c_α is the marginal private cost, and the term a_α is the marginal administration cost.

The first-order "enforcement" condition in equation (1) has a straightforward interpretation in recognisable terms (Creedy [45], p.12). By rearranging equation (1) into a simple equi-marginal condition, the more intuitive model read:

$$v'\left(\frac{t\delta z}{\delta \alpha}\right) = c_{\alpha} + v' a_{\alpha} \qquad (2)$$

in which the left-hand side measures the marginal revenue valued in terms of the benefit from the resulting expenditure, and the right-hand side measures the marginal cost of raising that revenue. Therefore, it can be said that for a given tax rate, the marginal benefits and costs of raising α must be equal at the optimum. The revenue component, $\left(\frac{t\delta z}{\delta \alpha}\right)$, and the marginal valuation, v', are likely to fall as α increases, while the marginal costs are likely to increase. Therefore, α increases until the two sides of equation (2) are equal, and it acquires the increase in enforcement if marginal revenue is greater than marginal costs.

A direct implication from the abovementioned discussion is, on the one side, that the enforcement cost seems far from the optimum so that the government seeks to reduce the gap between actual costs, namely, official salary and operational expenditures, and the empirical benchmark. This is an exercise of efficiency measurement (see, for example, [46,47]. On the other side, individual economic agents in the KS model incur some costs to comply with the tax enforcement [48]. In this sense, we can consider reducing the tax complexity giving rise to a gain in social welfare, through decreasing social deadweight loss [[49], [50], [51]].

From this observation, tax agency would minimise input usage conditional on a unit social welfare or maximise social gains given its current level of complexity. It is worth emphasizing that social welfare is a conceptual (virtual) measurement, which can be normalised by an arbitrary constant; whereas, tax complexity is proxied by several dimensions such as time to comply (taxtime) and number of tax payments (taxpay) [6,7,15,18]. Therefore, benchmarking tax administration performance across countries and over time can be achieved from utilising the conventional frontier techniques.

3. Methodology

In this section, we first present the nonparametric frontier methods to measure the performance of tax systems in the presence of a constant input or output. Next, we expand the model to account for panel data. Finally, the ranking and productively change measure methods are discussed.

Every specific decision-making unit (DMU)—tax agency—chooses a production plan, say, a combination of inputs and outputs to convert inputs into outputs. The background of the DEA literature is production theory, and DMUs have a common underlying technology (T), which is:

$$T = \left\{ (x, y) \in R_+^m \times R_+^n \,\middle|\, xcanproducey \right\}$$

Where DMU k uses m inputs to produce n outputs $x^k = (x_1^k, \ldots, x_m^k) \in R_+^m$

and $y^k = (y_1^k, \ldots, y_n^k) \in R_+^n$

DEA combines an estimation of the technology with the measurement of performance related to this technology. This is a mathematical programming approach that was introduced by Ref. [52] (CCR), to estimate the best practice production frontiers and evaluate the relative efficiency of different units.

The relative efficiency is defined as the ratio of total weighted output to total weighted input. By comparing n units with single output3 denoted by x_{ij} $(i \in [1 \ldots m])$,

and m inputs denoted by (), the CCR or constant returns-to-scale (CRS) efficiency measure for DMU j can be expressed in the primal program as

$$\min\theta_o^* = \sum_{i=1}^{m} v_i x_{io}$$
s.t.
$$u y_o = 1$$
$$u y_j - \sum_{i=1}^{m} v_i x_{ij} \leq 0 \quad j = 1, \ldots n$$
$$u \geq 0$$
$$v_i \geq 0 \quad i = 1 \ldots m. \qquad (3)$$

where v_i and u are weights for ith input and single output, respectively. We solve the program (3) n times to obtain a set of θ_o^*—efficiency score of the observed decision-making unit. The unit is called CCR efficient if $\theta_o = \theta_o^{*-1} = 1$, otherwise $0 < \theta_o < 1$.4

In practice, the case of evaluating performance using (3) without a single explicit output or input is found in many applications (for example, see Refs. [32,33,[53], [54], [55], [56]]; etc.). If the DMU does not have an explicit output, then [31] showed that no model is found without input or output, but with constant input or output. Thus, any implicit output or input can be replaced with a constant, so that their CRS efficiency scores are also [57] (or BCC) variable returns-to-scale (VRS) efficiency measures. Returns-to-scale is, thus, irrelevant in any model with single constant output or input. Model (3) is rewritten for $y_j = 1 \ \forall j$, which is in the DEA-WEO form where there are only inputs and a single constant output, as

$$\min\theta_o^* = \sum_{i=1}^{m} v_i x_{io}$$
s.t.
$$\sum_{i=1}^{m} v_i x_{ij} \geq 1 \quad j = 1, \ldots n$$
$$v_i \geq 0 \quad i = 1 \ldots m. \qquad (3a)$$

Besides the cross-sectional computations for short-run performance, we considered the long-run performance of tax administration agencies by using longitudinal data to capture performance over the period of 2005–2016. We adapt the new proposal of panel data DEA, first suggested by Ref. [1] and extended by Ref. [2]; to apply the single constant output time-invariant panel data DEA model as below:

$$\min_{u^{ti},v_i^{ti}} \theta_o^{*ti,crs} = \sum_{i=1}^{m} v_i^{ti} \overline{x}_i^o$$

s.t.

$$u^{ti}\overline{y}_o = 1$$

$$u^{ti} y_j - \sum_{i=1}^{m} v_i^{ti} x_{ij}^{\tau} \leq 0 \quad j = 1 \ldots n;\ \tau = 1 \ldots t$$

$$u^{ti} \geq 0;\ v_i^{ti} \geq 0; \quad i = 1, \ldots, m. \tag{4}$$

where the superscript t_i merely refers to time-invariant panel measure. Practically, one sets the constant output $y_j=1$ for all DMUs so that $u^{ti} = 1$. Subscripts i and j have a usual meaning as in (3), while is the time variable that runs from period 1 to t. Overbar $\overline{x}_i^o$ represents the average x_i value of input of the observed DMU over the time, and v_i^{ti} $(i \in [1 \ldots n])$ are common weights. The input-oriented efficiency score is merely $\theta_o^{ti,crs} = (\theta^{*ti,crs})^{-1}$.

We note that, as shown in Ref. [2]; if a DMU is long-run efficient, it is also efficient in each and every year over the assessment period, but not vice versa.

Analogously to the definition of time-variant panel DEA efficiency in Ref. [2]; we decompose the time-invariant panel score of model (5) as follows.

$$\theta_j^{*ti,crs} = w_1 \theta_{j,\tau=1}^{*tv,crs} + w_2 \theta_{j,\tau=2}^{*tv,crs} + \ldots + w_T \theta_{j,\tau=t}^{*tv,crs} \tag{5}$$

where the superscript tv denotes the time-variant panel score, and $w_{\tau \in [1..t]}$ is the weight set that takes the constant value of 1/t since in the DEA-WEO model, output is a single constant. $\theta_j^{*tv,crs}$, time-variant panel score of DMU j, is computed as in Ref. [2] using the estimated common set of input weights (v_i^{ti}) for the complete time span in formula (5).

To complement the efficiency assessment, this paper employed two alternative estimation techniques to provide insights on the estimated efficiency scores of tax systems in the sample. First, we ranked the tax system performance to discriminate between the efficient units based on their efficiency scores using the two-step mixed integer linear program described in Ref. [42].5

Second, we measured the productivity change of TA agencies in these countries, i.e. we adapted Karagiannis and Lovell's [58] formulas to compute the individual and aggregate Malmquist indices.6 This is the technology-based productivity index, which is expressed in terms of distance functions defined on the benchmark technology. Applying the input-orientation in the DEA-WEO context, the Malmquist index can be decomposed into a product of technical efficiency change effect (ΔTE) and technical change effect (ΔT) as below.

$$Malmquist\ index\ (MI) = (Catch-up) \times (Frontier-shift) = \Delta TE \times \Delta T = \frac{D_i^{t+1}(x^{t+1},1)}{D_i^t(x^t,1)} \left[\frac{D_i^t(x^t,1)}{D_i^{t+1}(x^t,1)} \times \frac{D_i^t(x^{t+1},1)}{D_i^{t+1}(x^{t+1},1)} \right]^{\frac{1}{2}}$$

(7)

The aggregate productivity index is calculated by aggregating the individual productivity indices, adapting [34] formulas and [59] definition of the aggregate output-oriented Malmquist productivity index to the single constant input model to form the aggregate input-oriented Malmquist productivity index () with single constant output as a geometric average of the individual contemporaneous and mixed-period input distance functions.

$$M_I^A = \left[\frac{\sum_k D_{I,k}^t \left(x_k^{t+1}, 1\right)}{\sum_k D_{I,k}^t \left(x_k^t, 1\right)} \frac{\sum_k D_{I,k}^{t+1} \left(x_k^{t+1}, 1\right)}{\sum_k D_{I,k}^{t+1} \left(x_k^t, 1\right)} \right]^{1/2} \quad (8)$$

4. Sample and data collection

Tax simplification, following [18]; was measured by the two sub-indicators of paying taxes (as an indicator of measuring the ease of doing business) i.e., time to comply (taxtime) and number of payments (taxpay). The taxtime indicator refers to the time needed to comply with taxes i.e., the time to prepare, file and pay taxes. The taxpay indicator measures the total number of tax payments by businesses, including electronic filing. We extracted data on tax complexity from Paying Taxes – PricewaterhouseCoopers (PwC) ‘s reports7 (part of the World Bank's Doing Business project) for obtaining the components of tax costs, i.e., time-to-comply with the three individual taxes, which are used as inputs for the performance evaluation in the paper. This is the annual data for every year from 2007 to 2018, which corresponds to data for the calendar years 2005–2016. In spite of some criticism on the choice of paying taxes indicators for measuring the tax complexity [60] regarding the robustness of measure, methodology and data presentation, they are considered the only available set of data points providing the objective, worldwide comparison of indicators on the tax simplicity of tax regimes, as mentioned in Ref. [18].

