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Article

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Cogent Economics & Finance

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Suggested Citation: Nimer, Khalil; Uyar, Ali; Kuzey, Cemil; Schneider, Friedrich (2022) : E-government, education quality, internet access in schools, and tax evasion, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 10, Iss. 1, pp. 1-32,
<https://doi.org/10.1080/23322039.2022.2044587>

This Version is available at:

<https://hdl.handle.net/10419/303600>

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To cite this article: Khalil Nimer, Ali Uyar, Cemil Kuzey & Friedrich Schneider (2022) E-government, education quality, internet access in schools, and tax evasion, Cogent Economics & Finance, 10:1, 2044587, DOI: [10.1080/23322039.2022.2044587](https://doi.org/10.1080/23322039.2022.2044587)

To link to this article: <https://doi.org/10.1080/23322039.2022.2044587>



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Received: 14 October 2021
Accepted: 13 February 2022

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

E-government, education quality, internet access in schools, and tax evasion

Khalil Nimer^{1*}, Ali Uyar², Cemil Kuzey³ and Friedrich Schneider⁴

Abstract: The study examines whether e-government services reduce the prevalence of tax evasion. Importantly, the study also investigates whether education quality as captured by three proxies and internet connection in schools strengthens the negative relationship between e-government services and tax evasion. The period covered by the study is confined to the years from 2006 to 2017 due to the data availability and Time Fixed-Effects Panel Data Analysis was adopted as empirical methodology. The results confirmed the significance of e-government services in reducing tax evasion and the moderating role of education quality in this relationship. More specifically, while overall, education quality and the quality of business management schools were shown to reinforce the significant negative link between e-government and tax evasion, the quality of math education did not. Finally, internet connection in schools was also found to reinforce the negative association between e-government and tax evasion. For public administrations, e-government initiatives and services are strengthening the capacity to leverage online services in the public domain to enhance tax compliance. Education system

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PUBLIC INTEREST STATEMENT

As technological advancements have penetrated almost all aspects of daily life, this research sought to determine whether such progress has provided solutions to social issues, such as tax evasion. More specifically, the study examined whether e-government services reduce the prevalence of tax evasion through education quality and internet connection in schools. The results confirmed the significance of e-government services in reducing tax evasion and the moderating role of education quality and internet connection in schools in this relationship. Specifically, the study found that education quality, the quality of business schools, and internet connection in schools help e-government reduce tax evasion in countries. For public administrations, e-government initiatives and services are strengthening the capacity to leverage online services in the public domain to enhance tax compliance. Education system designers can consider these results in shaping curricula, integrating taxation issues in curricula, and enabling more equitable and reliable internet access in schools.

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Subjects: Public Finance; Accounting Education; Public Management; Management of Technology & Innovation; Management of Technology

Keywords: E-government; education quality; internet connection; tax evasion

1. Introduction

National governments all over the world are shifting their governance paradigm toward digitalizing their services through huge investment in information and communication technology (ICT) and by integrating their citizens in these digital public services to face the new social and economic challenges. Zhang and Zhang (2009) attributed this considerable investment made by governments in the (ICT) to improve the efficiency of government services. This increase in efficiency leads, in the long run, to reduce tax evasion due to (1) improved tax filing and e-payment systems, which lessen the magnitude of tax evasion (Denison et al., 2013; Night & Bananuka, 2019), and (2) decrease corruption (Adam, 2020; Linhartová, 2019; Nam, 2018; Suhendi et al., 2020), which leads to a commensurate decrease in the prevalence of tax evasion (Marriott, 2017; Schlenther, 2017). Nevertheless, the digitalization of government services does not guarantee increased efficiency (Choi & Chandler, 2020), as poorly planned e-government initiatives could fail (Anthopoulos et al., 2016; Dawes, 2008; Zhang & Feeney, 2020). This, in turn, would not help reduce the prevalence of tax evasion, and associated efforts and investments would consequently be wasted. Therefore, to achieve the desired objectives of e-government initiatives, other facilitating factors that play a vital role in the relationship between e-government services and tax compliance or evasion must be considered.

Education quality can be expected to influence the prevalence of tax evasion when such education is geared toward improving taxpayers' knowledge of tax regulations and calculations. In addition, education quality can help taxpayers develop the skills needed to successfully navigate the digitalized services provided by e-government, such as e-tax systems. Consequently, improving the quality of education concerning tax knowledge and digital e-government services could have a considerable moderating role in the relationship between such services and the prevalence of tax evasion. Given this argument, the current study sought to answer the following research question: What role does education quality play in the relationship between e-government services and tax evasion?

Several academic studies have depicted education as fundamental to improving tax compliance (Jackson & Milliron, 1986; Rutkauskas, 2016) because such education can be expected to encourage conformity to social and cultural norms. More specifically, Jackson and Milliron (1986) argued that education that enhances tax awareness and associated knowledge can improve tax compliance. This argument has since been empirically supported in several studies. For example, McGee and Ross (2012) reported that education significantly impacted attitudes toward tax evasion among respondents in six countries. Likewise, Kwok and Yip (2018) also reported a significant positive association between tax education and tax compliance. However, previous research on tax education and (its relationship to) tax evasion had some limitations. Notably, different definitions of tax education in relation to tax evasion were used. For instance, some studies used tax knowledge as a proxy for education (Kwok & Yip, 2018; Tan & Chin-Fatt, 2000), while others employed general business, accounting, and economic knowledge as a proxy for education quality (Mkhize, 2019; Warsono et al., 2009). The third group of studies, on the other hand, considered only general education quality in relation to tax evasion (Groenland & Van Veldhoven, 1983; Rutkauskas, 2016). Another limitation evident in the e-government literature concerns the research concentration.

Namely, many studies of tax evasion have focused mainly on factors that might impact taxpayers' acceptance of e-tax systems (Kimathi et al., 2019) or on how e-tax systems can improve the level of tax compliance (Night and Bananuka, 2019; Bhuasiri et al., 2016).

Considering these research limitations, the present study makes the following contributions to the extant e-government and taxation literature: First, based on the notion that tax education can be expected to enhance digital tax skills, improve tax knowledge, and promote tax-related morality and values, particularly among younger generations, this study concentrated on the role that education quality can play in strengthening the negative correspondence between e-government services and tax evasion. Second, based on the digital divide approach, which considers problems associated with unequal access to ICT (Bélanger & Carter, 2009), the current research addressed the impact of internet connection in schools as another moderating variable. This is because national and regional differences in internet connection and digital infrastructure can be expected to influence not just the relative strength of digital skills and the availability of digital services but also the strength of the relationship between e-government services and tax evasion. Third, to avoid the problems faced by previous studies concerning defining education quality, three variables were used in the present research to examine education quality: education system quality, math education quality, and business management school education quality. Fourth, in contrast to the extant literature, which primarily focused on the influence of e-tax systems on levels of tax compliance, a broader concept of e-government was deployed in the current study. In this study, we argue that well-planned e-government initiatives can substantively increase the efficiency of public services, which will consequently lead to enhanced performance among all public agencies (European Commission, 2006a). As a result, corruption will drastically decline at all levels (Adam, 2020; Nam, 2018), as will the prevalence of tax evasion (Ajaz & Ahmad, 2010; Alm & Liu, 2017; Schlenther, 2017).

This paper is organized as follows. The next section outlines the theoretical framework for the research and the research hypotheses. This is followed by a description of the research methodology, including sampling procedures, data preprocessing steps, and the overall empirical methodology. The fourth section documents the findings of the baseline and moderation analyses. The last two sections discuss the results, draw some conclusions, suggest implications based on the findings, and make some recommendations for future research avenues.

2. Theoretical framework and formulation of hypotheses

The tax evasion phenomenon has been investigated extensively from many different perspectives and under several distinct theories. Earlier studies applied classical economic and utilization theories, which postulate that taxpayers compare the expected benefits of tax evasion to the expected costs if discovered and plan their behavior accordingly (Allingham & Sandmo, 1972). However, the empirical evidence in this regard did not support the argument that higher sanctions would lead to a lower prevalence of tax evasion (Alm et al., 2012; Swanepoel & Meiring, 2017). Therefore, researchers began applying other theories, such as socio-economic, psychological, and institutional theories, to the phenomenon of tax evasion. Under the guidance of these theories, other potential determinants of tax evasion, such as cultural effects, social fairness of tax distribution, morals, and common norms, have been investigated (Alm & Torgler, 2011; Altaf et al., 2019; Kang, 2016). Recently, upon entering the digital era, researchers have begun to adopt more timely theories, such as innovation theory and modernization theory, to examine the effect of technology and digitalization on tax evasion (Bhuasiri et al., 2016; Uyar et al., 2021).

