

E-government and corporate tax planning: Evidence from a global sample[★]

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Panagiotis Karavitis

University of Glasgow, Adam Smith Business School

Pantelis Kazakis

University of Glasgow, Adam Smith Business School

Niswatil Mouna

University of Glasgow, Adam Smith Business School

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* Authors' information. — Karavitis, Kazakis, and Mouna are with the University of Glasgow, Adam Smith Business School, University Avenue, Gilbert Scott Building, G12 8QQ, Glasgow, United Kingdom. Their e-mail addresses are Panagiotis.Karavitis@glasgow.ac.uk, Pantelis.Kazakis@glasgow.ac.uk, and n.mouna.1@research.gla.ac.uk.

E-government and corporate tax planning: Evidence from a global sample

Abstract:

This study investigates the impact of e-government on a firm's tax planning activities. We argue that e-government adoption not only mitigates unnecessary bureaucracy and accelerates public services but also, importantly, improves the government's monitoring ability against corporate tax misconduct. More precisely, we expect that a higher level of government digitalization will enhance the government's ability to reduce the firms' tax avoidance and corporate tax aggressiveness vis-à-vis their industry peers. Using worldwide firm-level accounting information for 12,200 businesses in 94 countries from 2008 to 2021, our baseline results confirm our hypothesis that the adoption of e-government has a positive relationship with the firm's GAAP (cash) effective tax rate, indicating that e-government reduces tax avoidance. Our findings further suggest that e-government adoption enhances the monitoring ability of the government to identify firms' aggressive tax behaviour, as shown by the positive effect of e-government on the effective tax rate difference between a firm and its industry peers. The results are robust to a series of sensitivity tests that use the long-run GAAP (cash) effective tax rate, the lag of the variable of interest, various fixed effects, as well as instrumental variable estimation to further mitigate concerns for omitted factors. The findings suggest that e-government not only alleviates firms' tax avoidance but also makes it easier for the government to focus on the most tax-aggressive firms in an industry (i.e., larger effective tax rate differences between firms vis-à-vis industry peers). Moreover, we find that the negative relationship is attenuated by industry-level market competition.

Keywords: Tax avoidance; Tax aggressiveness; Digitalization; E-government; Digital government; Market Competition

1. Introduction

The digital economy permits modern corporations to fully operate either in their domestic country or to other countries, even without physical presence taking advantage of their markets. This can potentially lead them to tax favourable outcomes that would be much more difficult and costly to devise in most traditional economy contexts. In this research, we investigate the impact that e-government (also known as digitalization of government or digital government, the term will be used interchangeably) has on firms' tax planning activity. Government has a legitimate power to alleviate tax avoidance and to punish tax avoiders with hefty taxes and penalties. Nevertheless, government's monitoring ability to identify tax avoider firms is still disputed, particularly given the limited resources available for this purpose. The implementation of technology infrastructure and ubiquitous usage of Information and Communication Technology (ICT) in digitalization of government services is expected to assist the government in curbing tax aggressiveness (Uyar et al., 2021, Alm and Liu, 2017).

The COVID-19 crisis in 2020 worked as a catalyst, pushing governments worldwide to accelerate their digitalization. The 2020 United Nations E-Government Surveys indicate a persistently

positive trend toward a higher level of e-government adoption across member states, as indicated by a 43% increase of countries in the very-high e-government index and a 50% reduction of countries in the low e-government index compared to the previous period (UNDESA, 2020). At the same time, governments boost their spending on digital infrastructures to enable digital transformation, and it is projected that worldwide spending on information technology will exceed the threshold of 200 billion U.S. dollars in 2022, up 10% from 2021 (Gartner, 2022). In this study, we argue that a government's digitalization not only mitigates unnecessary bureaucracy and accelerates public services but also, and this is important, improves the government's monitoring ability against corporate tax misconduct. More precisely, we expect that a higher level of government digitalization will enhance the government's ability to reduce tax avoidance.

In recent years, research on tax planning has progressed significantly, but empirical research on its relationship with digitalization remains scarce. Previous research mainly focused on the effect that firms' information and technology (IT) infrastructure has on corporate tax planning. Klassen et al. (2014) and Argilés-Bosch et al. (2020) find that electronic commerce (e-commerce) firms systematically exhibit lower effective tax rates. In addition, Klein et al. (2021) investigate the firm's internal digitalization and find that highly digitalized firms shift income more aggressively. Regardless of the limited empirical evidence, the results point in the same direction, indicating that the digitalization of a firm seems to support tax planning strategies.

In this study, our focus is on the governments' level of digitalization. We examine the effect of e-government on firms' tax planning activities. This is an important research question that can help policymakers evaluate the role that a government's digitalization has on the mitigation of corporate tax aggressiveness. To this end, we ask whether government digitalization affects firms' tax avoidance and corporate tax aggressiveness as captured by the comparison of a firm's tax planning with its peers (see, e.g., Balakrishnan et al., 2019). According to the underlining mechanism of this study, a higher e-government level will improve the general governments' monitoring ability. Given that the majority of transactions are now digitally recorded, a higher government's digitalization level will make easier the monitoring and identification of tax avoiders and tax aggressive firms or industries.

Additionally, the study also examines the moderating effect of market competition in the association between e-government and corporate tax planning. A highly competitive market indicates there are more players in the industry, resulting in a less concentrated industry. In this type of market, competition can either motivate them to innovate to survive (Porter, 1990) or, in contrast, induce them to conduct an earnings manipulation to allow the firm extra cash for competing with rivals (Shleifer, 2014). In addition, based on the mimicking arguments, players in a competitive market also tend to follow the behaviour of their market leaders (Kubick et al., 2015). On the contrary, a less competitive market (a more concentrated market), with only one or a few powerful firms to control the market, has the advantage of stable profitability and insulation from competitive threats (Peress, 2010, Kubick et al., 2015). Previous studies have observed the direct effect of market competition on tax avoidance (Cai

and Liu, 2009; Kubick et al., 2015); or market competition and digitalization (Wang and Zhang, 2015; Wen et al., 2022). However, the indirect effect of market competition on the association between e-government and corporate tax planning is yet to be discussed. We conjecture that the effect of e-government on corporate tax planning will be different based on the degree of market competition. However, due to the mixed findings of previous studies on market competition and tax avoidance, we do not expect a certain direction for our interaction coefficient.

Following the United Nations, we define e-government as the government's use of information and communication technology (ICT) to disseminate information and provide public services (see United Nations, 2005). Tax avoidance is broadly defined as any actions taken to reduce the firm's tax liability (Dyreng et al., 2008; Hanlon and Heitzman, 2010). Meanwhile, to separate it from “ordinary” tax avoidance activity, tax aggressiveness is defined as the downward management of taxable income through tax-planning activities and is best defined by comparing firms with their peers (Rego and Wilson, 2012; Richardson et al., 2014; Balakrishnan et al., 2019).

We used firm-level accounting information from Compustat for 12,200 businesses in 94 countries from 2008 to 2021. In line with Klein et al. (2020), we exclude the utility sectors (SIC codes 4900–4999) and the financial services sectors (SIC codes 6000–6799) because they are subject to different regulations. We also eliminate negative pre-tax income and negative tax expense or cash taxes because it is difficult to interpret effective tax rates for loss firms (Beer et al., 2018; Chen et al., 2019). We measure firms' tax avoidance using annual GAAP and the cash effective tax rate (ETR) (Hasan et al., 2014; Klassen et al., 2014; Lanis and Richardson, 2015; Graham et al., 2017; Argilés-Bosch et al., 2020). In addition, we construct three-year long-run GAAP and cash ETR as an alternative to overcome significant year-to-year volatility of annual ETR (Dyreng et al., 2008).

Additionally, we measure the tax aggressiveness of firms relative to their industry counterparts, as firms frequently compare their ETRs to those of their industry peers. We do so by estimating the absolute ETR difference between a firm's ETR and the average industry ETR using annual and long-run GAAP and cash ETR (Balakrishnan et al., 2019, Klein et al., 2020). We opt to use the absolute value instead of the simple difference due to the nature of our research question. The greater the difference between a firm's ETR and that of its industry peers, the easier it will be for the government to identify the aggressiveness level of each firm. From a government perspective, the lower the absolute value, the more difficult it is to identify tax-aggressive firms or industries, as they are all at the same ETR level, and vice versa. We predict that the increase in e-government adoption will have a positive correlation with ETR difference, enabling governments to identify the firm or industry with the highest absolute ETR difference. Our specifications include a variety of fixed effects, including firm, industry, year, and country, as well as clustered standard errors at firm.

The results confirm our hypothesis that the adoption of e-government has a positive relationship with the firm's annual GAAP ETR and cash ETR, indicating that e-government reduces tax avoidance. Qualitatively similar are the results when we use long-run GAAP and cash ETR to overcome significant

year-to-year volatility. Alternately, we employ a one- and two-year lag of the variable of interest to forecast if the effect of e-government adoption is not directly reflected in the change of ETR in the current year but rather in the subsequent year, and our results are robust enough to confirm the prediction. These results are robust when using various types of fixed effects to control for unobserved heterogeneity as well as using country-control variables and instrumental variable estimation to further mitigate concerns for omitted factors.

We next find that e-government adoption has a positive effect on the annual GAAP ETR difference and cash ETR difference, indicating that e-government adoption enhances the monitoring ability of a government to identify firms' tax aggressive behaviour. The results are robust to a series of sensitivity tests that use long-run GAAP (cash) ETR, the lag of the variable of interest, various fixed effects, as well as the use of instrumental variable estimation to further mitigate concerns for omitted factors.

We also find that the interaction between e-government and market competition has a negative effect on the annual GAAP ETR. It indicates that the effect of e-government adoption as a tool to reduce tax avoidance is less prominent in a less competitive market, as can be seen from the reduction in the firm's ETR. Similar results also happen when we examine the interaction between e-government and market competition on the annual GAAP ETR difference. These indirect effects of market competition confirm [Kubick et al.'s \(2015\)](#)

findings on the direct effect of market competition on tax avoidance, where a more concentrated market has an incentive to engage in tax avoidance. The results are robust when we use alternative proxies for market competition, different dependent variables, sub-indices of the e-government index, and a one-year and two-year lag of variable of interest. These results are significant because it shed a light that in order to alleviate the corporate tax avoidance, governments need to address pressing market anti-competitive issues afflicting their economies and enact antitrust legislation above and beyond e-government adoption.

In light of the rising importance of global efforts to combat tax avoidance and tax aggressiveness, the findings contribute to the literature on e-government and tax avoidance by providing evidence about the relationship between e-government adoption and tax avoidance and aggressiveness. We expand the literature on the determinants of tax avoidance by bringing to the fore the role of ICT investment. Second, we demonstrate that investments in information and communication technologies (ICTs) assist the government in tracking down tax-evading companies and industries. Consequently, ICT investment can be a very effective tool for combating serial tax avoiders. Finally, we prove that lowered market competition impedes government efforts to combat tax avoidance. In addition to investing in ICT, governments should strive to establish the necessary market conditions and antitrust policies if they wish to reduce firms tax avoidance.

The remainder of this research is organised as follows: Section 2 sets the context by reviewing the literature and providing testable hypotheses. Section 3 explains the research design and presents the

dataset. Section 4 analyses the empirical findings and robustness tests. Section 5 presents the conclusions.

2. Prior Research and Hypotheses Development

2.1. E-government and Firm's Tax Planning

"Tax avoidance" and "tax aggressiveness" are related terms that describe the legal tax planning activities undertaken by businesses to reduce their tax bills. [Hanlon and Heitzman \(2010\)](#) view tax avoidance as a continuum of tax planning strategies, with legitimate tax avoidance at one end and tax aggressive behaviour, evasion, sheltering, and noncompliance at the other. Tax avoidance is broadly defined as any financial-related actions taken to reduce a company's tax liability ([Hanlon and Heitzman, 2010](#); [Wang et al., 2020](#); [Dyreng et al., 2008](#); [Cooper and Nguyen, 2020](#)). To distinguish tax aggressiveness from "ordinary" tax avoidance, it is defined as the downward management of taxable income through tax-planning activities, which may include prohibited activities. It is best defined as risky tax avoidance by comparing more aggressive firms to their peers ([Slemrod, 2004](#); [Balakrishnan et al., 2019](#); [Richardson et al., 2014](#); [Rego and Wilson, 2012](#)). Firms may adjust their tax position in relation to their peers by shifting the tax rate in the same direction as their peers and attempting not to deviate significantly from them to increase their legitimacy and survival prospects, avoid being perceived as a tax-aggressive firm, or for managerial career considerations ([Kubick et al., 2015](#); [Armstrong et al., 2019](#); [Klein, 2022](#); [Bird et al., 2018](#); [Chyz and Gaertner, 2018](#)). This type of behaviour enables firms to maintain their relative performance with rivals when compared on after-tax performance benchmarks ([Chen and Macmillan, 1992](#); [Genesove and Mullin, 2001](#)).

The significance of tax avoidance and tax aggressiveness is primarily debated from the corporation's perspective. Profit maximisation framework asserts that a company engages in tax planning to reduce its tax obligations to the government and increase shareholder wealth. However, tax planning is not always executed in consideration of cost-related factors, such as future anticipated audits and penalties by the government, potential tax-related agency conflicts, or a decrease in the firm's accountability and transparency ([Balakrishnan et al., 2019](#)). The issue of tax avoidance and tax aggressiveness is becoming more pervasive in the era of digitalization as the world becomes more digitally interconnected. Prior empirical research indicates that IT and ICT infrastructures facilitate tax planning strategies for businesses. [Klassen et al. \(2014\)](#) and [Argilés-Bosch et al. \(2020\)](#) find that firms engaged in electronic commerce (e-commerce) exhibit consistently lower effective tax rates. In addition, [Klein et al. \(2021\)](#) investigate the firm's internal digitalization and find that highly digitalized firms shift income more aggressively. investigate the firm's internal digitalization and find that highly digitalized companies shift income more aggressively. Regardless of the limited empirical evidence, the results indicate that the digitalization of a company appears to facilitate tax planning strategies.

However, tax avoidance is not only an important matter for firms but also for the government as a tax collector because corporate income tax is one of the most important sources of revenue, particularly in developing economies¹ (OECD, 2022). Under institutional theory, government has a legitimate power to regulate the citizen's behaviour, including increasing the taxpayers' compliance and exacerbating the firms' incentives for tax avoidance and tax aggressiveness (Meyer and Rowan, 1977; Scholes et al., 2014). Using this power, the government can scrutinise taxpayers and punish tax avoiders and tax aggressive firms through extra taxes with interest and penalties. As a consequence, firms' cash flow decreases, which then affects shareholders' wealth and firms' value in the long run (Klein, 2022; Hoopes et al., 2012).

The government also embodied the digitalization of its organizations. The digitalization of government (e-government) is an outward-looking framework to perceive how the government agencies utilise information and communication technology to interact with citizens, businesses, and other governmental organisations in the delivery of public services (Das et al., 2017, Elbahnasawy, 2021). Perceiving digital government as a whole system within a country is an important shift of paradigm, because as the digital economy keeps advancing, the government services are becoming more connected each day, and the exchange of information among each government service and between government and firms or people is becoming inevitable.

Weber's modernization theory² argues that improvements in technology can influence social change (Nam, 2018). The influence of e-government can be immediate or indirect (MacLean and Titah, 2022). In this context, governments equipped with more advanced technological infrastructures, expanded internet access, and ubiquitous ICT usage are immediately benefited by increasing efficiency, productivity, and capacity through automation and data-driven management, which in the longer term can lead to an increase in revenue and growth (World Bank, 2016; Kochanova et al., 2020; Niebel, 2018; Campbell and Hanschitz, 2018, MacLean and Titah, 2022). It also influences the bureaucracy by either reduce, optimize, or modernizes the bureaucracy from street-level to system-level (Welch and Pandey, 2006; Ahn and Bretschneider, 2011; Cordella and Tempini, 2015). Another benefit of e-government is an improvement in transparency, fairness, and trust from businesses and people (i.e., through the availability of a data exchange platform between tax administrators and firms) (Nataliia and Inna, 2021; United Nations, 2018; Campbell and Hanschitz, 2018; Devereux and Vella, 2018). In longer term, higher e-government adoption could lead to social changes such as lower incentives for the informal economy, tax evasion, and corruption (Uyar et al., 2021; Elbahnasawy, 2021).

¹ Average corporate tax revenues as a share of total tax revenues were 12.6-15% from 2000-2019. Corporate tax revenues were a larger share of total tax revenue on average in Africa, Asia and Pacific, and Latin America and Caribbean than the OECD. <https://www.oecd.org/tax/tax-policy/corporate-tax-statistics-fourth-edition.pdf> (accessed 25 January 2023).

² Weber's (1948) idea about the machine (technology) as iron cage is being rationalized into everyday life, bring about the routine which eventually create changes in society. For more detail into Weber's theory, see e.g., Schroeder, R. and Ling, R., (2014) ; Colignon, R. and Covalleski, M. (1991)

The impact of e-government on taxpayers can be perceived indirectly through the improvement in government capabilities to improve the process or services that better meet the organizational objectives and the needs of clients (taxpayers) (MacLean and Titah, 2022). The flow of data to tax administrators can determine the level of tax compliance by matching the data (i.e., e-procurement data, local council's data on taxes and bills, land and building data, and the register of vehicles) vis-à-vis declared tax returns. It can create a comprehensive profile of their taxpayers, thus allowing them to tailor different approaches to different taxpayers (i.e., convert tax into incentives for certain industries; impose additional taxes given the economic condition; select taxpayers subject to field audits versus desk audits). Therefore, all this digital infrastructure and technology can benefit the government in terms of alleviating tax avoidance and increasing tax compliance.

Regardless of the importance of e-government in mitigating tax planning, empirical research in this area remains scarce. E-government adoption study on the macro-level associates' tax-related digitalization or e-government adoption with a reduction in tax evasion and the informal economy and an increase in tax compliance and tax revenue within a country (Uyar et al., 2021; Nimer et al., 2022; Kochanova et al., 2020; Elbahnasawy, 2021). Kochanova et al. (2020) investigate the use of e-filing on tax compliance, tax revenue, and corruption and find that e-filing reduces tax compliance costs and increases the tax revenue to GDP ratio. Uyar et al. (2021) find that the digitalization of government services has a stronger effect on mitigating tax evasion in countries with higher adoption of ICT. Elbahnasawy (2021) finds that e-government adoption reduces the informal economy, and hence tax evasion, within a country. In addition, Nimer et al. (2022) find that e-government and the moderating effect of education quality and internet access in schools have a significant effect on reducing tax evasion.

What is missing from the studies is firm-level analysis of e-government adoption. Therefore, the objective of this study is to observe the association between e-government adoption and a firm's tax planning. Analysing the effect of firms' tax planning behaviour on government policy is an important contribution to answering the anecdote that the government's adoption of digitalization reduces tax evasion by providing empirical evidence from a micro perspective. We argue that the digitalization of government lowers firms' incentives for tax avoidance, as shown by higher ETR. In the presence of tax avoidance, the association between digital government and ETR is negative. Therefore, we expect a positive association between digital government and a firm's ETR as an indication of lower tax avoidance. This rationale leads to our first hypothesis:

Hypothesis 1: *All else equal, the digitalization of government has a positive effect on a firm's ETR.*

Additionally, we also need to consider the strategic reactions of firms that are not directly affected by the policy but are indirectly affected through changes in their tax planning behaviour. Dyreng et al. (2016) believe that firms will conduct their tax planning in close conformity with their

industry peers in order not to be identified in enforcement activities (e.g., a tax audit). In addition, firms are mimicking the industry leaders, who are expected to have better information about tax planning (Kubick et al., 2015). Armstrong et al. (2019) argue that tax authorities who fail to consider the strategic reactions will cause an inaccurate estimation of the total effect of a given tax policy. Therefore, to obtain a complete picture about the direct effect of e-government on corporate tax planning, we also compare the tax aggressiveness of firms vis-à-vis their industry peers. Donohoe and Robert Knechel (2014) argue that firms that show a low tax rate vis-à-vis their industry peers are more likely to be using aggressive tax strategies. We do so by estimating the absolute difference between a firm's ETR and the average industry ETR. The greater the difference between a firm's ETR and its industry's ETR, the easier it is for the government to identify the aggressiveness level of each firm. It is more difficult for the government to identify tax-aggressive firms or industries if they have a smaller ETR difference. Therefore, we predict a positive association between the digitalization of government and the absolute value of the ETR difference between a firm and its industry peers, enabling the government to identify the firm or industry with the highest absolute ETR difference. This justification brings us to our second hypothesis:

Hypothesis 2: *All else equal, the digitalization of government has a positive effect on the absolute ETR difference between a firm and its industry.*

2.2. Moderating Effect of Market Competition

Literature on industrial organisation argues that industrial characteristics such as a competitive market relate to the firm's incentive to engage in tax planning activities (Kubick et al., 2015; Cai and Liu, 2009; Asiri et al., 2020; Sorbe and Johansson, 2017). However, the empirical evidence is mixed. On one hand, firms compete with one another to obtain market share and maximise profit, thus creating a competitive environment that can induce innovation (Porter, 1990). Yet, it also caused the spread of unethical behaviour, such as corporate earnings manipulation (Shleifer, 2004). Firms under greater competition pressure are more motivated to avoid tax and have more cash-flow in their possession to be utilised in financing or investment activities to survive in a competitive market (Cai and Liu, 2009; Asiri et al., 2020). Cai and Liu (2009) analyse how product market competition affects the firm's incentive to avoid corporate income tax in Chinese industrial firms and find a negative correlation between tax avoidance and market competition. Wang (2019) finds that firms in competitive industries show a lower effective tax rate than their counterparts. Asiri et al. (2020) find that more tax avoidance activities in U.S. firms result in more investment inefficiency, and the effect is significantly mediated by product market competition.

On the other hand, Kubick et al. (2015) argue that firms in less competitive industries have more incentives to engage in tax planning activities. They examine the association between product market power and tax avoidance and find that product market power is positively related to tax

avoidance, where the higher the product market power (less competitive market), the higher the firm's tax avoidance, as shown by the low ETR. In a similar vein, [Sorbe and Johansson \(2017\)](#) also find a positive relationship between industry concentration and tax planning by multinationals. They posit that multinational firms exploit their tax planning activities and create a more concentrated market with higher markup rates. More concentrated markets (i.e., monopolies or oligopolies) can result in insufficient competition, which can be detrimental to consumer welfare and innovation.

Regardless of mixed arguments on the association of market competition with tax avoidance, [Kubick et al. \(2015\)](#) find that firms are mimicking the tax avoidance of their product market leaders by either engaging in the same tax-planning strategies as those of market leaders or by adjusting their accounting choices through accruals that affect their GAAP ETRs. They suggest that governments that target market leaders using enforcement actions (i.e., tax audit) could benefit from additional revenue caused by a decrease in peers' tax avoidance that mimics the behaviour of market leaders.

In terms of market competition and a firm's digitalization, previous researchers also had mixed findings about the association between digitalization and market competition. [Chen \(2020\)](#) and [Wen et al. \(2022\)](#) argue that firms' digitalization improves market competition, while [Wang and Zhang \(2015\)](#) find the contrary. [Chen \(2020\)](#) reviews some economic research on this topic and concludes that the digital economy poses new challenges to competition. He argues that digitalization also intensifies market competition, which forces firms to innovate their products. [Wen et al. \(2022\)](#) examines the indirect effect of a firm's digitalization on its market competition strategy. Using a sample of Chinese manufacturing industries, they find that firms have a stronger incentive to increase their investment in innovation activities to gain a competitive advantage in the market. [Wang and Zhang \(2015\)](#) use the data from North American companies to analyse the relationship between internet use and market competition. They find that internet use reduces industry competition, and the effect is stronger in the manufacturing and wholesale sectors.

Based on the aforementioned discussion, we hypothesise that how effectively firms adjust their ETR depends on the degree of competition in their industry. Following the mimicry argument of firms ([Kubick et al., 2015](#)), we argue that market competition led firms to adjust their ETR close to their industry peers' or leaders' (the "peers' effect"). If the industry or its leaders are tax avoiders, then the firm will adjust accordingly, and vice versa. In relation to the digitalization of government, we argue that digitalization adopted by government along with a competitive market can have a certain effect on a firm's ETR. Therefore, we posit that market competition may have a mediating effect on the association between e-government and corporate tax planning. Due to mixed prior findings, we do not specify the direction of this interaction. We derive our hypothesis for a firm's tax avoidance as follows:

Hypothesis 3: *Market competition mediates the association between the digitalization of government and tax avoidance.*

In addition, we also predict that the role of e-government in mitigating the tax aggressiveness of firms vis-à-vis industry peers is more prominent in a more competitive market, and vice versa, in a less competitive market, the role of e-government will be less influential, considering that only a few firms control the market. Therefore, we derive our hypothesis for tax aggressiveness as follows:

Hypothesis 4: *Market competition mediates the association between the digitalization of government and tax aggressiveness.*

3. Research Design and Data

3.1. Research Design

We want to check the relationship between the level of e-government adoption and its tax avoidance and tax aggressiveness behaviour. To test the first hypothesis about the effect of e-government adoption on tax avoidance, we formulate the following empirical model:

$$ETR_{it} = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (1)$$

In equation (1), the dependent variable, ETR_{it} , is a proxy for the firm's tax avoidance, and it is calculated as a ratio of total income tax expense (or tax paid) by pre-tax income. For our baseline analysis, we use annual GAAP ETR and cash ETR, following previous researchers (Klassen et al., 2014; Argilés-Bosch et al., 2020; Lanis and Richardson, 2015; Hasan et al., 2014; Graham et al., 2017); but we also check the long-run GAAP and cash ETR in our robustness test. Our variable of interest is $EGDI_{jt}$, is a country-level e-government development index from the United Nations Department of Economic and Social Affairs (UNDESA). EGDI is a composite index consisting of three dimensions: the online service index (OSI) as a measurement of the provision of online services, the telecommunications infrastructure index (TII) to measure the adequacy of available infrastructures, and the human capital index (HCI) to measure the ability of human capital to adopt ICT. To supplement EGDI, the survey also measures separately the use of ICT for the public to participate in decision-making, administration, and delivery of government services, as measured by the e-participation index (EPI).the online service index (OSI) as a measurement of the provision of online services, the telecommunications infrastructure index (TII) to measure the adequacy of available infrastructures, and the human capital index (HCI) to measure the ability of human capital to adopt ICT. To supplement EGDI, the survey also measures separately the use of ICT for the public to participate in decision-making, administration, and delivery of government services, as measured by the e-participation index (EPI). Consistent with previous studies on tax avoidance and tax aggressiveness, $CONTROLS_{it}$ is firm-year control variables, while ξ represents various fixed effects and ε_{it} is error term. i indicates the i -th firm, t the t -th year, and k the k -th industry, and j the j -th country.