Based on the dataset of Paying Taxes (PwC's reports), the countries are selected conditional to the availability of data and data quality throughout the period of 12 years (2005–2016) to guarantee a balanced panel data. Otherwise, countries are excluded. Finally, we obtain the data set of 88 countries, including 35 OECD countries and 53 other countries, covering all continents and regions and representing the whole world.

Regarding variable selection, in order to measure the performance of tax procedures, we apply the DEA-WEO model with four inputs, namely, total number of tax payments (taxpay) and time to comply (taxtime) for three types of tax (corporate income, labour, and consumption) and a constant virtual output of one. The input variables reflect not only the taxpayers' resources devoted to tax compliance but also the tax system's effort towards procedure simplification to obtain effective tax enforcement.

Table 1, Table 2 show the data description and statistics summary of the variables used in the model.

Table 1
Data description of variables.

Variable	Definition	Source
Taxpay	Number of Tax payments by businesses: the total number of taxes per year paid by businesses, including electronic filing. In other words, it is the frequency with which the company has to file and pay different types of taxes and contributions, adjusted for the manner in which those filings and payments are made per year.	Paying Taxes, PwC & World Bank
Taxtime_corp	Time (hour) to comply with corporate income tax i.e. the total time (hours) per year required to prepare, file and pay corporate income tax.	
Taxtime_lab	Time (hour) to comply with labour tax i.e. the total time (hours) per year required to prepare, file and pay labour tax.	
Taxtime_cons	Time (hour) to comply with consumption tax i.e. the total time (hours) per year required to prepare, file and pay consumption tax.	

Table 2
Summary statistics of variables used in the model.

	Tax_pay					Tax_time_corp				
	Mean	p50	SD	Min	Max	Mean	p50	SD	Min	Max
2005	37.4	33.5	25.9	3	130	102.0	49.0	151.5	5	960
2006	34.3	29.5	26.0	2	124	106.8	48.5	150.0	5	960
2007	31.2	23	25.5	2	113	98.6	49.5	142.0	5	960
2008	30.7	22	27.7	2	147	95.5	48.5	126.3	5	736
2009	28.6	20	24.6	2	135	86.3	48.5	104.3	5	736
2010	26.4	17	23.4	4	135	83.5	49.5	99.6	5	736
2011	22.7	15	17.3	4	71	79.8	53.5	93.0	10	736
2012	22.0	12.5	17.2	4	71	79.6	53.5	92.9	10	736
2013	21.0	11	17.0	4	71	77.8	51.5	91.8	10	736
2014	20.1	11	16.4	4	70	76.8	51.5	91.1	10	736
2015	19.2	11	16.1	4	70	70.6	51.5	70.7	10	486
2016	18.5	11	16.0	4	70	64.6	46.0	60.8	5	462
	Tax_time_lab					Tax_time_cons				
	Mean	p50	SD	Min	Max	Mean	p50	SD	Min	Max
2005	159.3	96.0	149.8	10	800	150.2	96.0	197.3	8	1374
2006	156.4	98.5	146.6	10	732	147.3	94.0	192.7	8	1374
2007	143.6	96.0	129.4	10	700	134.9	90.0	170.4	8	1374
2008	136.1	96.0	124.7	10	700	129.0	86.0	167.7	8	1374
2009	125.6	96.0	103.3	10	490	126.4	84.5	164.3	8	1374
2010	121.1	86.5	102.9	10	490	121.9	79.5	163.2	8	1374
2011	113.6	86.0	95.7	10	507	115.1	76.0	160.8	8	1374
2012	112.4	86.0	95.3	10	507	113.9	73.0	161.0	8	1374
2013	108.8	80.0	94.9	10	507	112.1	69.5	161.7	8	1374
2014	106.5	80.0	92.8	12	507	111.6	69.0	161.5	8	1374
2015	100.0	80.0	83.9	13	507	105.4	69.5	138.1	8	1189
2016	95.0	77.0	77.6	10	507	102.5	67.5	135.7	8	1161

Table 3
Summary statistics of contemporaneous efficiency scores for 12 years.

Statistics	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mean	0.400	0.413	0.457	0.476	0.488	0.512	0.535	0.543	0.566	0.580	0.563	0.522
Std. dev	0.260	0.253	0.249	0.257	0.252	0.248	0.244	0.243	0.244	0.244	0.238	0.216
Min	0.046	0.050	0.091	0.098	0.109	0.104	0.115	0.115	0.115	0.121	0.120	0.095
Median	0.313	0.344	0.409	0.411	0.423	0.482	0.500	0.510	0.519	0.543	0.542	0.526
IQR	0.322	0.328	0.300	0.326	0.336	0.364	0.355	0.332	0.341	0.356	0.362	0.326
Max	1	1	1	1	1	1	1	1	1	1	1	1

Note: IQR is interquartile range.

5. Performance measure

In this section, we measure the performance of tax procedure simplification using a DEA-WEO model, based on the contemporaneous analysis with annual data and the long-run analysis with longitudinal data.

5.1. Contemporaneous analysis

We utilise the DEA-WEO model with data from the 12 years between 2005 and 2016. As mentioned earlier in the Data section, the model uses four inputs, i.e., number of payments and time to comply with three types of tax (corporate income, labour, and consumption), and a constant virtual output of one. Table 3 reports the summary statistics of the efficiency scores of these tax agencies during these years.[8]

As observed in Table 3, the average performance of tax systems has improved throughout the years, demonstrating an increase from a median of 31.3% in 2005 to above 52% in the last three years 2014–2016, with a fluctuation within the range of 52%–56%. This was also accompanied by a gradual reduction in standard deviation throughout the years, signalling an increasingly narrowed dispersion of the efficiency in tax simplification process among countries in the sample. It could be argued that the estimated distance from the frontiers throughout the years (for example, 68.7% for 2005 or 48% for 2016) has revealed many opportunities for these countries to improve the simplification of tax procedures. The countries that make the list of relative efficiency will be introduced later, in Table 5.

Table 4
Time-invariant long-run DEA efficiency scores.

Statistics	Mean	Std. dev	Median	Min	Max
Full Sample	0.353	0.207	0.287	0.088	1
OECD	0.500	0.200	0.464	0.210	1
Non-OECD	0.256	0.145	0.228	0.088	0.960
High income	0.496	0.218	0.460	0.176	1
Upper Middle Income	0.288	0.122	0.270	0.092	0.674
Lower Middle & Low Income	0.197	0.072	0.201	0.088	0.325

Table 5
The efficient DMUs with times appearing in reference sets through years.

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Panel	Total
Estonia					29			29	35	14		61		168
Finland				16	6	27	28	9	9	32	23			150
France					9	14	20	5						48
Ireland	48	64	40	39	39	38	36	29	31	32	37			433
Jordan	15	6	4	4	5	5	2	2	1	1	1			46
New Zealand	30		45	41										116
Norway	46	51	51	54	47	45	49	49	60	63	40	45		600
Singapore	45	49	23	22	27	30	29	23	19	15	54	52		388
Sweden	4	14	20	20	15	18	20	24						135
Switzerland	11	21	23	24	33	32	30	28	25	25	20	1	x	273
United Kingdom	7													7
Total	206	205	206	220	210	209	214	198	180	182	175	159		2364

Fig. 3(a) graphically depicts the trend of efficiency scores of tax systems throughout the 12 years. Fig. 3(b) shows the distribution of efficiency scores for some typical years (i.e., 2005, 2009, 2013, and 2016). It seems reasonable to confirm that movement of efficiency shifts from the left to the right side throughout the years, representing the growing efficiency and convergence tendency of the benchmarking countries.