In this study, institutional and modernization theories were deployed (Caprini and Keeter, 1996; Nie et al., 1996). In line with institutional theory, education quality should enhance taxpayers' knowledge about tax rules and tax calculations, as well as the knowledge and skills needed to

successfully navigate and use e-tax and e-payment systems. Modernization theory is associated with e-government initiatives such that the digitalization of public services triggers changes in societies (Nam, 2018). That said, modernization theory also argues that technologically advanced societies will reap the advantages of digitalization, whereas less technologically advanced societies will not (Barker, 2003). The consequences and corresponding challenges of such unequal access to technology have been conceptualized as the “digital divide” (Bélanger & Carter, 2009). Relative access to the internet in schools has been discussed under both theories because e-government initiatives are unlikely to be successful in the long run if younger generations are not equipped with the requisite digital education and skills needed to both understand and effectively use such services.

2.1. Tax evasion and e-government

Studies that have examined the nature of the relationship between the digitalization of government services and taxation have been predominantly of two types. The first type has investigated the degree of acceptance of e-tax systems by taxpayers (Denison et al., 2013; Kimathi et al., 2019), while the second type has primarily concentrated on the impact of implementing e-payment and e-tax filing systems on tax revenues and the overall efficiency of tax systems in various countries. For example, Bhuasiri et al. (2016) examined factors affecting the acceptance of e-tax filing and e-payment systems among taxpayers in Thailand. Night and Bananuka (2019) investigated the extent to which implementing an e-tax system influenced the relationship between the level of tax compliance and attitudes toward the e-tax system in African developing countries using a questionnaire survey. They revealed a significant effect of attitudes toward the e-tax system on the level of tax compliance. Similar studies conducted in other countries, such as that by Tjondro et al. (2019) in Indonesia, reported that job productivity and convenience of living (i.e., the system can be used at any time and from anywhere) significantly influence overall satisfaction with e-tax systems. Also, Kimathi et al. (2019) reported that perceived ease of use and perceived usefulness significantly impacted user acceptance of e-taxation systems.

In the current study, e-government services were measured (as an average of five indicators) (see Table 1) rather than assessing only the e-tax system because e-government and tax evasion should be evaluated from a broader perspective than simply focusing on e-tax-related issues (Uyar et al., 2021). According to Uyar et al. (2021), a well-planned e-government initiative can radically improve the efficiency of government services, which will in turn lead to better performance among all public agencies (European Commission, 2006a). As a result, corruption will drastically decline (Adam, 2020; Nam, 2018), as will the prevalence of tax evasion (Baum et al., 2017; Swanepoel & Meiring, 2017). Hence, the first hypothesis was formulated as follows:

H1: The implementation of e-government services significantly reduces tax evasion.

2.2. The moderating effect of education quality

Based on institutional theories, education quality can be expected to reduce the prevalence of tax evasion because it reinforces social and cultural norms, increases awareness and knowledge among younger generations, and improves their technological skills (Enachescu et al., 2019; Jackson & Milliron, 1986; Kang, 2016). Recent empirical studies have reported a significant positive impact of education on perceptions of tax evasion (Kwok & Yip, 2018; McGee & Ross, 2012; Park & Hyun, 2003). However, earlier studies reported mixed results; for instance, Friedland et al. (1978) and Wallschutzky (1984) reported a significant positive effect of education on the level of tax compliance. In contrast, Groenland and Van Veldhoven (1983) and Wärneryd and Walerud (1982) observed a significant negative effect of education on tax compliance. Meanwhile, another group of studies failed to find any association between education and tax compliance (Chan et al., 2000; Jackson & Milliron, 1986). The variation in these empirical results could be attributable to the

Table 1. List of variables, their definitions, and their sources

Variable	Definition	Source
<i>Dependent variable:</i>		
TaxEvasion	Tax evasion is calculated by the size of the informal (shadow) economy relative to Gross Domestic Product (GDP)	Medina and Schneider (2019)
<i>Independent variable:</i>		
Egovernment	Egovernment is the average of five indicators, namely EParticipation, GovPolStab, GovRespCha, LegalFrame, and GovernVision, which are defined below	WEF (2020)
EParticipation	A government's online service utilization, scaled from 0 to 100 (Excellent)	WEF (2020)
GovPolStab	Establishment of stable policies by the government for doing business, scaled from 0 to 100 (Excellent)	WEF (2020)
GovRespCha	A government's effective response to social, economic, and technological changes, scaled from 0 to 100 (Excellent)	WEF (2020)
LegalFrame	Adoption of a legal framework in digital business models, scaled from 0 to 100 (Excellent)	WEF (2020)
GovernVision	A government's long-term vision, scaled from 0 to 100 (Excellent)	WEF (2020)
<i>Moderator:</i>		
QuaEduSys	Quality and competitiveness of the overall education system in the world, ranging between 1 (Extremely weak) and 7 (Excellent)	WEF (2020)
QuaMath	Math education quality, ranging between 1 (Extremely weak) and 7 (Excellent)	WEF (2020)
QuaManSch	Quality of business management schools, ranging between 1 (Extremely weak) and 7 (Excellent)	WEF (2020)
InterConnect	Internet connection in schools, ranging between 1 (Not at all) and 7 (To a great extent)	WEF (2020)
<i>Control variable:</i>		
AgrVal	Value-added agriculture as percentage of GDP	WBank (2020)
FDInet	The proportion of net foreign direct investment inflows to GDP	WBank (2020)
LnGDP	Natural logarithm of per capita GDP	WBank (2020)
GovExp	The proportion of government expenditure to GDP	WBank (2020)
Inflation	Annual inflation rate (%)	WBank (2020)
LnPop	Natural logarithm of the total population	WBank (2020)
UrbPop	Urban population percentage	WBank (2020)

(Continued)

Table1. (Continued)

Variable	Definition	Source
PrimEduc	Duration (years) of primary education	WBank (2020)
Trade	Trade as percentage of GDP	WBank (2020)

inconsistent use of education proxies, as some studies used education in general (McGee & Ross, 2012; Park & Hyun, 2003; Rutkauskas, 2016), while others examined the impact of tax education only (Alcock et al., 2008; Mkhize, 2019). The third group of studies differentiated between undergraduate degree holders and postgraduate degree holders (Kasipillai et al., 2003). To avoid the potential for adverse consequences of such inconsistency in the present research, three proxies for education quality were used as moderating variables between e-government services and tax evasion, namely education system quality, math education quality, and business management school education quality. In addition, these three variables correspond to the various skills and knowledge required to navigate and successfully use e-tax filing and e-payment systems, such as knowledge of tax rules, knowledge regarding the importance of taxes and its impact on national prosperity, and digital skills.

2.3. Education system quality

Countries with resilient, high-quality education systems are expected to provide their citizens, especially younger generations, with sufficient technological knowledge and advanced digital skills so that they can comprehend and successfully use a wide range of digital applications and other technological devices and programs (Wu & Liu, 2021; Zhang et al., 2020). Ensuring a high-quality education system would also increase awareness of the importance of taxation, its vital role in supporting national prosperity, and the severe consequences of tax evasion on national wealth, health, and social welfare (Piatak & Holt, 2020; Rasmussen & Nørgaard, 2018). About this, Chan (2019) argued that, based on social identity theory, exposure to the national flag would motivate people to sacrifice their self-interest on behalf of that of their country, and that this would consequently reduce the prevalence of tax evasion. His empirical results have shown that exposure to the Australian, British, and American flags reduced the incidence of tax evasion among citizens of these countries and increased positive attitudes toward paying taxes.