We also test the second hypothesis about the relationship between e-government and tax aggressiveness using equation (2) as follow:

$$|ETR Diff_{it}| = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (2)$$

In equation (2), we use $|ETR Diff_{it}|$ (absolute ETR difference) as a proxy for tax aggressiveness, and it is measured by the absolute value of the ETR difference between the firm and its industry peers.

$$|ETR Diff_{it}| = |ETR_{it} - \overline{ETR}_{kt}|$$

For our baseline analysis on tax aggressiveness, we find the difference between the firm's ETR and its average industry ETR and take the absolute value of the ETR difference to observe the deviation of each firm from its industry peers, following [Graham et al. \(2017\)](#) and [Balakrishnan et al. \(2019\)](#).

Next, the moderating effect of market competition is analysed by adding the interaction of market competition proxies with e-government as our variable of interest. We analyse the mediating effect with regards to tax avoidance, and the model is expressed in equation (3) as follows:

$$ETR_{it} = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 HHI_{jkt} + \beta_3 EGDI_{jt} * HHI_{jkt} + \beta_4 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (3)$$

In addition, we also examine its effect with regards to tax aggressiveness in equation (4) as follows:

$$|ETR Diff_{it}| = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 HHI_{jkt} + \beta_3 EGDI_{jt} * HHI_{jkt} + \beta_4 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (4)$$

For moderating effect, we use HHI_{jkt} using industry-level Herfindahl-Hirschman Index (HHI) as our main proxy of market competition. In the robustness test, we alternate it with a categorical variable, HHI_high/low_{jkt} where we create dummies of high, medium, and low HHI and industry-level concentration ratio ($Top4sale_{jkt}$). We are interested in the interaction between market competition and e-government adoption, as captivated by β_3 . The higher the HHI value, the lower the competition as industry becomes more concentrated, and vice versa.

We define all variables in Table 1. In support of Hypothesis 1, β_1 is expected to be positive and statistically significant to show a decrease in the firm's tax avoidance behaviour, as indicated by an increase in the firm's ETR. In support of Hypothesis 2, β_1 is expected to be positive and statistically significant to imply the level of tax aggressiveness. Higher absolute ETR difference indicating that either the firm or its industry peers are more aggressive within this cluster as compared to lower absolute ETR difference, where the firm and industry peers are indifferent, thus the government will have more difficulties tracing which firms or industries are more aggressive in their tax planning activities. In terms

of moderating effect, in support of Hypothesis 3 and Hypothesis 4, β_3 is expected to be statistically significant to show a mediating effect of market competition, but we do not predict the direction of this interaction.

3.2. Data

We use international firm-level accounting information listed on Compustat from 2008 to 2021. The monetary data are presented in millions of local currencies. Appendix Table A.1. shows our sample derivation. In line with Klein et al. (2020), we exclude the utility sectors (SIC codes 4900–4999) and the financial services sectors (SIC codes 6000–6799) because they are subject to different regulations. We also eliminate negative pre-tax income and negative income taxes because it is difficult to interpret effective tax rates for loss firms (Chen et al., 2019; Beer et al., 2018; Kubick et al., 2015). We require each firm to have at least five observations and to have data on EGDI and income classification during the sample period. Following previous research, we winsorize all dependent variables at the top and bottom 1% and all independent continuous variables at the 1st and 99th percentiles. Finally, we retain data from 94 countries. The final sample includes 12,200 businesses with 92,320 firm-year observations. Appendix Table A.2. presents the dispersion of firms across the Top 20 countries, where more than 50% of our samples are firms located in China, India, and the United States. Appendix Table A.3. presents the industries to which firms belong. We compiled a two-digit Standard Industrial Classification (SIC) code of economic activities into a one-digit SIC code. More than 60% of our samples are firms in the manufacturing industry, and 14% are firms in the services industry.

Table 1 provides the definition of variables used in the empirical analysis, the data sources, and their expected signs.

(Insert Table 1 about here)

We measure firms' tax avoidance using annual GAAP ETR and cash ETR for our baseline analysis (Klassen et al., 2014; Argilés-Bosch et al., 2020; Lanis and Richardson, 2015; Hasan et al., 2014; Graham et al., 2017). Annual GAAP ETR is a widely used measurement in tax avoidance literature since it reflects accounting earnings and is calculated as a ratio of total income tax expense to pre-tax income. However, GAAP ETR cannot detect the effects of temporary book-tax differences or tax deferral strategies, e.g., accelerated depreciation for tax purposes (Hanlon and Heitzman, 2010; Kubick et al., 2015). Therefore, we also construct cash ETR, which reflects temporary (tax deferral strategies) and permanent differences and is unaffected by tax accruals. It is calculated as the ratio of income tax paid to pre-tax income. In addition, we also construct three-year long-run GAAP and cash ETR as an alternative to overcome significant year-to-year volatility of annual ETR (Balakrishnan et al., 2019; Dyreng et al., 2008; Graham et al., 2017; Klein et al., 2020). ETR is adjusted to a value between zero and one, where we adjust ETRs as one if the value is greater than one (Graham et al.,

2017, Koester et al., 2017, Rego, 2003, Donohoe and Knechel, 2014). The higher the ETR, the lower the tax avoidance, and vice versa.

We measure tax aggressiveness between firms and their industry peers based on the argument that ETR among different industries might differ significantly, and thus stand-alone tax avoidance measurements might not be able to explain the firm's level of aggressiveness. In addition, firms tend to compare their ETRs against their industry peers across different countries (Klein et al., 2020). Therefore, we construct ETR difference as a tax aggressiveness proxy to allow for cross-sectional variation in firms' tax planning and benchmark the firms' tax aggressiveness level relative to that of their peers in the same industry, following Balakrishnan et al. (2019). The higher the deviation between a firm's ETR and that of its industry peers, as shown by a high absolute ETR difference, can be an indicator of tax aggressiveness, where either the firm is more aggressive than the industry or vice versa. This absolute deviation gives an opportunity for government to identify the tax-aggressive firm or industry and take the necessary actions. On the contrary, the lower the deviation, as shown by a low absolute ETR difference, the more difficult it is to identify the tax aggressive firms or industry because they simultaneously adjust their ETRs in the same direction. Similar to tax avoidance, we measure tax aggressiveness using the annual GAAP ETR difference and the cash ETR difference. Alternatively, we also use the long-run GAAP ETR difference and the long-run cash ETR difference in our robustness tests.

To measure government's digitalization, we rely on the e-government development index (EGDI) from a biennial survey questionnaire conducted by UNDESA, which measures the effectiveness of e-government adoption by 193 United Nations members in delivering services to the public. The survey covers a period of 2001–2022, the latest available data, and ranks the countries on a scale of 0–1, with a higher value indicating higher e-government adoption. EGDI has been used in macro-level studies on e-government, e.g., Elbahnasawy (2021). We argue that EGDI gives a comprehensive view of the outward-looking framework of e-government not only from the utilisation of technologies embodied in government but also from the connection with external stakeholders such as citizens, firms, and other government agencies. To gain a complete picture, we are not only analysing EGDI as a proxy for e-government adoption but also alternating it with each of its sub-indices, in our robustness test.

While the digitalization of firms exacerbates their tax avoidance behaviour, we expect a positive relationship between the digitalization of government and firms' GAAP and cash ETR. We hypothesise that an increase in e-government adoption will result in an increase in the firm's GAAP and cash ETR, as an indicator of a reduction in the firm's tax avoidance. In addition, we also expect a positive relationship between e-government adoption and absolute GAAP and the cash ETR difference. The higher the e-government adoption, the easier it is for the government to identify the tax aggressive firms or industries, as indicated by the high absolute deviation between a firm's ETR and its industry average ETR.

To observe the indirect effect of market competition on the relationship between tax avoidance, tax aggressiveness, and e-government, we use several proxies of market competition. First and our main proxy is the industry-level Herfindahl-Hirschman Index (HHI) (Leong and Yang, 2020; Hou and Robinson, 2006; Karuna, 2007; Wang and Zhang, 2015; Cai and Liu, 2009; Michaelides et al., 2019, Vural-Yavaş, 2021; Beiner et al., 2011), which is calculated by the sum of squared of the market shares of all firms in the industry based on total sales in that industry.

We use industry-level measures of product market competition per country, industry, and year. The value of HHI ranges between 0 and 1, where a high value of HHI indicates a highly concentrated market (low competition) and a low HHI value indicates a lower market concentration (a highly competitive industry). HHI is equal to one, indicating a monopoly market, and zero, indicating a highly competitive industry. We use two-digit SIC codes (Cai and Liu, 2009; Leong and Yang, 2020; Beiner et al., 2011) in our analysis. As part of our robustness analysis, we also calculate HHI for each industry in a country within a certain year using a three-digit SIC code (Michaelides et al., 2019, Vural-Yavaş, 2021). We also use a dummy variable for HHI to alternate the continuous HHI. After computing the HHI value, we divide the HHI into competition dummy terciles, namely high, medium, and low competition. Low HHI values belong to the first tercile to indicate a high competition dummy, middle HHI values represent the second tercile to indicate a neutral competition dummy (we set this as our base group), and high HHI values belong to the third tercile, which constitutes a low competition dummy (Vural-Yavaş, 2021; Michaelides et al., 2019). In addition, following Leong and Yang (2020) and Cai and Liu (2009), we alternatively use the concentration ratio by calculating the proportion of total sales for the top 4 firms in the industry within a country for each year and assuming that in a less competitive market, a large proportion of sales tend to be concentrated on the top 4 firms.

We draw on prior literature on tax avoidance and aggressiveness in identifying firm-level control variables. *Size* is proxied by the logarithm of total assets (Rego and Wilson, 2012; Kerr, 2019; Li et al., 2021; Klein et al., 2020; Klassen et al., 2016). We expect a negative relation between firm size and a firm's ETR, in which bigger firms tend to have tax avoidance and tax aggression compared to smaller firms. *Growth* offers more opportunities to engage in tax avoidance, and it is calculated by the ratio of revenues at year t to revenues at year t-1 (Graham et al., 2017, Argilés-Bosch et al., 2020). We do not have any expected signs for this control variable. *Profitability* is proxied by Return on Assets (ROA) (Argilés-Bosch et al., 2020), and it is calculated by the ratio of pre-tax income to total assets. Profitable firms are more likely to engage in aggressive tax schemes or arrangements to avoid paying corporate taxes than unprofitable ones (Gupta and Newberry, 1997). We expect a negative relationship between profitability and the firm's ETR and a tendency for increased tax avoidance. *Leverage* is a proxy for risk exposure to control the firm's debt service needs and capital structure. It is calculated by dividing total long-term debt by total assets (Balakrishnan et al., 2019). Leveraged firms have a greater tendency to be more tax aggressive than capitalised firms by exploiting the tax deductibility of interest payments and loan fees to shift debts across jurisdictions (Bernard et al., 2006; Dyreng et al., 2008), so

we expect a negative relationship with the firm's ETR. *Age* is proxied by the natural logarithm of the number of years the firm has been listed on Compustat, and it is used to control the effect of firm maturity and the economic life cycle and explain the relation with the quality of the information environment (Donohoe and Knechel, 2014; Balakrishnan et al., 2019). We use the natural logarithm of the difference between the first year a firm appears in Compustat and the current year, and following previous researchers, we do not assign any expectation for this variable. *Net Operating Loss Carry-forward* (NOLREV) is the existence of previous losses and measured by sum of profits in last four years, including current year, scaled by revenue (Argilés-Bosch et al., 2020). Additionally, we use *Loss* which is a dummy variable with 1 if loss carry-forward is positive at the beginning of year *t* and 0 otherwise (Graham et al., 2017; Klassen et al., 2014). We expect a negative relationship between prior losses and tax avoidance, or a positive sign of this variable, because a high amount of loss carryforward can reduce the tax bill in the current year.

Intangible Assets are one of the important features to support the digitalization. The use of software within the firm is reflected in this account. Also, tax planning strategies utilise intangibles to shift income across affiliates in different jurisdictions (Hanlon and Heitzman, 2010; Devereux and Maffini, 2007; Grubert and Altshuler, 2008; Li et al., 2021); thus, we expect a negative relationship with the firm's ETR to indicate tax avoidance behaviour. It is proxied as intangible intensity and calculated by the ratio of intangible assets to total assets (Argilés-Bosch et al., 2020; Kerr, 2019; Klassen et al., 2014; Klein et al., 2020). *RnD* is the intensity ratio of research and development expense to total assets. This variable is to capture the self-created intangibles, while intangible asset intensity is to capture other intangible assets; thus, we use both measurements. This is an important measurement, especially for self-created intangible assets as one of the reflections of a firm's digitalization adoption, because spending on research and development (RnD) is sensitive to tax rates and credit incentives (Klassen et al., 2014). Following the earlier researchers, it is set equal to 0 if there is no value (Koester et al., 2017; Li et al., 2021; Klein et al., 2020), and we expect a negative relationship with the firm's ETR. *Inventory* as proxied by inventory intensity, which is a ratio of total inventories to total assets (Argilés-Bosch et al., 2020; Klein et al., 2020). Inventory-intensive firms should be less tax avoidant than capital-intensive firms, so we expect a positive relationship with the firm's ETR. *Property, Plant, and Equipment (PPE)* (Argilés-Bosch et al., 2020; Klein et al., 2020) is a ratio of net property, plant, and equipment to total assets as a proxy for capital intensity. To support the digitalization, firms invest in their hardware digital technologies, and it is reflected in their PPE account. Therefore, we expect a negative relationship with the firm's ETR because the greater the PPE intensity, the higher the tax avoidance (Kerr, 2019). *BIG4* auditing services can reduce tax avoidance activities via monitoring and higher audit quality. Following Argilés-Bosch et al. (2020) and Lanis and Richardson (2015), we use the dummy variable one if the firm is audited by one of the BIG 4 accounting firms (Deloitte, KPMG, Ernst & Young, and PwC), and 0 otherwise. There are contrary arguments related to BIG 4. While Lanis and Richardson (2015) argue that the use of Big Four audit firms can help reduce tax avoidance,

Lisowsky (2010) finds that big audit firms are engaged in promoting tax shelters. Therefore, following Argilés-Bosch et al. (2020), we do not have any defined expectation for the sign of this variable. *Market-to-book (mtb)* is a ratio of the market value of assets to its book value, and it controls for the firm's growth opportunities and its transparency (Balakrishnan et al., 2019). Klein et al. (2020) use the period-close market price multiplied by common shares outstanding divided by total assets. We obtain the data for period-close market price from Compustat Security Daily and calculate the market value as price times outstanding shares, scaled by total assets. Following the previous researchers, we do not set a predicted sign for this variable. *Volatility* is used to capture stock return volatility and controlled by the standard deviation of annual sales computed over the previous five years (Balakrishnan et al., 2019). We transform it using the logarithm of volatility to fit the model and expect a negative relationship with ETR. *Selling, general, and administrative (sga) expense* (Dyreng et al., 2010) is control variable for non-tax cost of tax avoidance. It is scaled by sales, and a negative sign of this variable is expected as an indication of tax avoidance. Alternatively, we use *advertising expense* as another control variable following Koester et al. (2017) because not only does it mirror the non-tax cost of tax avoidance (Hanlon and Slemrod, 2009), but also advertising expense is increasing in the digital economy due to the borderless impact that advertising can have. Advertising expense is scaled by sales, and it is expected to have a positive relationship with tax avoidance, so we expect a negative sign for this variable in its relationship with ETR. Since the data on advertising expenses is only available in a small number of firm-year observations (20,312), we follow Dyreng et al. (2010) and set the missing values to 0. Advertising expense is scaled by sales, and it is expected to have a positive relationship with tax avoidance, so we expect a negative sign for this variable in its relationship with ETR. Since the data on advertising expenses is only available in a small number of firm-year observations (20,312), we follow Dyreng et al. (2010) and set the missing values to 0. *Capital expenditure (capex)* is a ratio of total capital expenditure scaled by sales (Rego and Wilson, 2012; Koester et al., 2017; Li et al., 2021; Klassen et al., 2014), and we expect that it has a negative relationship with the firm's ETR to capture the effect of depreciation deduction on firm's profit, and eventually, ETR (Rego and Wilson, 2012, Koester et al., 2017, Li et al., 2021, Klassen et al., 2014). In our robustness test, we also add country-control variables, namely GDP per capita, bureaucracy, and corruption risk, obtained from World Bank.

Our primary tests estimate corporate tax avoidance (tax aggressiveness) as a function of changes in e-government adoption. We applied panel data analysis using Ordinary Least Square (OLS) with various fixed effects, including firm, industry, year, and country, as well as clustered standard error at firm, for our analysis. This type of analysis allows us to tackle the omitted variable bias issue, where time-invariant characteristics can be mis specified in our models. We use the firm-fixed effect to control for unobserved time-invariant characteristics of firm *i*, the year-fixed effect to control for unobserved common changes of all firms in a given year, industry and alternatively industry-year fixed effect to control for unobserved time-invariant industry characteristics and common shocks that affect industries, and the country-fixed effect to account for possible changes at the country level, e.g., the corporate tax

rate, that can affect all firms within a country. This multi-level fixed structure controls for time-invariant firm-level and country-level characteristics that could influence the level of tax avoidance and tax aggressiveness so that we can isolate the association between within-country changes in e-government and tax avoidance and tax aggressiveness. For our baseline analysis, we posit a positive relationship between changes in e-government adoption and ETR as an indication of lower tax avoidance, and similarly, a positive relationship between e-government adoption and the absolute value of the ETR difference as an indication of wider tax aggressiveness between the firm and its peers using the full sample. For the moderating effect of market competition, we predict that a competitive (less concentrated) market moderates the positive effect of e-government adoption on tax planning activities. We use a variety of industry and year fixed-effect regression to analyse the interaction, following the previous literature.

We present the descriptive statistics in Table 2. Firms in our sample have an annual average GAAP ETR, cash ETR, and current ETR of 24%, 28%, and 21% consecutively, lower than the top statutory tax rate in the latest year of observation at 35%³. In addition, on average, the GAAP ETR difference, cash ETR difference, and current ETR difference between firms and their industry peers are 10%, 18%, and 12%, respectively, in absolute value. The higher the number, the easier it is for the government to spot the more tax-aggressive firms vis-à-vis industries, and vice versa. The statistics reveal that the cash ETR difference shows a relatively higher deviation compared to GAAP or the current ETR, giving a possibility for the government to observe tax aggressive firms or groups of industries through their cash ETR.

(Insert Table 2 about here)

Table 3 displays Pearson correlations among variables. Most of the variables have significant correlations. Our variable of interest has a positive correlation to our tax avoidance proxies (annual and long-run GAAP ETR and cash ETR); meanwhile, it shows a negative and significant relationship to a set of tax aggressiveness variables (annual and long-run GAAP ETR difference and cash ETR difference). We test the multicollinearity using variance inflation factors (VIFs), and following the rule of thumb that any number below ten is not severely affected by the multicollinearity issue, we proceed with these variables (O'Brien, 2007).

(Insert Table 3 about here)

³ OECD Tax Database Table II.1. Statutory Corporate Income Tax Rate.
https://stats.oecd.org/Index.aspx?DataSetCode=TABLE_III (accessed 27 November 2022).

4. Results

Having constructed our variables and research design, we analyse the relationship between e-government adoption and firm tax avoidance and tax aggressiveness using OLS regressions and present the findings in our baseline results. Following the initial findings, we investigate the moderating effect of market competition on this relationship. A battery of robustness tests is then conducted. Finally, we also address endogeneity issues, specifically those concerning reverse causality.

4.1. E-government and Tax Avoidance

We begin the analysis by reporting the baseline estimation for the relationship between e-government adoption and tax avoidance. Table 4 summarises our baseline analysis.

(Insert Table 4 about here)

We use annual GAAP ETR as a dependent variable (columns 1–4) and include e-government proxy and firm-level control variables in our baseline estimation. The findings show that the coefficient for the annual GAAP ETR is positive and significant at the 1% level. Since GAAP ETR does not reflect temporary tax savings from timing differences, alternatively, in columns 5–8, we use annual cash ETR as a dependent variable because it reflects tax deferral strategies that firms use that retain cash within the firm. The results are also positive and significant. These baseline results confirm Hypothesis 1, that an increase in e-government adoption has a positive and significant association with an increase in a firm's ETR or that e-government adoption reduces tax avoidance. With respect to economic magnitude, the effect of an increase in the e-government index by 0.01-point (one percent) ranges from a 1.6-2.2% increase in the firm's ETR. This result complements the previous finding by [Uyar et al. \(2021\)](#) that the digitalization of government alleviates tax evasion.

4.2. E-government and Tax Aggressiveness

Table 5 reports the regression analysis from our second hypothesis, which is measuring the relationship between e-government and a firm's tax aggressiveness vis-à-vis its industry peers.

(Insert Table 5 about here)

We use the absolute value of the annual GAAP ETR difference between the firm and its industry peers as a tax aggressiveness proxy, and the coefficients are positive and significant. We have similar results when we replace the dependent variable with the cash ETR difference as an alternative proxy. The findings confirm Hypothesis 2 that an increase in e-government adoption has a positive effect on the government's ability to identify tax aggressive firms or industries, as seen from the higher the deviation between the firm's ETR and the average industries' ETR. In terms of economic magnitude, a one percent increase in e-government adoption implies an increase in the absolute ETR difference by a range of 1.1%–2.7%, which can be contributed by either the firm or the industry that deviates from the

group. The wider the increase in absolute ETR difference, the easier it is for government to spot the tax aggressive clusters of industries, and vice versa, the lower the absolute ETR difference, the more difficult it is for government to check which firms or industries are more aggressive, because both of them synchronise their ETRs in the same direction, either both of them are tax avoidant or compliant.

4.3. The Moderating effect of Market Competition

Table 6 presents the moderating effect of market competition on the association between e-government and a firm's tax avoidance to test Hypothesis 3.

(Insert Table 6 about here)

The coefficient for our moderating variable, market competition, is negative and significant at the 1% significant level. The results are similar when we alternate our dependent variable, GAAP ETR, with cash ETR. The findings indicate that an increase in e-government in a less competitive (more concentrated) market has a negative effect on a firm's ETR, an indication of increased tax avoidance. The results also hold using various types of fixed effects. The results indicate that we cannot reject Hypothesis 3.

We test Hypothesis 4 about the moderating effect of market competition on the association between e-government and tax aggressiveness of firms vis-à-vis industry peers and present the result in Table 7.

(Insert Table 7 about here)

The interaction between e-government and market competition is negative and significant at the 1% significance level. It is interesting to note that when we use GAAP ETR Difference as our proxy for tax aggressiveness, the main effects are not significant when we use industry and year fixed effects, and only significant at the 10% level when we use year fixed effects, but the interaction is negative and significant, indicating the crossover interaction. This means that the mediating effect of market competition in the relationship between e-government and tax aggressiveness is the opposite of the main effects, which is confirmed by a negative coefficient of interaction. However, when we use cash ETR as a dependent variable, the main effect is positive and significant, similar to our baseline analysis, and the interaction is negative and significant. The results show that we cannot reject Hypothesis 4, indicating that the increase in e-government adoption in a less competitive (more concentrated) market has a negative effect on a firm's ETR difference vis-à-vis industry ETR (a decrease in the absolute value of the ETR difference), an indication for higher tax aggressiveness as the government has more difficulties identifying the tax aggressive firms or industries despite the sophisticated adoption of e-government because in a more concentrated market there are fewer players (e.g., oligopoly or monopoly).

Our results indicate that although in general e-government adoption reduces firms' tax avoidance and improves the government's ability to identify tax aggressive activities of firms and industries, being in a less competitive (more concentrated) market exacerbates firms' tax avoidance and

makes it more difficult for tax authorities to identify tax aggressive firms and industries, as their ETR differences are smaller since they are moving in the same direction. These findings contribute to the debate on market competition and corporate tax planning and support [Kubick et al.'s \(2015\)](#) finding that less market competition (as indicated by higher market power) induces tax avoidance.

4.4. Robustness Tests

Hitherto, our baseline analysis suggests that digitalization in government reduces firms' tax avoidance and allows the government to observe tax-aggressive firms vis-à-vis industries using annual GAAP and cash ETR. To avoid year-to-year volatility of annual ETR, we also conduct robustness tests to test the effect of e-government on a firm's tax avoidance behaviour using a three-year summation of total income tax expense by the sum of three-year pre-tax income to reflect long-run GAAP. Additionally, we replace the numerator with the sum of cash taxes paid over the past three years to reflect the long-run cash ETR. The results are shown in Appendix Table A.4., and they consistently give a positive and significant coefficient. In terms of economic magnitude, a 0.01-point increase in the e-government index increases the long-run firm's GAAP ETR by 1.4–2.5% and cash ETR by 2.25–2.62%. Next, we also check the relationship between e-government and the current ETR as an alternative to our two earlier proxies to measure total tax expense less deferrals ([Hanlon and Heitzman, 2010](#); [Donohoe and Knechel, 2014](#)). We use annual current ETR and three-year long-run current ETR, and the results are shown in Appendix Table A.5. The coefficients of our variable of interest, EGDI, are positive and significant, confirming our baseline results.

We also conduct a similar test for Hypothesis 2, where we use the absolute value of the three-year long-run GAAP ETR difference and cash ETR difference to measure the distance between the designated firm's ETR vis-à-vis its industry peers. The higher the distance, the more aggressively the firm or industry is taxed, and vice versa. Appendix Table A.6. concludes the result. Tax aggressiveness proxies are consistently positive and significant when we use GAAP ETR difference, showing an increase between 1.2-1.7% of ETR difference between the firm and its industry peers as the e-government index increased by 0.01 point. In other words, an increase in e-government adoption increases the ability of the government to observe the tax aggressiveness of firms and industries. Alternatively, we use the long-run cash ETR difference and find a similar direction, where the analysis shows a positive and significant relationship between e-government and the cash ETR difference. In terms of economic magnitude, the increase in the e-government index by 1% increased the ETR difference by 4.2–5.6%. In addition, we also measure the tax aggressiveness using the current ETR, as shown in Appendix Table A.7. The results are contradictory to our baseline analysis, where it is negative and significant at the 10% significant level when we use the annual current ETR difference as our tax aggressiveness proxy, while it is negative but not significant when we use the long-run current ETR difference.

Following [Balakrishnan et al. \(2019\)](#), we also use the non-absolute value of the ETR difference to check whether e-government decreases the firm's tax aggressiveness towards industry peers. The result is shown in Appendix Table A.8., which confirms our prediction that the ETR difference is positive and significant. According to our prediction, a positive value of the ETR difference between firms and industries indicates that firms pay more tax than their industries, a signal of the lower tax aggressiveness of firms vis-à-vis their industry peers.

Our next robustness test is by computing the e-government index using lag-dated information from the year prior to tax avoidance, as follows:

$$ETR_{it} = \beta_0 + \beta_1 EGDI_{ijt-1} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (5)$$

In addition, when we check the tax aggressiveness, we use the following estimation:

$$|ETR\ Diff_{it}| = \beta_0 + \beta_1 EGDI_{ijt-1} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (6)$$

We use lag to partially mitigate potential endogeneity issues since the effect of e-government adoption on a firm's tax avoidance might not be directly seen in the same year. Appendix Table A.9. presents the regression results of e-government in year t-1 and tax avoidance in year t. The results are consistent with our baseline analysis, where a one percent increase in the e-government index in the previous year contributed to an increase in the firm's ETR in the following year and an indication of a decrease in tax avoidance. In terms of economic magnitude, the increase is in a range of 2.0–3.1% of annual GAAP and cash ETR. We see a similar pattern when we alternate the tax avoidance proxies with long-run GAAP and cash ETR. Appendix Table A.10. shows that the coefficient is consistently positive and significant, where an increase in the e-government index contributes to increasing the firm's long-run ETR by 2.68–4.3%.