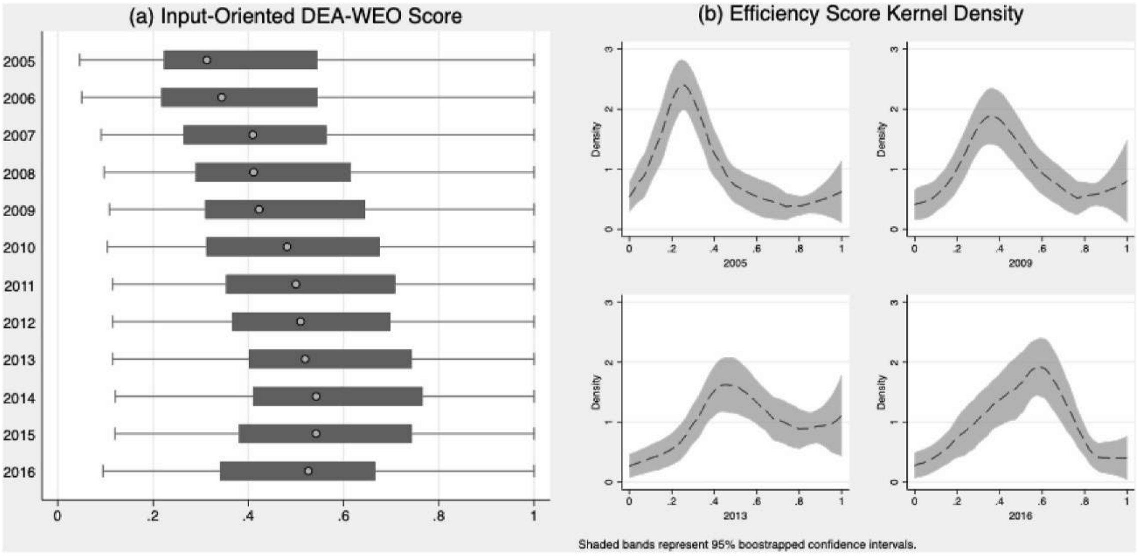


Fig. 3. Contemporaneous efficiency scores of tax systems through 12 years.

5.2. Long-run panel data DEA analysis

In order to observe the long-run performance of the tax systems for the entire period (2005–2016), we apply the panel data DEA model for WEO conditions (or panel data DEA-WEO).

Table 4 shows the summary statistics of the time-invariant long-run performance, classified by the different groups: (i) full sample, (ii) OECD and non-OECD, and (iii) high income, upper middle income, low income and lower middle income.[9]

As observed in Table 4, the tax systems in the sample show, on the average, an inefficiency in tax administrative burden performance, with a median of 28.7% efficiency. The minimum relative efficiency is quite low (8.8%) and this belongs to the Ukraine.10 Remarkably, the only relatively long-run efficient country is Switzerland, asserting a stable performance over the 12 years. We did also consider two other countries, Norway (96.2%) and Singapore (96%), to be efficient over the period. These countries are followed by Ireland (80.9%). These tax systems appear the most frequently in the reference sets and should be regarded as the most feasible benchmarking units to be learnt from by other peers in the segments.11 Besides, there is sharp difference between OECD and non-OECD groups, illustrated by the respective medians of 46.4% and 22.8%. In terms of income groups, the high-income group's superiority (46%) was noticeably clear when compared with upper-middle income group (27%) and lower-middle- and low-income group (20.1%). Obviously, the non-OECD and middle and low-income groups will require many improvements in tax simplification to reach the levels of the OECD and high-income groups, which are still far from the potential frontiers.

In terms of time-variant long-run efficiency estimation, the study revealed the year-on-year evolution of the time-invariant performance during the period. Fig. 3 depicts the evolution of median values of time-variant panel data efficiency throughout the 12-year period.12 While Fig. 4(a) characterises the full sample, Fig. 4(b) demonstrates the difference between OECD and non-

OECD groups and Fig. 4(c) illustrates performance according to income level. The figures suggest an uptrend for the average performance of tax systems throughout the years, with a rise from the median of 21.5% in 2005 to a median of 28.7% in 2016. In addition, the standard deviation decreasing from 22.9% (2005) to 20.7% (2016) demonstrates the convergence tendency of tax simplification efficiency. The uptrend of tax simplification efficiency appears in all groups, regardless of the existing gaps in their performances. OECD countries experience the 7% increase in reduction of tax costs (from 39.9% in 2005 to 46.4% in 2016) compared to the non-OECD group's rise of 4% (from 18.9% in 2005 to 22.8% in 2016). Meanwhile, the improvements are obtained at 6.4%, 7.5%, and 2.3% for high-income, upper-middle, and lower middle- and low-income groups, respectively. These findings confirm the need for greater efforts in tax procedure simplification in non-OECD and middle and low-income countries in order to achieve better performance.

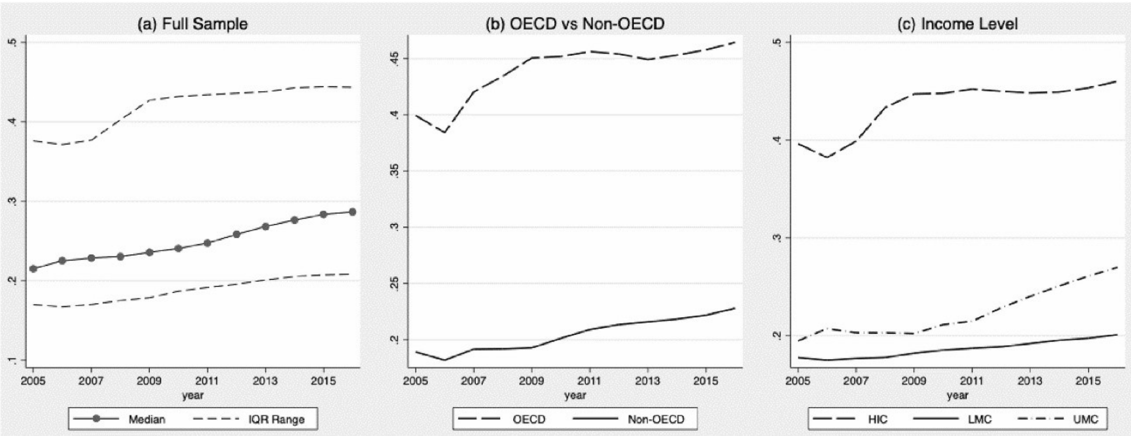


Fig. 4. Evolution of time-variant panel data efficiency over years.

We conducted nonparametric tests to consolidate the significant difference in efficiency and its distribution across the years. The results from the tests suggest a significant inequality in kernel density and difference in rank between 2005 or the panel and the other individual years in terms of density (see Table A2. Nonparametric tests in the Appendix).