Therefore, the present research postulates that education system quality plays a moderating role in the relationship between e-government services and tax evasion; education system quality fosters a negative relationship because countries with high-quality education systems are expected to provide their citizens with sufficient technological knowledge of digital applications, such as E-Systems and services. National governments are also expected to provide their citizens with at least basic knowledge regarding tax regulations and laws, the close association between taxation and national prosperity, and the adverse effects of tax evasion on national prosperity. Lastly, governments are expected to educate citizens on their responsibilities as citizens and on the importance of prioritizing national interests over self-interests. Based on this argument, the first sub-hypothesis of the second hypothesis was formulated as follows:

H2a: Education system quality plays a moderating role in the relationship between e-government services and tax evasion such that education system quality fosters a negative relationship.

2.4. Math education quality

Taxation as a discipline is typically taught as part of the accounting and economics majors. Both accounting and economics require at least a decent comprehension of mathematics (Mkhize, 2019). Besides, empirical research has documented the fundamental importance of mathematics to understanding accounting and economics subjects (Alcock et al., 2008; Mkhize, 2019). As a case in point, Alcock et al. (2008) demonstrated that students who took more advanced mathematics subjects significantly outperformed other students in accounting courses. Of course, people who possess good mathematics skills are also those most likely to be able to handle sophisticated tax calculations even if they have no background in accounting or economics. That said, e-government systems can lessen the need for such skills in tax filing by implementing more user-friendly online interfaces and form-filling programs.

It can thus be argued that countries that provide high-quality mathematics education would also be providing future taxpayers with a strong background in mathematics skills and knowledge, which would, in turn, enable them to better understand tax rules and make complex tax calculations. Therefore, the second sub-hypothesis of the second hypothesis was formulated as follows:

H2b: Math education quality plays a moderating role in the relationship between e-government services and tax evasion such that math education quality augments the negative nature of this relationship.

2.5. Business management school quality

Business management school graduates would typically have the knowledge required to understand tax systems, appreciate the importance of taxation, and comprehend the salience of tax revenues for society. However, some researchers have argued that taxpayers who have greater tax knowledge are also more likely to take advantage of loopholes in tax regulations to evade paying taxes (Gilligan & Richardson, 2005). Nevertheless, the empirical evidence indicates that greater tax knowledge and education are directly related to a lower tendency to evade taxes (Hassan et al., 2016; Kwok & Yip, 2018). Contemporary business management schools have begun implementing technological and digital programs and tools to teach accounting, economics, and related subjects (Ahmed, 2008; Gerstein & Friedman, 2016). These efforts are intended to help business graduates obtain the knowledge and skills needed to successfully use online services, such as filling out tax forms and making online tax payments (Hassan et al., 2016).

Accordingly, the present study contends that countries with high-quality business management schools provide their students with the knowledge and skills required to comprehend tax rules, use e-tax systems, and make tax calculations.

Therefore, the third sub-hypothesis of the second hypothesis was formulated as follows:

H2c: Business management school quality plays a moderating role in the relationship between e-government services and tax evasion such that business management school quality reinforces the negative nature of this relationship.

2.6. The moderating effect of internet connection in schools

There is no doubt that contemporary educational processes and programs are working to fully integrate ICT. This is clearly evident in the extent to which digital technologies have been incorporated into a host of modules and courses in schools, colleges, and universities (Ju et al., 2016). Therefore, consistent and reliable internet connection in schools is essential to successfully

complete the transformation from traditional learning to digitally mediated learning and is indeed the decisive determinant of education quality insofar as it makes available to students an immense corpus of information.

Based on this fact, internet connection in schools could moderate the relationship between e-government services and tax evasion from two perspectives. First, generally speaking, widespread internet connection is a reliable indicator that a country's education system is of high quality. Within this context, Chen et al. (2021) examined the impact of district spending on internet service on the academic performance of 9,000 public schools between 2000 and 2014. Their results suggested that increased spending on internet service in schools leads to improvements in eight indicators of academic performance. Also, steady and sufficient internet connection in schools facilitates increased use of the internet in the education process. This point has been discussed by proponents of the "digital divide," the literature for which covers two main divides: an access divide, which refers to the availability of the internet to the whole society, and skills divide, which refers to the capacity of the whole society to use online digital services successfully (Bélanger & Carter, 2009; Shakina et al., 2021). These two digital divides constitute one of the main challenges to the successful implementation of e-government initiatives, as it illustrates the extent to which e-government benefits are inaccessible to some segments of the population (Bélanger & Carter, 2009). Likewise, Shakina et al. (2021) stressed the severity of this challenge for corporations, especially when it comes to the relationship between the access divide and innovation.

Accordingly, ensuring internet connection in schools could help overcome the problem of the skills divide, as students would consequently also have steady access to online services provided by the government. Relatedly, Venkataswamy (2015) comparatively investigated internet access in elite private schools and rural public schools. The results revealed significant differences in digital skills between students at the two kinds of schools. Therefore, Venkataswamy recommended ensuring equal internet access so that disadvantaged students are not excluded from digital learning. It is thus asserted that the education quality of schools and students' digital knowledge and skills, including skills related to e-government and other digital service platforms, are reliant on internet connection. Evidently, internet connection also plays a vital role in strengthening the negative association between e-government services and tax evasion. Therefore, our third hypothesis was formulated as follows:

H3: Internet connection in schools plays a moderating role in the relationship between e-government services and tax evasion such that internet connection in schools strengthens the negative nature of this relationship.

3. Research methodology

3.1. Variables

All of the variables employed in the study were country-level indicators retrieved from three sources: the World Bank (WBank, 2020), the World Economic Forum (WEF, 2020), and Medina and Schneider (2019). The tax evasion (TaxEvasion) data as measured by the size of the informal (shadow) economy relative to GDP were retrieved from Medina and Schneider (2019). The E-government indicators—namely EParticipation, GovPolStab, GovRespCha, LegalFrame, and GovernVision—were downloaded from the WEF (2020). Moreover, moderators such as education quality (QuaEduSys), math education quality (QuaMath), business management school quality (QuaManSch), and internet connection in schools (InterConnect) were also derived from the WEF (2020). Lastly, the control variables were downloaded from the World Development Indicators

published by the World Bank (WBank, 2020). The data provided by the WEF (2020) were retrievable from 2006 onward, whereas the TaxEvasion data were accessible until 2017; hence, the time period covered by the study was confined to the years 2006 to 2017. Detailed descriptions of the variables and their sources are provided in Table 1.

3.2. Sample and data screening

Data preprocessing is a critical task to conduct prior to running baseline analyses. The task involves data cleaning, descriptive statistical analysis of the initial sample, missing data analysis, determination of possible outliers, the winsorization of extreme values, and finally imputation of missing values of the variables. According to the initial descriptive statistics, FDI, Inflation, and Trade indicated heavy skewness with large variability around mean values. Thus, these variables are subject to winsorization at both ends at 1%. The extreme values are consequently replaced in both tails with their winsorized values.

The initial missing data analysis with descriptive statistics indicated that some of the research variables had missing values¹. The ratios thus range from 0.71% to 6.8%, which, although only slightly above 5% on the one end, are significantly less than 10% on the other. According to Schafer (1999), a sample with 5% or fewer missing values can be considered inconsequential; while according to Bennett (2001), the results of a missing data analysis can be biased if the sample has more than 10% missing values. Even though the number of missing values in the current analysis can be considered inconsequential and therefore did not threaten to bias the results, in the following step of the data screening phase, imputation analysis was performed. To do so, the Markov chain Monte Carlo (MCMC) approach with linear regression as the model type for scale variables was used.

Next, potentially significant outliers are examined. For outlier detection, the minimum covariance determinant (MCD) estimator is used. This approach can robustify the Mahalanobis distance (Verardi & Dehon, 2010) which is used for determining the significant multivariate outliers. Ultimately, 12 country-year observations out of the initial sample size of 1,692 country-year records are determined to be significant outliers and are removed from the sample before further analysis.

As a result of outlier detection and removal, 1,680 country-year observations for the 12-year observation period remained as the final sample for further analyses.² Finally, the country-level sampling distribution is provided with a list of 141 countries in the sample and their mean TaxEvasion and Egovernment values (Please see Table A1 in Appendix section).