Appendix Table A.11. shows the result of the relationship between e-government and tax aggressiveness using lag of variable of interest. In line with the baseline analysis, when we lag the variable of interest, EGDI, the results are positive and significant when we use GAAP and cash ETR difference, indicating that e-government allows the government to identify the tax aggressive cluster of firms and industries as shown by higher ETR difference. The results are consistent when we alternate the proxies with long-run GAAP ETR difference and cash ETR difference as shown in Appendix Table A.12. In addition, because e-government index is biennial, we also lagged the variable of interest by two prior years following [Elbahnasawy \(2021\)](#)⁴. The effect of the two-prior-year e-government index is still positive and significant with the current-year firm's ETR, as shown in Appendix Table A.13., indicating that the adoption of e-government reduces tax avoidance. In a similar vein, the two-year lag

⁴ For instance, 2014 index was completed in December 2013 and launched in June 2014, which makes them as 2012 in the sample.

of e-government adoption also has positive and significant results with tax aggressiveness proxies, as shown in Appendix Table A.14. To further test the robustness, instead of using EGDI as a composite index, we disaggregate it with each of the sub-indices, namely OSI, TII, HCI, and EPI. The results are similar to those of the baseline analysis, except for HCI, where the results are not significant.

Although our OLS regression results using different measurements support our hypotheses, the results should be interpreted with caution. The endogeneity issue may appear in estimating the causal relationship between e-government and a firm's tax planning activities. One of the potential sources of endogeneity is the omitted variables, which explain tax avoidance and tax aggressiveness but are not included in our models. Also, the variables in our empirical analysis are likely to be measured with error, in which case our baseline analysis will produce biased and inconsistent estimates. Another possible source of endogeneity is reverse causality, where the direction of causation is reversed, in which e-government is caused by a firm's tax planning activities rather than the other way around. To deal with endogeneity and claim causality, which is needed for policy analysis, we employ instrumental variables (IV) approaches.

In mathematical terms, the model for firm's tax avoidance using IV approach is as follow:

$$ETR_{it} = \beta_0 + \beta_1 \widehat{EGDI}_{jt} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (7)$$

$$EGDI_{it} = \gamma_0 + \gamma_1 IV_{jt} + \varsigma_{it} \quad (8)$$

Meanwhile, when we measure the tax aggressiveness using IV approach, the model is as follow:

$$|ETR Diff_{it}| = \beta_0 + \beta_1 \widehat{EGDI}_{jt} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{it} \quad (9)$$

$$EGDI_{it} = \gamma_0 + \gamma_1 IV_{jt} + \varsigma_{it} \quad (10)$$

Similar to our baseline specification, ETR_{it} denotes firm's tax avoidance, $|ETR Diff_{it}|$ is a proxy for tax aggressiveness, $CONTROLS_{it}$ is firm-year control variables, ξ represents various fixed effects, while ε_{it} and ς_{it} are error terms. Unlike our baseline analysis, for equation (7) and (9), we use the fitted value of $EGDI_{jt}$, obtained from equation (8) and (10) respectively.

We try to find an instrument that has the property that changes in the instrument are associated with changes in e-government but do not lead to changes in a firm's tax avoidance and tax aggressiveness except through the indirect route through e-government. We use mobile cellular subscriptions per 100 people and individuals using the internet (percentage of population) obtained from World Development Indicators, World Bank, as possible instruments (Elbahnasawy, 2021). We expect these instruments to be exogenous and to have no correlation with the firm's tax avoidance and tax aggressiveness except through the adoption of e-government. We perform two-stage least squares (2SLS) estimations and present our results in Table 8. We conduct several tests to study the validity of the instrumental variables used in the analysis.

(Insert Table 8 about here)

The result from the 2SLS analysis shows a similar result to our baseline analysis, where the instrument has a positive and significant coefficient in the first stage. Also, first-stage F-statistics are higher than the [Stock and Yogo \(2002\)](#) critical values, indicating that there is no weak instrumental issue with our instruments. The second-stage regression is analysed by replacing the endogenous variable, e-government, with its predicted values obtained from the first stage and regressing the outcome variable, tax avoidance, on the predicted value of e-government and all of the control variables. The coefficient for our variable of interest, e-government, is positive and statistically significant, but higher than the baseline results. The results hold when we interchange GAAP ETR with cash ETR, use various fixed effects, and use different instruments. In addition, we also check the long-run GAAP and cash ETR as presented in Appendix Table A.15. and the coefficient of interest, EGDI, which consistently proves to be positive and statistically significant.

We also conduct an IV analysis to check the association between e-government and tax aggressiveness. Table 9 presents our results when we conduct the estimation using the absolute value of GAAP ETR difference and cash ETR difference as our dependent variables, instrumented by mobile cellular subscriptions and individuals using the internet.

(Insert Table 9 about here)

The results are in line with our baseline analysis, where, in the first stage, both instruments have a positive and statistically significant result. The first-stage F-statistics are higher than the [Stock and Yogo \(2002\)](#) critical values. In addition, the coefficient of fitted value of EGDI as our variable of interest is positive and statistically significant. The results continue to hold when we alternate the dependent variable with the cash ETR difference, using different combinations of fixed effects and instruments. It shows that e-government has a positive effect on the increase in ETR difference between firms and industries, a signal to identify tax aggressive firms or industries. As our robustness check, we also conduct IV estimation using long-run absolute GAAP and cash ETR difference as an alternative proxy to overcome year-to-year volatility of the annual ETR difference. Appendix Table A.16. shows the coefficients of EGDI are positive and statistically significant.

Additionally, we use one-year and two-year lag EGDI to observe the association between e-government and tax avoidance, and the results are shown in Appendix Table A.17. and Appendix Table A.18., respectively. The coefficients of lagged e-government continue to be positive and statistically significant using annual GAAP and cash ETR. We also conduct IV regression using the lag of a variable of interest, EGDI, to observe the association between e-government and tax aggressiveness, as proxied by the absolute value of GAAP and cash ETR difference. Appendix Table A.19. presents our results using a one-year lag of EGDI, and Appendix Table A.20. shows the results using a two-year lag. The coefficients are continuously positive and significant.

Also, we alternate EGDI with its sub-indices, namely OSI, TII, and EPI and conduct a fixed effect analysis and IV analysis for tax avoidance and tax aggressiveness. The results are consistent where coefficient of our variable of interest continue to be positive and statistically significant. In

addition, we also add the country-control variables, namely the GDP per capita, bureaucracy and corruption level. We do not provide the results in appendix, but it is available upon request.

For moderating regression, we conduct a battery of robustness tests using alternative proxies for market competition. Firstly, we alternate two-digit SIC to construct HHI with 3-digit SIC, as shown in Appendix Table A.21. for tax avoidance and Appendix Table A.22. for tax aggressiveness. The results are similar to our moderating analysis using 2-digit SIC, where the interaction between e-government and market competition is negative and significant at the 1% significant level. In addition, we also use a dummy variable of HHI as presented in Appendix Table A.23. for tax avoidance and Appendix Table A.24. for tax aggressiveness. The interaction between EGDI and dummy HHI for low competition (high HHI value/more concentrated market) is negative and significant, supporting the main analysis. Furthermore, we use Top 4 Sales as an alternative proxy for market competition and present the results in Appendix Table A.25. for tax avoidance and Appendix Table A.26. for tax aggressiveness. The results are in line with our main analysis using HHI as a market competition proxy. To complete the battery of robustness checks, we alternate the dependent variable with long-run GAAP and cash ETR (ETR difference) and a one- and two-year lag of the variable of interest, EGDI, and the results are still consistently negative and significant using HHI and Top4sale as our proxies for market competition (results are available upon request).

5. Conclusion

We investigate the effect of e-government adoption on tax avoidance and tax aggressiveness using firm-level financial information available for 106 countries from Compustat within the period of 2008 to 2021. We argue that the increase in e-government adoption will increase the firm's ETR, an indication of a reduction in tax avoidance. In addition, it also has a positive association with the government's ability to identify tax-aggressive firms or industries, as seen from the greater value of the absolute ETR difference between firms and industries. We conduct an empirical analysis using various fixed effects and cluster the standard error by firm. Our findings indicate that e-government is likely to reduce the firm's tax avoidance. In terms of economic significance, a one percent increase in e-government adoption leads to an increase in a firm's ETR of 1.6-2.2%. Furthermore, e-government also allows the government to better identify the tax aggressive firms or industries, as seen from the positive association between e-government and the absolute value of the ETR difference.

To eliminate the endogeneity issue, a battery of robustness tests is employed using long-run GAAP (cash) ETR, lags of variable of interest, and IV analysis, and the result confirms the previous findings. In addition, we also find that market competition moderates the relationship between e-government and tax avoidance and tax aggressiveness. We use industry-level HHI (2-digit SIC) to measure market competition, where the higher the index, the less competition in the market, and vice versa. We find that e-government adoption in a highly competitive market contributes to this positive

association, indicating a reduction in tax avoidance. On the contrary, e-government adoption in a less competitive market (a concentrated market) has a negative association with tax avoidance and tax aggressiveness. Our results are robust when we alternate the measurement with HHI (3-digit SIC), a dummy variable of HHI, and Top 4 Sales within the industry.

Furthermore, we find that e-government reduce asymmetric information between government and firms by observing the mediating effect of dispersion from analysts' forecast using an augmented model. Moreover, we also find that e-government adoption is less profound in reducing the corporate tax avoidance in a country with more complex taxation as perceived from the negative effect on firms' effective tax rates.

We conclude that the digitalization of government has a positive effect on reducing firms' tax avoidance and allowing the government to identify tax aggressive firms or industries. In addition, e-government in a less competitive market has a negative effect on firms' tax avoidance and tax aggressiveness behaviour, and vice versa. We believe that the findings of this study can shed some light on the importance of the digitalization of government to combat tax avoidance and tax aggressiveness.

Our study has some limitations. We address that e-government index as our variable of interest is less granular due to the nature of the biennial country-level e-government survey. There are also other surveys on e-government conducted annually by different bodies that could be other options for future research. In addition, some financial information that is available in Compustat North America is unavailable in Compustat Global, e.g., foreign income and loss company data, so future research in this area can explore alternative databases to address this limitation. We try to overcome the possible omitted variable bias issue through a series of robustness analyses. In addition, our proxy for market competition is not perfect because competition does not only happen at the industry level but can also take place at the firm level and product level. Future research in this area can explore alternative databases to address the limitations of this study. Also, future work may also examine the effect of e-government on distinct forms of tax planning activities.

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Table 1. Variable Descriptions

Variables	Description	Sources	Sign
<u>Tax Avoidance Variables</u>			
GAAP ETR	Annual GAAP Effective Tax Rate defined as total tax expense (txt) divided by pre-tax accounting income (pi) scaled between 0-1	Compustat	
CASH ETR	Annual Cash Effective Tax Rate defined as tax paid (txpd) divided by pre-tax accounting income (pi) scaled between 0-1	Compustat	
CURRENT ETR	Annual Current Effective Tax Rate defined as current income tax expense (txc) divided by pre-tax accounting income(pi) scaled between 0-1	Compustat	
GAAPLR ETR	Long Run GAAP Effective Tax Rate defined as sum of three-years (t to t-2) of total tax expense (txt) divided by sum of three-years (t to t-2) of total pre-tax accounting income (pi) scaled between 0-1	Compustat	
CASHLR ETR	Long Run Cash Effective Tax Rate defined as sum of three-years (t to t-2) of total tax paid (txpd) divided by sum of three-years (t to t-2) of total pre-tax accounting income (pi) scaled between 0-1	Compustat	
CURRENTLR ETR	Long Run Current Effective Tax Rate defined as sum of three-years (t to t-2) of total tcurrent income tax expense (txc) divided by sum of three-years (t to t-2) of total pre-tax accounting income (pi) scaled between 0-1	Compustat	
<u>Tax Aggressiveness Variables</u>			
GAAP ETR Difference	Absolute value of GAAP ETR difference. Calculated as the difference between firm's GAAP ETR and average industry GAAP ETR.	Own calculation	
CASH ETR Difference	Absolute value of Cash ETR difference. Calculated as the difference between firm's cash ETR and average industry cash ETR.	Own calculation	
CURRENT ETR Difference	Absolute value of Current ETR difference. Calculated as the difference between firm's current ETR and average industry current ETR.	Own calculation	
GAAPLR ETR Difference	Absolute value of long-run GAAP ETR difference. Calculated as the difference between long-run firm's GAAP ETR and long-run average industry GAAP ETR.	Own calculation	
CASHLR ETR Difference	Absolute value of long-run Cash ETR difference. Calculated as the difference between long-run firm's cash ETR and long-run average industry cash ETR.	Own calculation	
CURRENTLR ETR Difference	Absolute value of long-run Current ETR difference. Calculated as the difference between long-run firm's current ETR and long-run average industry current ETR.	Own calculation	
<u>Variables of Interest</u>			
EGDI	E-Government Development Index. A composite index based on the weighted average of three normalized indices, namely OSI, TII, and HCI.It is used to measure the readiness and capacity of national institutions to use ICTs to deliver public services.	UNDESA	+
OSI	Online Service Index. Sub-indices of EGDI which assess the national online presence of UN member states.	UNDESA	+

Table 1. Variable Descriptions

Variables	Description	Sources	Sign
TII	Telecommunications Infrastructure Index. Sub-indices of EGDI which assess the status of the development of telecommunication infrastructure.	UNDESA	+
HCI	Human Capital Index. Sub-indices of EGDI which assess the human capital ability to adopt ICT.	UNDESA	+/-
EPI	E-Participation Index. A supplementary index to the UN E-Government Survey which focus on the government use of online services in providing information to its citizens, interacting with stakeholders, and engaging in decision-making processes.	UNDESA	+
<u>Moderating Variables</u>			
HHI	Herfindahl-Hirschman Index. Industry-level (2-digit or 3-digit SIC) proxy for market competition and calculated as sum of squared of the market shares of all firms in the industry based on total sales of that industry. HHI value is between 0 (highly competitive market/less concentrated) and 1(low competitive market/more concentrated).	Own Calculation	+
HHI_high/low	Terciles of HHI value. 1=high competition, 2=medium competition, 3=low competition.	Own Calculation	+
Top4sale	Concentration ratio, calculated as proportion of total sales for top 4 firms in the industry within a country for each year.	Own Calculation	+
<u>Control Variables</u>			
Size	Firm's size as proxied by log of total assets (at)	Compustat	-
Growth	Change in revenue (revt) at (year t - year (t-1)) by revenue (revt) at year (t-1)	Compustat	+/-
Profitability	Profitability ratio as measured by Return on Assets (ROA), defined as pretax income (pi) /total assets (at)	Compustat	-
Leverage	Total long-term debt (dltt) / total assets (at)	Compustat	-
Age (log)	Firm's age as proxied by log of number of years firm has been listed on Compustat	Compustat	+/-
Net Operating Loss Carry-forward (NOLREV)	Existence of previous loss, calculated as sum of 4 years of profit/revenue	Compustat	+
Loss Firm	Dummy variable, 1 if firm's income before extraordinary items (ib) is less than zero in current year, 0 otherwise	Compustat	+
Intangible	Intangible Intensity as proxied by intangible assets (intan)/total assets(at)	Compustat	-
RnD	R&D Intensity as calculated by Research&Development expense (xrd)/total assets(at)	Compustat	-
Inventory	Inventory Intensity as proxied by total inventories (inv)/total assets(at)	Compustat	+
Property, Plant, and Equity (PPE)	Net property, plant, and equipment (ppent)/total assets(at)	Compustat	-
BIG4	Dummy variable, 1 if audited by BIG4 auditing services (Deloitte, KPMG, Ernst and Young, and PwC), 0 otherwise	Compustat	+/-

Table 1. Variable Descriptions

Variables	Description	Sources	Sign
Market-to-Book (mtb)	Market value of assets, calculated by [Period-end market price(prccd)/common outstanding(cshocombined)]/total assets (at)	Compustat	+/-
Volatility	log of standard deviation of sales for the past 5 years	Compustat	-
Selling, General and Administrative (sga)	Selling, general and administrative expense (xsga)/sales(sale)	Compustat	-
Advertising	Advertising expense (xad)/ sales (sale)	Compustat	-
Capital Expenditure (capex)	Total capital expenditure(capx)/sales(sale)	Compustat	-
<u>Instruments</u>			
Mobile	Mobile cellular subscription per 100 people	WDI	
Internet	individuals using internet (percentage of population)	WDI	

Table 2. Descriptive Statistics

Variables	Obs	Mean	SD	Min	p25	p50	p75	Max
<u>Tax Avoidance (firm-level)</u>								
GAAP ETR	92,320	0.241	0.143	0	0.149	0.223	0.299	1
CASH ETR	92,320	0.306	0.255	0	0.141	0.250	0.389	1
GAAPLR ETR	92,320	0.234	0.114	0	0.154	0.225	0.296	1
CASHLR ETR	92,320	0.284	0.220	0	0.152	0.247	0.355	1
CURRENT ETR	92,320	0.212	0.170	0	0.111	0.201	0.287	1
CURRENTLR ETR	92,320	0.195	0.138	0	0.104	0.194	0.276	1
<u>Tax Aggressiveness (firm-level)</u>								
GAAP ETR Difference	92,306	0.096	0.104	0	0.036	0.074	0.118	0.820
CASH ETR Difference	92,306	0.179	0.165	0	0.067	0.140	0.222	0.921
GAAPLR ETR Difference	92,306	0.082	0.077	0	0.034	0.068	0.107	0.815
CASHLR ETR Difference	92,306	0.150	0.144	0	0.055	0.116	0.190	0.923
CURRENT ETR Difference	92,306	0.118	0.116	0	0.044	0.092	0.159	0.883
CURRENTLR ETR Difference	92,306	0.101	0.086	0	0.041	0.085	0.143	0.886
<u>Variables of Interest (Country-level)</u>								
EGDI	92,320	0.647	0.174	0	0.517	0.612	0.803	0.976
OSI	92,320	0.711	0.211	0	0.536	0.752	0.906	1
TII	92,320	0.470	0.247	0.007	0.302	0.440	0.717	0.998
HCI	92,316	20.959	429.197	0	0.684	0.754	0.882	9,141
EPI	92,320	0.671	0.276	0	0.477	0.762	0.905	1
<u>Moderating Variable (Industry-level)</u>								
HHI (2 digit SIC)	92,312	0.291	0.294	0.007	0.073	0.168	0.419	1
HHI dummy	92,312	1.962	0.838	1	1	2	3	3
Top 4 Sale	92,312	0.365	0.404	0	0.018	0.144	0.852	1
<u>Control Variables (firm-level)</u>								
Size	92,320	7.894	2.339	2.962	6.408	7.667	9.068	15.208
Growth	92,320	0.131	0.258	0	0	0.087	0.210	1.407
Profitability	92,320	0.097	0.075	0.003	0.044	0.078	0.127	0.402
Leverage	92,320	0.097	0.125	0	0	0.043	0.157	0.547
Age	92,320	5.838	3.448	1	3	5	9	13
log(age)	92,320	1.531	0.753	0	1.099	1.609	2.197	2.565
NOLREV	92,320	0.309	0.280	0	0.114	0.239	0.426	1.387
Loss	92,320	0.010	0.099	0	0	0	0	1
Intangible	92,320	0.097	0.151	0	0.002	0.028	0.117	0.668
R&D (rnd)	92,320	0.011	0.023	0	0	0	0.013	0.139
Inventory	92,320	0.144	0.126	0	0.045	0.119	0.207	0.595
PPE	92,320	0.272	0.196	0.003	0.114	0.234	0.394	0.830
BIG4	92,320	0.356	0.479	0	0	0	1	1
Market-to-Book (mtb)	92,320	0.007	0.034	0	0	0	0	0.272
Volatility (log)	92,320	5.625	2.507	0.167	4.027	5.407	6.922	13.399
SGA expense	92,320	0.169	0.131	0	0.075	0.136	0.227	0.645
Advertising	92,320	0.001	0.005	0	0	0	0	0.041
Capital Expenditure (capex)	92,320	0.078	0.107	0	0.018	0.041	0.091	0.659
<u>Instruments (Country-level)</u>								
Mobile	92,303	107.370	26.577	17.594	88.306	107.993	123.045	212.639
Internet	91,949	56.953	25.306	1.070	38.300	59.200	77.844	100

Table 3. Pearsons Correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
(1) GAAP ETR	1																				
(2) GAAPLR ETR	0.820*	1																			
(3) CASH ETR	0.368*	0.308*	1																		
(4) CASHLR ETR	0.293*	0.354*	0.857*	1																	
(5) CURRENT ETR	0.657*	0.556*	0.503*	0.409*	1																
(6) CURRENTLR ETR	0.549*	0.657*	0.402*	0.463*	0.831*	1															
(7) GAAP ETR DI	0.582*	0.365*	0.250*	0.156*	0.378*	0.232*	1														
(8) GAAPLR ETR DI	0.383*	0.489*	0.141*	0.173*	0.228*	0.284*	0.724*	1													
(9) CASH ETR DI	0.225*	0.124*	0.626*	0.486*	0.249*	0.113*	0.356*	0.238*	1												
(10) CASHLR ETR DI	0.116*	0.135*	0.479*	0.607*	0.108*	0.121*	0.242*	0.298*	0.742*	1											
(11) CURRENT ETR DI	0.493*	0.337*	0.297*	0.185*	0.535*	0.308*	0.646*	0.467*	0.421*	0.283*	1										
(12) CURRENTLR ETR DI	0.365*	0.439*	0.177*	0.211*	0.327*	0.416*	0.471*	0.618*	0.274*	0.346*	0.710*	1									
(13) EGD I	0.053*	0.071*	0.056*	0.078*	0.179*	0.218*	-0.007	-0.018*	-0.019*	-0.034*	0	-0.018*	1								
(14) OSI	0.070*	0.098*	0.171*	0.206*	0.238*	0.295*	-0.003	-0.012*	0.003	-0.007	-0.039*	-0.054*	0.838*	1							
(15) TII	0.043*	0.054*	0.059*	0.074*	0.189*	0.222*	-0.008*	-0.026*	-0.013*	-0.040*	-0.007	-0.036*	0.953*	0.717*	1						
(16) HCI	0.011*	0.015*	-0.002	-0.007	0.013*	0.012*	-0.004	-0.003	-0.010*	-0.015*	0	-0.004	0.059*	0.032*	0.068*	1					
(17) EPI	0.028*	0.049*	0.204*	0.234*	0.230*	0.278*	-0.010*	-0.022*	0.031*	0.015*	-0.061*	-0.087*	0.733*	0.902*	0.651*	0.005	1				
(18) HHI (2 digit)	0.099*	0.107*	-0.054*	-0.061*	0.100*	0.108*	0.038*	0.038*	-0.055*	-0.086*	0.053*	0.042*	0.117*	-0.065*	0.181*	0.038*	-0.094*	1			
(19) HHI (3 digit)	0.123*	0.139*	-0.049*	-0.052*	0.124*	0.141*	0.026*	0.030*	-0.064*	-0.096*	0.046*	0.037*	0.162*	-0.017*	0.223*	0.035*	-0.053*	0.752*	1		
(20) HHI (dummy)	0.116*	0.127*	-0.068*	-0.077*	0.120*	0.134*	0.026*	0.024*	-0.069*	-0.103*	0.039*	0.024*	0.142*	-0.047*	0.210*	0.045*	-0.082*	0.824*	0.707*	1	
(21) Top4sale	0.099*	0.107*	-0.047*	-0.053*	0.090*	0.097*	0.034*	0.034*	-0.057*	-0.087*	0.050*	0.038*	0.136*	-0.072*	0.206*	0.035*	-0.098*	0.785*	0.683*	0.757*	1

Notes: Significant differences at *** p < 0.01, ** p < 0.05 and * p < 0.1

Table 4. E-government and Tax Avoidance

The dependent variable is annual GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.022*** [3.586]	0.022*** [3.584]	0.022*** [3.583]	0.016** [2.410]	0.207*** [15.352]	0.207*** [15.346]	0.207*** [15.339]	0.176*** [13.154]
Size	-0.007*** [-4.436]	-0.007*** [-4.434]	-0.007*** [-4.432]	-0.006*** [-3.563]	0.008** [2.168]	0.008** [2.167]	0.008** [2.166]	0.008** [2.243]
Growth	-0.012*** [-6.594]	-0.012*** [-6.592]	-0.012*** [-6.588]	-0.012*** [-6.515]	-0.085*** [-23.294]	-0.085*** [-23.286]	-0.085*** [-23.275]	-0.084*** [-22.954]
Profitability	-0.317*** [-28.362]	-0.317*** [-28.352]	-0.317*** [-28.338]	-0.313*** [-27.400]	-1.052*** [-44.971]	-1.052*** [-44.955]	-1.052*** [-44.933]	-1.055*** [-44.447]
Leverage	0.000 [0.013]	0.000 [0.013]	0.000 [0.013]	0.004 [0.513]	-0.027* [-1.703]	-0.027* [-1.703]	-0.027* [-1.702]	-0.017 [-1.066]
Age (log)	0.001 [0.515]	0.001 [0.515]	0.001 [0.514]	0.001 [0.470]	-0.055*** [-12.070]	-0.055*** [-12.066]	-0.055*** [-12.060]	-0.056*** [-12.170]
Loss	0.581*** [76.287]	0.581*** [76.260]	0.581*** [76.222]	0.582*** [76.652]	0.401*** [37.018]	0.401*** [37.005]	0.401*** [36.987]	0.400*** [36.376]
NOLREV	-0.022*** [-6.678]	-0.022*** [-6.676]	-0.022*** [-6.672]	-0.022*** [-6.480]	-0.033*** [-4.465]	-0.033*** [-4.463]	-0.033*** [-4.461]	-0.033*** [-4.430]
Intangible	-0.019** [-2.155]	-0.019** [-2.154]	-0.019** [-2.153]	-0.017* [-1.925]	0.275*** [11.943]	0.275*** [11.939]	0.275*** [11.933]	0.275*** [12.375]
R&D (rnd)	-0.012 [-0.308]	-0.012 [-0.308]	-0.012 [-0.308]	-0.034 [-0.793]	4.072*** [24.414]	4.072*** [24.406]	4.072*** [24.393]	3.813*** [23.795]
Inventory	0.064*** [6.546]	0.064*** [6.543]	0.064*** [6.540]	0.070*** [7.170]	-0.001 [-0.058]	-0.001 [-0.058]	-0.001 [-0.058]	0.026 [1.048]
PPE	0.013* [1.899]	0.013* [1.899]	0.013* [1.898]	0.019*** [2.695]	-0.116*** [-6.620]	-0.116*** [-6.618]	-0.116*** [-6.614]	-0.100*** [-5.760]
BIG4	-0.004* [-1.728]	-0.004* [-1.727]	-0.004* [-1.726]	-0.004* [-1.818]	-0.019*** [-3.736]	-0.019*** [-3.734]	-0.019*** [-3.733]	-0.021*** [-4.126]
Market-to-Book (mtb)	-0.007 [-0.260]	-0.007 [-0.260]	-0.007 [-0.260]	-0.011 [-0.372]	0.113** [2.126]	0.113** [2.125]	0.113** [2.124]	0.063 [1.105]
Volatility (log)	0.004*** [6.136]	0.004*** [6.134]	0.004*** [6.131]	0.005*** [6.449]	0.009*** [5.708]	0.009*** [5.706]	0.009*** [5.703]	0.011*** [7.138]
Advertising	-0.048 [-0.128]	-0.048 [-0.128]	-0.048 [-0.128]	-0.059 [-0.154]	-1.978** [-2.368]	-1.978** [-2.367]	-1.978** [-2.366]	-1.635* [-1.932]
Capex	-0.038*** [-6.331]	-0.038*** [-6.329]	-0.038*** [-6.326]	-0.038*** [-6.190]	-0.128*** [-9.208]	-0.128*** [-9.205]	-0.128*** [-9.200]	-0.117*** [-8.608]
Constant	0.283*** [22.543]	0.283*** [22.535]	0.283*** [22.524]	0.272*** [20.944]	0.245*** [8.799]	0.245*** [8.795]	0.245*** [8.791]	0.243*** [8.457]
Observations	92,320	92,320	92,320	91,962	92,320	92,320	92,320	91,962
Adjusted R-squared	0.573	0.573	0.572	0.577	0.459	0.458	0.458	0.484
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Table 5. E-government and Tax Aggressiveness