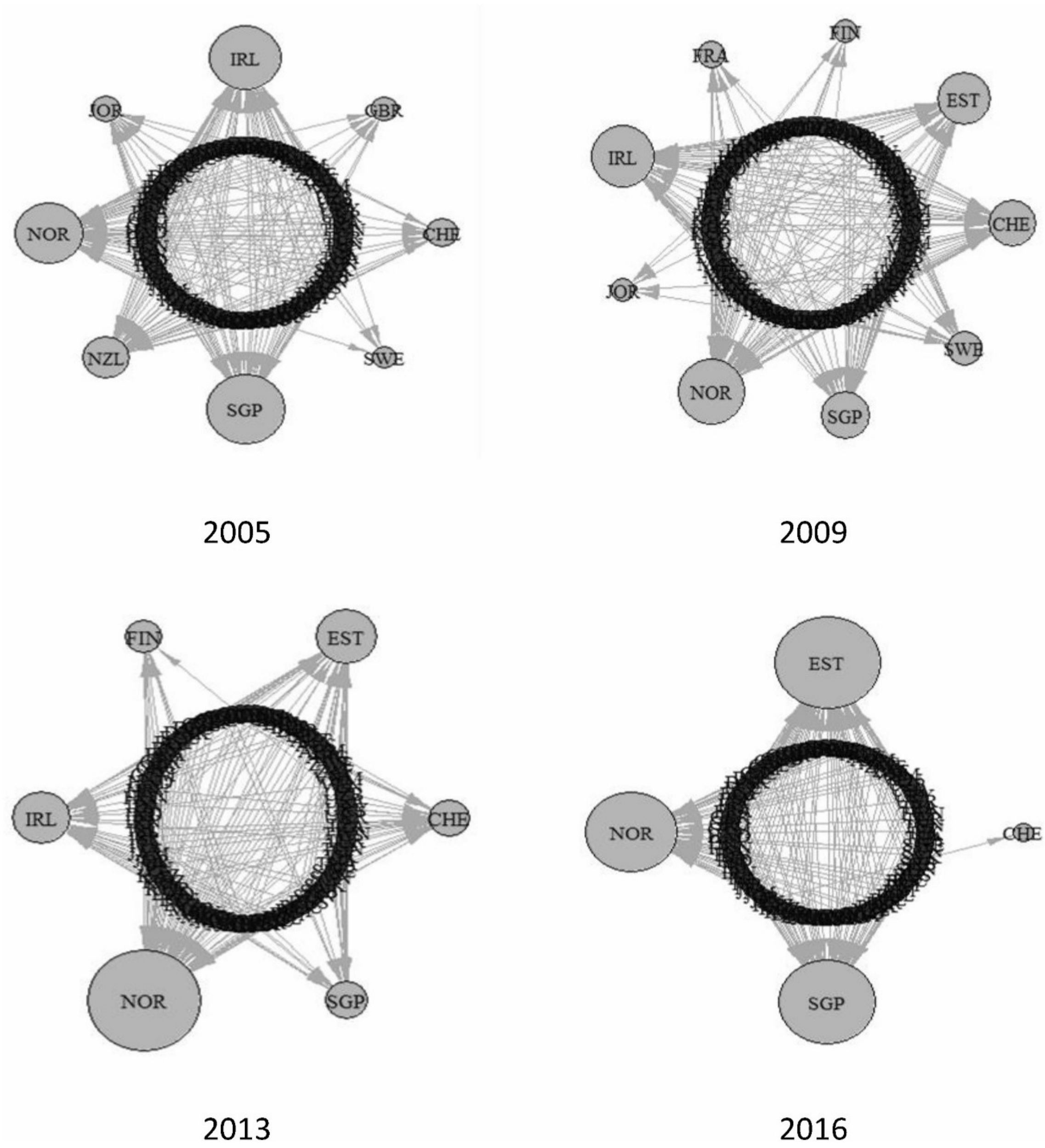
5.3. Benchmarking performance

Table 5 summarises the efficient tax systems, taking short-run and long-run perspectives and discussing number of appearances in the reference sets, corresponding to the individual year and efficient country. As discussed earlier, of the 88 studied tax systems, Switzerland is the only efficient unit, when considering the time-invariant panel data estimation. Two other countries, Norway and Singapore, were found to be inefficient, despite being found to be efficient in all 12 years from 2005 to 2016.

In the extreme of benchmark performance, we identified 11 countries to form the efficiency list, including Estonia, Finland, France, Ireland, Jordan, New Zealand, Norway, Singapore, Sweden, Switzerland, and the United Kingdom. The number of efficient units for the 12 years vary from four to nine, occupying approximately 4.5%–10.2% of the studied sample.

Another finding that should be of concern are the good practices and models. Ireland ranks first in the years 2005 and 2006, appearing 48 times and 63 times, respectively, in the reference sets. The list of top ranking for consecutive years includes Norway for 8 continuous years from 2007 to 2014 (with 51 times, 54 times, 47 times, 45 times, 49 times, 49 times, 60 times, and 63 times, respectively); and accounts for Singapore (54 times), and Estonia (61 times) for the last 2 years 2015 and 2016, respectively. Accordingly, during the whole period (2005–2016), Norway appears the most with a total of 600 times. As a result, Norway is likely to be the best practice and model for other tax systems in the segment to imitate and emulate. Norway is followed by Ireland and Singapore, with a total of 433 times and 388 times, respectively. Switzerland only appears 273 times as a reference peer, even though it was found to be efficient every year of the whole period and is the only efficient tax system when considering the long-run performance estimation.

Fig. 5 illustrates the reference sets in certain years. The outer circles represent the peer units. The bigger the circle, the more frequently this unit appears in the reference sets for the other units in the segments to imitate and emulate. The arrow connects an inefficient unit—lying on the central ring—to its peers in the reference set, so that the connection density between the outer circle and the ring represents the number of times that an efficient tax agency appears as a good practice and model. In this respect, Fig. 5 visualises the information summarised in Table 5.



6. Rank identification and discussion

The preceding analysis provides a list of efficient tax systems (efficiency scores are of 1) in Table 5, but the DEA-WEO estimator cannot distinguish efficient agencies from one another as they all have the same scores of one. Practically, it is tempting to properly identify these tax systems based on their efficiency level (performance in terms of tax system simplification) to provide guidance for policy implication and recommendation.

Using the sorting method specifically designed for DEA-WEO model [42],13 we compute the ranks of the studied countries for every year from 2005 to 2016, and present the best and worst 10 countries classified by the different groups: (i) full sample, (ii) OECD, and (iii) non-OECD corresponding to each year in Table 6. We also ran the rankings corresponding to two separate sub-groups and the results are reported in Table A4 in the Appendix. Accordingly, the results largely hold as expected.

Table 6
The 10 top and bottom ranked tax systems through years (2005–2016), full sample.

	Rank	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
THE BEST													
Full	1	SGP	SGP	NZL	NZL	CHE	CHE	CHE	CHE	CHE	CHE	SGP	EST
	2	NZL	NZL	IRL	IRL	IRL	IRL	SGP	SGP	SGP	NOR	CHE	SGP
	3	CHE	IRL	CHE	CHE	EST	SGP	IRL	IRL	NOR	EST	NOR	CHE
	4	IRL	CHE	SGP	SGP	SGP	NOR	NOR	NOR	EST	SGP	IRL	NOR
	5	NOR	NOR	NOR	NOR	NOR	EST	EST	EST	IRL	IRL	EST	IRL
	6	GBR	EST	EST	EST	GBR	FIN	FIN	FIN	FIN	FIN	FIN	FIN
	7	EST	GBR	GBR	MKD	AUS	GBR	GBR	GBR	AUS	AUS	AUS	AUS
	8	AUS	AUS	MKD	GBR	SWE	AUS	AUS	AUS	GBR	GBR	GBR	GBR
	9	JOR	SWE	AUS	AUS	JOR	SWE	SWE	SWE	MKD	MKD	MKD	LTU
	10	SWE	JOR	SWE	SWE	CAN	NLD	NLD	NLD	SWE	SWE	SWE	MKD
OECD	1	NZL	NZL	NZL	NZL	CHE	CHE	CHE	CHE	CHE	CHE	CHE	EST
	2	CHE	IRL	IRL	IRL	IRL	IRL	IRL	NOR	NOR	NOR	NOR	CHE
	3	IRL	CHE	CHE	CHE	EST	NOR	NOR	EST	EST	EST	IRL	NOR
	4	NOR	NOR	NOR	NOR	NOR	EST	EST	IRL	IRL	IRL	EST	IRL
	5	GBR	EST	EST	EST	GBR	FIN	FIN	FIN	FIN	FIN	FIN	FIN
Non-OECD	1	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP
	2	JOR	JOR	MKD	MKD	JOR	JOR	MYS	MYS	MKD	MKD	MKD	MKD
	3	MKD	MKD	JOR	JOR	TUN	MYS	MKD	MKD	MYS	MYS	TUN	MNG
	4	THA	MYS	MYS	MYS	MYS	MKD	TUN	TUN	TUN	TUN	CRI	JOR
	5	PHL	TZA	ZAF	ZAF	MKD	TUN	JOR	JOR	ROU	CRI	MNG	TUN
THE WORST													
Full	79	CZE	VEN	VEN	COG	ECU	ECU	CAF	CAF	CAF	CAF	BGR	EGY
	80	VNM	CZE	CZE	UKR	COG	COG	PAK	PAK	PAK	PAK	CAF	BGR
	81	TWN	VNM	UKR	VEN	CMR	BLR	ECU	COG	COG	COG	VNM	VNM
	82	BOL	BOL	NGA	NGA	UKR	CMR	COG	ECU	ECU	ECU	COG	CAF
	83	NGA	NGA	ARM	BLR	BLR	UKR	CMR	CMR	CMR	CMR	ECU	COG
	84	ARM	ARM	VNM	ARM	VEN	VEN	VEN	VEN	VEN	VNM	CMR	CMR
	85	BLR	BLR	BOL	VNM	NGA	VNM	VNM	VNM	VNM	VEN	VEN	ECU
	86	CMR	CMR	BLR	BOL	VNM	NGA	NGA	NGA	NGA	NGA	NGA	VEN
	87	UKR	UKR	CMR	CMR	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL
	88	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA
OECD	31	ITA	SVK	SVK	ITA	CHL	CHL	CHL	CHL	CHL	HUN	ISR	CZE
	32	CHL	JPN	JPN	JPN	POL	POL	POL	POL	POL	MEX	POL	POL
	33	MEX	POL	POL	POL	JPN	JPN	MEX	MEX	MEX	CHL	HUN	ISR
	34	ESP	MEX	MEX	MEX	MEX	MEX	JPN	JPN	JPN	JPN	MEX	HUN
	35	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CHL	CHL
Non-OECD	49	ARM	ARM	VNM	ARM	VEN	VEN	VEN	VEN	VEN	VNM	CMR	CMR
	50	BLR	BLR	BOL	VNM	NGA	NGA	VNM	VNM	VNM	VEN	VEN	ECU
	51	CMR	CMR	BLR	BOL	VNM	VNM	NGA	NGA	NGA	NGA	NGA	VEN
	52	UKR	UKR	CMR	CMR	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL
	53	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA

As can be seen in general, Singapore is the top ranked tax system in 2005, 2006, and 2015. New Zealand is ranked first in 2007 and 2008. Estonia is the best country in 2016. Switzerland tops the board for the six consecutive years from 2009 to 2014. In reverse, the bottom ranked country is Brazil for all years of the period (2005–2016). The list of the worst countries also includes Bolivia, Ukraine, Cameroon, and Czechia among others.