3.3. Methodology

The formulation of the models as well as the rationale for the selection of approaches used are presented below. *Factor Analysis*: Egovernment has five sub-dimensions: Eparticipation, GovPolStab, GovRespCha, LegalFrame, and GovernVision. These five dimensions of e-government are subjected to exploratory factor analysis (EFA). During the analysis, principal component analysis (PCA), as the extraction method based on Eigenvalues greater than one, and Varimax, as the factor rotation method, are chosen.

Time Fixed-Effects Panel Data Analysis: In order to run the baseline models, a panel regression approach is adopted as a suitable method, for two reasons. First, a country-year panel structure constituted the sample structure. Second, a time-variant association existed between the dependent and the predictor variables. Furthermore, there are various advantages of using the fixed-effects panel regression method. First, it minimized the risk of multicollinearity as well as potential biases in the estimations (Baltagi, 2001). Second, fixed-effects panel regression is widely used to

mitigate selection bias by removing large variations from observational data (Mummolo & Peterson, 2018). Finally, fixed-effects panel regression is employed to control for omitted variable bias (Baltagi, 2001; Greene, 2003; Wooldridge, 2010, 2013) and to minimize threats to internal validity.

During the analysis, the *F*-test, the Breusch-Pagan Lagrange Multiplier (LM) test, and Hausman's test are performed as the post-estimation tests.³ All in all, the results of these tests revealed that fixed-effects panel regression analysis is the most suitable methodology for testing the research hypotheses.

The functional representation in Equation (1) represents the research models incorporating time fixed-effects. The rationale for using time fixed-effects is that the testing variables remained constant across countries yet varied over the years (Time). The fixed-effects approach mitigates omitted variable bias as it excludes unobserved variables that vary over time (year) yet stays constant across panels (countries) (Baltagi, 2001; Greene, 2003; Wooldridge, 2010, 2013). Accordingly, the representation of the functional relationship in the proposed research model is as follows:

$$y_{it} = \alpha + \beta X_{it} + \delta_2 B2_t + \dots + \delta_T BT_t + \epsilon_{it} \quad (1)$$

In Equation (1), the term *T*: 2, 3, ..., *t* (*T*-1) dummy time variables are included, whereas *B1* was excluded because the model's representation already includes an intercept (α). In the conceptual model, the term " y_{it} " depicts TaxEvasion as the dependent variable; " X_{it} " depicts the independent testing and the independent control variables. Accordingly, the testing predictor is EgoGovernment, whereas the control variables are AgrVal, FDI_{net}, LnGDP, GovExp, Inflation, LnPop, UrbPop, PrimEduc, and Trade. Also, "*i*" depicts the country, while the index "*t*" depicts the year. Finally, " ϵ_{it} " represents the regular error term. To eliminate the risk of heteroskedasticity in the analyses, heteroskedasticity-consistent robust standard errors based on the Eicker-Huber-White standard errors approach (Eicker, 1967; Huber, 1967; White, 1980) are reported during the subsequent regression analysis.

3.4. Moderation analysis

The proposed model for the moderation analysis is illustrated in Eq (2), which represents the moderating effect of the proposed moderators between the independent test variable and the dependent variable. Similarly, time fixed-effects panel data regression analysis with a moderator is included in the proposed model.

$$y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 M_{it} + \beta_3 (X_{1it} * M_{it}) + \beta_4 X_{2it} + \delta_2 B2_t + \dots + \delta_T BT_t + \epsilon_{it} \quad (2)$$

In Equation (2), the moderator (M_{it}) is represented by QuaEduSys, QuaMath, QuaManSch, and InterConnect; the independent test variable (X_{1it}) is represented by EgoGovernment; the dependent variable (y_{it}) is represented by TaxEvasion; and the control variables are represented by (X_{2it}). The moderation analysis is performed based on Hayes's (2018) methodology, which employs a Stata module (Jose, 2013).

4. Findings

Factor Analysis: The results of the EFA, provided in Table 2, show that only one factor is extracted with an Eigenvalue of $3.730 > 1$. The percentage of variance, which indicated the ratio of the total variance in EgoGovernment that is explained by variations in the sub-dimensions of EgoGovernment, is 74.61%—significantly higher than 50% (Hair et al., 2010). The reliability of the five sub-dimensions

Table 2. Factor analysis results

Item	Factor1 ^a
	Egovernment
GovRespChange	.961
GovPolStab	.937
LegalFramework	.912
GovernVision	.896
EParticipation	.542
Eigenvalue	3.730
Percentage of variance	74.608
Cronbach's alpha	.866
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	.801
Bartlett's Test of Sphericity: χ^2 -statistics; df; p-value	9055.901; 10; .0001

Extraction method: Principal component analysis (PCA).

Rotation: Varimax.

^a1 component(s) extracted.

based on Cronbach's alpha is 0.866, which is significantly higher than the cut-off value of 0.7 (Hair et al., 2010). In addition, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.801, which is significantly higher than the threshold value of 0.7 (Hair et al., 2010). This indicates that the EFA is both suitable and useful for the research sample. Furthermore, Bartlett's Test of Sphericity with an alternative hypothesis as "Correlation matrix is an identity matrix" is statistically significant (p -value: 0.0001), which suggests that the variables of interest are related and are thus suitable for structure detection. Therefore, the factor analysis is useful for the sample.

The factor loadings of the sub-dimensions range from 0.542 (Eparticipation) to 0.961 (GovRespChange). The sufficient factor loading score is 0.35 based on the sample size of 350 (Hair et al., 2010), and thus the minimum factor loading of 0.542 is significantly higher than the suggested sufficient factor loading with a significantly large sample size of 1,680.

After the factor analysis, the composite score of Egovernment is calculated in four different ways: sum, arithmetic average, weighted average, and factor score of the values of the sum-dimensions (five variables). The new variable, "Egovernment_sum," is obtained by adding the values of the five items; "Egovernment_ave" is generated by taking the arithmetic average of the five items; "Egovernment_weighted" is obtained by taking the weighted average of the items using the values of the factor loadings as the corresponding weights; and "Egovernment_fact" is obtained by generating factor scores based on a regression method. These composite Egovernment indicators are used to test the first hypothesis as a robustness test of the findings.

4.1. Descriptive statistics of variables

The summary of the variables' descriptive statistics based on means, variability using standard deviations, and lowest and highest values are presented in Table 3. The results show that TaxEvasion's mean is 27.43 ± 11.86 and ranges from 5.13 to 63.33. The mean composite score of Egovernment (Egovernment_ave is included in the descriptive statistics measures) is 50.66 ± 14.25 , while the mean scores of Egovernment's sub-dimensions are EParticipation (66.37 ± 24.85), GovPolStab (49.86 ± 16.36), GovRespCha (45.12 ± 14.68), LegalFram

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TaxEvasion	1,680	27.43	11.86	5.13	63.33
Egovernment	1,680	50.66	14.25	14.96	87.74
EParticipation	1,680	66.37	24.85	7.87	100.00
GovPolStab	1,680	49.86	16.36	5.76	89.66
GovRespCha	1,680	45.12	14.68	7.20	85.22
LegalFrame	1,680	44.69	13.43	14.71	78.03
GovernVision	1,680	47.28	16.71	6.64	91.20
QuaEduSys	1,680	3.76	0.90	1.72	6.24
QuaMath	1,680	4.03	0.93	1.52	6.48
QuaManSch	1,680	4.23	0.83	1.76	6.39
InterConnect	1,680	4.11	1.23	1.28	6.77
AgrVal	1,680	9.82	9.74	0.03	55.77
FDInet	1,680	5.31	8.10	-4.85	73.53
LnGDP	1,680	8.71	1.48	5.37	11.63
GovExp	1,680	15.79	5.26	2.05	41.89
Inflation	1,680	5.05	5.02	-1.54	27.28
LnPop	1,680	16.25	1.63	11.35	21.05
UrbPop	1,680	60.04	22.37	9.62	100.00
PrimEduc	1,680	5.69	0.86	3.00	8.00
Trade	1,680	90.62	55.46	25.85	371.75

(44.69 \pm 13.43), and GovernVision (47.28 \pm 16.71). Finally, the results of the moderating variables yielded the following means: QuaEduSys (3.76 \pm 0.90), QuaMath (4.03 \pm 0.93), QuaManSch (4.23 \pm 0.83), and InterConnect (4.11 \pm 1.23), all with relatively little variability.