The dependent variable is absolute annual GAAP ETR Difference (column (1)-(4)) and absolute annual CASH ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference				CASH ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.012** [2.369]	0.012** [2.368]	0.012** [2.367]	0.011** [2.154]	0.027*** [3.514]	0.027*** [3.513]	0.027*** [3.511]	0.020** [2.451]
Size	-0.008*** [-6.488]	-0.008*** [-6.486]	-0.008*** [-6.482]	-0.008*** [-5.640]	-0.013*** [-5.493]	-0.013*** [-5.491]	-0.013*** [-5.489]	-0.012*** [-5.147]
Growth	-0.013*** [-8.826]	-0.013*** [-8.823]	-0.013*** [-8.818]	-0.011*** [-7.758]	-0.038*** [-15.239]	-0.038*** [-15.233]	-0.038*** [-15.226]	-0.036*** [-14.059]
Profitability	-0.253*** [-28.984]	-0.253*** [-28.974]	-0.253*** [-28.959]	-0.249*** [-27.983]	-0.543*** [-36.188]	-0.543*** [-36.176]	-0.543*** [-36.157]	-0.544*** [-35.148]
Leverage	0.020*** [3.334]	0.020*** [3.333]	0.020*** [3.331]	0.017*** [2.858]	0.024** [2.445]	0.024** [2.444]	0.024** [2.443]	0.024** [2.354]
Age (log)	-0.002 [-1.147]	-0.002 [-1.147]	-0.002 [-1.146]	-0.002 [-1.006]	-0.022*** [-7.319]	-0.022*** [-7.317]	-0.022*** [-7.313]	-0.022*** [-7.151]
Loss	0.521*** [71.571]	0.521*** [71.547]	0.521*** [71.510]	0.521*** [72.599]	0.321*** [35.993]	0.321*** [35.981]	0.321*** [35.963]	0.318*** [35.663]
NOLREV	-0.023*** [-9.269]	-0.023*** [-9.266]	-0.023*** [-9.261]	-0.021*** [-8.340]	-0.050*** [-11.307]	-0.050*** [-11.303]	-0.050*** [-11.298]	-0.049*** [-11.108]
Intangible	-0.006 [-0.972]	-0.006 [-0.972]	-0.006 [-0.972]	-0.005 [-0.819]	-0.000 [-0.019]	-0.000 [-0.019]	-0.000 [-0.019]	0.008 [0.662]
R&D (rnd)	0.125*** [3.963]	0.125*** [3.961]	0.125*** [3.959]	0.129*** [3.850]	0.488*** [6.297]	0.488*** [6.295]	0.488*** [6.292]	0.474*** [6.248]
Inventory	-0.001 [-0.085]	-0.001 [-0.085]	-0.001 [-0.085]	0.005 [0.624]	0.018 [1.187]	0.018 [1.187]	0.018 [1.186]	0.032** [2.182]
PPE	0.001 [0.110]	0.001 [0.110]	0.001 [0.109]	0.003 [0.559]	-0.013 [-1.343]	-0.013 [-1.343]	-0.013 [-1.342]	-0.006 [-0.638]
BIG4	-0.000 [-0.128]	-0.000 [-0.128]	-0.000 [-0.128]	0.000 [0.208]	-0.001 [-0.306]	-0.001 [-0.306]	-0.001 [-0.305]	-0.001 [-0.369]
Market-to-Book (mtb)	-0.026 [-1.374]	-0.026 [-1.374]	-0.026 [-1.373]	-0.029 [-1.438]	0.016 [0.462]	0.016 [0.462]	0.016 [0.462]	0.009 [0.262]
Volatility (log)	0.002*** [3.904]	0.002*** [3.903]	0.002*** [3.901]	0.002*** [3.203]	0.005*** [4.802]	0.005*** [4.801]	0.005*** [4.798]	0.006*** [5.396]
Advertising	-0.115 [-0.415]	-0.115 [-0.415]	-0.115 [-0.415]	-0.109 [-0.390]	-0.971** [-2.047]	-0.971** [-2.046]	-0.971** [-2.045]	-0.874* [-1.666]
Capex	-0.012*** [-2.677]	-0.012*** [-2.676]	-0.012*** [-2.675]	-0.013*** [-2.702]	-0.044*** [-5.315]	-0.044*** [-5.313]	-0.044*** [-5.311]	-0.041*** [-4.991]
Constant	0.171*** [17.422]	0.171*** [17.416]	0.171*** [17.407]	0.164*** [15.860]	0.337*** [18.819]	0.337*** [18.812]	0.337*** [18.803]	0.329*** [17.733]
Observations	92306	92306	92306	91962	92,306	92,306	92,306	91,962
Adjusted R-squared	0.488	0.487	0.487	0.49	0.384	0.384	0.383	0.394
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Table 6. E-government and Tax Avoidance Moderated by Market Competition

The dependent variable is annual GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition (HHI based on 2-digit SIC). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR			CASH ETR		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	0.022*** [2.680]	0.014* [1.661]	0.029*** [3.613]	0.169*** [13.482]	0.139*** [10.302]	0.169*** [13.879]
HHI	0.055*** [5.430]	0.056*** [5.108]	0.068*** [6.839]	0.152*** [9.871]	0.125*** [7.482]	0.153*** [10.253]
EGDI x HHI	-0.061*** [-4.227]	-0.060*** [-3.895]	-0.070*** [-4.896]	-0.325*** [-14.852]	-0.290*** [-12.187]	-0.297*** [-13.876]
Size	-0.010*** [-11.966]	-0.010*** [-11.791]	-0.011*** [-12.410]	-0.007*** [-4.958]	-0.009*** [-6.210]	-0.005*** [-3.671]
Growth	-0.038*** [-19.320]	-0.037*** [-17.754]	-0.039*** [-19.477]	-0.088*** [-24.892]	-0.086*** [-23.516]	-0.090*** [-25.071]
Profitability	-0.125*** [-12.146]	-0.136*** [-12.738]	-0.115*** [-11.121]	-0.722*** [-37.385]	-0.743*** [-37.760]	-0.683*** [-35.327]
Leverage	0.094*** [13.155]	0.095*** [12.856]	0.097*** [13.558]	-0.108*** [-9.298]	-0.104*** [-8.698]	-0.116*** [-9.882]
Age (log)	0.010*** [7.018]	0.009*** [6.717]	0.009*** [6.637]	-0.004 [-1.577]	-0.005* [-1.957]	-0.004* [-1.687]
Loss	0.643*** [83.006]	0.643*** [83.699]	0.646*** [82.858]	0.446*** [39.589]	0.444*** [39.171]	0.447*** [39.590]
NOLREV	-0.005* [-1.877]	-0.006* [-1.908]	-0.004 [-1.194]	-0.009* [-1.698]	-0.011** [-2.075]	-0.006 [-1.082]
Intangible	0.050*** [7.968]	0.045*** [6.914]	0.054*** [8.630]	0.070*** [6.665]	0.067*** [6.171]	0.073*** [7.051]
R&D (rnd)	-0.449*** [-12.560]	-0.380*** [-9.687]	-0.556*** [-16.175]	1.138*** [16.057]	1.313*** [17.445]	0.878*** [13.145]
Inventory	0.075*** [10.364]	0.075*** [9.725]	0.051*** [7.961]	0.001 [0.090]	0.009 [0.611]	0.024** [1.971]
PPE	0.037*** [7.005]	0.037*** [6.617]	0.033*** [6.804]	-0.020** [-2.184]	-0.018* [-1.944]	0.018** [2.150]
BIG4	0.010*** [5.707]	0.011*** [5.698]	0.010*** [5.291]	-0.049*** [-15.157]	-0.045*** [-13.965]	-0.052*** [-16.044]
Market-to-Book (mtb)	0.126*** [5.686]	0.126*** [5.670]	0.120*** [5.431]	0.029 [0.824]	0.014 [0.391]	0.013 [0.385]
Volatility (log)	0.009*** [11.502]	0.009*** [11.304]	0.010*** [12.474]	0.011*** [8.345]	0.013*** [9.410]	0.011*** [8.604]
Advertising	1.150*** [8.917]	1.106*** [8.246]	1.269*** [9.957]	-1.212*** [-5.320]	-1.351*** [-5.568]	-0.619*** [-2.784]
Capex	-0.112*** [-15.701]	-0.108*** [-15.011]	-0.108*** [-14.783]	-0.122*** [-10.073]	-0.108*** [-8.820]	-0.125*** [-10.214]
Constant	0.223*** [32.464]	0.229*** [30.915]	0.219*** [32.402]	0.321*** [27.770]	0.347*** [28.225]	0.285*** [24.869]
Observations	92,312	91,960	92,312	92,312	91,960	92,312
Adjusted R-squared	0.302	0.311	0.290	0.206	0.245	0.190
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Table 7. E-government and Tax Aggressiveness Moderated by Market Competition

The dependent variable is absolute annual GAAP ETR Difference (column (1)-(4)) and absolute annual CASH ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition (HHI based on 2-digit SIC). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference			CASH ETR Difference		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	-0.007 [-1.430]	-0.006 [-1.103]	-0.008* [-1.679]	0.050*** [6.278]	0.055*** [6.326]	0.047*** [6.021]
HHI	0.026*** [4.310]	0.028*** [4.298]	0.033*** [5.514]	0.022** [2.281]	0.026** [2.537]	0.017* [1.740]
EGDI x HHI	-0.031*** [-3.590]	-0.036*** [-3.766]	-0.039*** [-4.426]	-0.074*** [-5.501]	-0.086*** [-5.813]	-0.059*** [-4.341]
Size	-0.003*** [-4.959]	-0.002*** [-4.039]	-0.002*** [-4.259]	-0.001 [-1.286]	-0.002** [-2.478]	0.000 [0.026]
Growth	-0.009*** [-6.861]	-0.008*** [-5.812]	-0.009*** [-6.411]	-0.024*** [-10.248]	-0.023*** [-9.447]	-0.025*** [-10.312]
Profitability	-0.208*** [-31.421]	-0.206*** [-30.059]	-0.206*** [-31.286]	-0.497*** [-42.119]	-0.501*** [-41.036]	-0.478*** [-40.281]
Leverage	0.028*** [6.428]	0.030*** [6.545]	0.026*** [5.766]	-0.054*** [-7.542]	-0.054*** [-7.182]	-0.065*** [-8.806]
Age (log)	-0.001 [-1.280]	-0.001 [-1.577]	-0.001 [-1.191]	0.002 [0.937]	-0.000 [-0.169]	0.001 [0.851]
Loss	0.547*** [74.966]	0.547*** [75.804]	0.550*** [75.339]	0.328*** [37.225]	0.325*** [36.902]	0.329*** [37.524]
NOLREV	-0.015*** [-8.232]	-0.015*** [-8.023]	-0.012*** [-6.280]	-0.034*** [-10.349]	-0.036*** [-10.875]	-0.030*** [-8.974]
Intangible	-0.025*** [-6.574]	-0.026*** [-6.475]	-0.021*** [-5.577]	-0.039*** [-6.229]	-0.038*** [-5.804]	-0.035*** [-5.569]
R&D (rnd)	0.172*** [8.418]	0.142*** [6.496]	0.180*** [9.377]	0.299*** [7.680]	0.343*** [7.900]	0.220*** [5.887]
Inventory	-0.023*** [-5.337]	-0.023*** [-5.061]	-0.035*** [-8.932]	-0.026*** [-2.795]	-0.027*** [-2.790]	-0.017** [-2.010]
PPE	-0.005* [-1.717]	-0.006* [-1.795]	-0.006** [-1.979]	-0.016*** [-2.842]	-0.011* [-1.741]	0.005 [0.874]
BIG4	-0.003*** [-2.748]	-0.003*** [-2.624]	-0.003*** [-3.033]	-0.029*** [-14.139]	-0.028*** [-13.373]	-0.031*** [-14.864]
Market-to-Book (mtb)	-0.025** [-1.982]	-0.025* [-1.953]	-0.021* [-1.698]	-0.074*** [-3.501]	-0.062*** [-2.810]	-0.069*** [-3.258]
Volatility (log)	0.000 [0.314]	-0.000 [-0.272]	-0.000 [-0.265]	0.001 [1.035]	0.002** [2.134]	0.001 [1.114]
Advertising	0.380*** [4.952]	0.360*** [4.414]	0.357*** [4.747]	-0.629*** [-5.280]	-0.744*** [-5.531]	-0.451*** [-4.054]
Capex	0.008* [1.843]	0.005 [1.185]	0.012*** [2.744]	0.006 [0.821]	0.005 [0.591]	0.006 [0.728]
Constant	0.144*** [35.006]	0.142*** [32.601]	0.142*** [35.254]	0.241*** [32.107]	0.244*** [30.235]	0.223*** [29.876]
Observations	92,298	91,960	92,298	92,298	91,960	92,298
Adjusted R-squared	0.340	0.346	0.333	0.153	0.173	0.136
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Table 8. Instrumental Variable Estimations for Tax Avoidance

The dependent variable is GAAP ETR (column (1), (2), (5), (6)) and CASH ETR (column (3), (4), (7), (8)). Variable of interest is e-government development index (EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to(8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR		CASH ETR		GAAP ETR		CASH ETR	
	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI (fitted)	0.211*** [7.183]		1.832*** [25.246]		0.171*** [4.965]		1.165*** [15.549]	
Instrument		0.002*** [42.020]		0.002*** [42.020]		0.003*** [24.080]		0.003*** [24.080]
Size	-0.011*** [-6.201]	0.013*** [12.423]	-0.026*** [-5.963]	0.013*** [12.423]	-0.010*** [-5.625]	0.018*** [14.920]	-0.011*** [-2.840]	0.018*** [14.920]
Growth	-0.011*** [-5.999]	-0.002** [-2.431]	-0.076*** [-19.217]	-0.002** [-2.431]	-0.012*** [-6.180]	-0.004*** [-3.339]	-0.080*** [-21.328]	-0.004*** [-3.339]
Profitability	-0.314*** [-27.808]	-0.001 [-0.133]	-1.028*** [-39.667]	-0.001 [-0.133]	-0.311*** [-27.925]	-0.008 [-0.991]	-1.036*** [-42.805]	-0.008 [-0.991]
Leverage	0.014* [1.792]	-0.061*** [-10.347]	0.096*** [5.138]	-0.061*** [-10.347]	0.012 [1.440]	-0.068*** [-11.564]	0.046*** [2.608]	-0.068*** [-11.564]
Age (log)	-0.000 [-0.138]	0.009*** [4.910]	-0.066*** [-12.090]	0.009*** [4.910]	-0.000 [-0.112]	0.005*** [2.838]	-0.062*** [-12.616]	0.005*** [2.838]
Loss	0.582*** [75.446]	-0.002 [-0.541]	0.407*** [31.987]	-0.002 [-0.541]	0.582*** [75.332]	-0.004 [-1.092]	0.406*** [34.728]	-0.004 [-1.092]
NOLREV	-0.020*** [-6.017]	-0.008*** [-3.080]	-0.016* [-1.934]	-0.008*** [-3.080]	-0.020*** [-6.287]	-0.007** [-2.468]	-0.024*** [-3.097]	-0.007** [-2.468]
Intangible	-0.014 [-1.567]	-0.030*** [-4.505]	0.319*** [13.345]	-0.030*** [-4.505]	-0.014* [-1.647]	-0.026*** [-3.892]	0.297*** [12.985]	-0.026*** [-3.892]
R&D (rnd)	-0.121*** [-2.766]	0.344*** [11.299]	3.143*** [20.128]	0.344*** [11.299]	-0.096** [-2.137]	0.463*** [14.295]	3.505*** [21.706]	0.463*** [14.295]
Inventory	0.071*** [7.257]	-0.022*** [-3.287]	0.064** [2.415]	-0.022*** [-3.287]	0.070*** [7.067]	-0.032*** [-4.699]	0.037 [1.423]	-0.032*** [-4.699]
PPE	0.029*** [3.938]	-0.066*** [-13.600]	0.020 [1.079]	-0.066*** [-13.600]	0.027*** [3.554]	-0.072*** [-14.350]	-0.036** [-1.965]	-0.072*** [-14.350]
BIG4	-0.004* [-1.789]	0.002 [0.956]	-0.021*** [-3.341]	0.002 [0.956]	-0.004* [-1.896]	-0.001 [-0.379]	-0.020*** [-3.629]	-0.001 [-0.379]
Market-to-Book (mtb)	-0.016 [-0.571]	0.031** [2.146]	0.040 [0.702]	0.031** [2.146]	-0.014 [-0.514]	0.042*** [3.032]	0.065 [1.187]	0.042*** [3.032]
Volatility (log)	0.004*** [5.921]	0.000 [0.664]	0.008*** [4.568]	0.000 [0.664]	0.004*** [6.052]	0.001* [1.792]	0.008*** [5.137]	0.001* [1.792]
Advertising	0.004 [0.012]	-0.435** [-2.110]	-1.509** [-2.096]	-0.435** [-2.110]	-0.007 [-0.019]	-0.304 [-1.359]	-1.707** [-2.294]	-0.304 [-1.359]
Capex	-0.040*** [-6.524]	0.010*** [2.916]	-0.139*** [-9.720]	0.010*** [2.916]	-0.040*** [-6.622]	0.009** [2.451]	-0.135*** [-9.767]	0.009** [2.451]
Observations	92,302		92,302		91,935.00		91,935	
Adjusted R-squared	0.265		-0.090		0.269		0.083	
Cragg-Donald Wald								
F Statistics	5,319.66		5,319.66		3,421.12		3,421.12	
Kleibergen-Paap rk wald								
F Statistics	1,765.68		1,765.68		579.85		579.85	
Stock-Yogo critical values								
10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Table 9. Instrumental Variable Estimations for Tax Aggressiveness

The dependent variable is absolute value of GAAP ETR Difference (column (1), (2), (5), (6)) and CASH ETR Difference (column (3), (4), (7), (8)). Variable of interest is e-government development index (EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR Diff		CASH ETR Diff		GAAP ETR Diff		CASH ETR Diff	
	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI (fitted)	0.163*** [7.363]		0.319*** [7.500]		0.106*** [3.967]		0.701*** [13.825]	
Instrument		0.002*** [42.022]		0.002*** [42.022]		0.003*** [24.075]		0.003*** [24.075]
Size	-0.011*** [-8.050]	0.013*** [12.416]	-0.019*** [-7.127]	0.013*** [12.416]	-0.010*** [-7.110]	0.018*** [14.917]	-0.027*** [-9.315]	0.018*** [14.917]
Growth	-0.012*** [-8.160]	-0.002** [-2.445]	-0.036*** [-14.428]	-0.002** [-2.445]	-0.012*** [-8.519]	-0.004*** [-3.345]	-0.034*** [-13.092]	-0.004*** [-3.345]
Profitability	-0.251*** [-28.511]	-0.001 [-0.119]	-0.539*** [-35.538]	-0.001 [-0.119]	-0.251*** [-28.586]	-0.007 [-0.987]	-0.535*** [-33.483]	-0.007 [-0.987]
Leverage	0.031*** [5.033]	-0.061*** [-10.358]	0.046*** [4.403]	-0.061*** [-10.358]	0.027*** [4.311]	-0.068*** [-11.568]	0.075*** [6.657]	-0.068*** [-11.568]
Age (log)	-0.003* [-1.805]	0.009*** [4.904]	-0.024*** [-7.799]	0.009*** [4.904]	-0.003* [-1.712]	0.005*** [2.836]	-0.027*** [-8.207]	0.005*** [2.836]
Loss	0.521*** [70.755]	-0.002 [-0.537]	0.322*** [35.623]	-0.002 [-0.537]	0.521*** [70.809]	-0.004 [-1.091]	0.324*** [34.570]	-0.004 [-1.091]
NOLREV	-0.021*** [-8.481]	-0.008*** [-3.118]	-0.047*** [-10.453]	-0.008*** [-3.118]	-0.022*** [-8.839]	-0.007** [-2.487]	-0.043*** [-8.831]	-0.007** [-2.487]
Intangible	-0.002 [-0.337]	-0.030*** [-4.512]	0.008 [0.616]	-0.030*** [-4.512]	-0.004 [-0.672]	-0.026*** [-3.898]	0.017 [1.295]	-0.026*** [-3.898]
R&D (rnd)	0.039 [1.131]	0.344*** [11.297]	0.322*** [4.082]	0.344*** [11.297]	0.068* [1.916]	0.463*** [14.294]	0.099 [1.204]	0.463*** [14.294]
Inventory	0.005 [0.725]	-0.022*** [-3.291]	0.030* [1.952]	-0.022*** [-3.291]	0.003 [0.381]	-0.032*** [-4.701]	0.044*** [2.766]	-0.032*** [-4.701]
PPE	0.013** [2.418]	-0.066*** [-13.591]	0.011 [1.084]	-0.066*** [-13.591]	0.009 [1.636]	-0.072*** [-14.346]	0.044*** [3.956]	-0.072*** [-14.346]
BIG4	-0.000 [-0.230]	0.002 [0.952]	-0.001 [-0.417]	0.002 [0.952]	-0.000 [-0.236]	-0.001 [-0.384]	-0.002 [-0.538]	-0.001 [-0.384]
Market-to-Book (mtb)	-0.033* [-1.715]	0.031** [2.123]	0.003 [0.081]	0.031** [2.123]	-0.031 [-1.623]	0.042*** [3.054]	-0.017 [-0.472]	0.042*** [3.054]
Volatility (log)	0.002*** [3.717]	0.000 [0.669]	0.005*** [4.591]	0.000 [0.669]	0.002*** [3.811]	0.001* [1.793]	0.004*** [4.190]	0.001* [1.793]
Advertising	-0.065 [-0.241]	-0.435** [-2.111]	-0.877* [-1.881]	-0.435** [-2.111]	-0.080 [-0.295]	-0.304 [-1.359]	-0.745 [-1.583]	-0.304 [-1.359]
Capex	-0.013*** [-2.874]	0.010*** [2.925]	-0.046*** [-5.502]	0.010*** [2.925]	-0.013*** [-2.753]	0.009** [2.456]	-0.049*** [-5.676]	0.009** [2.456]
Observations	92,288		92,288		91,921		91,921	
Adjusted R-squared	0.313		0.087		0.320		0.003	
Cragg-Donald Wald F Statistics	5,320.44		5,320.44		3,419.77		3,419.77	
Kleibergen-Paap rk wald F Statistics	1,765.81		1,765.81		579.59		579.59	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.1. Sample Derivation

Criteria	Firm-Year Observations	N firms
Compustat Global	381,607	
Compustat North America	<u>130,961</u>	
		512,568
less: duplicates	(36,791)	
less: fiscal year <2008 and NA	(6,061)	
less: observations in financial service sectors (SIC 6000-6999)	(36,338)	
less: observations in utility sectors (SIC 4900-4999)	(15,609)	
less: observations SIC NA	(962)	
less: negative pre-tax income and NA	(129,960)	
less: negative total income taxes and NA	(17,360)	
less: negative income taxes paid and NA	(84,554)	
less: negative current income taxes and NA	(20,575)	
less: firms with <5 observations	(25,083)	
less: firms without country income classification	(12)	
Unbalanced data		<u>139,263</u>
dropped due to unbalanced data		<u>(46,943)</u>
Final sample (balanced data)		92,320 12,200

Appendix Table A.2. Number of Firms by Countries

Country name	Number of firms	Percentage (%)
China	3,688	30.23
India	1,694	13.89
United States	1,194	9.79
Thailand	432	3.54
Malaysia	429	3.52
United Kingdom	353	2.89
Viet Nam	337	2.76
Singapore	290	2.38
Indonesia	250	2.05
Germany	246	2.02
Australia	222	1.82
Sweden	202	1.66
Pakistan	188	1.54
France	179	1.47
Poland	160	1.31
Bangladesh	146	1.20
Israel	144	1.18
Turkey	121	0.99
Italy	113	0.93
South Africa	106	0.87
Rest of the jurisdictions	1,706	13.98
Total firms	12,200	100
Total firm-year observations	92,320	100

Appendix Table A.3. Number of Firms by Industries

Industry Name	Number of Firms	Percentage (%)
Manufacturing	7,422	60.84
Services	1,799	14.75
Transportation and Public Utilities	742	6.08
Retail Trade	616	5.05
Wholesale Trade	581	4.76
Construction	462	3.79
Mining	339	2.78
Agriculture, Forestry, and Fishing	128	1.05
Public Administration	111	0.91
Total firms	12,200	100
Total firm-year observations	92,320	100