Looking into groups, New Zealand appears the best in 4 consecutive years 2005–2008, Switzerland leads the table in 7 continuous years 2009–2015, and the top belongs to Estonia in 2016 for the OECD group. On the contrary, Czechia occupies the bottom the most frequently in 10 years, from 2005 to 2014 besides Chile in 2015–2016. As regards the non-OECD group, Singapore undeniably outperforms during the whole timespan 2005–2016, oppositely to Brazil at the bottom list as anticipated.

Switzerland's efficiency derives from tax simplification. While the tax procedures (i.e. tax payments) during the period are not far from the average number of the sample,14 the compliance time quite clearly demonstrates the great effort expended towards tax system improvement and reform. In general, Switzerland uses 15 h for corporate income tax, 40 h for labour tax, and 8 h for consumption tax. These numbers show a superiority over the average sample from 102 to 64 h, from 159 to 95 h, and from 150 to 102 h, corresponding to the three afore-mentioned taxes (see

Table 2 for summary statistics of the variables). This signifies the effective and efficient process and lower compliance cost resulting from the automation and modernisation of the tax system in this country. In 2002, this country has replaced in the VAT administration its paper archive with an electronic archive system by scanning all the taxpayers' documents and it was used with “open case management"- a case workflow tool - to administratively support the treatment of the taxpayers' declarations and demands for standard authorizations. Remarkably, taxpayers were offered the additional incentives for using the electronic services. By doing so, the filing by electronic interface usage were then provided the extended deadlines [61]. The Swiss digital government was witnessed in multiple areas such as governance, infrastructure, legislation, services for citizens and business [62]. In the more recent years (from 2015 onwards), however, Switzerland is not regarded as the leading unit any longer. This may mean that this country had already reached its optimal capacity, and/or that its technology seems infeasible, hindering peers from imitating and elaborating on the technology (refer to Table 5 and Fig. 5 for more details).

Singapore's outcomes are clearly due to the tax system's simplicity. Singapore only carried out a small number of tax payments during the period, while also having a smaller amount of time for tax compliance.[15]

Likewise, New Zealand, during the 12 years (2005–2016), was found to be efficient in 3 years (2005, 2007, and 2008). 2007 and 2008 helped to establish the first order, with the same 8 tax payments and 70 h. The resources that taxpayers in this country spent on tax compliance are much lower than the average level (around 31 and 30 payments, and 377 and 360 h) of the studied countries in the sample. Nonetheless, the later years (2009–2016) reveal a considerable rise in tax time, despite reducing the tax payments, kicking New Zealand out of the efficiency list.

It is worth noting the case of Estonia, which gains the most efficient classification in 2016 with a total of 8 payments and only 50 h of tax procedures. It also appears in the reference sets in 2009, 2012, 2013 and 2014. In accordance with the digital economy and e-government model, Estonia implemented new electronic services in tax administration. Consequently, Estonia is among the most competitive tax systems in the developed world, having a simplified tax system, neutral property taxes, and a simple, broad-based value-added tax. This country has been used as an example when discussing the business tax reform, due to the full expensing and single layer of taxation on corporations, the exemption of foreign earned income, and the well-structured property taxes. Indeed, Estonia was considered a model for e-government by introducing a public system for electronic tax filing in 2000 [63]. This country was also a frontrunner targeting to modernize the public sector and make governance more transparent with time and money efficiency for both the government and public. This resulted from the application of modern ICT tool in public administration management [64]. Therefore, Estonia is now known worldwide with a proud brand name – electronic or e-Estonia through the impressive results in advancing various technology-driven platforms such as e-governance, e-participation, e-commerce, e-voting, e-taxation, and many other e-initiatives [65].

On the other hand, Brazil is a typical case of tax complexity, highlighting the need to simplify tax procedures for the sake of tax compliance. Although the number of tax payments is below the average number of the studied sample, the taxpayers in this country generally spend a large amount of time on tax compliance, which is far from the average level of the sample.16 It is clear that Brazil has been following the trend of tax simplification and has made some improvement with respect to tax payments and tax compliance time. Brazil is still far from achieving efficiency and competitiveness in reducing the tax expenditures and relieving the burden of starting and/or doing business cost. By achieving this, Brazil may attract more investment and new entry, which may contribute to the country's economic growth.

Up to this point, panel efficiency and ranking measurements confirm a pronounced reduction of tax complexity across countries around the world. This empiric implies that tax agencies have implemented the expanding assistance strategy for taxpayers over the past decade [11] to alleviate the rise of compliance risk due to the 2008 Global Financial Crisis [10]. However, it is also worth comprehending how each country individually achieves its simplification target over a period of time.

7. Productivity analysis

The productivity change is measured by distance function through Malmquist index (MI) [34] for the 2006–2011 and 2011–2015 periods respectively. This index represents effort on tax system reform (concerning number of payments and time-to-comply for taxes) of TA agencies across the countries included in the sample. A great MI signifies a good improvement in tax system procedures, i.e. less administrative burden. MI > 1 represents a progress in total factor productivity, which is opposed by a regress in the total factor productivity represented by MI < 1. MI = 1 indicates status quo in the total factor productivity. To see the potential change of productivity during the period, we chose three years (2006, 2011, and 2016) as the interval points to mark equal intervals of five years. These years were also chosen due to the similar distribution of efficiency score for two years 2005 and 2006 (see Fig. 3 for efficiency scores of tax systems throughout the 12 years).

The results show that, on the average, these countries obtain productivity progress in both periods, showing the mean indices of 1.277 and 1.196, respectively. We found that the progress was slightly higher in the former period (see Table 7). This might be explained by the fact that the countries in the sample had, in the latter period, already reached or approached their own frontiers relating to the extent of tax system simplification, causing the slowdown in productivity change.[17]

Table 7
Summary of Malmquist index.

Statistics	Min	Median	Mean	Max	Aggregation
Malmquist index (MI) 2006–2011	0.575	1.047	1.277	4.274	1.076
Catch-up (ΔTE)	0.586	1.269	1.540	4.786	
Frontier-shift (ΔT)	0.449	0.903	0.858	1.055	
Malmquist index (MI) 2011–2016	0.705	1.025	1.196	4.185	1.125
Catch-up (ΔTE)	0.500	0.922	1.043	3.978	
Frontier-shift (ΔT)	0.992	1.152	1.166	2.001	

The former period, 2006 to 2011, shows progress in the relative efficiency (ΔTE = 1.540) accompanied by a regress in the frontier technology (ΔT = 0.858). This is the opposite of the latter period, 2011 to 2016, which shows progress both in the relative efficiency (ΔTE = 1.043) and in the frontier technology (ΔT = 1.166). To be clear, in the former period, the slow shift of frontier opened space for the tax systems in the studied countries to keep pace with the frontier, and vice versa, in the latter period. The quick shift of frontier slowed down in some of the tax systems in the segment, making them lag behind the frontier. This resulted in the lower average index in the latter period when compared to the former period.

In terms of aggregate productivity index, similar to MI with composition, the progress in both periods was represented by the respective indices of 1.076 and 1.125. Unlike the mean Malmquist index with decomposition, however, the progress is slightly higher in the latter period. If compared between the two Malmquist indices within every period, a decrease in aggregation index (1.076 vs. 1.277 and 1.125 vs. 1.196 for 2 periods, respectively) became apparent. As mentioned in the formula for computation (Methodology section), in the single constant output case, the aggregate input-oriented MI is given by the geometric average between any two periods of the simple (un-weighted) arithmetic average of the individual contemporaneous and mixed period input distance functions. The results help consolidate the improvement in total factor productivity for the countries in both periods. Moreover, the aggregation Malmquist index (or harmonic mean) could be of higher validity and reliability than simple mean MI values and eliminated the leveraging effects of some super-efficiency units in the samples.