4.2. Correlation analysis

The Pearson's correlation coefficients showing the bivariate linear correlations are provided in Table 4. Regarding the independent testing variable, the results indicated that Egovernment has a significant negative correlation with TaxEvasion. In addition, the moderating variables including QuaEduSys, QuaMath, QuaManSch, and InterConnect have a significant negative linear correlation with TaxEvasion.

4.3. Baseline analysis

The results of the baseline analysis used to test the first proposed hypothesis (H1) are provided in Table 5. The time fixed-effects regression analysis for the panel data is used as it was the most appropriate analytical tool, as previously explained in detail. As described in the factorial analysis, the independent test variable included in the analysis had four alternative composite scores of Egovernment obtained from the results of EFA: Egovernment_sum, Egovernment_ave, Egovernment_weighted, and Egovernment_fact.

The results show that Egovernment based on sum, average, weighted, and factor scores has a significant negative relationship with TaxEvasion ($p < 0.01$). Hence, the negative association between e-government proxies and tax evasion is robustly confirmed by various methodologies, thereby leading to the acceptance of H1.

Table 4. Pearson's correlation coefficients

Variable	V1	V2	V3	V4	V5	V6	V7	V8
(1) TaxEvasion	1							
(2) Egovention	-0.574*	1						
(3) QuaEduSys	-0.513*	0.613*	1					
(4) QuaMath	-0.519*	0.497*	0.837*	1				
(5) QuaManSch	-0.499*	0.521*	0.772*	0.642*	1			
(6) InterConnect	-0.616*	0.644*	0.738*	0.706*	0.710*	1		
(7) AgricVal	0.522*	-0.401*	-0.352*	-0.370*	-0.451*	-0.577*	1	
(8) FDIret	-0.130*	0.198*	0.170*	0.174*	0.081*	0.158*	-0.126*	1
(9) LnGDP	-0.698*	0.590*	0.529*	0.513*	0.599*	0.738*	-0.837*	
(10) GovExp	-0.366*	0.145*	0.207*	0.227*	0.195*	0.287*	-0.437*	
(11) Inflation	0.176*	-0.215*	-0.169*	-0.166*	-0.156*	-0.216*	0.184*	
(12) LnPop	0.033	-0.014	-0.131*	-0.153*	0.032	-0.140*	0.214*	
(13) UrbPop	-0.503*	0.427*	0.354*	0.344*	0.497*	0.576*	-0.744*	
(14) PrimEduc	-0.011	0.011	0.144*	-0.094*	0.187*	-0.033	0.037	
(15) Trade	-0.284*	0.310*	0.281*	0.340*	0.131*	0.347*	-0.305*	
Variable	V9	V10	V11	V12	V13	V14	V15	
(9) LnGDP	1							
(10) GovExp	0.402*	1						
(11) Inflation	-0.226*	-0.130*	1					
(12) LnPop	-0.207*	-0.289*	0.101*	1				
(13) UrbPop	0.815*	0.273*	-0.149*	-0.131*	1			
(14) PrimEduc	0.002	0.079*	-0.016	-0.102*	-0.001	1		
(15) Trade	0.321*	0.103*	-0.087*	-0.454*	0.269*	0.008	1	

*p < 0.05

Table 5. Time fixed-effects panel regression

	(1)	(2)	(3)	(4)
Independent Variable	TE ^e	TE	TE	TE
Egovernment_sum ^a	-0.031*** (-8.71)			
Egovernment_ave ^b		-0.15*** (-8.71)		
Egovernment_weighted ^c			-0.15*** (-9.06)	
Egovernment_fact ^d				-2.18*** (-9.30)
AgrVal	-0.22*** (-5.68)	-0.22*** (-5.68)	-0.21*** (-5.56)	-0.21*** (-5.47)
FDInet	0.010 (0.35)	0.010 (0.35)	0.0080 (0.28)	0.0067 (0.23)
LnGDP	-6.10*** (-18.89)	-6.10*** (-18.89)	-6.16*** (-19.46)	-6.19*** (-19.77)
GovExp	-0.42*** (-9.92)	-0.42*** (-9.92)	-0.42*** (-9.93)	-0.41*** (-9.91)
Inflation	0.0060 (0.14)	0.0060 (0.14)	0.0074 (0.17)	0.0073 (0.17)
LnPop	-1.36*** (-9.78)	-1.36*** (-9.78)	-1.40*** (-10.20)	-1.42*** (-10.38)
PrimEduc	-0.045 (-0.20)	-0.045 (-0.20)	0.017 (0.08)	0.040 (0.18)
Trade	-0.030*** (-6.22)	-0.030*** (-6.22)	-0.029*** (-6.08)	-0.028*** (-5.98)
UrbPop	0.067*** (4.42)	0.067*** (4.42)	0.067*** (4.41)	0.067*** (4.45)
Constant	119.0*** (30.42)	119.0*** (30.42)	119.6*** (30.83)	112.3*** (27.33)
Time Fixed-Effects	Yes	Yes	Yes	Yes
N	1680	1680	1680	1680
Adj. R ²	0.580	0.580	0.582	0.583
F-statistics	111.63***	111.63***	112.32***	112.79***

^aEgovernment_sum" obtained by adding the values of the five items.

^bEgovernment_ave" generated by taking the arithmetic average of the five items.

^cEgovernment_weighted" was obtained by taking the weighted average of the items using the values of the factor loadings as the corresponding weights.

^dEgovernment_fact" obtained by generating factor scores based on the regression method.

^eTax evasion.

t-statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

Table 6. Moderation analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Independent variables	TE ^a	TE	TE	TE	TE	TE	TE	TE
Egovernm_ave ^b	-0.12*** (-6.16)	-0.12*** (-6.95)	-0.14*** (-7.83)	-0.13*** (-7.11)	0.078 (1.37)	-0.12* (-1.87)	0.27*** (3.86)	0.020 (0.39)
QuaEduSys	-1.29*** (-4.59)				1.50* (1.85)			
QuaMath		-1.77*** (-7.02)				-1.66** (-2.15)		
QuaManSch			-0.79** (-2.54)				4.28*** (4.83)	
InterConnect				-0.90*** (-3.84)				0.93 (1.46)
Egovernm_ave * QuaEduSys					-0.053*** (-3.66)			
Egovernm_ave * QuaMath						-0.0022 (-0.15)		
Egovernm_ave * QuaManSch							-0.099*** (-6.10)	
Egovernm_ave * InterConnect								-0.037*** (-3.07)
AgriVal	-0.20*** (-5.31)	-0.19*** (-5.14)	-0.21*** (-5.68)	-0.21*** (-5.67)	-0.16*** (-4.12)	-0.19*** (-4.96)	-0.15*** (-3.73)	-0.17*** (-4.38)
FDInet	0.019 (0.68)	0.016 (0.56)	0.019 (0.67)	0.013 (0.44)	0.013 (0.45)	0.016 (0.55)	0.015 (0.52)	0.0067 (0.23)
LnGDP	-5.77*** (-17.48)	-5.56*** (-16.96)	-5.92*** (-17.80)	-5.75*** (-17.12)	-5.49*** (-16.26)	-5.56*** (-16.75)	-5.46*** (-16.17)	-5.50*** (-15.90)
GovExp	-0.41*** (-9.87)	-0.40*** (-9.56)	-0.42*** (-10.03)	-0.41*** (-9.85)	-0.41*** (-9.86)	-0.40*** (-9.55)	-0.40*** (-9.59)	-0.41*** (-9.74)
Inflation	-0.011 (-0.26)	-0.023 (-0.57)	-0.015 (-0.37)	-0.022 (-0.54)	-0.0079 (-0.19)	-0.023 (-0.56)	-0.027 (-0.66)	-0.022 (-0.55)
LnPop	-1.40*** (-10.11)	-1.38*** (-10.08)	-1.32*** (-9.42)	-1.36*** (-9.81)	-1.33*** (-9.60)	-1.38*** (-9.92)	-1.20*** (-8.54)	-1.30*** (-9.36)
PrimEduc	0.11	-0.28	0.082	-0.12	0.22	-0.27	0.28	0.046