Appendix Table A.4. E-government and Long-run Tax Avoidance

The dependent variable is three-year long-run GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.025*** [4.568]	0.025*** [4.567]	0.025*** [4.565]	0.014** [2.514]	0.262*** [20.614]	0.262*** [20.607]	0.262*** [20.596]	0.225*** [18.277]
Size	-0.005*** [-3.452]	-0.005*** [-3.451]	-0.005*** [-3.450]	-0.003** [-2.291]	0.019*** [5.812]	0.019*** [5.810]	0.019*** [5.807]	0.018*** [5.366]
Growth	-0.006*** [-4.718]	-0.006*** [-4.717]	-0.006*** [-4.714]	-0.007*** [-5.002]	-0.034*** [-11.770]	-0.034*** [-11.766]	-0.034*** [-11.760]	-0.035*** [-12.038]
Profitability	-0.120*** [-15.632]	-0.120*** [-15.627]	-0.120*** [-15.619]	-0.115*** [-14.781]	-0.478*** [-26.441]	-0.478*** [-26.432]	-0.478*** [-26.419]	-0.477*** [-26.057]
Leverage	0.012* [1.673]	0.012* [1.672]	0.012* [1.671]	0.015** [2.182]	-0.035** [-2.377]	-0.035** [-2.376]	-0.035** [-2.375]	-0.021 [-1.439]
Age (log)	0.002 [0.978]	0.002 [0.977]	0.002 [0.977]	0.002 [0.835]	-0.058*** [-13.599]	-0.058*** [-13.594]	-0.058*** [-13.587]	-0.058*** [-13.576]
Loss	0.191*** [24.919]	0.191*** [24.910]	0.191*** [24.897]	0.190*** [24.997]	0.121*** [14.190]	0.121*** [14.185]	0.121*** [14.178]	0.122*** [14.169]
NOLREV	-0.032*** [-12.108]	-0.032*** [-12.104]	-0.032*** [-12.098]	-0.032*** [-11.887]	-0.078*** [-11.200]	-0.078*** [-11.196]	-0.078*** [-11.190]	-0.078*** [-11.181]
Intangible	-0.008 [-1.031]	-0.008 [-1.030]	-0.008 [-1.030]	-0.010 [-1.201]	0.253*** [12.008]	0.253*** [12.004]	0.253*** [11.998]	0.251*** [12.343]
R&D (rnd)	0.022 [0.590]	0.022 [0.590]	0.022 [0.590]	-0.027 [-0.702]	3.526*** [23.865]	3.526*** [23.857]	3.526*** [23.845]	3.280*** [23.122]
Inventory	0.046*** [5.698]	0.046*** [5.696]	0.046*** [5.693]	0.048*** [5.858]	-0.036 [-1.472]	-0.036 [-1.471]	-0.036 [-1.470]	-0.015 [-0.621]
PPE	0.010 [1.589]	0.010 [1.588]	0.010 [1.587]	0.017*** [2.623]	-0.122*** [-7.303]	-0.122*** [-7.301]	-0.122*** [-7.297]	-0.105*** [-6.404]
BIG4	-0.004** [-2.009]	-0.004** [-2.008]	-0.004** [-2.007]	-0.005** [-2.212]	-0.016*** [-3.447]	-0.016*** [-3.446]	-0.016*** [-3.444]	-0.017*** [-3.867]
Market-to-Book (mtb)	-0.030 [-1.421]	-0.030 [-1.420]	-0.030 [-1.420]	-0.027 [-1.213]	-0.015 [-0.313]	-0.015 [-0.313]	-0.015 [-0.313]	-0.051 [-0.997]
Volatility (log)	0.000 [0.099]	0.000 [0.099]	0.000 [0.099]	0.000 [0.513]	-0.001 [-0.868]	-0.001 [-0.868]	-0.001 [-0.868]	0.001 [0.703]
Advertising	0.170 [0.486]	0.170 [0.486]	0.170 [0.486]	0.135 [0.381]	-1.071 [-1.416]	-1.071 [-1.415]	-1.071 [-1.414]	-0.986 [-1.348]
Capex	-0.035*** [-7.284]	-0.035*** [-7.281]	-0.035*** [-7.277]	-0.033*** [-6.778]	-0.131*** [-10.321]	-0.131*** [-10.318]	-0.131*** [-10.312]	-0.122*** [-9.902]
Constant	0.269*** [23.655]	0.269*** [23.647]	0.269*** [23.635]	0.260*** [22.029]	0.128*** [4.867]	0.128*** [4.866]	0.128*** [4.863]	0.140*** [5.097]
Observations	92,320	92,320	92,320	91,962	92,320	92,320	92,320	91,962
Adjusted R-squared	0.678	0.678	0.677	0.684	0.555	0.554	0.554	0.583
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.5. E-government and Tax Avoidance using Current ETR

The dependent variable is annual current ETR (column (1)-(4)) and three-year long-run current ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	CURRENT ETR				CURRENT LR ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.105*** [11.688]	0.105*** [11.684]	0.105*** [11.678]	0.091*** [9.801]	0.114*** [14.901]	0.114*** [14.896]	0.114*** [14.888]	0.095*** [12.635]
Size	0.010*** [4.750]	0.010*** [4.748]	0.010*** [4.746]	0.011*** [5.093]	0.010*** [5.900]	0.010*** [5.898]	0.010*** [5.895]	0.011*** [6.162]
Growth	-0.015*** [-6.973]	-0.015*** [-6.970]	-0.015*** [-6.967]	-0.014*** [-6.389]	-0.004*** [-2.749]	-0.004*** [-2.748]	-0.004*** [-2.747]	-0.005*** [-2.920]
Profitability	-0.474*** [-31.590]	-0.474*** [-31.579]	-0.474*** [-31.563]	-0.469*** [-30.576]	-0.146*** [-14.670]	-0.146*** [-14.664]	-0.146*** [-14.657]	-0.143*** [-14.078]
Leverage	-0.022** [-2.203]	-0.022** [-2.202]	-0.022** [-2.201]	-0.017 [-1.632]	-0.023*** [-2.796]	-0.023*** [-2.795]	-0.023*** [-2.793]	-0.019** [-2.285]
Age (log)	0.000 [0.086]	0.000 [0.086]	0.000 [0.086]	0.001 [0.388]	-0.007*** [-2.721]	-0.007*** [-2.720]	-0.007*** [-2.719]	-0.006** [-2.523]
Loss	0.453*** [41.514]	0.453*** [41.499]	0.453*** [41.478]	0.452*** [41.549]	0.146*** [18.247]	0.146*** [18.240]	0.146*** [18.231]	0.144*** [18.494]
NOLREV	-0.028*** [-6.528]	-0.028*** [-6.525]	-0.028*** [-6.522]	-0.028*** [-6.342]	-0.041*** [-11.289]	-0.041*** [-11.285]	-0.041*** [-11.279]	-0.041*** [-10.923]
Intangible	0.078*** [6.051]	0.078*** [6.049]	0.078*** [6.046]	0.080*** [6.199]	0.066*** [6.076]	0.066*** [6.074]	0.066*** [6.071]	0.063*** [5.756]
R&D (rnd)	1.061*** [15.659]	1.061*** [15.654]	1.061*** [15.646]	1.029*** [15.245]	0.732*** [13.050]	0.732*** [13.045]	0.732*** [13.039]	0.692*** [12.279]
Inventory	-0.002 [-0.177]	-0.002 [-0.177]	-0.002 [-0.176]	0.012 [0.876]	-0.004 [-0.386]	-0.004 [-0.386]	-0.004 [-0.386]	0.000 [0.030]
PPE	-0.084*** [-8.867]	-0.084*** [-8.864]	-0.084*** [-8.859]	-0.075*** [-7.936]	-0.079*** [-10.095]	-0.079*** [-10.091]	-0.079*** [-10.086]	-0.071*** [-9.111]
BIG4	0.005 [1.479]	0.005 [1.479]	0.005 [1.478]	0.003 [0.830]	0.003 [0.881]	0.003 [0.880]	0.003 [0.880]	0.001 [0.265]
Market-to-Book (mtb)	0.023 [0.692]	0.023 [0.692]	0.023 [0.692]	0.011 [0.323]	-0.032 [-1.198]	-0.032 [-1.198]	-0.032 [-1.197]	-0.038 [-1.353]
Volatility (log)	0.004*** [3.790]	0.004*** [3.789]	0.004*** [3.787]	0.004*** [3.855]	-0.001 [-0.957]	-0.001 [-0.956]	-0.001 [-0.956]	-0.001 [-0.702]
Advertising	-1.045* [-1.719]	-1.045* [-1.718]	-1.045* [-1.717]	-1.016* [-1.693]	-0.381 [-0.652]	-0.381 [-0.652]	-0.381 [-0.652]	-0.372 [-0.655]
Capex	-0.059*** [-7.757]	-0.059*** [-7.754]	-0.059*** [-7.750]	-0.057*** [-7.577]	-0.033*** [-5.556]	-0.033*** [-5.554]	-0.033*** [-5.551]	-0.030*** [-5.074]
Constant	0.106*** [6.334]	0.106*** [6.332]	0.106*** [6.328]	0.100*** [5.724]	0.093*** [6.527]	0.093*** [6.525]	0.093*** [6.522]	0.093*** [6.237]
Observations	92,320	92,320	92,320	91,962	92,320	92,320	92,320	91,962
Adjusted R-squared	0.514	0.513	0.513	0.522	0.660	0.659	0.659	0.670
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓

Appendix Table A.6. E-government and Long-run Tax Aggressiveness

The dependent variable is three-year long-run GAAP ETR Difference (column (1)-(4)) and three-year long-run cash ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP LR ETR Difference				CASH LR ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.017*** [4.013]	0.017*** [4.011]	0.017*** [4.009]	0.012*** [2.818]	0.056*** [8.133]	0.056*** [8.131]	0.056*** [8.127]	0.042*** [5.952]
Size	-0.006*** [-4.905]	-0.006*** [-4.904]	-0.006*** [-4.901]	-0.005*** [-3.941]	-0.007*** [-3.234]	-0.007*** [-3.233]	-0.007*** [-3.231]	-0.007*** [-3.052]
Growth	-0.000 [-0.222]	-0.000 [-0.222]	-0.000 [-0.222]	-0.000 [-0.213]	-0.011*** [-5.530]	-0.011*** [-5.528]	-0.011*** [-5.525]	-0.011*** [-5.214]
Profitability	-0.081*** [-13.356]	-0.081*** [-13.352]	-0.081*** [-13.345]	-0.079*** [-12.774]	-0.171*** [-14.778]	-0.171*** [-14.772]	-0.171*** [-14.765]	-0.179*** [-14.794]
Leverage	0.018*** [3.250]	0.018*** [3.248]	0.018*** [3.247]	0.015*** [2.603]	0.005 [0.594]	0.005 [0.594]	0.005 [0.594]	0.006 [0.651]
Age (log)	-0.002 [-1.277]	-0.002 [-1.276]	-0.002 [-1.276]	-0.002 [-1.409]	-0.033*** [-11.299]	-0.033*** [-11.295]	-0.033*** [-11.289]	-0.032*** [-10.830]
Loss	0.161*** [21.428]	0.161*** [21.421]	0.161*** [21.410]	0.159*** [21.528]	0.090*** [12.155]	0.090*** [12.151]	0.090*** [12.145]	0.087*** [11.935]
NOLREV	-0.028*** [-13.505]	-0.028*** [-13.501]	-0.028*** [-13.494]	-0.027*** [-12.489]	-0.079*** [-18.012]	-0.079*** [-18.005]	-0.079*** [-17.996]	-0.077*** [-17.547]
Intangible	-0.009 [-1.575]	-0.009 [-1.574]	-0.009 [-1.573]	-0.011* [-1.681]	0.012 [0.981]	0.012 [0.981]	0.012 [0.980]	0.018 [1.524]
R&D (rnd)	0.097*** [3.068]	0.097*** [3.067]	0.097*** [3.065]	0.078** [2.368]	0.477*** [6.489]	0.477*** [6.487]	0.477*** [6.484]	0.470*** [6.443]
Inventory	-0.005 [-0.715]	-0.005 [-0.715]	-0.005 [-0.714]	-0.002 [-0.347]	0.001 [0.097]	0.001 [0.097]	0.001 [0.097]	0.013 [0.897]
PPE	-0.006 [-1.307]	-0.006 [-1.307]	-0.006 [-1.306]	-0.005 [-0.975]	-0.023** [-2.345]	-0.023** [-2.344]	-0.023** [-2.343]	-0.016* [-1.657]
BIG4	-0.001 [-0.794]	-0.001 [-0.793]	-0.001 [-0.793]	-0.001 [-0.815]	0.003 [0.900]	0.003 [0.900]	0.003 [0.899]	0.002 [0.554]
Market-to-Book (mtb)	-0.045*** [-2.583]	-0.045*** [-2.582]	-0.045*** [-2.581]	-0.037** [-2.082]	-0.053* [-1.656]	-0.053* [-1.656]	-0.053* [-1.655]	-0.053 [-1.581]
Volatility (log)	-0.001** [-2.298]	-0.001** [-2.297]	-0.001** [-2.296]	-0.001** [-2.385]	-0.001 [-1.289]	-0.001 [-1.289]	-0.001 [-1.288]	-0.000 [-0.013]
Advertising	0.054 [0.226]	0.054 [0.226]	0.054 [0.226]	0.077 [0.309]	-0.435 [-0.987]	-0.435 [-0.987]	-0.435 [-0.986]	-0.513 [-1.109]
Capex	-0.006 [-1.635]	-0.006 [-1.634]	-0.006 [-1.633]	-0.005 [-1.252]	-0.052*** [-6.762]	-0.052*** [-6.760]	-0.052*** [-6.756]	-0.051*** [-6.669]
Constant	0.141*** [15.495]	0.141*** [15.490]	0.141*** [15.482]	0.137*** [14.186]	0.272*** [15.678]	0.272*** [15.673]	0.272*** [15.665]	0.269*** [14.753]
Observations	92,306	92,306	92,306	91,962	92,306	92,306	92,306	91,962
Adjusted R-squared	0.502	0.502	0.501	0.508	0.509	0.508	0.508	0.522
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.7. E-government and Tax Aggressiveness using Current ETR

The dependent variable is annual current ETR Difference (column (1)-(4)) and three-year long-run current ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	CURRENT ETR Difference				CURRENTLR ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	-0.010*	-0.010*	-0.010*	-0.008	-0.004	-0.004	-0.004	-0.007
	[-1.648]	[-1.647]	[-1.646]	[-1.180]	[-0.862]	[-0.862]	[-0.861]	[-1.278]
Size	-0.018***	-0.018***	-0.018***	-0.016***	-0.013***	-0.013***	-0.013***	-0.012***
	[-10.234]	[-10.231]	[-10.226]	[-8.998]	[-9.001]	[-8.998]	[-8.993]	[-7.864]
Growth	-0.013***	-0.013***	-0.013***	-0.011***	-0.004***	-0.004***	-0.004***	-0.004***
	[-7.626]	[-7.624]	[-7.620]	[-6.556]	[-3.677]	[-3.676]	[-3.674]	[-3.358]
Profitability	-0.346***	-0.346***	-0.346***	-0.344***	-0.096***	-0.096***	-0.096***	-0.097***
	[-30.283]	[-30.272]	[-30.257]	[-29.207]	[-13.474]	[-13.469]	[-13.463]	[-13.005]
Leverage	0.035***	0.035***	0.035***	0.031***	0.014**	0.014**	0.014**	0.012*
	[4.824]	[4.822]	[4.820]	[4.131]	[2.295]	[2.295]	[2.294]	[1.950]
Age (log)	-0.003	-0.003	-0.003	-0.003	0.003*	0.003*	0.003*	0.002
	[-1.259]	[-1.259]	[-1.258]	[-1.293]	[1.882]	[1.881]	[1.880]	[1.318]
Loss	0.414***	0.414***	0.414***	0.413***	0.128***	0.128***	0.128***	0.126***
	[43.360]	[43.345]	[43.323]	[43.518]	[17.418]	[17.412]	[17.403]	[17.505]
NOLREV	-0.027***	-0.027***	-0.027***	-0.025***	-0.036***	-0.036***	-0.036***	-0.034***
	[-9.164]	[-9.161]	[-9.156]	[-8.271]	[-13.933]	[-13.928]	[-13.921]	[-12.898]
Intangible	-0.033***	-0.033***	-0.033***	-0.027***	-0.042***	-0.042***	-0.042***	-0.042***
	[-3.868]	[-3.866]	[-3.864]	[-3.135]	[-5.710]	[-5.708]	[-5.705]	[-5.455]
R&D (rnd)	-0.375***	-0.375***	-0.375***	-0.331***	-0.374***	-0.374***	-0.374***	-0.378***
	[-9.120]	[-9.116]	[-9.112]	[-7.589]	[-9.601]	[-9.598]	[-9.593]	[-9.392]
Inventory	0.030***	0.030***	0.030***	0.037***	0.032***	0.032***	0.032***	0.033***
	[3.454]	[3.453]	[3.451]	[4.233]	[4.588]	[4.586]	[4.584]	[4.599]
PPE	-0.002	-0.002	-0.002	0.001	-0.006	-0.006	-0.006	-0.004
	[-0.360]	[-0.360]	[-0.360]	[0.081]	[-1.191]	[-1.190]	[-1.190]	[-0.747]
BIG4	-0.004	-0.004	-0.004	-0.004	-0.000	-0.000	-0.000	-0.001
	[-1.521]	[-1.521]	[-1.520]	[-1.575]	[-0.202]	[-0.202]	[-0.202]	[-0.602]
Market-to-Book (mtb)	-0.025	-0.025	-0.025	-0.021	-0.052**	-0.052**	-0.052**	-0.042**
	[-1.020]	[-1.019]	[-1.019]	[-0.817]	[-2.558]	[-2.557]	[-2.556]	[-1.988]
Volatility (log)	0.004***	0.004***	0.004***	0.004***	0.000	0.000	0.000	0.000
	[6.582]	[6.580]	[6.577]	[5.832]	[0.389]	[0.388]	[0.388]	[0.500]
Advertising	-0.651	-0.651	-0.651	-0.737*	0.092	0.092	0.092	-0.027
	[-1.538]	[-1.537]	[-1.536]	[-1.683]	[0.230]	[0.230]	[0.230]	[-0.063]
Capex	-0.020***	-0.020***	-0.020***	-0.021***	-0.008**	-0.008**	-0.008**	-0.008*
	[-3.835]	[-3.833]	[-3.831]	[-3.881]	[-2.090]	[-2.089]	[-2.088]	[-1.870]
Constant	0.287***	0.287***	0.287***	0.270***	0.224***	0.224***	0.224***	0.217***
	[21.797]	[21.790]	[21.779]	[19.873]	[19.874]	[19.867]	[19.857]	[18.339]
Observations	92,306	92,306	92,306	91,962	92,306	92,306	92,306	91,962
Adjusted R-squared	0.377	0.376	0.375	0.384	0.468	0.467	0.466	0.476
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.8. E-government and Tax Aggressiveness using non-absolute value of ETR

The dependent variable is annual non-absolute value of GAAP ETR Difference (column (1)-(4)) and cash ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference				CASH ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI	0.024*** [3.854]	0.024*** [3.852]	0.024*** [3.850]	0.016** [2.426]	0.203*** [15.360]	0.203*** [15.354]	0.203*** [15.347]	0.178*** [13.173]
Size	-0.006*** [-3.965]	-0.006*** [-3.963]	-0.006*** [-3.961]	-0.006*** [-3.469]	0.006* [1.685]	0.006* [1.685]	0.006* [1.684]	0.008** [2.254]
Growth	-0.011*** [-6.079]	-0.011*** [-6.077]	-0.011*** [-6.074]	-0.013*** [-6.516]	-0.082*** [-22.794]	-0.082*** [-22.786]	-0.082*** [-22.775]	-0.084*** [-22.923]
Profitability	-0.312*** [-27.862]	-0.312*** [-27.852]	-0.312*** [-27.838]	-0.315*** [-27.369]	-1.038*** [-44.664]	-1.038*** [-44.648]	-1.038*** [-44.626]	-1.062*** [-44.445]
Leverage	0.002 [0.199]	0.002 [0.199]	0.002 [0.199]	0.004 [0.542]	-0.021 [-1.366]	-0.021 [-1.365]	-0.021 [-1.365]	-0.016 [-1.004]
Age (log)	0.001 [0.691]	0.001 [0.691]	0.001 [0.691]	0.001 [0.538]	-0.056*** [-12.422]	-0.056*** [-12.418]	-0.056*** [-12.411]	-0.056*** [-12.162]
Loss	0.579*** [76.021]	0.579*** [75.995]	0.579*** [75.956]	0.586*** [76.772]	0.399*** [36.882]	0.399*** [36.869]	0.399*** [36.850]	0.403*** [36.425]
NOLREV	-0.021*** [-6.454]	-0.021*** [-6.452]	-0.021*** [-6.449]	-0.022*** [-6.436]	-0.032*** [-4.311]	-0.032*** [-4.309]	-0.032*** [-4.307]	-0.033*** [-4.385]
Intangible	-0.016* [-1.861]	-0.016* [-1.860]	-0.016* [-1.859]	-0.018* [-1.944]	0.268*** [11.973]	0.268*** [11.969]	0.268*** [11.963]	0.276*** [12.322]
R&D (rnd)	0.006 [0.147]	0.006 [0.147]	0.006 [0.147]	-0.033 [-0.768]	3.844*** [24.323]	3.844*** [24.314]	3.844*** [24.302]	3.826*** [23.800]
Inventory	0.068*** [7.098]	0.068*** [7.096]	0.068*** [7.092]	0.071*** [7.186]	0.011 [0.460]	0.011 [0.460]	0.011 [0.459]	0.027 [1.070]
PPE	0.013* [1.870]	0.013* [1.869]	0.013* [1.868]	0.019*** [2.629]	-0.117*** [-6.741]	-0.117*** [-6.738]	-0.117*** [-6.735]	-0.102*** [-5.825]
BIG4	-0.004* [-1.679]	-0.004* [-1.678]	-0.004* [-1.677]	-0.004* [-1.791]	-0.019*** [-3.746]	-0.019*** [-3.745]	-0.019*** [-3.743]	-0.021*** [-4.101]
Market-to-Book (mtb)	-0.007 [-0.258]	-0.007 [-0.258]	-0.007 [-0.258]	-0.010 [-0.344]	0.109** [2.067]	0.109** [2.066]	0.109** [2.065]	0.065 [1.139]
Volatility (log)	0.005*** [6.389]	0.005*** [6.387]	0.005*** [6.384]	0.005*** [6.381]	0.010*** [6.175]	0.010*** [6.173]	0.010*** [6.170]	0.011*** [7.116]
Advertising	-0.056 [-0.146]	-0.056 [-0.146]	-0.056 [-0.146]	-0.058 [-0.150]	-1.509* [-1.823]	-1.509* [-1.822]	-1.509* [-1.821]	-1.635* [-1.916]
Capex	-0.038*** [-6.165]	-0.038*** [-6.163]	-0.038*** [-6.160]	-0.038*** [-6.124]	-0.124*** [-8.998]	-0.124*** [-8.995]	-0.124*** [-8.990]	-0.117*** [-8.533]
Constant	0.031** [2.436]	0.031** [2.435]	0.031** [2.434]	0.029** [2.251]	-0.030 [-1.107]	-0.030 [-1.107]	-0.030 [-1.106]	-0.046 [-1.580]
Observations	92,298	92,298	92,298	91,954	92,298	92,298	92,298	91,954
Adjusted R-squared	0.556	0.556	0.556	0.559	0.408	0.408	0.407	0.422
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.9. E-government and Tax Avoidance using one-year lag EGDI

The dependent variable is annual GAAP ETR (column (1)-(4)) and cash ETR (column (5)-(8)). Variable of interest is one-year lag of e-government development index (L.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.EGDI	0.031*** [4.331]	0.031*** [4.329]	0.031*** [4.327]	0.022*** [2.952]	0.228*** [14.824]	0.228*** [14.819]	0.228*** [14.811]	0.201*** [12.827]
Size	-0.007*** [-4.420]	-0.007*** [-4.418]	-0.007*** [-4.416]	-0.006*** [-3.550]	0.009** [2.501]	0.009** [2.500]	0.009** [2.499]	0.009** [2.485]
Growth	-0.012*** [-6.566]	-0.012*** [-6.564]	-0.012*** [-6.561]	-0.012*** [-6.495]	-0.085*** [-23.248]	-0.085*** [-23.240]	-0.085*** [-23.228]	-0.084*** [-22.935]
Profitability	-0.316*** [-28.329]	-0.316*** [-28.319]	-0.316*** [-28.305]	-0.313*** [-27.383]	-1.051*** [-44.865]	-1.051*** [-44.850]	-1.051*** [-44.827]	-1.054*** [-44.383]
Leverage	-0.000 [-0.003]	-0.000 [-0.003]	-0.000 [-0.003]	0.004 [0.503]	-0.031** [-1.967]	-0.031** [-1.966]	-0.031** [-1.965]	-0.020 [-1.220]
Age (log)	0.001 [0.480]	0.001 [0.480]	0.001 [0.479]	0.001 [0.445]	-0.055*** [-12.107]	-0.055*** [-12.103]	-0.055*** [-12.097]	-0.056*** [-12.209]
Loss	0.581*** [76.309]	0.581*** [76.282]	0.581*** [76.244]	0.582*** [76.671]	0.402*** [37.029]	0.402*** [37.016]	0.402*** [36.997]	0.400*** [36.378]
NOLREV	-0.022*** [-6.682]	-0.022*** [-6.679]	-0.022*** [-6.676]	-0.022*** [-6.486]	-0.034*** [-4.540]	-0.034*** [-4.538]	-0.034*** [-4.536]	-0.034*** [-4.511]
Intangible	-0.019** [-2.132]	-0.019** [-2.131]	-0.019** [-2.130]	-0.017* [-1.912]	0.275*** [11.943]	0.275*** [11.939]	0.275*** [11.933]	0.275*** [12.370]
R&D (rnd)	-0.014 [-0.339]	-0.014 [-0.339]	-0.014 [-0.339]	-0.034 [-0.811]	4.088*** [24.436]	4.088*** [24.428]	4.088*** [24.416]	3.822*** [23.802]
Inventory	0.064*** [6.543]	0.064*** [6.541]	0.064*** [6.537]	0.070*** [7.169]	-0.004 [-0.138]	-0.004 [-0.138]	-0.004 [-0.138]	0.024 [0.980]
PPE	0.013* [1.911]	0.013* [1.910]	0.013* [1.909]	0.019*** [2.698]	-0.120*** [-6.795]	-0.120*** [-6.792]	-0.120*** [-6.789]	-0.102*** [-5.861]
BIG4	-0.004* [-1.751]	-0.004* [-1.750]	-0.004* [-1.749]	-0.004* [-1.836]	-0.019*** [-3.798]	-0.019*** [-3.797]	-0.019*** [-3.795]	-0.021*** [-4.201]
Market-to-Book (mtb)	-0.007 [-0.250]	-0.007 [-0.250]	-0.007 [-0.250]	-0.010 [-0.365]	0.117** [2.207]	0.117** [2.206]	0.117** [2.205]	0.065 [1.158]
Volatility (log)	0.004*** [6.124]	0.004*** [6.122]	0.004*** [6.119]	0.005*** [6.448]	0.009*** [5.672]	0.009*** [5.671]	0.009*** [5.668]	0.011*** [7.144]
Advertising	-0.053 [-0.141]	-0.053 [-0.141]	-0.053 [-0.141]	-0.062 [-0.162]	-2.025** [-2.428]	-2.025** [-2.427]	-2.025** [-2.426]	-1.680** [-1.990]
Capex	-0.038*** [-6.320]	-0.038*** [-6.317]	-0.038*** [-6.314]	-0.038*** [-6.174]	-0.127*** [-9.131]	-0.127*** [-9.127]	-0.127*** [-9.123]	-0.116*** [-8.538]
Constant	0.277*** [21.853]	0.277*** [21.846]	0.277*** [21.835]	0.268*** [20.538]	0.228*** [8.084]	0.228*** [8.081]	0.228*** [8.077]	0.224*** [7.721]
Observations	92,318	92,318	92,318	91,960	92,318	92,318	92,318	91,960
Adjusted R-squared	0.573	0.573	0.572	0.577	0.458	0.458	0.457	0.483
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.10. E-government and Long-run Tax Avoidance using lag variable of interest