It is also interesting to discuss the most and the least improved countries due to the technology progress level in tax procedure simplification. In the former period (2006–2011), the ten countries forming the top list are China, Ukraine, Russia, Mexico, Armenia, Korea, Belarus, Argentina, Tunisia, and Slovak Republic, whose productivity progress was recorded between 327.4% (MI = 4.274) and 83% (MI = 1.83). Accordingly, China gained the leading position with the decomposition of progress in technical efficiency (ΔTE = 4.786) and a technical regress (ΔT = 0.893). It seems clear that China greatly improved their technical efficiency and, thus, achieved a great improvement in tax procedure simplification.18 The innovation aspect, however, revealed an incompatible shift of the frontier. Put differently, China's frontier shifted quite slowly, facilitating the improvement of its technical efficiency. This could be seen through their relatively inefficient performance of 11.9% in 2006, increasing up to 57.1% in 2011, leaving a substantial distance to the segment's potential frontier. On the contrary, New Zealand occupied the bottom rank in the studied sample with a productivity decline of 42.5% (MI = 0.575), covering a regress in both technical efficiency (ΔTE = 0.706) and innovation (ΔT = 0.814).19

Regarding the latter period from 2011 to 2016, the leading country is the Ukraine with a great progress in total factor productivity of 318.5% (MI = 4.185), decomposed into the progress in both technical efficiency (ΔTE = 3.978) and innovation (ΔT = 1.052). This was illustrated by tax system simplification, with 5 payments and 328 total hours for complying with taxes in 2016, compared to 28 payments and a total of 491 h for tax compliance in 2011. Clearly, the Ukraine made a significant advance in tax procedure simplification despite their existing poor performance (long-run efficiency of 8.8%). This country has never been relatively efficient considering the short-run efficiency (the highest efficiency at 80% in 2016, compared to 20.1% in 2011). Therefore, Ukraine still needs a lot of augmentation to catch up with the reference tax systems in the segment to achieve good practice. The list of top countries includes Guatemala, Vietnam, Tajikistan, Morocco, India, Poland, Romania, Uzbekistan, and Estonia whose total factor productivity recorded an improvement between 154.9% (MI = 2.549) and 64.6% (MI = 1.646).

At the other extreme, the ten countries that made the worst list include Ireland, Brazil, Chile, Sweden, Colombia, France, Ecuador, Tanzania, Democratic Republic of Congo, and Croatia. They all presented a regress in total factor productivity. Croatia had the deepest regress of 29.5% (MI = 0.705) with a significant decline of 44.2% (ΔTE = 0.558) in technical efficiency, despite an innovation increase of 26.3% (ΔT = 1.263).20

In addition, the productivity change was also measured for the two separate sub-groups (OECD and non-OECD) and the results are shown in Table 8b. The outcomes remain as expected. In OECD sub-sample, Mexico leads the board, followed by Korea, Finland, Slovakia, Poland for the former period (2006–2011). In the meantime, Poland gains the first position, considering the latter period (2011–2016) before Estonia, Lithuania, Slovakia, and Austria. They all demonstrate a productivity progress. Contrastively, New Zealand, Sweden, Italy, the USA, and Portugal; and France, Chile, Sweden, Ireland, and Germany are considered the bottom of the list for the two periods, respectively.

Table 8a
Top & Bottom 10 countries ranked by Malmquist index, full sample.

Period		2006–2011				2011–2016			
\		Country	MI	ΔTE	ΔT	Country	MI	ΔTE	ΔT
TOP	**Full**	CHN	4.274	4.786	0.893	UKR	4.185	3.978	1.052
		UKR	3.968	3.990	0.994	GTM	2.549	2.374	1.074
		RUS	3.379	4.197	0.805	VNM	2.153	2.113	1.019
		MEX	3.076	4.263	0.722	TJK	2.119	1.911	1.109
		ARM	2.785	3.044	0.915	MAR	2.046	1.903	1.075
		KOR	2.123	3.349	0.634	IND	1.763	1.475	1.195
		BLR	1.962	2.543	0.772	POL	1.761	1.651	1.067
		ARG	1.906	2.233	0.853	ROU	1.742	1.422	1.225
		TUN	1.890	2.567	0.736	UZB	1.725	1.523	1.133
		SVK	1.830	1.918	0.954	EST	1.646	1.028	1.602
	OECD	MEX	3.076	4.263	0.722	POL	1.761	1.651	1.067
		KOR	2.123	3.349	0.634	EST	1.646	1.028	1.602
		SVK	1.830	1.918	0.954	SVK	1.395	1.215	1.149
		FIN	1.767	1.834	0.963	LTU	1.390	1.147	1.212
		POL	1.588	1.704	0.932	AUT	1.366	1.113	1.227
	Non-OECD	CHN	4.274	4.786	0.893	UKR	4.185	3.978	1.052
		UKR	3.968	3.990	0.994	GTM	2.549	2.374	1.074
		RUS	3.379	4.197	0.805	VNM	2.153	2.113	1.019
		ARM	2.785	3.044	0.915	TJK	2.119	1.911	1.109
		BLR	1.962	2.543	0.772	MAR	2.046	1.903	1.075
BOTTOM	**Full**	USA	0.858	1.622	0.529	IRL	0.918	0.785	1.169
		PRT	0.854	0.886	0.964	BRA	0.900	0.900	1.000
		PRY	0.738	0.862	0.857	CHL	0.857	0.857	1.000
		ITA	0.670	0.788	0.850	SWE	0.841	0.833	1.009
		UZB	0.669	0.727	0.920	COL	0.830	0.762	1.089
		SWE	0.634	1.000	0.634	FRA	0.813	0.717	1.134
		SGP	0.623	1.000	0.623	ECU	0.800	0.800	1.000
		JOR	0.604	1.000	0.604	TZA	0.791	0.678	1.167
		IRN	0.587	0.586	1.003	COD	0.788	0.603	1.305
		NZL	0.575	0.706	0.814	HRV	0.705	0.558	1.263
	OECD	USA	0.858	1.622	0.529	DEU	0.967	0.850	1.139
		PRT	0.854	0.886	0.964	IRL	0.918	0.785	1.169
		ITA	0.670	0.788	0.850	CHL	0.857	0.857	1.000
		SWE	0.634	1.000	0.634	SWE	0.841	0.833	1.009
		NZL	0.575	0.706	0.814	FRA	0.813	0.717	1.134
	Non-OECD	PRY	0.738	0.862	0.857	COL	0.830	0.762	1.089
		UZB	0.669	0.727	0.920	ECU	0.800	0.800	1.000
		SGP	0.623	1.000	0.623	TZA	0.791	0.678	1.167
		JOR	0.604	1.000	0.604	COD	0.788	0.603	1.305
		IRN	0.587	0.586	1.003	HRV	0.705	0.558	1.263

Table 8b
Top & Bottom countries ranked by Malmquist index, sub-samples.

Period		2006–2011				2011–2016			
		Country	MI	ΔTE	ΔT	Country	MI	ΔTE	ΔT
OECD	**TOP**	MEX	2.573	3.319	0.775	POL	1.731	1.651	1.049
		KOR	2.179	2.579	0.845	EST	1.590	1.000	1.590
		FIN	1.840	1.828	1.006	LTU	1.419	1.212	1.170
		SVK	1.768	1.852	0.955	SVK	1.348	1.217	1.108
		POL	1.598	1.653	0.967	AUT	1.328	1.099	1.208
	BOTTOM	PRT	0.858	0.886	0.969	DEU	0.975	0.914	1.067
		USA	0.846	1.073	0.789	IRL	0.921	0.785	1.172
		ITA	0.673	0.763	0.883	SWE	0.879	0.914	0.962
		SWE	0.671	1.000	0.671	CHL	0.857	0.857	1.000
		NZL	0.566	0.670	0.846	FRA	0.811	0.751	1.079
Non-OECD	**TOP**	CHN	4.670	4.800	0.973	UKR	4.276	3.729	1.147
		UKR	3.788	4.021	0.942	TJK	2.351	2.073	1.134
		RUS	3.585	4.090	0.877	VNM	2.286	2.286	1.000
		ARM	2.345	2.493	0.941	MAR	2.227	1.971	1.130
		ARG	2.111	2.111	1.000	GTM	2.148	1.593	1.348
	BOTTOM	IRN	0.683	0.815	0.838	JAM	0.866	0.745	1.162
		JOR	0.672	1.000	0.672	COL	0.864	0.726	1.190
		UZB	0.650	0.883	0.736	CHN	0.818	0.778	1.052
		SGP	0.521	1.000	0.521	ECU	0.800	0.800	1.000
		PRY	0.485	0.581	0.835	HRV	0.795	0.763	1.042

The non-OECD sub-sample witnesses, on the one hand, the strong productivity progress in tax procedure simplification in the top countries, which include China, Ukraine, Russia, Armenia, and Argentina for the former period (2006–2011), and Ukraine, Tajikistan, Vietnam, Morocco, and Guatemala for the latter period (2011–2016). On the other hand, the bottom positions host

Paraguay, Singapore, Uzbekistan, Jordan, and Iran along with Croatia, Ecuador, China, Colombia, and Jamaica for the two respective periods.

8. Robustness analysis

To gain further insights on the extent to which the tax simplification progress can be comprehended through a set of socio-economic indicators such as financial deepening, information technology development, and institutional levels, we set up a simple panel model following the generic specification of [66] as

$$\begin{aligned} Effscore_{it} &= \alpha + \beta_1 ins\mathrm{tvar}_{\mathrm{it}-1} + \beta_2 internet_{it-1} + \beta_3 trade_{it-1} + \beta_4 pcrdgdp_{it-1} \\ &+ \beta_5 lgdp_{it-1} + \eta_{\mathrm{i}} + \varepsilon_{it} \end{aligned}$$

where denotes the measured DEA-WEO efficiency scores in the previous section, is a vector of determinants including private-credit-to-GDP (pcrdgdp), real GDP per capita (lgdp) in the log-form, percentage of population using internet (internet), trade openness (trade), and six-dimensional variables (instvar) proxying for country governance development.21 accounts for remaining country fixed-effects while ε_{it} is the error terms. All data of regressors are collected from the World Development Indicator database. Notice that all the right-hand variables enter into the empirical panel model in the one-period lagged fashion to alleviate the potentially endogenous matter.