(Continued)

Table6. (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(0.47)	(-1.27)	(0.36)	(-0.53)	(0.97)	(-1.22)	(1.23)	(0.20)
Trade	-0.030***	-0.026***	-0.032***	-0.029***	-0.026***	-0.026***	-0.025***	-0.024***
	(-6.37)	(-5.49)	(-6.72)	(-6.02)	(-5.25)	(-5.15)	(-5.20)	(-4.90)
UrbPop	0.060***	0.056***	0.068***	0.066***	0.066***	0.056***	0.072***	0.072***
	(3.95)	(3.71)	(4.49)	(4.39)	(4.33)	(3.70)	(4.77)	(4.75)
Constant	118.1***	120.5***	118.0***	117.8***	103.1***	119.9***	88.8***	105.6***
	(30.58)	(31.42)	(30.33)	(30.39)	(18.30)	(21.01)	(14.45)	(19.04)
Time Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1680	1680	1680	1680	1680	1680	1680	1680
Adj. R ²	0.584	0.591	0.580	0.582	0.587	0.591	0.589	0.584
F-statistics	215.22***	221.37***	212.05***	213.85***	199.87***	202.80***	201.70***	197.81***

^aTE: Tax evasion.

^b"Egovernment_ave" was generated by taking the arithmetic average of the five items: EParticipation, GovPolStab, GovRespCha, LegalFrame, and GovernVision.

t-statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

4.4. Moderation analysis

The results of the moderation analysis are documented in [Table 6](#). The moderating effect of QuaEduSys, QuaMath, QuaManSch, and InterConnect on the relationship between Egovernment_ave and TaxEvasion are examined. Egovernment with a composite score based on the average of the five sub-dimensions of Egovernment is subjected to the analysis. Time fixed-effects regression analysis for panel data is employed to determine the significance of the interaction variables.

Accordingly, the results showed that the moderating effect of QuaEduSys on the relationship between Egovernment_ave and TaxEvasion is significant because the interaction term “Egovernment_ave X QuaEduSys” is both significant and negative ($p < 0.01$, Column #5). Thus, the moderating role of education quality between e-government and tax evasion is confirmed, thereby validating H2a. In addition, the moderating effect of QuaMath on the relationship between Egovernment_ave and TaxEvasion is not significant as the coefficient of the interaction term “Egovernment_ave X QuaMath” is not significant ($p > 0.05$, Column #6). Thus, the moderating role of math education quality between e-government provision and tax evasion is not validated, thus rejecting H2b. Furthermore, the moderating effect of QuaManSch and InterConnect between Egovernment_ave and TaxEvasion is statistically significant. The coefficients of the interaction variables “Egovernment_ave X QuaManSch” ($p < 0.01$, Column #7) and “Egovernment_ave X InterConnect” ($p < 0.01$, Column #8) are significant and negative. Hence, the moderating role of business management school quality between e-government services and tax evasion is confirmed, thereby validating H2c. Finally, the moderating role of internet connection in schools between e-government and tax evasion is confirmed, validating H3.

4.5. Checking the robustness of the findings

Two further analyses are performed for examining the robustness of the baseline analysis results. First, the moderation analysis is re-examined using an alternative independent test variable. Thus, the alternative independent test variable, EGovernment_fact, is used in the proposed model ([Table 7](#)) for the robustness check of the moderation analysis. The results show that QuaEduSys (Egovernment_fact X QuaEduSys), QuaManSch (Egovernment_fact X QuaManSch), and InterConnect (Egovernment_fact X InterConnect) are significant moderators in the relationship between EGovernment_fact and TaxEvasion as the coefficients of the interaction variables are statistically significant. Furthermore, QuaMath is not a significant moderator (in line with the baseline analysis) in the relationship between Egovernment_fact and TaxExasion, as the coefficient of the interaction term (Egovernment_fact X QuaMath) is not statistically significant. All interaction effects are parallel to the baseline analysis reported earlier in [Table 6](#).

Second, the baseline research models ([Table 5](#)) are subject to robustness check by using the country fixed-effect regression analysis. The results are provided in [Table 8](#). Accordingly, the coefficients of Egovernment based on sum, average, weighted, and factor scores are significant and negative ($p < 0.01$) which are in line with the baseline findings reported in [Table 5](#).

5. Discussion and conclusion

As technological advancements have penetrated almost all aspects of daily life, this research sought to determine whether such progress has provided solutions to social issues, such as tax evasion. More specifically, the study examined whether e-government services reduce the prevalence of tax evasion. Importantly, the study also investigated whether education quality as captured by three proxies and internet connection in schools strengthens the negative relationship between e-government services and tax evasion, presuming that education quality may hasten and facilitate the adoption of technological tools and the use of online public services and may also improve tax compliance by fostering moral values and citizenship duties. Finally, the study

Table 7. Alternative calculations of “Egovernment” based on predicted factorial scores after EFA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Independent variables	TE ^b	TE	TE	TE	TE	TE	TE	TE
Egovernment_fact ^a	-1.72*** (-6.69)	-1.79*** (-7.52)	-2.03*** (-8.45)	-1.90*** (-7.80)	0.79 (0.99)	-2.14** (-2.47)	3.87*** (3.93)	-0.13 (-0.16)
QuaEduSys	-1.19*** (-4.21)				-1.13*** (-4.00)			
QuaMath		-1.72*** (-6.87)				-1.72*** (-6.81)		
QuaManSch			-0.77** (-2.48)				-0.71** (-2.34)	
InterConnect				-0.89*** (-3.83)				-0.94*** (-4.06)
Egovernment_fact*QuaEduSys					-0.68*** (-3.31)			
Egovernment_fact*QuaMath						0.088 (0.42)		
Egovernment_fact*QuaManSch							-1.42*** (-6.18)	
Egovernment_fact*InterConnect								-0.43** (-2.46)
AgriVal	-0.20*** (-5.17)	-0.19*** (-4.97)	-0.21*** (-5.47)	-0.21*** (-5.45)	-0.16*** (-4.20)	-0.19*** (-4.94)	-0.14*** (-3.67)	-0.18*** (-4.50)
FDInet	0.017 (0.58)	0.013 (0.47)	0.016 (0.56)	0.010 (0.35)	0.010 (0.36)	0.014 (0.49)	0.011 (0.37)	0.0056 (0.19)
LnGDP	-5.87*** (-18.19)	-5.65*** (-17.65)	-6.01*** (-18.50)	-5.82*** (-17.66)	-5.64*** (-17.16)	-5.66*** (-17.55)	-5.60*** (-17.10)	-5.63*** (-16.65)
GovExp	-0.41*** (-9.87)	-0.39*** (-9.56)	-0.42*** (-10.02)	-0.41*** (-9.86)	-0.41*** (-9.94)	-0.39*** (-9.53)	-0.40*** (-9.80)	-0.41*** (-9.86)
Inflation	-0.0099 (-0.24)	-0.022 (-0.55)	-0.015 (-0.35)	-0.022 (-0.54)	-0.0071 (-0.17)	-0.023 (-0.56)	-0.026 (-0.63)	-0.021 (-0.51)
LnPop	-1.44*** (-10.59)	-1.43*** (-10.58)	-1.38*** (-9.94)	-1.41*** (-10.30)	-1.39*** (-10.18)	-1.44*** (-10.50)	-1.28*** (-9.25)	-1.37*** (-9.94)
PrimEduc	0.16	-0.21	0.16	-0.041	0.25	-0.22	0.31	0.081

(Continued)

Table 7. (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(0.72)	(-0.93)	(0.69)	(-0.19)	(1.13)	(-1.00)	(1.38)	(0.36)
Trade	-0.029*** (-6.18)	-0.025*** (-5.30)	-0.031*** (-6.47)	-0.028*** (-5.79)	-0.025*** (-5.18)	-0.026*** (-5.18)	-0.024*** (-4.97)	-0.024*** (-4.89)
UrbPop	0.061*** (4.00)	0.056*** (3.74)	0.068*** (4.51)	0.066*** (4.40)	0.067*** (4.40)	0.055*** (3.63)	0.074*** (4.92)	0.072*** (4.71)
Constant	112.9*** (27.76)	114.9*** (28.39)	111.8*** (27.38)	111.9*** (27.49)	108.7*** (25.59)	115.4*** (27.46)	104.4*** (24.79)	108.5*** (25.30)
Time-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1680	1680	1680	1680	1680	1680	1680	1680
Adj. R ²	0.586	0.593	0.583	0.585	0.588	0.593	0.592	0.586
F-statistics	216.70***	223.14***	214.18***	216.05***	200.74***	204.46***	203.90***	199.14***

^a"Egovernment_fact" is obtained by generating factor scores based on Regression method for the following items: EParticipation, GovPolStab, GovRespCha, LegalFrame, and GovernVision.