The dependent variable is three-year long-run GAAP ETR (column (1)-(4)) and cash ETR (column (5)-(8)). Variable of interest is one-year lag of e-government development index (L.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP LR ETR				CASH LR ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.EGDI	0.043*** [6.226]	0.043*** [6.224]	0.043*** [6.221]	0.029*** [4.243]	0.305*** [19.798]	0.305*** [19.791]	0.305*** [19.781]	0.268*** [17.624]
Size	-0.005*** [-3.497]	-0.005*** [-3.496]	-0.005*** [-3.494]	-0.003** [-2.369]	0.020*** [6.206]	0.020*** [6.204]	0.020*** [6.201]	0.019*** [5.650]
Growth	-0.006*** [-4.648]	-0.006*** [-4.646]	-0.006*** [-4.644]	-0.007*** [-4.941]	-0.034*** [-11.709]	-0.034*** [-11.705]	-0.034*** [-11.699]	-0.035*** [-12.018]
Profitability	-0.119*** [-15.582]	-0.119*** [-15.577]	-0.119*** [-15.569]	-0.115*** [-14.747]	-0.476*** [-26.319]	-0.476*** [-26.310]	-0.476*** [-26.297]	-0.476*** [-25.987]
Leverage	0.012* [1.715]	0.012* [1.714]	0.012* [1.713]	0.016** [2.225]	-0.039*** [-2.687]	-0.039*** [-2.686]	-0.039*** [-2.685]	-0.024 [-1.625]
Age (log)	0.002 [0.903]	0.002 [0.903]	0.002 [0.902]	0.001 [0.772]	-0.058*** [-13.687]	-0.058*** [-13.682]	-0.058*** [-13.675]	-0.058*** [-13.657]
Loss	0.191*** [24.918]	0.191*** [24.909]	0.191*** [24.897]	0.190*** [24.995]	0.122*** [14.179]	0.122*** [14.174]	0.122*** [14.167]	0.122*** [14.133]
NOLREV	-0.032*** [-12.105]	-0.032*** [-12.100]	-0.032*** [-12.094]	-0.032*** [-11.885]	-0.079*** [-11.267]	-0.079*** [-11.263]	-0.079*** [-11.258]	-0.079*** [-11.275]
Intangible	-0.008 [-0.977]	-0.008 [-0.977]	-0.008 [-0.976]	-0.009 [-1.155]	0.253*** [12.044]	0.253*** [12.040]	0.253*** [12.033]	0.252*** [12.361]
R&D (rnd)	0.017 [0.459]	0.017 [0.459]	0.017 [0.458]	-0.032 [-0.831]	3.538*** [23.878]	3.538*** [23.870]	3.538*** [23.858]	3.287*** [23.119]
Inventory	0.046*** [5.719]	0.046*** [5.717]	0.046*** [5.714]	0.048*** [5.890]	-0.038 [-1.558]	-0.038 [-1.557]	-0.038 [-1.556]	-0.016 [-0.694]
PPE	0.010* [1.681]	0.010* [1.680]	0.010* [1.679]	0.017*** [2.697]	-0.126*** [-7.481]	-0.126*** [-7.478]	-0.126*** [-7.474]	-0.107*** [-6.512]
BIG4	-0.004** [-2.047]	-0.004** [-2.047]	-0.004** [-2.046]	-0.005** [-2.240]	-0.016*** [-3.543]	-0.016*** [-3.542]	-0.016*** [-3.540]	-0.018*** [-3.971]
Market-to-Book (mtb)	-0.030 [-1.418]	-0.030 [-1.418]	-0.030 [-1.417]	-0.027 [-1.214]	-0.010 [-0.217]	-0.010 [-0.217]	-0.010 [-0.217]	-0.048 [-0.934]
Volatility (log)	0.000 [0.073]	0.000 [0.073]	0.000 [0.073]	0.000 [0.499]	-0.001 [-0.912]	-0.001 [-0.911]	-0.001 [-0.911]	0.001 [0.709]
Advertising	0.166 [0.476]	0.166 [0.476]	0.166 [0.475]	0.134 [0.382]	-1.130 [-1.500]	-1.130 [-1.499]	-1.130 [-1.499]	-1.040 [-1.430]
Capex	-0.035*** [-7.271]	-0.035*** [-7.269]	-0.035*** [-7.265]	-0.033*** [-6.752]	-0.130*** [-10.210]	-0.130*** [-10.206]	-0.130*** [-10.201]	-0.121*** [-9.793]
Constant	0.259*** [22.336]	0.259*** [22.329]	0.259*** [22.317]	0.252*** [20.985]	0.098*** [3.648]	0.098*** [3.646]	0.098*** [3.644]	0.110*** [3.946]
Observations	92,318	92,318	92,318	91,960	92,318	92,318	92,318	91,960
Adjusted R-squared	0.678	0.678	0.677	0.684	0.554	0.553	0.553	0.583
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.11. E-government and Tax Aggressiveness using one-year lag EGDI

The dependent variable is absolute value of annual GAAP ETR Difference (column (1)-(4)) and cash ETR Difference (column (5)-(8)). Variable of interest is one-year lag of e-government development index (L.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference				CASH ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.EGDI	0.016*** [2.955]	0.016*** [2.954]	0.016*** [2.953]	0.012** [2.183]	0.037*** [4.249]	0.037*** [4.248]	0.037*** [4.246]	0.031*** [3.362]
Size	-0.008*** [-6.484]	-0.008*** [-6.482]	-0.008*** [-6.479]	-0.007*** [-5.598]	-0.013*** [-5.481]	-0.013*** [-5.479]	-0.013*** [-5.477]	-0.012*** [-5.164]
Growth	-0.013*** [-8.814]	-0.013*** [-8.811]	-0.013*** [-8.807]	-0.011*** [-7.768]	-0.038*** [-15.219]	-0.038*** [-15.214]	-0.038*** [-15.206]	-0.036*** [-14.037]
Profitability	-0.253*** [-28.961]	-0.253*** [-28.951]	-0.253*** [-28.937]	-0.249*** [-27.975]	-0.543*** [-36.166]	-0.543*** [-36.153]	-0.543*** [-36.135]	-0.544*** [-35.135]
Leverage	0.020*** [3.328]	0.020*** [3.327]	0.020*** [3.326]	0.017*** [2.829]	0.024** [2.431]	0.024** [2.430]	0.024** [2.429]	0.024** [2.362]
Age (log)	-0.002 [-1.165]	-0.002 [-1.165]	-0.002 [-1.164]	-0.002 [-1.005]	-0.022*** [-7.342]	-0.022*** [-7.339]	-0.022*** [-7.335]	-0.022*** [-7.177]
Loss	0.521*** [71.586]	0.521*** [71.561]	0.521*** [71.525]	0.521*** [72.620]	0.321*** [36.010]	0.321*** [35.997]	0.321*** [35.979]	0.318*** [35.675]
NOLREV	-0.023*** [-9.276]	-0.023*** [-9.273]	-0.023*** [-9.268]	-0.021*** [-8.359]	-0.050*** [-11.310]	-0.050*** [-11.306]	-0.050*** [-11.300]	-0.049*** [-11.106]
Intangible	-0.006 [-0.956]	-0.006 [-0.955]	-0.006 [-0.955]	-0.005 [-0.819]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]	0.008 [0.682]
R&D (rnd)	0.125*** [3.953]	0.125*** [3.952]	0.125*** [3.950]	0.130*** [3.883]	0.487*** [6.280]	0.487*** [6.278]	0.487*** [6.274]	0.471*** [6.214]
Inventory	-0.001 [-0.089]	-0.001 [-0.089]	-0.001 [-0.089]	0.005 [0.608]	0.018 [1.182]	0.018 [1.182]	0.018 [1.181]	0.033** [2.187]
PPE	0.001 [0.112]	0.001 [0.112]	0.001 [0.112]	0.003 [0.531]	-0.013 [-1.343]	-0.013 [-1.342]	-0.013 [-1.341]	-0.006 [-0.621]
BIG4	-0.000 [-0.143]	-0.000 [-0.143]	-0.000 [-0.143]	0.000 [0.198]	-0.001 [-0.331]	-0.001 [-0.330]	-0.001 [-0.330]	-0.001 [-0.394]
Market-to-Book (mtb)	-0.026 [-1.365]	-0.026 [-1.365]	-0.026 [-1.364]	-0.029 [-1.429]	0.016 [0.473]	0.016 [0.473]	0.016 [0.472]	0.009 [0.267]
Volatility (log)	0.002*** [3.895]	0.002*** [3.894]	0.002*** [3.892]	0.002*** [3.205]	0.005*** [4.789]	0.005*** [4.788]	0.005*** [4.785]	0.006*** [5.390]
Advertising	-0.117 [-0.425]	-0.117 [-0.424]	-0.117 [-0.424]	-0.112 [-0.401]	-0.977** [-2.060]	-0.977** [-2.060]	-0.977** [-2.059]	-0.876* [-1.671]
Capex	-0.012*** [-2.668]	-0.012*** [-2.667]	-0.012*** [-2.666]	-0.013*** [-2.692]	-0.044*** [-5.301]	-0.044*** [-5.299]	-0.044*** [-5.296]	-0.041*** [-4.971]
Constant	0.168*** [17.030]	0.168*** [17.024]	0.168*** [17.016]	0.163*** [15.822]	0.330*** [18.383]	0.330*** [18.377]	0.330*** [18.368]	0.323*** [17.247]
Observations	92,304	92,304	92,304	91,960	92,304	92,304	92,304	91,960
Adjusted R-squared	0.488	0.487	0.487	0.490	0.384	0.384	0.383	0.394
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.12. E-government and Long-run Tax Aggressiveness using one-year lag EGDI

The dependent variable is absolute value of long-run GAAP ETR Difference (column (1)-(4)) and cash ETR Difference (column (5)-(8)). Variable of interest is one-year lag of e-government development index (L.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP LR ETR Difference				CASH LR ETR Difference			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.EGDI	0.024*** [4.421]	0.024*** [4.419]	0.024*** [4.417]	0.018*** [3.173]	0.058*** [6.858]	0.058*** [6.855]	0.058*** [6.852]	0.043*** [4.895]
Size	-0.006*** [-4.891]	-0.006*** [-4.889]	-0.006*** [-4.887]	-0.005*** [-3.936]	-0.007*** [-3.084]	-0.007*** [-3.083]	-0.007*** [-3.081]	-0.007*** [-2.949]
Growth	-0.000 [-0.209]	-0.000 [-0.209]	-0.000 [-0.209]	-0.000 [-0.216]	-0.011*** [-5.538]	-0.011*** [-5.536]	-0.011*** [-5.533]	-0.011*** [-5.239]
Profitability	-0.081*** [-13.321]	-0.081*** [-13.317]	-0.081*** [-13.310]	-0.079*** [-12.752]	-0.171*** [-14.761]	-0.171*** [-14.756]	-0.171*** [-14.748]	-0.179*** [-14.789]
Leverage	0.018*** [3.243]	0.018*** [3.242]	0.018*** [3.241]	0.015*** [2.599]	0.004 [0.453]	0.004 [0.453]	0.004 [0.452]	0.005 [0.577]
Age (log)	-0.002 [-1.306]	-0.002 [-1.306]	-0.002 [-1.305]	-0.002 [-1.424]	-0.033*** [-11.307]	-0.033*** [-11.303]	-0.033*** [-11.297]	-0.032*** [-10.830]
Loss	0.161*** [21.432]	0.161*** [21.424]	0.161*** [21.414]	0.159*** [21.528]	0.090*** [12.158]	0.090*** [12.154]	0.090*** [12.148]	0.087*** [11.931]
NOLREV	-0.028*** [-13.525]	-0.028*** [-13.521]	-0.028*** [-13.514]	-0.027*** [-12.514]	-0.079*** [-18.044]	-0.079*** [-18.038]	-0.079*** [-18.028]	-0.077*** [-17.585]
Intangible	-0.009 [-1.546]	-0.009 [-1.545]	-0.009 [-1.544]	-0.010* [-1.662]	0.012 [0.981]	0.012 [0.981]	0.012 [0.981]	0.018 [1.517]
R&D (rnd)	0.096*** [3.035]	0.096*** [3.034]	0.096*** [3.033]	0.077** [2.345]	0.482*** [6.560]	0.482*** [6.558]	0.482*** [6.554]	0.474*** [6.495]
Inventory	-0.005 [-0.718]	-0.005 [-0.717]	-0.005 [-0.717]	-0.002 [-0.346]	0.001 [0.053]	0.001 [0.053]	0.001 [0.053]	0.013 [0.862]
PPE	-0.006 [-1.296]	-0.006 [-1.295]	-0.006 [-1.295]	-0.005 [-0.971]	-0.024** [-2.460]	-0.024** [-2.459]	-0.024** [-2.457]	-0.017* [-1.725]
BIG4	-0.001 [-0.820]	-0.001 [-0.820]	-0.001 [-0.819]	-0.001 [-0.836]	0.002 [0.868]	0.002 [0.867]	0.002 [0.867]	0.001 [0.520]
Market-to-Book (mtb)	-0.044** [-2.570]	-0.044** [-2.569]	-0.044** [-2.568]	-0.037** [-2.073]	-0.052 [-1.620]	-0.052 [-1.619]	-0.052 [-1.619]	-0.053 [-1.560]
Volatility (log)	-0.001** [-2.313]	-0.001** [-2.312]	-0.001** [-2.311]	-0.001** [-2.391]	-0.001 [-1.299]	-0.001 [-1.299]	-0.001 [-1.298]	-0.000 [-0.010]
Advertising	0.051 [0.212]	0.051 [0.212]	0.051 [0.212]	0.074 [0.300]	-0.448 [-1.015]	-0.448 [-1.015]	-0.448 [-1.014]	-0.524 [-1.134]
Capex	-0.006 [-1.618]	-0.006 [-1.617]	-0.006 [-1.616]	-0.005 [-1.232]	-0.051*** [-6.725]	-0.051*** [-6.723]	-0.051*** [-6.720]	-0.051*** [-6.640]
Constant	0.137*** [14.702]	0.137*** [14.697]	0.137*** [14.689]	0.134*** [13.629]	0.269*** [15.340]	0.269*** [15.334]	0.269*** [15.327]	0.267*** [14.467]
Observations	92,304	92,304	92,304	91,960	92,304	92,304	92,304	91,960
Adjusted R-squared	0.502	0.502	0.501	0.508	0.509	0.508	0.508	0.522
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.13. E-government and Tax Avoidance using two-year lag EGDI

The dependent variable is annual GAAP ETR (column (1)-(4)) and cash ETR (column (5)-(8)). Variable of interest is two-year lag of e-government development index (L2.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L2.EGDI	0.161***	0.161***	0.161***	0.139***	0.514***	0.514***	0.514***	0.467***
	[10.303]	[10.299]	[10.292]	[8.575]	[15.629]	[15.623]	[15.613]	[13.526]
Size	-0.009***	-0.009***	-0.009***	-0.008***	0.006	0.006	0.006	0.006
	[-4.425]	[-4.423]	[-4.420]	[-3.749]	[1.318]	[1.317]	[1.316]	[1.338]
Growth	-0.012***	-0.012***	-0.012***	-0.012***	-0.086***	-0.086***	-0.086***	-0.084***
	[-6.122]	[-6.120]	[-6.116]	[-5.828]	[-20.480]	[-20.471]	[-20.459]	[-19.785]
Profitability	-0.321***	-0.321***	-0.321***	-0.321***	-1.094***	-1.094***	-1.094***	-1.105***
	[-24.904]	[-24.893]	[-24.878]	[-24.411]	[-40.424]	[-40.406]	[-40.381]	[-40.105]
Leverage	-0.005	-0.005	-0.005	0.000	-0.026	-0.026	-0.026	-0.024
	[-0.611]	[-0.611]	[-0.610]	[0.034]	[-1.416]	[-1.415]	[-1.414]	[-1.264]
Age (log)	-0.002	-0.002	-0.002	-0.003	-0.065***	-0.065***	-0.065***	-0.068***
	[-0.420]	[-0.420]	[-0.419]	[-0.713]	[-7.809]	[-7.806]	[-7.801]	[-8.042]
Loss	0.576***	0.576***	0.576***	0.577***	0.401***	0.401***	0.401***	0.400***
	[61.743]	[61.716]	[61.678]	[62.221]	[31.463]	[31.449]	[31.430]	[31.152]
NOLREV	-0.023***	-0.023***	-0.023***	-0.022***	-0.034***	-0.034***	-0.034***	-0.033***
	[-6.509]	[-6.506]	[-6.502]	[-6.072]	[-4.081]	[-4.080]	[-4.077]	[-3.916]
Intangible	-0.024**	-0.024**	-0.024**	-0.027***	0.296***	0.296***	0.296***	0.289***
	[-2.544]	[-2.543]	[-2.541]	[-2.790]	[11.228]	[11.224]	[11.216]	[11.406]
R&D (rnd)	-0.046	-0.046	-0.046	-0.044	4.147***	4.147***	4.147***	3.863***
	[-1.013]	[-1.012]	[-1.012]	[-0.904]	[22.087]	[22.077]	[22.064]	[21.469]
Inventory	0.062***	0.062***	0.062***	0.072***	-0.001	-0.001	-0.001	0.028
	[5.763]	[5.760]	[5.757]	[6.691]	[-0.030]	[-0.030]	[-0.030]	[0.966]
PPE	0.016**	0.016**	0.016**	0.021***	-0.112***	-0.112***	-0.112***	-0.093***
	[2.056]	[2.055]	[2.054]	[2.596]	[-5.485]	[-5.482]	[-5.479]	[-4.684]
BIG4	-0.005**	-0.005**	-0.005**	-0.005*	-0.017***	-0.017***	-0.017***	-0.018***
	[-1.975]	[-1.974]	[-1.973]	[-1.739]	[-3.060]	[-3.059]	[-3.057]	[-3.332]
Market-to-Book (mtb)	0.012	0.012	0.012	0.016	0.136**	0.136**	0.136**	0.079
	[0.413]	[0.413]	[0.413]	[0.545]	[2.556]	[2.555]	[2.553]	[1.382]
Volatility (log)	0.006***	0.006***	0.006***	0.006***	0.009***	0.009***	0.009***	0.012***
	[6.241]	[6.238]	[6.234]	[6.442]	[4.287]	[4.285]	[4.282]	[5.930]
Advertising	0.150	0.150	0.150	0.167	-1.824**	-1.824**	-1.824**	-1.540*
	[0.376]	[0.376]	[0.376]	[0.406]	[-2.050]	[-2.049]	[-2.048]	[-1.723]
Capex	-0.035***	-0.035***	-0.035***	-0.036***	-0.127***	-0.127***	-0.127***	-0.114***
	[-5.451]	[-5.449]	[-5.445]	[-5.333]	[-8.108]	[-8.105]	[-8.100]	[-7.461]
Constant	0.211***	0.211***	0.211***	0.212***	0.104***	0.104***	0.104***	0.111***
	[12.052]	[12.047]	[12.040]	[11.726]	[2.742]	[2.741]	[2.739]	[2.830]
Observations	74,389	74,389	74,389	74,013	74,389	74,389	74,389	74,013
Adjusted R-squared	0.591	0.590	0.590	0.594	0.487	0.487	0.486	0.513
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.14. E-government and Tax Aggressiveness using two-year lag EGDI

The dependent variable is annual GAAP ETR Difference (column (1)-(4)) and cash ETR Difference (column (5)-(8)). Variable of interest is two-year lag of e-government development index (L2.EGDI). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L2.EGDI	0.161*** [10.303]	0.161*** [10.299]	0.161*** [10.292]	0.139*** [8.575]	0.514*** [15.629]	0.514*** [15.623]	0.514*** [15.613]	0.467*** [13.526]
Size	-0.009*** [-4.425]	-0.009*** [-4.423]	-0.009*** [-4.420]	-0.008*** [-3.749]	0.006 [1.318]	0.006 [1.317]	0.006 [1.316]	0.006 [1.338]
Growth	-0.012*** [-6.122]	-0.012*** [-6.120]	-0.012*** [-6.116]	-0.012*** [-5.828]	-0.086*** [-20.480]	-0.086*** [-20.471]	-0.086*** [-20.459]	-0.084*** [-19.785]
Profitability	-0.321*** [-24.904]	-0.321*** [-24.893]	-0.321*** [-24.878]	-0.321*** [-24.411]	-1.094*** [-40.424]	-1.094*** [-40.406]	-1.094*** [-40.381]	-1.105*** [-40.105]
Leverage	-0.005 [-0.611]	-0.005 [-0.611]	-0.005 [-0.610]	0.000 [0.034]	-0.026 [-1.416]	-0.026 [-1.415]	-0.026 [-1.414]	-0.024 [-1.264]
Age (log)	-0.002 [-0.420]	-0.002 [-0.420]	-0.002 [-0.419]	-0.003 [-0.713]	-0.065*** [-7.809]	-0.065*** [-7.806]	-0.065*** [-7.801]	-0.068*** [-8.042]
Loss	0.576*** [61.743]	0.576*** [61.716]	0.576*** [61.678]	0.577*** [62.221]	0.401*** [31.463]	0.401*** [31.449]	0.401*** [31.430]	0.400*** [31.152]
NOLREV	-0.023*** [-6.509]	-0.023*** [-6.506]	-0.023*** [-6.502]	-0.022*** [-6.072]	-0.034*** [-4.081]	-0.034*** [-4.080]	-0.034*** [-4.077]	-0.033*** [-3.916]
Intangible	-0.024** [-2.544]	-0.024** [-2.543]	-0.024** [-2.541]	-0.027*** [-2.790]	0.296*** [11.228]	0.296*** [11.224]	0.296*** [11.216]	0.289*** [11.406]
R&D (rnd)	-0.046 [-1.013]	-0.046 [-1.012]	-0.046 [-1.012]	-0.044 [-0.904]	4.147*** [22.087]	4.147*** [22.077]	4.147*** [22.064]	3.863*** [21.469]
Inventory	0.062*** [5.763]	0.062*** [5.760]	0.062*** [5.757]	0.072*** [6.691]	-0.001 [-0.030]	-0.001 [-0.030]	-0.001 [-0.030]	0.028 [0.966]
PPE	0.016** [2.056]	0.016** [2.055]	0.016** [2.054]	0.021*** [2.596]	-0.112*** [-5.485]	-0.112*** [-5.482]	-0.112*** [-5.479]	-0.093*** [-4.684]
BIG4	-0.005** [-1.975]	-0.005** [-1.974]	-0.005** [-1.973]	-0.005* [-1.739]	-0.017*** [-3.060]	-0.017*** [-3.059]	-0.017*** [-3.057]	-0.018*** [-3.332]
Market-to-Book (mtb)	0.012 [0.413]	0.012 [0.413]	0.012 [0.413]	0.016 [0.545]	0.136** [2.556]	0.136** [2.555]	0.136** [2.553]	0.079 [1.382]
Volatility (log)	0.006*** [6.241]	0.006*** [6.238]	0.006*** [6.234]	0.006*** [6.442]	0.009*** [4.287]	0.009*** [4.285]	0.009*** [4.282]	0.012*** [5.930]
Advertising	0.150 [0.376]	0.150 [0.376]	0.150 [0.376]	0.167 [0.406]	-1.824** [-2.050]	-1.824** [-2.049]	-1.824** [-2.048]	-1.540* [-1.723]
Capex	-0.035*** [-5.451]	-0.035*** [-5.449]	-0.035*** [-5.445]	-0.036*** [-5.333]	-0.127*** [-8.108]	-0.127*** [-8.105]	-0.127*** [-8.100]	-0.114*** [-7.461]
Constant	0.211*** [12.052]	0.211*** [12.047]	0.211*** [12.040]	0.212*** [11.726]	0.104*** [2.742]	0.104*** [2.741]	0.104*** [2.739]	0.111*** [2.830]
Observations	74,389	74,389	74,389	74,013	74,389	74,389	74,389	74,013
Adjusted R-squared	0.591	0.590	0.590	0.594	0.487	0.487	0.486	0.513
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	-	✓	✓	✓	-
Industry FE	-	✓	✓	-	-	✓	✓	-
Industry-Year FE	-	-	-	✓	-	-	-	✓
Country FE	-	-	✓	✓	-	-	✓	✓

Appendix Table A.15. Instrumental Variable Estimations for Long-run Tax Avoidance