Before discussing the panel estimation, it is worth visually checking the relationship between tax simplification relative efficiency and variables of interest. Fig. 6 suggests strong positive connections between Effscore and rullaw, internet, and pcrdgdp, respectively. Moreover, high-income countries (blue points) deem to cluster in the subplots' north-east region showing that the higher socio-economic development implies better tax simplification progress over the years (see Table 8a).

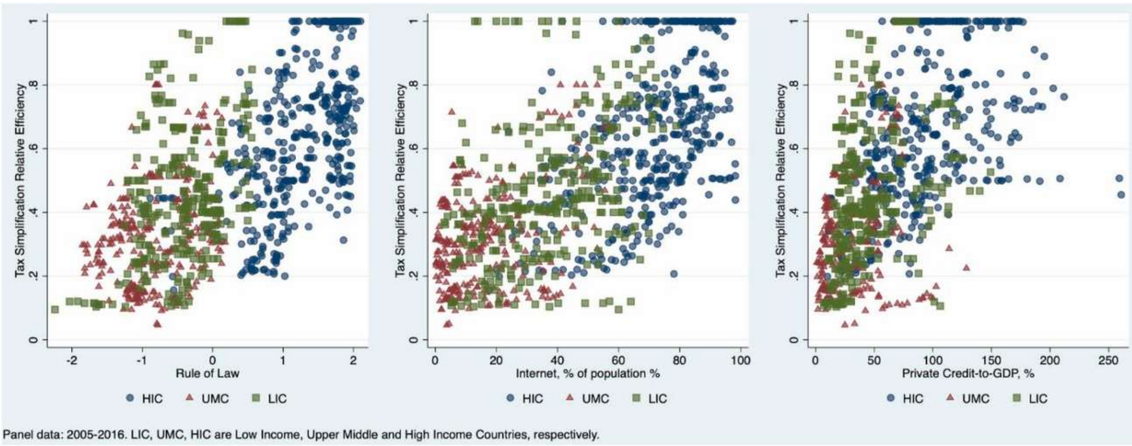


Fig. 6. Relationship between tax simplification performance and macro environment-related variables.

Following closely [67,68]; we estimate the panel model utilising the bootstrapped truncated fixed-effects estimator with clustered-robust standard errors controlling for any cross-sectional dependency. Table 9 presents the final outcome, which yields the consistently expected signs of all variables of interest.[22]

Table 9
Robustness regression.

MODEL	(1)	(2)	(3)	(4)	(5)	(6)
Variables | instvar	concor	Goveff	polsta	Rullaw	regqua	voiacc
internet(-1)	0.00496***	0.00487***	0.00457***	0.00476***	0.00507***	0.00504***
	(0.000450)	(0.000440)	(0.000514)	(0.000459)	(0.000442)	(0.000470)
trade(-1)	0.0463**	0.0488***	0.0602***	0.0296	0.0534***	0.0444**
	(0.0216)	(0.0187)	(0.0191)	(0.0254)	(0.0179)	(0.0214)
pcrdbgdp(-1)	0.000161	0.000213	0.000289	0.000117	0.000180	0.000218
	(0.000189)	(0.000184)	(0.000188)	(0.000186)	(0.000163)	(0.000180)
lgdp(-1)	0.0302	0.0263	0.0650	0.0300	0.0207	0.0231
	(0.0508)	(0.0648)	(0.0522)	(0.0579)	(0.0587)	(0.0554)
instvar(-1)	0.0498	0.0830***	0.00465	0.0922***	0.0880**	0.113*
	(0.0382)	(0.0222)	(0.0170)	(0.0342)	(0.0407)	(0.0646)
LMC # instvar(-1)	−0.158***	−0.0768	−0.0987***	−0.172**	−0.105*	−0.151***
	(0.0605)	(0.0699)	(0.0271)	(0.0768)	(0.0557)	(0.0521)
UMC # instvar(-1)	−0.105*	−0.0444	−0.0367	0.00312	−0.111***	−0.160***
	(0.0551)	(0.0389)	(0.0354)	(0.0700)	(0.0345)	(0.0560)
Constant	−0.632	−0.534	−1.571	−0.570	−0.335	−0.505
	(1.350)	(1.738)	(1.397)	(1.528)	(1.573)	(1.473)
Sigma (σ_e)	0.0930***	0.0928***	0.0918***	0.0928***	0.0929***	0.0931***
	(0.00561)	(0.00655)	(0.00616)	(0.00622)	(0.00633)	(0.00590)
Observations	914	913	912	914	913	914

Notes: bootstrapped standard errors in parentheses | ***p < 0.01, **p < 0.05, *p < 0.1 | instvars of (1)–(6) are concor, goveff, polstab, rullaw, regqua and voiacc, respectively.

Except for the corruption control and political stability variables, the rest of four institutional indicators statistically significantly improve tax simplification progress in the developed countries. Notably, the rule of law and voice accountability exhibit the highest impact on the Effscore among others, and their effects seem to be more pronounced in the HICs than those of LMCs and UMCs as shown in Columns (4) and (6), respectively. The estimated coefficients of the HICs' institutional indicators imply, on average, a marginally institutional quality improvement could raise the Effscore by 4.6–11.3%. Yet, it is also observed the remarkedly adverse interaction effects of the UMC and LMC groups on these institutional regressors. For example, if a country belongs to the LMC group, then the marginal impact of the rule of law on the Effscore lies on the negative side, as of −8%, cetaris paribus, implying that the quality of country institutions is firmly a major driving force of the tax simplification progress.

Regarding other determinants, it is shown that the development of information technology could help reduce tax compliance burden since the higher percentage rate of the population accessing the internet highly likely induces the more effective and productive applications of electronic document filing and automated tax process systems. Besides, macroeconomic controllers such as lgdp, trade and pcrdgdp also positively affect the tax simplification relative efficiency. Nevertheless, there finds only trade effects are statistically significant, indicating that the higher competitive economy is likely associated with the less complex tax system and vice versa.

9. Conclusions

The paper seeks to evaluate the performance of the tax systems of 88 countries through tax procedure simplification using the lens of latent social cost. In other words, this study investigates the competitiveness of the various tax systems through tax simplicity to minimise the compliance burden paid by taxpayers when complying with taxes, in addition to the general purpose of tax revenue collection.

This paper's contribution is twofold. First, the paper methodologically extends the standard panel data DEA estimator [1,2] to apply for the WEO condition. Second, it is the first empirical application of panel data DEA-WEO proposal for long-run panel estimation in addition to contemporaneous analysis with cross-sectional data DEA-WEO model, to provide practical contribution results from the measuring of tax system performance. This is comprehensively completed through measuring the efficiency (both contemporaneous and long-run panel data analysis), ranking, examining the productivity change, and identifying the potential determinants of tax competitiveness of 88 tax systems throughout the period (2005–2016), addressing the implied social costs (tax costs) paid by the taxpayers in order to comply with taxes. With the synthetic assessment of combined tax burden indicators (tax payments and time to comply), the findings, including the benchmarking peers, the assessment of efforts on tax simplification, reflect the overall level of recovery and innovation, along with the positive correlation between some macro factors and tax simplification efficiency and might act as a source of reference relating to the policy implications for tax design and reform.

The results suggest a general conclusion that, even though Switzerland appears to be the most efficient tax system, Norway is the most feasible tax system, and one that the policymakers, in other countries in the segment, should seek to emulate to enhance the efficiency of tax simplification. It is worthy, however, to carefully consider the recommendations when applied to a context. Other countries that could be considered feasible references are Singapore, Ireland, and Estonia.

The study leaves room to further explore the determinants affecting tax simplicity performance. Indeed, the inefficiency may result from the impact of various country-specific factors, for example, country governance, macroeconomic conditions, the infrastructure, and the taxpayers' perception, etc. Even within the tax complexity framework, effects could be derived from either pure complexity of procedure, bureaucracy, tax system structure or tax levels. Another proposal that requires further study is the interaction of tax complexity measures with other ease-of-doing-business indicators. Similarly, an in-depth study on whether tax simplification convergence is a general trend or is observed only in certain legal traditions and depends on particular institutional conditions should be of interest. As an alternative, it should also be worthy to explore the link between the specific tax i.e. income, corporate, consumption, labour and the performance of tax systems. In a broader scope, it is also worthwhile to frame tax simplification under the procedure streamlining perspective as the increasingly good practice in public administration for tackling the business bureaucracy. These require further thorough examination.

Appendix A Supplementary data

Appendix.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.seps.2021.101154.