^bTE: Tax evasion.

t statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

Table 8. Country fixed-effect regression analysis

	(1)	(2)	(3)	(4)
Independent Variable	TE ^e	TE	TE	TE
Egovernment_sum ^a	-0.14*** (-15.72)			
Egovernment_ave ^b		-0.68*** (-15.72)		
Egovernment_weighted ^c			-0.68*** (-15.72)	
Egovernment_fact ^d				-9.64*** (-15.72)
AgrVal	0.10*** (3.98)	0.10*** (3.98)	0.10*** (3.98)	0.10*** (3.98)
FDInet	-0.0081 (-1.12)	-0.0081 (-1.12)	-0.0081 (-1.12)	-0.0081 (-1.12)
LnGDP	-9.62*** (-22.24)	-9.62*** (-22.24)	-9.62*** (-22.24)	-9.62*** (-22.24)
GovExp	0.27*** (13.24)	0.27*** (13.24)	0.27*** (13.24)	0.27*** (13.24)
Inflation	0.022** (2.01)	0.022** (2.01)	0.022** (2.01)	0.022** (2.01)
LnPop	-4.27*** (-6.10)	-4.27*** (-6.10)	-4.27*** (-6.10)	-4.27*** (-6.10)
PrimeEduc	-0.72*** (-3.00)	-0.72*** (-3.00)	-0.72*** (-3.00)	-0.72*** (-3.00)
Trade	-0.033*** (-9.48)	-0.033*** (-9.48)	-0.033*** (-9.48)	-0.033*** (-9.48)
UrbPop	0.013 (0.41)	0.013 (0.41)	0.013 (0.41)	0.013 (0.41)
Constant	206.0*** (17.37)	206.0*** (17.37)	204.4*** (17.35)	170.5*** (16.69)
Country—effect	Yes	Yes	Yes	Yes
N	1680	1680	1680	1680
Adj. R ²	0.984	0.984	0.984	0.984
F-stat.	684.86***	684.86***	684.86***	684.86***

^a“Egovernment_sum” obtained by adding the values of the five items.

^b“Egovernment_ave” generated by taking the arithmetic average of the five items.

^c“Egovernment_weighted” was obtained by taking the weighted average of the items using the values of the factor loadings as the corresponding weights.

^d“Egovernment_fact” obtained by generating factor scores based on the regression method.

^eTax evasion.

t-statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$.

sought to determine whether internet connection in schools also corroborated the negative relationship between e-government services and tax evasion. This was based on the assumption that internet connection enhances the familiarity of younger generations with digital applications and lessens the digital “divide” in society when such internet connection is fairly and equitably distributed.

The results confirmed the significant role of e-government services in mitigating tax evasion. As the aggregate proxy of e-government was based on five sub-proxies of e-government, they are all potentially useful for reducing tax evasion. Hence, it can be argued that a government’s long-term vision, online service delivery, stable business policies, quick response to technological changes, and formulation of a regulatory framework for digitalization in business transactions all mitigate tax evasion (Uyar et al., 2021). The moderating role of education quality on the negative relationship between e-government initiatives and tax evasion provides further insights into how to curb tax evasion, as documented below. This finding confirms that innovation and modernization theories well explain the effect of technology and digitalization on tax evasion (Bhuasiri et al., 2016; Uyar et al., 2021). The results also might imply the taxpayers’ positive attitude towards e-tax systems (Denison et al., 2013; Kimathi et al., 2019) and enhanced efficiency of e-payment and e-tax filing systems in collecting tax revenues (Bhuasiri et al., 2016).

The details of the moderation analysis revealed that while overall education quality and the quality of business management schools strengthen the negative association between e-government services and tax evasion, the quality of math education does not. The positive moderating role of overall education quality is attributable to the role of education in knowledge enrichment (Wu & Liu, 2021), increased comprehension among students about the causes and consequences of tax evasion (Chan, 2019), and enhanced appreciation of citizenship duties (Rasmussen & Nørgaard, 2018). More importantly, the quality of business management schools helps to achieve greater benefits from e-government initiatives with respect to reducing tax evasion. This outcome confirms the findings and propositions of prior studies that graduates of business management schools are better equipped with both technical taxation knowledge and digital skills, which in turn helps them take advantage of e-government services (Kwok & Yip, 2018; Hassan et al., 2016). The insignificance of math education could be attributable to the fact that e-government services often offer form-filler programs and user interfaces aimed at reducing the burden of performing manual calculations for taxpayers, unlike manual paper-based tax filing systems. Overall, our evidence based on the moderating effect of education quality between e-government and tax evasion expands prior studies that examined the direct effect of education on tax evasion and found inconclusive results (Chan et al., 2000; Kwok & Yip, 2018; Wärneryd & Walerud, 1982).

Finally, internet connection in schools also reinforces the negative association between e-government and tax evasion. This highlights that increased investment in internet service in schools not only leads to improvements in academic performance (Chen et al., 2021) but also enriches the next generation’s ability to get acquainted with digital services in the public domain. As digitalization is increasingly permeating all domains of life, giving young generations the means and opportunity to become better acquainted with cutting-edge technologies, the internet, and mobile applications, among other programs and services, at earlier ages will help to ensure their proficiency in e-government services at later ages. Internet connection in schools could also help to eliminate access and skills divides by providing all students with equal access to digital tools and software (Arakpogun et al., 2020; Bélanger & Carter, 2009; Shakina et al., 2021). This will in turn allow all students to become equally familiar with online public services as well as other programs and services.

The following section suggests some theoretical and practical implications of the digitalization of government services, improved education quality, and equal internet connection in schools in combatting tax evasion.

6. Implications and future research avenues

The first theoretical implication of this study is that the interplay between institutional theory and modernization theory sheds light on the role of e-government initiatives in reducing the prevalence of tax evasion as moderated by education. Second, in line with institutional theory, education improves the behavior of taxpayers (Caprini and Kateer, 1996; Nie et al., 1996) by boosting their knowledge about and comprehension of taxation issues. And, in line with modernization theory (Barker, 2003), the extent to which digitalization is incorporated in schools will determine the degree to which younger generations become acquainted with e-government services. Third, the negative association between e-government and tax evasion confirms one main postulate of modernization theory (Uyar et al., 2021): that innovation in public services generates substantial social benefits, including reducing the prevalence of tax evasion.

Furthermore, the study offers some practical implications for public administrations, education systems, ICT adoption, and internet connection in schools. For public administrations, the results suggest that a future-oriented and long-term vision on the part of a government can accelerate and strengthen the leveraging of online services in the public domain for enhancing tax compliance. Although such initiatives typically demand massive investments in cutting-edge technologies at earlier stages, they essentially pay for themselves by promoting greater tax compliance and consequently reducing tax evasion. These implications are of critical importance to underdeveloped and developing countries, where tax evasion is a significant problem while the adoption of technology has thus far proceeded very slowly.

Moreover, the findings suggest that education quality plays a complementary role in increasing tax compliance through the provision of online public services. This in turn suggests that education system designers and educators should formulate education policies by incorporating subjects related to tax and public administration and by considering such subjects when developing curricula. They could also more strongly emphasize morality and social and cultural values, focus on the drawbacks and adverse consequences of tax evasion, and more fully discuss the benefits of tax compliance for society. The insignificance of math education quality could be attributable to the facilitative role of online services in tax filing. Although traditional paper-based taxation systems may require some computational skills, e.g. calculating deductions and taxable income, online services increasingly offer more user-friendly interfaces for tax filling purposes. Hence, these developments render computational skills unnecessary to some extent.