The dependent variable is GAAPLR ETR (column (1), (2), (5), (6)) and CASHLR ETR (column (3), (4), (7), (8)). Variable of interest is e-government development index (EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAPLR ETR		CASHLR ETR		GAAPLR ETR		CASHLR ETR	
	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EGDI (fitted)	0.161*** [5.962]		2.104*** [29.179]		0.214*** [6.702]		1.186*** [17.155]	
Instrument		0.002*** [42.020]		0.002*** [42.020]		0.003*** [24.080]		0.003*** [24.080]
Size	-0.008*** [-4.837]	0.013*** [12.423]	-0.018*** [-4.404]	0.013*** [12.423]	-0.009*** [-5.269]	0.018*** [14.920]	0.001 [0.236]	0.018*** [14.920]
Growth	-0.005*** [-4.103]	-0.002** [-2.431]	-0.024*** [-7.057]	-0.002** [-2.431]	-0.005*** [-3.941]	-0.004*** [-3.339]	-0.030*** [-9.717]	-0.004*** [-3.339]
Profitability	-0.118*** [-15.183]	-0.001 [-0.133]	-0.451*** [-20.217]	-0.001 [-0.133]	-0.115*** [-14.734]	-0.008 [-0.991]	-0.463*** [-24.226]	-0.008 [-0.991]
Leverage	0.022*** [3.036]	-0.061*** [-10.347]	0.105*** [5.665]	-0.061*** [-10.347]	0.026*** [3.555]	-0.068*** [-11.564]	0.036** [2.196]	-0.068*** [-11.564]
Age (log)	0.001 [0.447]	0.009*** [4.910]	-0.071*** [-12.999]	0.009*** [4.910]	0.000 [0.109]	0.005*** [2.838]	-0.066*** [-14.004]	0.005*** [2.838]
Loss	0.191*** [24.835]	-0.002 [-0.541]	0.128*** [11.538]	-0.002 [-0.541]	0.190*** [24.559]	-0.004 [-1.092]	0.124*** [13.248]	-0.004 [-1.092]
NOLREV	-0.031*** [-11.471]	-0.008*** [-3.080]	-0.059*** [-7.198]	-0.008*** [-3.080]	-0.030*** [-11.143]	-0.007** [-2.468]	-0.069*** [-9.625]	-0.007** [-2.468]
Intangible	-0.005 [-0.570]	-0.030*** [-4.505]	0.302*** [13.295]	-0.030*** [-4.505]	-0.004 [-0.439]	-0.026*** [-3.892]	0.273*** [13.054]	-0.026*** [-3.892]
R&D (rnd)	-0.055 [-1.377]	0.344*** [11.299]	2.474*** [17.918]	0.344*** [11.299]	-0.085** [-2.033]	0.463*** [14.295]	2.979*** [20.849]	0.463*** [14.295]
Inventory	0.052*** [6.311]	-0.022*** [-3.287]	0.038 [1.469]	-0.022*** [-3.287]	0.053*** [6.453]	-0.032*** [-4.699]	0.001 [0.024]	-0.032*** [-4.699]
PPE	0.021*** [3.316]	-0.066*** [-13.600]	0.032* [1.760]	-0.066*** [-13.600]	0.026*** [3.807]	-0.072*** [-14.350]	-0.045*** [-2.619]	-0.072*** [-14.350]
BIG4	-0.005** [-2.077]	0.002 [0.956]	-0.018*** [-2.928]	0.002 [0.956]	-0.005** [-2.225]	-0.001 [-0.379]	-0.017*** [-3.384]	-0.001 [-0.379]
Market-to-Book (mtb)	-0.036* [-1.704]	0.031** [2.146]	-0.098* [-1.795]	0.031** [2.146]	-0.036* [-1.679]	0.042*** [3.032]	-0.057 [-1.137]	0.042*** [3.032]
Volatility (log)	0 [-0.022]	0.000 [0.664]	-0.002 [-1.362]	0.000 [0.664]	0.000 [0.074]	0.001* [1.792]	-0.002 [-1.179]	0.001* [1.792]
Advertising	0.219 [0.652]	-0.435** [-2.110]	-0.525 [-0.841]	-0.435** [-2.110]	0.215 [0.650]	-0.304 [-1.359]	-0.807 [-1.231]	-0.304 [-1.359]
Capex	-0.036*** [-7.491]	0.010*** [2.916]	-0.143*** [-10.729]	0.010*** [2.916]	-0.036*** [-7.467]	0.009** [2.451]	-0.137*** [-10.852]	0.009** [2.451]
Observations	92,302		92,302		91,935		91,935	
Adjusted R-squared	0.075		-0.443		0.057		-0.009	
Cragg-Donald Wald F Statistics	5,319.66		5,319.66		3,421.12		3,421.12	
Kleibergen-Paap rk wald F Statistics	1,765.68		1,765.68		579.85		579.85	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.16. Instrumental Variable Estimations for Long-run Tax Aggressiveness

The dependent variable is absolute value of GAAPLR ETR Difference (column (1), (2), (5), (6)) and CASHLR ETR Difference (column (3), (4), (7), (8)). Variable of interest is e-government development index (EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAPLR ETR Diff		CASHLR ETR Diff		GAAPLR ETR Diff		CASHLR ETR Diff	
	Second-stage (1)	First-stage (2)	Second-stage (3)	First-stage (4)	Second-stage (5)	First-stage (6)	Second-stage (7)	First-stage (8)
EGDI (fitted)	0.120*** [5.657]		0.442*** [10.325]		0.100*** [3.902]		0.714*** [14.599]	
Instrument		0.002*** [42.022]		0.002*** [42.022]		0.003*** [24.075]		0.003*** [24.075]
Size	-0.008*** [-6.063]	0.013*** [12.416]	-0.015*** [-5.872]	0.013*** [12.416]	-0.007*** [-5.561]	0.018*** [14.917]	-0.021*** [-7.510]	0.018*** [14.917]
Growth	0.000 [0.298]	-0.002** [-2.445]	-0.009*** [-4.313]	-0.002** [-2.445]	0.000 [0.090]	0.004*** [-3.345]	-0.007*** [-3.451]	0.004*** [-3.345]
Profitability	-0.079*** [-12.985]	-0.001 [-0.119]	-0.166*** [-13.802]	-0.001 [-0.119]	-0.079*** [-12.968]	-0.007 [-0.987]	-0.162*** [-12.593]	-0.007 [-0.987]
Leverage	0.026*** [4.479]	-0.061*** [-10.358]	0.034*** [3.512]	-0.061*** [-10.358]	0.025*** [4.159]	0.068*** [-11.568]	0.056*** [5.335]	0.068*** [-11.568]
Age (log)	-0.003* [-1.746]	0.009*** [4.904]	-0.035*** [-11.689]	0.009*** [4.904]	-0.003* [-1.758]	0.005*** [2.836]	-0.038*** [-11.625]	0.005*** [2.836]
Loss	0.162*** [21.379]	-0.002 [-0.537]	0.091*** [12.124]	-0.002 [-0.537]	0.161*** [21.229]	-0.004 [-1.091]	0.093*** [11.933]	-0.004 [-1.091]
NOLREV	-0.027*** [-12.774]	-0.008*** [-3.118]	-0.075*** [-16.648]	-0.008*** [-3.118]	-0.028*** [-12.985]	-0.007** [-2.487]	-0.073*** [-15.025]	-0.007** [-2.487]
Intangible	-0.007 [-1.092]	-0.030*** [-4.512]	0.022* [1.822]	-0.030*** [-4.512]	-0.008 [-1.307]	0.026*** [-3.898]	0.028** [2.230]	0.026*** [-3.898]
R&D (rnd)	0.039 [1.116]	0.344*** [11.297]	0.257*** [3.444]	0.344*** [11.297]	0.048 [1.325]	0.463*** [14.294]	0.095 [1.212]	0.463*** [14.294]
Inventory	-0.000 [-0.053]	-0.022*** [-3.291]	0.017 [1.132]	-0.022*** [-3.291]	-0.002 [-0.254]	0.032*** [-4.701]	0.028* [1.772]	0.032*** [-4.701]
PPE	0.002 [0.494]	-0.066*** [-13.591]	0.009 [0.901]	-0.066*** [-13.591]	0.001 [0.161]	0.072*** [-14.346]	0.033*** [2.995]	0.072*** [-14.346]
BIG4	-0.002 [-0.870]	0.002 [0.952]	0.002 [0.692]	0.002 [0.952]	-0.002 [-0.908]	-0.001 [-0.384]	0.002 [0.533]	-0.001 [-0.384]
Market-to-Book (mtb)	-0.049*** [-2.826]	0.031** [2.123]	-0.070** [-2.147]	0.031** [2.123]	-0.046*** [-2.673]	0.042*** [3.054]	-0.082** [-2.438]	0.042*** [3.054]
Volatility (log)	-0.001** [-2.394]	0.000 [0.669]	-0.001 [-1.488]	0.000 [0.669]	-0.001** [-2.279]	0.001* [1.793]	-0.002 [-1.556]	0.001* [1.793]
Advertising	0.097 [0.423]	-0.435** [-2.111]	-0.313 [-0.725]	-0.435** [-2.111]	0.072 [0.310]	-0.304 [-1.359]	-0.227 [-0.518]	-0.304 [-1.359]
Capex	-0.007* [-1.808]	0.010*** [2.925]	-0.054*** [-6.982]	0.010*** [2.925]	-0.006 [-1.624]	0.009** [2.456]	-0.056*** [-7.006]	0.009** [2.456]
Observations	92,288		92,288		91,921		91,921	
Adjusted R-squared	0.076		-0.015		0.080		-0.128	
Cragg-Donald Wald F Statistics	5,320.44		5,320.44		3,419.77		3,419.77	
Kleibergen-Paap rk wald F Statistics	1,765.81		1,765.81		579.59		579.59	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.17. Instrumental Variable Estimations for Tax Avoidance using one-year lag EGDI

The dependent variable is GAAP ETR (column (1), (2), (5), (6)) and CASH ETR (column (3), (4), (7), (8)). Variable of interest is one-year lag e-government development index (L. EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR		CASH ETR		GAAP ETR		CASH ETR	
	Second-stage (1)	First-stage (2)	Second-stage (3)	First-stage (4)	Second-stage (5)	First-stage (6)	Second-stage (7)	First-stage (8)
L. EGDI (fitted)	0.305*** [7.213]		2.647*** [24.409]		0.202*** [4.998]		1.379*** [16.293]	
Instrument		0.001*** [38.044]		0.001*** [38.044]		0.002*** [32.081]		0.002*** [32.081]
Size	-0.011*** [-6.116]	0.008*** [11.093]	-0.024*** [-5.481]	0.008*** [11.093]	-0.009*** [-5.391]	0.011*** [13.380]	-0.006 [-1.565]	0.011*** [13.380]
Growth	-0.011*** [-5.769]	-0.003*** [-3.407]	-0.073*** [-17.420]	-0.003*** [-3.407]	-0.012*** [-6.127]	-0.003*** [-3.852]	-0.079*** [-21.052]	-0.003*** [-3.852]
Profitability	-0.311*** [-27.460]	-0.009 [-1.563]	-1.008*** [-38.155]	-0.009 [-1.563]	-0.310*** [-27.810]	-0.012** [-2.158]	-1.029*** [-42.904]	-0.012** [-2.158]
Leverage	0.014* [1.748]	-0.041*** [-9.459]	0.093*** [4.910]	-0.041*** [-9.459]	0.009 [1.127]	-0.044*** [-10.237]	0.027 [1.604]	-0.044*** [-10.237]
Age (log)	-0.001 [-0.460]	0.008*** [6.768]	-0.072*** [-13.114]	0.008*** [6.768]	-0.000 [-0.230]	0.006*** [4.427]	-0.064*** [-13.242]	0.006*** [4.427]
Loss	0.583*** [75.468]	-0.004 [-1.324]	0.414*** [30.604]	-0.004 [-1.324]	0.582*** [75.541]	-0.005* [-1.820]	0.408*** [34.920]	-0.005* [-1.820]
NOLREV	-0.020*** [-6.058]	-0.005*** [-2.891]	-0.017** [-2.061]	-0.005*** [-2.891]	-0.021*** [-6.446]	-0.004* [-1.894]	-0.027*** [-3.560]	-0.004* [-1.894]
Intangible	-0.012 [-1.314]	-0.028*** [-5.699]	0.338*** [14.019]	-0.028*** [-5.699]	-0.014 [-1.564]	-0.026*** [-5.225]	0.302*** [13.310]	-0.026*** [-5.225]
R&D (rnd)	-0.137*** [-3.078]	0.291*** [12.042]	3.003*** [19.076]	0.291*** [12.042]	-0.089** [-2.008]	0.354*** [14.097]	3.556*** [21.972]	0.354*** [14.097]
Inventory	0.071*** [7.237]	-0.015*** [-3.090]	0.063** [2.369]	-0.015*** [-3.090]	0.068*** [6.956]	-0.021*** [-4.174]	0.027 [1.069]	-0.021*** [-4.174]
PPE	0.030*** [4.057]	-0.049*** [-14.371]	0.030 [1.543]	-0.049*** [-14.371]	0.025*** [3.372]	-0.052*** [-14.761]	-0.049*** [-2.715]	-0.052*** [-14.761]
BIG4	-0.005** [-2.029]	0.003** [1.997]	-0.026*** [-4.000]	0.003** [1.997]	-0.005** [-2.045]	0.001 [0.574]	-0.022*** [-4.110]	0.001 [0.574]
Market-to-Book (mtb)	-0.013 [-0.487]	0.014 [1.096]	0.060 [1.030]	0.014 [1.096]	-0.011 [-0.406]	0.021* [1.700]	0.085 [1.586]	0.021* [1.700]
Volatility (log)	0.004*** [5.792]	0.001 [1.534]	0.007*** [3.999]	0.001 [1.534]	0.004*** [6.007]	0.001*** [2.731]	0.008*** [4.981]	0.001*** [2.731]
Advertising	-0.040 [-0.114]	-0.157 [-0.713]	-1.891** [-2.464]	-0.157 [-0.713]	-0.045 [-0.126]	-0.068 [-0.296]	-1.967*** [-2.647]	-0.068 [-0.296]
Capex	-0.039*** [-6.393]	0.004 [1.570]	-0.131*** [-9.050]	0.004 [1.570]	-0.039*** [-6.518]	0.004 [1.413]	-0.130*** [-9.422]	0.004 [1.413]
Observations	92,302		92,302		91,933		91,933	
Adjusted R-squared	0.261		-0.191		0.271		0.091	
Cragg-Donald Wald F Statistics	4,036.17		4,036.17		3,932.05		3,932.05	
Kleibergen-Paap rk wald F Statistics	1,447.32		1,447.32		1,029.19		1,029.19	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.18. Instrumental Variable Estimations for Tax Avoidance using two-year lag EGDI

The dependent variable is GAAP ETR (column (1), (2), (5), (6)) and CASH ETR (column (3), (4), (7), (8)). Variable of interest is two-year lag e-government development index (L2.EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR		CASH ETR		GAAP ETR		CASH ETR	
	Second-stage (1)	First-stage (2)	Second-stage (3)	First-stage (4)	Second-stage (5)	First-stage (6)	Second-stage (7)	First-stage (8)
L2.EGDI (fitted)	0.547*** [8.252]		3.525*** [19.282]		0.182*** [3.370]		1.304*** [11.401]	
Instrument		0.001*** [36.409]		0.001*** [36.409]		0.003*** [21.376]		0.003*** [21.376]
Size	-0.013*** [-5.683]	0.014*** [13.022]	-0.021*** [-4.083]	0.014*** [13.022]	-0.009*** [-4.342]	0.018*** [14.828]	-0.000 [-0.098]	0.018*** [14.828]
Growth	-0.011*** [-5.568]	-0.004*** [-4.302]	-0.078*** [-17.089]	-0.004*** [-4.302]	-0.013*** [-6.175]	-0.005*** [-5.189]	-0.084*** [-19.855]	-0.005*** [-5.189]
Profitability	-0.321*** [-24.624]	-0.001 [-0.152]	-1.093*** [-37.321]	-0.001 [-0.152]	-0.318*** [-24.965]	-0.005 [-0.647]	-1.093*** [-40.288]	-0.005 [-0.647]
Leverage	0.011 [1.204]	-0.045*** [-7.925]	0.099*** [4.527]	-0.045*** [-7.925]	-0.004 [-0.452]	-0.051*** [-8.955]	0.006 [0.295]	-0.051*** [-8.955]
Age (log)	-0.008** [-1.989]	0.009*** [4.666]	-0.115*** [-11.007]	0.009*** [4.666]	-0.002 [-0.614]	0.005*** [2.773]	-0.080*** [-9.025]	0.005*** [2.773]
Loss	0.575*** [61.491]	-0.001 [-0.257]	0.394*** [27.096]	-0.001 [-0.257]	0.576*** [61.452]	-0.002 [-0.604]	0.399*** [30.564]	-0.002 [-0.604]
NOLREV	-0.022*** [-6.231]	-0.010*** [-3.736]	-0.028*** [-3.061]	-0.010*** [-3.736]	-0.023*** [-6.603]	-0.009*** [-3.290]	-0.033*** [-3.938]	-0.009*** [-3.290]
Intangible	-0.018* [-1.915]	-0.033*** [-4.967]	0.341*** [12.551]	-0.033*** [-4.967]	-0.023** [-2.446]	-0.030*** [-4.516]	0.304*** [11.734]	-0.030*** [-4.516]
R&D (rnd)	-0.179*** [-3.576]	0.339*** [10.202]	3.105*** [17.552]	0.339*** [10.202]	-0.050 [-1.031]	0.425*** [12.140]	3.861*** [20.739]	0.425*** [12.140]
Inventory	0.064*** [5.976]	-0.026*** [-3.775]	0.018 [0.574]	-0.026*** [-3.775]	0.062*** [5.770]	-0.037*** [-5.129]	0.003 [0.098]	-0.037*** [-5.129]
PPE	0.032*** [3.863]	-0.049*** [-10.345]	0.014 [0.621]	-0.049*** [-10.345]	0.018** [2.212]	-0.054*** [-11.003]	-0.080*** [-3.861]	-0.054*** [-11.003]
BIG4	-0.007*** [-2.689]	0.001 [0.624]	-0.032*** [-4.772]	0.001 [0.624]	-0.005** [-2.045]	-0.001 [-0.521]	-0.021*** [-3.675]	-0.001 [-0.521]
Market-to-Book (mtb)	0.014 [0.503]	0.028* [1.822]	0.156** [2.403]	0.028* [1.822]	0.011 [0.391]	0.035** [2.382]	0.136** [2.520]	0.035** [2.382]
Volatility (log)	0.006*** [6.037]	0.001 [1.211]	0.008*** [3.401]	0.001 [1.211]	0.006*** [6.275]	0.001** [2.154]	0.009*** [4.090]	0.001** [2.154]
Advertising	0.060 [0.158]	-0.616*** [-3.146]	-2.528** [-2.443]	-0.616*** [-3.146]	0.147 [0.371]	-0.506** [-2.405]	-2.012** [-2.373]	-0.506** [-2.405]
Capex	-0.035*** [-5.409]	0.003 [0.952]	-0.124*** [-7.838]	0.003 [0.952]	-0.036*** [-5.575]	0.002 [0.580]	-0.127*** [-8.218]	0.002 [0.580]
Observations	74,379		74,379		74,095		74,095	
Adjusted R-squared	0.259		-0.029		0.271		0.159	
Cragg-Donald Wald F Statistics	4,495.08		4,495.08		5,791.52		5,791.52	
Kleibergen-Paap rk wald F Statistics	784.75		784.75		1,343.74		1,343.74	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.19. Instrumental Variable Estimations for Tax Aggressiveness using one-year lag EGDI

The dependent variable is absolute value of GAAP ETR Difference (column (1), (2), (5), (6)) and CASH ETR Difference (column (3), (4), (7), (8)). Variable of interest is one-year lag e-government development index (L.EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR Diff		CASH ETR Diff		GAAP ETR Diff		CASH ETR Diff	
	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.EGDI (fitted)	0.236*** [7.358]		0.460*** [7.453]		0.125*** [3.983]		0.829*** [14.855]	
Instrument		0.001*** [38.056]		0.001*** [38.056]		0.002*** [32.071]		0.002*** [32.071]
Size	-0.011*** [-7.970]	0.008*** [11.080]	-0.018*** [-7.029]	0.008*** [11.080]	-0.010*** [-7.025]	0.011*** [13.372]	-0.023*** [-8.685]	0.011*** [13.372]
Growth	-0.012*** [-7.922]	-0.003*** [-3.431]	-0.036*** [-14.090]	-0.003*** [-3.431]	-0.012*** [-8.489]	-0.003*** [-3.868]	-0.034*** [-12.965]	-0.003*** [-3.868]
Profitability	-0.249*** [-28.197]	-0.008 [-1.530]	-0.535*** [-35.234]	-0.008 [-1.530]	-0.250*** [-28.484]	-0.012** [-2.135]	-0.530*** [-33.605]	-0.012** [-2.135]
Leverage	0.031*** [4.981]	-0.041*** [-9.480]	0.045*** [4.337]	-0.041*** [-9.480]	0.026*** [4.129]	-0.044*** [-10.253]	0.064*** [5.921]	-0.044*** [-10.253]
Age (log)	-0.003** [-2.121]	0.008*** [6.757]	-0.025*** [-8.081]	0.008*** [6.757]	-0.003* [-1.801]	0.006*** [4.420]	-0.028*** [-8.713]	0.006*** [4.420]
Loss	0.522*** [70.816]	-0.004 [-1.317]	0.323*** [35.682]	-0.004 [-1.317]	0.521*** [70.956]	-0.005* [-1.816]	0.326*** [35.014]	-0.005* [-1.816]
NOLREV	-0.021*** [-8.508]	-0.005*** [-2.995]	-0.047*** [-10.495]	-0.005*** [-2.995]	-0.022*** [-8.972]	-0.004** [-1.971]	-0.044*** [-9.490]	-0.004** [-1.971]
Intangible	-0.001 [-0.081]	-0.028*** [-5.706]	0.011 [0.875]	-0.028*** [-5.706]	-0.004 [-0.603]	-0.026*** [-5.231]	0.02 [1.543]	-0.026*** [-5.231]
R&D (rnd)	0.027 [0.755]	0.291*** [12.036]	0.298*** [3.734]	0.291*** [12.036]	0.073** [2.078]	0.354*** [14.094]	0.129 [1.604]	0.354*** [14.094]
Inventory	0.005 [0.714]	-0.015*** [-3.098]	0.029* [1.940]	-0.015*** [-3.098]	0.002 [0.273]	-0.021*** [-4.181]	0.038** [2.447]	-0.021*** [-4.181]
PPE	0.014** [2.544]	-0.049*** [-14.349]	0.013 [1.225]	-0.049*** [-14.349]	0.008 [1.459]	-0.052*** [-14.745]	0.036*** [3.374]	-0.052*** [-14.745]
BIG4	-0.001 [-0.476]	0.003** [1.998]	-0.002 [-0.685]	0.003** [1.998]	-0.001 [-0.351]	0.001 [0.574]	-0.003 [-0.956]	0.001 [0.574]
Market-to-Book (mtb)	-0.031 [-1.603]	0.013 [1.030]	0.007 [0.190]	0.013 [1.030]	-0.029 [-1.521]	0.020* [1.670]	-0.004 [-0.114]	0.020* [1.670]
Volatility (log)	0.002*** [3.574]	0.001 [1.549]	0.005*** [4.433]	0.001 [1.549]	0.002*** [3.761]	0.001*** [2.741]	0.004*** [4.060]	0.001*** [2.741]
Advertising	-0.099 [-0.368]	-0.157 [-0.714]	-0.943** [-2.017]	-0.157 [-0.714]	-0.104 [-0.382]	-0.068 [-0.297]	-0.902* [-1.873]	-0.068 [-0.297]
Capex	-0.013*** [-2.726]	0.004 [1.584]	-0.045*** [-5.354]	0.004 [1.584]	-0.012*** [-2.660]	0.004 [1.422]	-0.046*** [-5.396]	0.004 [1.422]
Observations	92,288		92,288		91,919		91,919	
Adjusted R-squared	0.309		0.081		0.321		0.017	
Cragg-Donald Wald F Statistics	4,039.59		4,039.59		3,929.93		3,929.93	
Kleibergen-Paap rk wald F Statistics	1,448.28		1,448.28		1,028.55		1,028.55	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

Appendix Table A.20. Instrumental Variable Estimations for Tax Aggressiveness using two-year lag EGDI

The dependent variable is absolute value of GAAP ETR Difference (column (1), (2), (5), (6)) and CASH ETR Difference (column (3), (4), (7), (8)). Variable of interest is two-year lag e-government development index (L2.EGDI). E-government is treated as endogenous, instrumented by mobile cellular subscriptions per 100 people (column (1) to (4)) and individuals using internet (column (5) to (8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	Instrument: Mobile cellular subscriptions (Mobile)				Instrument: Individuals using internet (Internet)			
	GAAP ETR Diff		CASH ETR Diff		GAAP ETR Diff		CASH ETR Diff	
	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage	Second-stage	First-stage
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L2.EGDI (fitted)	0.472*** [9.169]		0.533*** [5.499]		0.159*** [3.718]		0.955*** [13.076]	
Instrument		0.001*** [36.409]		0.001*** [36.409]		0.003*** [21.376]		0.003*** [21.376]
Size	-0.012*** [-6.529]	0.014*** [13.022]	-0.018*** [-5.671]	0.014*** [13.022]	-0.009*** [-5.187]	0.018*** [14.828]	-0.022*** [-6.809]	0.018*** [14.828]
Growth	-0.010*** [-6.442]	0.004*** [-4.302]	-0.035*** [-12.143]	0.004*** [-4.302]	-0.012*** [-7.207]	-0.005*** [-5.189]	-0.034*** [-11.603]	-0.005*** [-5.189]
Profitability	-0.259*** [-24.822]	-0.001 [-0.152]	-0.554*** [-31.079]	-0.001 [-0.152]	-0.258*** [-25.045]	-0.005 [-0.647]	-0.556*** [-30.487]	-0.005 [-0.647]
Leverage	0.035*** [4.886]	0.045*** [-7.925]	0.046*** [3.799]	0.045*** [-7.925]	0.022*** [3.245]	-0.051*** [-8.955]	0.063*** [5.174]	-0.051*** [-8.955]
Age (log)	-0.006* [-1.838]	0.009*** [4.666]	-0.023*** [-3.907]	0.009*** [4.666]	-0.001 [-0.253]	0.005*** [2.773]	-0.031*** [-5.194]	0.005*** [2.773]
Loss	0.520*** [58.748]	-0.001 [-0.257]	0.326*** [31.490]	-0.001 [-0.257]	0.521*** [58.905]	-0.002 [-0.604]	0.325*** [30.822]	-0.002 [-0.604]
NOLREV	-0.020*** [-7.136]	0.010*** [-3.736]	-0.044*** [-8.749]	0.010*** [-3.736]	-0.021*** [-7.564]	-0.009*** [-3.290]	-0.043*** [-8.330]	-0.009*** [-3.290]
Intangible	0.000 [0.050]	0.033*** [-4.967]	-0.001 [-0.074]	0.033*** [-4.967]	-0.005 [-0.691]	-0.030*** [-4.516]	0.004 [0.302]	-0.030*** [-4.516]
R&D (rnd)	-0.002 [-0.061]	0.339*** [10.202]	0.239*** [2.760]	0.339*** [10.202]	0.103*** [2.706]	0.425*** [12.140]	0.091 [1.065]	0.425*** [12.140]
Inventory	-0.001 [-0.126]	0.026*** [-3.775]	0.007 [0.405]	0.026*** [-3.775]	-0.003 [-0.373]	-0.037*** [-5.129]	0.008 [0.437]	-0.037*** [-5.129]
PPE	0.019*** [2.830]	0.049*** [-10.345]	0.019 [1.582]	0.049*** [-10.345]	0.006 [0.933]	-0.054*** [-11.003]	0.038*** [3.075]	-0.054*** [-11.003]
BIG4	-0.003 [-1.291]	0.001 [0.624]	-0.004 [-1.140]	0.001 [0.624]	-0.001 [-0.491]	-0.001 [-0.521]	-0.006* [-1.734]	-0.001 [-0.521]
Market-to-Book (mtb)	-0.011 [-0.532]	0.028* [1.822]	0.013 [0.353]	0.028* [1.822]	-0.013 [-0.673]	0.035** [2.382]	0.015 [0.382]	0.035** [2.382]
Volatility (log)	0.002*** [3.114]	0.001 [1.211]	0.005*** [3.436]	0.001 [1.211]	0.003*** [3.385]	0.001** [2.154]	0.004*** [3.276]	0.001** [2.154]
Advertising	0.064 [0.211]	0.616*** [-3.146]	-0.884 [-1.636]	0.616*** [-3.146]	0.135 [0.455]	-0.506** [-2.405]	-0.985* [-1.726]	-0.506** [-2.405]
Capex	-0.012** [-2.284]	0.003 [0.952]	-0.045*** [-4.768]	0.003 [0.952]	-0.012** [-2.331]	0.002 [0.580]	-0.045*** [-4.720]	0.002 [0.580]
Observations	74,367		74,367		74,083		74,083	
Adjusted R-squared	0.295		0.091		0.315		0.062	
Cragg-Donald Wald F Statistics	4,504.31		4,504.31		5,789.10		5,789.10	
Kleibergen-Paap rk Wald F Statistics	785.96		785.96		1,342.67		1,342.67	
Stock-Yogo critical values 10%	16.38		16.38		16.38		16.38	
Cluster	Firm		Firm		Firm		Firm	
Firm FE	✓		✓		✓		✓	
Year FE	✓		✓		✓		✓	
Industry FE	✓		✓		✓		✓	
Country FE	✓		✓		✓		✓	