Appendix

A1

Toloo and Kresta (2014) 's formula for rankings
We solve program (6a) to obtain the parameter $\varepsilon = \varepsilon^*$, then solve (6b) for finding the single most efficient unit alongside with the full ordering basing on optimised d_{max} values.

$min\ \varepsilon$ s.t (6a)	$min\ d_{max}$ s.t (6b)
$\sum_{i=1}^{m} v_i x_{ij} - d_j = 1 \quad j = 1, 2, \ldots, n$	$\sum_{i}^{m} v_i x_{ij} - d_j = 1 \quad j = 1, 2, \ldots, n$
$\sum_{j=1}^{n} \theta_j = n - 1$	$\sum_{j=1}^{n} \theta_j = n - 1$
$\theta_j \leq Md_j \quad j = 1, 2, \ldots, n$	$d_{max} - d_j \geq 0 \quad j = 1, 2, \ldots, n$
$d_j \leq N\theta_j \quad j = 1, 2, \ldots, n$	$\theta_j \leq Md_j \quad j = 1, 2, \ldots, n$
$d_j \geq 0 \quad j = 1, 2, \ldots, n$	$d_j \leq N\theta_j \quad j = 1, 2, \ldots, n$
$v_i \geq \varepsilon \quad i = 1, 2, \ldots, m$	$\theta_j \in \{0, 1\} \quad j = 1, 2, \ldots, n$
$\theta_j \in \{0, 1\} \quad j = 1, 2, \ldots, n$	$v_i \geq \varepsilon^* \quad i = 1, 2, \ldots, m$

Where d_j is deviation from common set of weights-efficiency for DMU j, $d_{max} = \min\{dj: j = 1, \ldots, n\}$; M and N are some large enough numbers. The most efficient unit will have $d^*_{max} = 0$ and $\theta^*_{max} = 0$ (otherwise$\theta_j = 1$). We solve program (6a) to obtain ε^*, then solve (6b). All computations are implemented in GAMS with the suitable mixed integer solver.

A2

Non-parametric tests.

Time	Li test (p-value)		Kruskal-Wallis test (p-value)	
	2005 vs.	Panel average vs.	2005 vs.	Panel average vs.
2005		>0.10		>0.10
2006	>0.10	<0.10	>0.10	>0.10
2007	<0.10	<0.05	<0.05	<0.01
2008	<0.10	<0.01	<0.05	<0.001
2009	<0.05	<0.01	<0.001	<0.001
2010	<0.01	<0.01	<0.001	<0.001
2011	<0.01	<0.001	<0.001	<0.001
2012	<0.01	<0.001	<0.001	<0.001
2013	<0.01	<0.001	<0.001	<0.001
2014	<0.001	<0.001	<0.001	<0.001
2015	<0.001	<0.001	<0.001	<0.001
2016	<0.001	<0.001	<0.001	<0.001

Note: Kernel Consistent Density Equality Test with Mixed Data Types (Li, Maasoumi, and Racine [69]), H0: density equality.

A3

Time-variant long-run DEA efficiency scores

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Full sample												
Mean	0.305	0.310	0.318	0.325	0.329	0.334	0.337	0.341	0.344	0.347	0.350	0.353
Std. dev	0.229	0.229	0.228	0.227	0.226	0.224	0.219	0.216	0.213	0.210	0.207	0.207
Median	0.215	0.225	0.229	0.230	0.236	0.241	0.247	0.258	0.268	0.276	0.284	0.287
Min	0.043	0.043	0.049	0.050	0.052	0.053	0.059	0.064	0.071	0.077	0.082	0.088
Max	1	1	1	1	1	1	1	1	1	1	1	1
OECD												
Mean	0.443	0.451	0.460	0.468	0.473	0.478	0.483	0.487	0.491	0.494	0.497	0.500
Std. dev	0.237	0.235	0.232	0.228	0.225	0.220	0.216	0.212	0.209	0.205	0.202	0.200
Median	0.399	0.384	0.420	0.434	0.451	0.452	0.456	0.454	0.449	0.453	0.458	0.464
Min	0.095	0.115	0.117	0.136	0.154	0.171	0.186	0.200	0.207	0.210	0.210	0.210
Max	1	1	1	1	1	1	1	1	1	1	1	1
Non-OECD												
Mean	0.215	0.218	0.225	0.231	0.234	0.239	0.241	0.244	0.247	0.250	0.253	0.256
Std. dev	0.173	0.171	0.171	0.171	0.171	0.171	0.161	0.156	0.153	0.149	0.145	0.145
Median	0.189	0.182	0.192	0.192	0.193	0.201	0.209	0.213	0.216	0.218	0.222	0.228
Min	0.043	0.043	0.049	0.050	0.052	0.053	0.059	0.064	0.071	0.077	0.082	0.088
Max	1	1	1	1	1	1	1	1	1	0.980392	0.956522	0.96
HIC												
Mean	0.439	0.447	0.457	0.465	0.471	0.475	0.481	0.485	0.488	0.491	0.493	0.496
Std. dev	0.257	0.254	0.249	0.245	0.242	0.238	0.234	0.231	0.227	0.223	0.219	0.218
Median	0.396	0.382	0.399	0.433	0.447	0.448	0.452	0.450	0.448	0.449	0.453	0.460
Min	0.100	0.124	0.154	0.158	0.156	0.155	0.158	0.161	0.163	0.166	0.170	0.176
Max	1	1	1	1	1	1	1	1	1	1	1	1
UMC												
Mean	0.224	0.235	0.245	0.254	0.258	0.264	0.266	0.270	0.275	0.280	0.284	0.288
Std. dev	0.176	0.174	0.174	0.173	0.174	0.174	0.152	0.140	0.133	0.128	0.124	0.123
Median	0.195	0.207	0.203	0.203	0.202	0.211	0.215	0.229	0.240	0.251	0.261	0.270
Min	0.087	0.091	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
Max	1	1	1	1	1	1	0.875	0.8	0.75	0.714286	0.6875	0.674157
LMC												
Mean	0.181	0.176	0.177	0.179	0.182	0.184	0.187	0.189	0.191	0.193	0.195	0.197
Std. dev	0.076	0.068	0.066	0.066	0.066	0.066	0.067	0.068	0.069	0.069	0.071	0.072
Median	0.178	0.175	0.177	0.178	0.182	0.185	0.187	0.189	0.192	0.195	0.197	0.201
Min	0.043	0.043	0.049	0.050	0.052	0.053	0.059	0.064	0.071	0.077	0.082	0.088
Max	0.371	0.333	0.322	0.317	0.314	0.312	0.309	0.311	0.313	0.314	0.318	0.325

A4

The top and bottom ranked tax systems through years (2005–2016), sub-samples

	Rank	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
OECD	**THE BEST**												
	1	NZL	NZL	NZL	NZL	CHE	CHE	CHE	CHE	CHE	CHE	CHE	EST
	2	CHE	IRL	IRL	IRL	IRL	IRL	IRL	NOR	NOR	NOR	NOR	CHE
	3	IRL	CHE	CHE	CHE	EST	NOR	NOR	EST	EST	EST	IRL	NOR
	4	NOR	NOR	NOR	NOR	NOR	EST	EST	IRL	IRL	IRL	EST	IRL
	5	GBR	EST	EST	EST	GBR	FIN	FIN	FIN	FIN	FIN	FIN	FIN
THE WO													
	31	ITA	SVK	SVK	ITA	CHL	CHL	CHL	CHL	CHL	HUN	ISR	CZE
	32	CHL	ITA	JPN	JPN	POL	POL	POL	POL	POL	MEX	POL	POL
	33	MEX	POL	POL	POL	JPN	JPN	MEX	MEX	MEX	CHL	HUN	ISR
	34	ESP	MEX	MEX	MEX	MEX	MEX	JPN	JPN	JPN	JPN	MEX	HUN
	35	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CZE	CHL	CHL
Non-OECD	**THE BEST**												
	1	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP	SGP
	2	JOR	JOR	MKD	MKD	JOR	JOR	MYS	MYS	MKD	MKD	MKD	MKD
	3	MKD	MKD	JOR	JOR	TUN	MYS	MKD	MKD	MYS	MYS	TUN	MNG
	4	THA	MYS	MYS	MYS	MYS	MKD	TUN	TUN	TUN	TUN	CRI	TUN
	5	PHL	TZA	ZAF	ZAF	MKD	TUN	JOR	JOR	ROU	CRI	MNG	JOR
	THE WORST												
	49	ARM	ARM	VNM	ARM	VEN	VEN	VEN	VEN	VEN	VNM	CMR	CMR
	50	BLR	BLR	BOL	VNM	NGA	NGA	VNM	VNM	VNM	VEN	VEN	ECU
	51	CMR	CMR	BLR	BOL	VNM	VNM	NGA	NGA	NGA	NGA	NGA	VEN
	52	UKR	UKR	CMR	CMR	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL
	53	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA	BRA

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