Furthermore, considering the *t*-statistics in regression outputs, the quality of business management schools had the greatest moderating effect between e-government services and tax evasion, which suggests that management schools should incorporate e-government and taxation subjects into their curricula if they have not done so already. While teaching about how public administration and the taxation system work is indisputably important, it is also imperative to adopt technological tools and solutions and to help students become more familiar with cutting-edge technologies and their value for sponsoring innovations in public services. Doing so may also help students develop their own innovations in the public domain and thereby further advance e-government initiatives and services. Finally, the ICT infrastructure in schools as well as sufficient and reliable internet access are of vital importance for reducing tax evasion through e-government initiatives. This is because students will be able to use such technology to become more familiar with online applications and interfaces, including ways in which information can be retrieved and e-applications can be completed.

As the study period was restricted to 2006 through 2017, caution should be exercised when seeking to generalize the findings. This is primarily because public administration, tax evasion, and control variables change over time. Future research avenues include employing some other moderating variables. For example, investigating the moderating role of freedom of the press, the Human Development Index (HDI), and globalization in the relationship between e-government services and tax evasion could yield further insights into how tax evasion could be reduced even further.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Citation information

Cite this article as: E-government, education quality, internet access in schools, and tax evasion, Khalil Nimer, Ali Uyar, Cemil Kuzey & Friedrich Schneider, *Cogent Economics & Finance* (2022), 10: 2044587.

Notes

1. TaxEvasion had 72 (4.26%) country-year missing values. LegalFrame had 48 (2.84%) and GovernVision had 12 (0.71%) missing values as the sub-dimensions of Egovernment. QuaEduSys, QuaMath, QuaManSch, and InterConnect as the moderating variables each had 115 (6.8%) missing values. Among the control variables, the following missing values were identified: AgricVal had 34(2.01%), FDI had 17(1%), GDPperCap had 15 (0.89%), GovExp had 55 (3.25%); Inflation had 44 (2.60%); Population, UrbPop, and PrimEduc had 12 (0.71%); and Trade had 46 (2.72%) country-year missing values.
2. The final sample size and the distribution of the sample over the observation period were as follows: 139 country-year records in 2010 and 2015; 140 country-year records in 2006, 2007, 2009, 2011, 2012, 2013, 2014, and 2017; and 141 country-year records in 2008 and 2016.
3. The three post-estimation tests are used to choose the correct estimator (fixed-effects, random-effects, or ordinary regression). Accordingly, the results of the F-test indicate that fixed-effects is a more suitable method than ordinary regression. Likewise, the LM test shows that random-effects is more suitable than ordinary regression. Subsequently, Hausman's test

(Hausman, 1978) results reveal that fixed-effects is a more suitable approach than the random-effects approach.

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Appendix A Table A1. Mean TaxEvasion and Egoovernment values of the countries		
Country	TaxEvasion	Egoovernment
Albania	27.88	49.80
Algeria	29.15	38.13
Angola	38.52	33.18
Argentina	23.11	44.34
Armenia	38.07	52.40
Australia	10.67	62.67
Austria	7.07	66.62
Azerbaijan	46.80	69.82
Bahrain	15.04	69.74
Bangladesh	29.80	53.61
Barbados	27.38	55.65
Belgium	16.61	52.94
Benin	46.16	45.18
Bolivia	56.84	30.31
Bosnia and Herzegovina	30.30	23.79
Botswana	25.51	46.66
Brazil	32.60	42.36
Brunei Darussalam	26.14	53.08
Bulgaria	25.33	52.24
Burkina Faso	32.98	47.41
Burundi	35.01	42.57
Cabo Verde	28.10	47.01
Cambodia	45.91	37.71
Cameroon	28.10	41.44
Canada	11.90	65.02

(Continued)

Appendix A Table A1. (Continued)		
Country	TaxEvasion	Egovernment
Chad	37.39	26.21
Chile	15.34	61.61
China	12.06	63.17
Colombia	28.73	50.94
Congo, Dem. Rep.	45.51	24.04
Costa Rica	22.41	49.21
Cote d'Ivoire	34.62	42.39
Croatia	23.85	33.55
Cyprus	25.29	54.68
Czech Republic	12.73	44.01
Denmark	11.96	71.94
Dominican Republic	29.35	46.88
Ecuador	30.98	38.58
Egypt	31.10	53.02
El Salvador	40.88	28.81
Estonia	21.03	60.39
Eswatini	38.28	39.15
Ethiopia	30.83	44.05
Finland	10.84	77.43
France	11.55	64.88
Gabon	48.44	35.22
Gambia	45.05	50.09
Georgia	56.24	50.19
Germany	9.92	69.90
Ghana	35.80	52.20

(Continued)

Appendix A Table A1. (Continued)		
Country	TaxEvasion	Egovernment
Greece	23.26	35.49
Guatemala	46.56	35.42
Guinea	33.41	44.98
Haiti	49.50	25.47
Honduras	44.80	44.94
Hong Kong SAR	13.30	72.72
Hungary	20.24	47.67
Iceland	12.29	61.13
India	20.43	65.78
Indonesia	22.13	60.46
Iran, Islamic Republic	15.40	34.81
Ireland	11.43	67.22
Israel	18.57	63.11
Italy	19.91	42.22
Jamaica	32.36	44.91
Japan	10.68	67.54
Jordan	15.05	51.26
Kazakhstan	35.21	60.27
Kenya	28.37	55.64
Korea, Rep.	23.65	62.76
Kuwait	16.67	53.04
Kyrgyz Republic	31.36	41.41
Lao PDR	26.92	45.16
Latvia	19.43	45.61
Lebanon	28.75	32.58

(Continued)

Appendix A Table A1. (Continued)		
Country	TaxEvasion	Egovernment
Lesotho	27.99	36.90
Lithuania	22.24	52.05
Luxembourg	8.52	83.65
Madagascar	37.95	33.86
Malawi	32.73	33.01
Malaysia	28.71	74.62
Mali	33.71	35.41
Malta	22.55	65.61
Mauritania	29.78	18.59
Mauritius	19.79	56.78
Mexico	28.24	50.11
Moldova	38.66	44.83
Mongolia	15.45	36.78
Montenegro	27.38	56.78
Morocco	30.15	57.29
Mozambique	34.24	35.04
Namibia	24.42	49.69
Nepal	34.47	43.91
Netherlands	9.01	73.86
New Zealand	10.46	68.89
Nicaragua	37.66	33.88
Nigeria	52.67	34.94
North Macedonia	27.38	39.80
Norway	11.38	69.98
Oman	15.30	72.75

(Continued)

Appendix A Table A1. (Continued)		
Country	TaxEvasion	Egovernment
Pakistan	31.57	49.50
Panama	27.38	47.64
Paraguay	32.57	39.10
Peru	47.72	45.63
Philippines	37.11	55.28
Poland	20.92	47.41
Portugal	17.73	54.25
Qatar	15.22	71.76
Romania	25.25	43.81
Russian Federation	36.04	56.71
Rwanda	30.65	72.81
Saudi Arabia	13.96	74.93
Senegal	39.67	53.19
Serbia	27.38	51.51
Seychelles	27.38	61.48
Singapore	10.33	87.74
Slovak Republic	13.34	42.96
Slovenia	20.46	50.32
South Africa	24.34	48.67
Spain	20.61	52.71
Sri Lanka	41.00	44.41
Sweden	10.34	67.20
Switzerland	5.46	74.32
Taiwan	25.29	56.87
Tajikistan	37.55	55.74

(Continued)

Appendix A Table A1. (Continued)		
Country	TaxEvasion	Egovernment
Tanzania	50.28	53.94
Thailand	45.57	50.64
Trinidad and Tobago	30.70	38.24
Tunisia	31.28	44.00
Turkey	27.77	56.55
Uganda	31.25	51.46
Ukraine	39.87	43.03
United Arab Emir	22.73	80.94
United Kingdom	9.59	66.60
United States	6.69	76.67
Uruguay	39.20	55.01
Venezuela	31.78	14.96
Vietnam	15.31	52.88
Yemen	23.57	17.00
Zambia	39.45	41.29
Zimbabwe	49.61	29.19



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