**Appendix Table A.21. E-government and Tax Avoidance Moderated by Market Competition
(HHI based on 3-digit SIC)**

The dependent variable is annual GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition (HHI based on 3-digit SIC). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR			CASH ETR		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	0.029*** [3.073]	0.023** [2.250]	0.036*** [3.920]	0.250*** [16.860]	0.228*** [14.240]	0.243*** [16.877]
HHI3	0.064*** [7.373]	0.067*** [6.847]	0.069*** [8.141]	0.176*** [13.049]	0.153*** [10.169]	0.168*** [12.845]
EGDI x HHI3	-0.059*** [-4.720]	-0.060*** [-4.311]	-0.067*** [-5.355]	-0.354*** [-17.839]	-0.343*** [-15.736]	-0.327*** [-16.913]
Size	-0.010*** [-11.784]	-0.010*** [-11.624]	-0.010*** [-12.271]	-0.007*** [-4.975]	-0.009*** [-6.321]	-0.006*** [-3.789]
Growth	-0.037*** [-18.851]	-0.036*** [-17.373]	-0.038*** [-19.036]	-0.090*** [-25.288]	-0.087*** [-23.963]	-0.092*** [-25.515]
Profitability	-0.128*** [-12.457]	-0.138*** [-12.957]	-0.118*** [-11.457]	-0.715*** [-37.069]	-0.735*** [-37.400]	-0.678*** [-35.228]
Leverage	0.090*** [12.611]	0.091*** [12.360]	0.095*** [13.352]	-0.100*** [-8.574]	-0.096*** [-8.017]	-0.111*** [-9.404]
Age (log)	0.010*** [7.209]	0.010*** [6.902]	0.009*** [6.746]	-0.004 [-1.387]	-0.005* [-1.798]	-0.004 [-1.481]
Loss	0.642*** [82.942]	0.642*** [83.687]	0.645*** [82.890]	0.445*** [39.711]	0.443*** [39.252]	0.447*** [39.656]
NOLREV	-0.005* [-1.810]	-0.006** [-2.011]	-0.003 [-1.002]	-0.011** [-2.015]	-0.012** [-2.198]	-0.007 [-1.342]
Intangible	0.050*** [7.985]	0.045*** [6.894]	0.053*** [8.548]	0.072*** [6.854]	0.070*** [6.476]	0.076*** [7.309]
R&D (rnd)	-0.424*** [-11.891]	-0.367*** [-9.436]	-0.533*** [-15.495]	1.073*** [15.006]	1.270*** [16.867]	0.820*** [12.159]
Inventory	0.073*** [10.153]	0.073*** [9.440]	0.048*** [7.377]	0.006 [0.469]	0.015 [1.066]	0.035*** [2.911]
PPE	0.036*** [6.841]	0.036*** [6.425]	0.032*** [6.673]	-0.021** [-2.272]	-0.018* [-1.867]	0.018** [2.189]
BIG4	0.008*** [4.573]	0.008*** [4.506]	0.008*** [4.580]	-0.048*** [-14.986]	-0.043*** [-13.242]	-0.051*** [-15.574]
Market-to-Book (mtb)	0.114*** [5.110]	0.114*** [5.055]	0.111*** [5.050]	0.028 [0.818]	0.025 [0.726]	0.018 [0.531]
Volatility (log)	0.009*** [11.342]	0.009*** [11.201]	0.009*** [12.290]	0.011*** [8.323]	0.013*** [9.396]	0.011*** [8.577]
Advertising	1.210*** [9.448]	1.183*** [8.908]	1.287*** [10.062]	-1.040*** [-4.419]	-1.322*** [-5.249]	-0.586*** [-2.580]
Capex	-0.107*** [-15.060]	-0.103*** [-14.413]	-0.104*** [-14.320]	-0.122*** [-10.087]	-0.112*** [-9.128]	-0.127*** [-10.387]
Constant	0.212*** [28.312]	0.216*** [26.407]	0.210*** [28.482]	0.275*** [22.075]	0.301*** [22.573]	0.245*** [19.816]
Observations	92,312	91,960	92,312	92,312	91,960	92,312
Adjusted R-squared	0.304	0.313	0.291	0.208	0.248	0.192
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Appendix Table A.22. E-government and Tax Aggressiveness Moderated by Market Competition (HHI based on 3-digit SIC)

The dependent variable is absolute annual GAAP ETR Difference (column (1)-(4)) and absolute annual CASH ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition (HHI based on 3-digit SIC). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference			CASH ETR Difference		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	0.002 [0.299]	0.000 [0.040]	-0.000 [-0.058]	0.069*** [7.537]	0.081*** [7.943]	0.065*** [7.167]
HHI	0.027*** [5.191]	0.025*** [4.215]	0.030*** [5.886]	0.025*** [2.932]	0.030*** [3.175]	0.020** [2.364]
EGDI x HHI	-0.037*** [-4.813]	-0.035*** [-4.093]	-0.040*** [-5.287]	-0.080*** [-6.624]	-0.099*** [-7.302]	-0.068*** [-5.649]
Size	-0.003*** [-5.002]	-0.002*** [-4.081]	-0.002*** [-4.243]	-0.001 [-1.342]	-0.002** [-2.566]	-0.000 [-0.083]
Growth	-0.009*** [-6.878]	-0.008*** [-5.872]	-0.009*** [-6.461]	-0.025*** [-10.578]	-0.024*** [-9.777]	-0.026*** [-10.665]
Profitability	-0.208*** [-31.321]	-0.206*** [-29.914]	-0.206*** [-31.137]	-0.494*** [-41.860]	-0.498*** [-40.757]	-0.475*** [-40.066]
Leverage	0.029*** [6.498]	0.030*** [6.625]	0.027*** [6.020]	-0.050*** [-7.045]	-0.050*** [-6.700]	-0.063*** [-8.510]
Age (log)	-0.001 [-1.272]	-0.001 [-1.583]	-0.001 [-1.258]	0.002 [0.979]	-0.000 [-0.115]	0.002 [0.913]
Loss	0.547*** [74.995]	0.547*** [75.852]	0.550*** [75.460]	0.328*** [37.387]	0.325*** [37.038]	0.330*** [37.672]
NOLREV	-0.015*** [-8.204]	-0.015*** [-7.980]	-0.011*** [-6.152]	-0.035*** [-10.535]	-0.036*** [-10.904]	-0.031*** [-9.152]
Intangible	-0.025*** [-6.538]	-0.026*** [-6.413]	-0.022*** [-5.599]	-0.038*** [-6.155]	-0.037*** [-5.641]	-0.034*** [-5.421]
R&D (rnd)	0.169*** [8.196]	0.138*** [6.323]	0.171*** [8.794]	0.270*** [6.888]	0.325*** [7.443]	0.193*** [5.095]
Inventory	-0.023*** [-5.298]	-0.023*** [-5.003]	-0.035*** [-9.001]	-0.024** [-2.566]	-0.024** [-2.502]	-0.012 [-1.411]
PPE	-0.005* [-1.654]	-0.006* [-1.727]	-0.005* [-1.816]	-0.016*** [-2.836]	-0.010* [-1.650]	0.005 [0.950]
BIG4	-0.003** [-2.475]	-0.003** [-2.224]	-0.003** [-2.533]	-0.028*** [-13.832]	-0.026*** [-12.674]	-0.030*** [-14.437]
Market-to-Book (mtb)	-0.024* [-1.933]	-0.023* [-1.847]	-0.020 [-1.598]	-0.070*** [-3.368]	-0.055** [-2.489]	-0.064*** [-3.052]
Volatility (log)	0.000 [0.236]	-0.000 [-0.343]	-0.000 [-0.367]	0.001 [1.077]	0.002** [2.138]	0.001 [1.165]
Advertising	0.359*** [4.693]	0.344*** [4.244]	0.330*** [4.397]	-0.586*** [-4.911]	-0.745*** [-5.495]	-0.448*** [-3.972]
Capex	0.008* [1.830]	0.005 [1.118]	0.012*** [2.682]	0.004 [0.560]	0.002 [0.220]	0.003 [0.429]
Constant	0.139*** [31.558]	0.140*** [29.112]	0.138*** [32.048]	0.233*** [29.204]	0.233*** [26.955]	0.215*** [27.014]
Observations	92,298	91,960	92,298	92,298	91,960	92,298
Adjusted R-squared	0.340	0.346	0.333	0.154	0.175	0.137
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Appendix Table A.23. E-government and Tax Avoidance Moderated by Market Competition (dummy HHI)

The dependent variable is annual GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition dummy (HHI dummy, 1=high competition, 2=medium competition (base group), 3=low competition). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR			CASH ETR		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	0.016** [2.106]	0.006 [0.803]	0.020*** [2.734]	0.036*** [3.043]	0.008 [0.635]	0.052*** [4.548]
HHI-high	-0.013** [-2.123]	-0.015** [-2.144]	-0.010* [-1.691]	-0.133*** [-12.402]	-0.140*** [-11.448]	-0.119*** [-11.777]
HHI-low	0.022*** [3.647]	0.020*** [3.040]	0.027*** [4.407]	0.030*** [3.201]	0.014 [1.402]	0.038*** [4.035]
EGDI x HHI-high	-0.015* [-1.696]	-0.014 [-1.354]	-0.020** [-2.170]	0.246*** [14.884]	0.265*** [14.214]	0.214*** [13.320]
EGDI x HHI-low	-0.035*** [-4.106]	-0.032*** [-3.508]	-0.039*** [-4.498]	-0.086*** [-6.451]	-0.064*** [-4.476]	-0.086*** [-6.486]
Size	-0.010*** [-11.955]	-0.010*** [-11.786]	-0.010*** [-12.351]	-0.008*** [-5.414]	-0.010*** [-6.717]	-0.006*** [-4.078]
Growth	-0.037*** [-18.726]	-0.036*** [-17.179]	-0.038*** [-18.844]	-0.089*** [-25.260]	-0.087*** [-23.864]	-0.091*** [-25.385]
Profitability	-0.129*** [-12.587]	-0.140*** [-13.195]	-0.118*** [-11.407]	-0.714*** [-37.142]	-0.734*** [-37.437]	-0.676*** [-35.008]
Leverage	0.091*** [12.819]	0.093*** [12.593]	0.093*** [13.097]	-0.107*** [-9.281]	-0.104*** [-8.683]	-0.114*** [-9.775]
Age (log)	0.010*** [7.136]	0.009*** [6.849]	0.009*** [6.849]	-0.004 [-1.415]	-0.005* [-1.885]	-0.004 [-1.613]
Loss	0.643*** [83.279]	0.642*** [83.982]	0.645*** [83.037]	0.446*** [39.817]	0.444*** [39.339]	0.447*** [39.812]
NOLREV	-0.005* [-1.872]	-0.006* [-1.899]	-0.003 [-1.057]	-0.011** [-2.012]	-0.013** [-2.375]	-0.007 [-1.361]
Intangible	0.049*** [7.716]	0.044*** [6.651]	0.053*** [8.596]	0.074*** [7.065]	0.071*** [6.547]	0.076*** [7.296]
R&D (rnd)	-0.418*** [-11.849]	-0.348*** [-9.002]	-0.496*** [-14.532]	1.064*** [15.231]	1.228*** [16.529]	0.802*** [12.059]
Inventory	0.072*** [9.901]	0.072*** [9.208]	0.050*** [7.647]	0.006 [0.480]	0.015 [1.034]	0.025** [2.110]
PPE	0.036*** [6.712]	0.036*** [6.300]	0.032*** [6.576]	-0.017* [-1.920]	-0.016* [-1.678]	0.020** [2.447]
BIG4	0.009*** [4.790]	0.009*** [4.734]	0.008*** [4.385]	-0.047*** [-14.897]	-0.044*** [-13.564]	-0.051*** [-15.746]
Market-to-Book (mtb)	0.116*** [5.253]	0.114*** [5.175]	0.113*** [5.144]	0.024 [0.708]	0.012 [0.358]	0.009 [0.259]
Volatility (log)	0.009*** [11.508]	0.009*** [11.295]	0.009*** [12.310]	0.011*** [8.470]	0.013*** [9.595]	0.012*** [8.756]
Advertising	1.172*** [9.160]	1.141*** [8.551]	1.266*** [10.002]	-1.195*** [-5.132]	-1.384*** [-5.541]	-0.597*** [-2.580]
Capex	-0.107*** [-15.063]	-0.103*** [-14.394]	-0.103*** [-14.179]	-0.126*** [-10.384]	-0.112*** [-9.092]	-0.128*** [-10.435]
Constant	0.241*** [35.384]	0.249*** [34.455]	0.239*** [35.769]	0.392*** [34.224]	0.415*** [33.961]	0.352*** [31.255]
Observations	92312	91960	92312	92,312	91,960	92,312
Adjusted R-squared	0.304	0.314	0.292	0.210	0.249	0.193
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Appendix Table A.24. E-government and Tax Aggressiveness Moderated by Market Competition (dummy HHI)

The dependent variable is absolute annual GAAP ETR Difference (column (1)-(4)) and absolute annual CASH ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is market competition dummy (HHI dummy, 1=high competition, 2=medium competition (base group), 3=low competition). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference			CASH ETR Difference		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	-0.017*** [-3.832]	-0.018*** [-3.773]	-0.018*** [-4.203]	0.019*** [2.605]	0.015* [1.892]	0.027*** [3.781]
HHI-high	-0.014*** [-4.017]	-0.018*** [-4.209]	-0.015*** [-4.324]	-0.026*** [-3.967]	-0.039*** [-5.184]	-0.015*** [-2.432]
HHI-low	0.012*** [3.124]	0.012*** [2.927]	0.015*** [4.118]	0.004 [0.622]	0.002 [0.245]	0.008 [1.320]
EGDI x HHI-high	0.026*** [4.772]	0.032*** [5.067]	0.024*** [4.452]	0.064*** [6.592]	0.089*** [7.933]	0.047*** [4.890]
EGDI x HHI-low	-0.015*** [-2.883]	-0.016*** [-2.815]	-0.020*** [-3.696]	-0.021** [-2.527]	-0.019** [-2.106]	-0.023*** [-2.751]
Size	-0.003*** [-5.214]	-0.002*** [-4.323]	-0.002*** [-4.421]	-0.001 [-1.502]	-0.003*** [-2.771]	-0.000 [-0.165]
Growth	-0.010*** [-7.094]	-0.009*** [-6.030]	-0.009*** [-6.595]	-0.025*** [-10.584]	-0.024*** [-9.782]	-0.026*** [-10.670]
Profitability	-0.207*** [-31.194]	-0.205*** [-29.826]	-0.204*** [-31.043]	-0.493*** [-41.884]	-0.497*** [-40.775]	-0.475*** [-40.125]
Leverage	0.029*** [6.698]	0.031*** [6.814]	0.027*** [6.100]	-0.053*** [-7.442]	-0.053*** [-7.115]	-0.063*** [-8.576]
Age (log)	-0.001 [-1.310]	-0.001 [-1.637]	-0.001 [-1.267]	0.002 [0.967]	-0.000 [-0.171]	0.001 [0.784]
Loss	0.547*** [75.061]	0.547*** [75.953]	0.551*** [75.519]	0.328*** [37.341]	0.325*** [37.002]	0.330*** [37.659]
NOLREV	-0.015*** [-8.290]	-0.015*** [-8.073]	-0.012*** [-6.323]	-0.035*** [-10.483]	-0.037*** [-11.042]	-0.031*** [-9.130]
Intangible	-0.025*** [-6.565]	-0.026*** [-6.480]	-0.022*** [-5.648]	-0.037*** [-5.942]	-0.036*** [-5.526]	-0.034*** [-5.426]
R&D (rnd)	0.158*** [7.761]	0.125*** [5.781]	0.162*** [8.344]	0.268*** [6.866]	0.304*** [6.995]	0.174*** [4.612]
Inventory	-0.023*** [-5.189]	-0.023*** [-4.859]	-0.035*** [-8.961]	-0.024** [-2.516]	-0.024** [-2.460]	-0.015* [-1.882]
PPE	-0.005 [-1.455]	-0.005 [-1.519]	-0.005 [-1.626]	-0.015*** [-2.621]	-0.009 [-1.490]	0.006 [1.116]
BIG4	-0.002** [-1.960]	-0.002* [-1.785]	-0.003** [-2.378]	-0.028*** [-13.718]	-0.027*** [-12.821]	-0.030*** [-14.331]
Market-to-Book (mtb)	-0.021* [-1.694]	-0.021 [-1.636]	-0.018 [-1.482]	-0.072*** [-3.432]	-0.058*** [-2.680]	-0.066*** [-3.167]
Volatility (log)	0.000 [0.336]	-0.000 [-0.236]	-0.000 [-0.249]	0.001 [1.115]	0.002** [2.250]	0.001 [1.277]
Advertising	0.326*** [4.295]	0.297*** [3.683]	0.315*** [4.238]	-0.639*** [-5.411]	-0.774*** [-5.807]	-0.457*** [-4.126]
Capex	0.006 [1.464]	0.004 [0.827]	0.011** [2.472]	0.003 [0.404]	0.002 [0.213]	0.002 [0.304]
Constant	0.151*** [36.828]	0.151*** [34.719]	0.151*** [37.180]	0.251*** [33.576]	0.259*** [32.762]	0.227*** [30.654]
Observations	92,298	91,960	92,298	92,298	91,960	92,298
Adjusted R-squared	0.341	0.347	0.333	0.154	0.175	0.138
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

Appendix Table A.25. E-government and Tax Avoidance Moderated by Market Competition (Top 4 Sale)

The dependent variable is annual GAAP ETR (column (1)-(4)) and CASH ETR (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is concentration ratio (Top4sale). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in parentheses) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR				CASH ETR	
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	0.010 [1.265]	0.001 [0.161]	0.019** [2.413]	0.164*** [13.774]	0.141*** [10.998]	0.168*** [14.399]
Top4sale	0.025*** [3.530]	0.026*** [3.347]	0.037*** [5.282]	0.091*** [8.308]	0.075*** [6.379]	0.099*** [9.454]
EGDI x Top4sale	-0.026** [-2.538]	-0.024** [-2.199]	-0.036*** [-3.539]	-0.234*** [-15.090]	-0.217*** [-12.884]	-0.217*** [-14.362]
Size	-0.010*** [-12.103]	-0.010*** [-11.919]	-0.011*** [-12.622]	-0.007*** [-5.129]	-0.010*** [-6.395]	-0.005*** [-3.750]
Growth	-0.039*** [-19.410]	-0.037*** [-17.801]	-0.039*** [-19.542]	-0.089*** [-25.221]	-0.087*** [-23.830]	-0.091*** [-25.381]
Profitability	-0.125*** [-12.106]	-0.136*** [-12.705]	-0.115*** [-11.089]	-0.718*** [-37.210]	-0.738*** [-37.530]	-0.680*** [-35.181]
Leverage	0.094*** [13.256]	0.096*** [12.965]	0.098*** [13.751]	-0.105*** [-9.039]	-0.100*** [-8.407]	-0.111*** [-9.479]
Age (log)	0.009*** [6.996]	0.009*** [6.728]	0.009*** [6.597]	-0.004 [-1.550]	-0.005** [-1.961]	-0.005* [-1.722]
Loss	0.644*** [83.067]	0.643*** [83.739]	0.646*** [82.959]	0.448*** [39.845]	0.445*** [39.408]	0.448*** [39.715]
NOLREV	-0.005* [-1.805]	-0.006* [-1.842]	-0.003 [-1.111]	-0.008 [-1.559]	-0.010* [-1.949]	-0.005 [-0.925]
Intangible	0.050*** [7.979]	0.046*** [6.926]	0.054*** [8.599]	0.072*** [6.866]	0.069*** [6.390]	0.072*** [6.962]
R&D (rnd)	-0.448*** [-12.500]	-0.377*** [-9.589]	-0.558*** [-16.147]	1.107*** [15.726]	1.279*** [17.168]	0.816*** [12.277]
Inventory	0.075*** [10.314]	0.075*** [9.646]	0.050*** [7.663]	0.005 [0.381]	0.013 [0.895]	0.029** [2.450]
PPE	0.037*** [6.993]	0.037*** [6.575]	0.032*** [6.610]	-0.016* [-1.818]	-0.014 [-1.517]	0.021** [2.563]
BIG4	0.011*** [6.140]	0.011*** [6.045]	0.010*** [5.729]	-0.045*** [-14.164]	-0.042*** [-12.975]	-0.049*** [-15.191]
Market-to-Book (mtb)	0.130*** [5.873]	0.129*** [5.815]	0.124*** [5.632]	0.028 [0.828]	0.014 [0.412]	0.012 [0.361]
Volatility (log)	0.009*** [11.554]	0.009*** [11.345]	0.010*** [12.602]	0.011*** [8.270]	0.013*** [9.363]	0.011*** [8.545]
Advertising	1.163*** [9.009]	1.135*** [8.448]	1.279*** [9.992]	-1.463*** [-6.386]	-1.637*** [-6.684]	-0.786*** [-3.490]
Capex	-0.113*** [-15.808]	-0.108*** [-15.070]	-0.108*** [-14.735]	-0.130*** [-10.801]	-0.117*** [-9.531]	-0.131*** [-10.735]
Constant	0.233*** [35.477]	0.239*** [33.730]	0.228*** [35.087]	0.330*** [29.764]	0.352*** [29.882]	0.290*** [26.273]
Observations	92,312	91,960	92,312	92,312	91,960	92,312
Adjusted R-squared	0.301	0.311	0.289	0.209	0.248	0.192
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-

**Appendix Table A.26. E-government and Tax Aggressiveness Moderated by Market Competition
(Top 4 Sale)**

The dependent variable is absolute annual GAAP ETR Difference (column (1)-(4)) and absolute annual CASH ETR Difference (column (5)-(8)). Variable of interest is e-government development index (EGDI). Moderating variable is concentration ratio (Top4sale). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table report coefficient estimates and t-statistics (in square brackets) for baseline estimation using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	GAAP ETR Difference			CASH ETR Difference		
	(1)	(2)	(3)	(4)	(5)	(6)
EGDI	-0.003 [-0.649]	-0.002 [-0.435]	-0.003 [-0.783]	0.061*** [8.038]	0.071*** [8.569]	0.060*** [7.922]
Top4sale	0.022*** [5.197]	0.023*** [5.040]	0.028*** [6.686]	0.023*** [3.368]	0.031*** [4.218]	0.022*** [3.239]
EGDI x Top4sale	-0.032*** [-5.371]	-0.034*** [-5.255]	-0.038*** [-6.338]	-0.074*** [-7.834]	-0.091*** [-8.702]	-0.065*** [-6.839]
Size	-0.003*** [-5.181]	-0.002*** [-4.251]	-0.002*** [-4.458]	-0.001 [-1.360]	-0.003*** [-2.606]	0.000 [0.042]
Growth	-0.010*** [-6.985]	-0.008*** [-5.907]	-0.009*** [-6.544]	-0.025*** [-10.383]	-0.024*** [-9.572]	-0.025*** [-10.452]
Profitability	-0.208*** [-31.330]	-0.206*** [-29.961]	-0.205*** [-31.173]	-0.495*** [-42.087]	-0.499*** [-40.979]	-0.476*** [-40.279]
Leverage	0.029*** [6.701]	0.031*** [6.812]	0.027*** [6.163]	-0.053*** [-7.389]	-0.052*** [-6.998]	-0.063*** [-8.573]
Age (log)	-0.001 [-1.271]	-0.001 [-1.562]	-0.001 [-1.221]	0.002 [0.962]	-0.000 [-0.145]	0.001 [0.837]
Loss	0.547*** [75.079]	0.547*** [75.906]	0.551*** [75.508]	0.328*** [37.374]	0.326*** [37.036]	0.330*** [37.629]
NOLREV	-0.015*** [-8.225]	-0.015*** [-8.009]	-0.012*** [-6.254]	-0.034*** [-10.358]	-0.036*** [-10.915]	-0.030*** [-8.970]
Intangible	-0.026*** [-6.634]	-0.026*** [-6.540]	-0.022*** [-5.718]	-0.038*** [-6.183]	-0.038*** [-5.773]	-0.036*** [-5.678]
R&D (rnd)	0.164*** [8.065]	0.135*** [6.191]	0.167*** [8.664]	0.282*** [7.238]	0.323*** [7.427]	0.190*** [5.066]
Inventory	-0.023*** [-5.333]	-0.023*** [-5.062]	-0.035*** [-8.981]	-0.025*** [-2.647]	-0.026*** [-2.647]	-0.014* [-1.676]
PPE	-0.005 [-1.602]	-0.006* [-1.690]	-0.005* [-1.832]	-0.015*** [-2.600]	-0.009 [-1.460]	0.007 [1.268]
BIG4	-0.002** [-2.180]	-0.002** [-2.107]	-0.003** [-2.454]	-0.028*** [-13.698]	-0.027*** [-12.946]	-0.030*** [-14.508]
Market-to-Book (mtb)	-0.022* [-1.784]	-0.022* [-1.777]	-0.019 [-1.495]	-0.075*** [-3.552]	-0.063*** [-2.866]	-0.069*** [-3.308]
Volatility (log)	0.000 [0.338]	-0.000 [-0.241]	-0.000 [-0.218]	0.001 [0.970]	0.002** [2.117]	0.001 [1.027]
Advertising	0.327*** [4.264]	0.310*** [3.795]	0.307*** [4.100]	-0.762*** [-6.325]	-0.903*** [-6.633]	-0.556*** [-4.945]
Capex	0.007 [1.615]	0.004 [0.990]	0.012** [2.567]	0.003 [0.398]	0.002 [0.204]	0.003 [0.343]
Constant	0.143*** [36.859]	0.142*** [34.196]	0.142*** [36.844]	0.236*** [32.666]	0.236*** [30.409]	0.216*** [29.967]
Observations	92,298	91,960	92,298	92,298	91,960	92,298
Adjusted R-squared	0.340	0.346	0.333	0.155	0.175	0.138
Firm FE	-	-	-	-	-	-
Year FE	✓	-	✓	✓	-	✓
Industry FE	✓	-	-	✓	-	-
Industry-Year FE	-	✓	-	-	✓	-
Country FE	-	-	-	-	-	-