An empirical examination of the influence of e-commerce on tax avoidance in Europe

Authors:

Corresponding author: Josep M. Argilés-Bosch. Department of Business, Universitat de Barcelona.

Antonio Somoza. Department of Business, Universitat de Barcelona.

Ravenda, Diego. Department of Management Control, Accounting and Auditing, Toulouse Business School in Barcelona.

García-Blandón, Josep. Faculty of Economics, IQS, Universitat Ramon Llull.

Abstract

This paper reports an empirical analysis of the influence of e-commerce business practices on tax avoidance. Using a sample of European parent firms in the retail trade industry from 22 different countries, we find empirical evidence that e-commerce firms are significantly more tax avoidant than traditional firms. However, as the latter have increasingly sought to avoid paying taxes over the period studied, the gap between the two firm types has been reduced. Our results are robust to different specifications of tax avoidance, time, and sample selection criteria.

Keywords: tax avoidance; tax aggressiveness; e-commerce; electronic commerce; retail industry; Europe.

1. Introduction

We analyze the influence of e-commerce business practices on tax avoidance[1], motivated precisely by the ongoing debate on the opportunities afforded by e-commerce

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[1] Some authors (e.g. Hasseldine & Morris, 2013; Kirchler, Maciejovsky, & Schneider, 2003; Lanis & Richardson, 2015) distinguish between tax avoidance and tax evasion, the former encompassing tax planning activities that are legal or which fall into a gray area, and the latter involving illegal activities. However, others do not consider this distinction relevant, because most tax avoidance transactions are technically legal, and because the legality of some transactions is often determined after the fact (Hanlon & Heitzman, 2010). The latter define tax avoidance very broadly as a continuum of tax planning strategies, with legal actions at one end, and evasion or illegal activities at the other (Hanlon & Heitzman, 2010, p. 139). Some empirical studies of tax avoidance explicitly consider this broad spectrum of tax planning strategies and activities (e.g. Christensen et al., 2015; Brown et al., 2016), while others merely employ the

for tax avoidance. Concerned by the strain placed on the international tax framework by the increasing integration of national economies and markets, the Organization of Economic Cooperation and Development (OECD) and G20 countries published their explanatory statement on the Base Erosion and Profit Shifting (BEPS) Project in 2015. BEPS refers to tax avoidance strategies that exploit gaps and mismatches in tax rules to artificially shift profits to low or no-tax locations. According to the statement issued, the digital economy has exacerbated the risks of BEPS (OECD/G20, 2015b). Consequently, the OECD and G20 countries developed and implemented the so-called BEPS package aimed at laying the foundations of a modern international tax framework, under which profits are taxed where economic activity and value creation occurs. Action 1 of this package addresses the tax challenges of the digital economy.

Likewise, various countries and tax jurisdictions, including the United States (US), the European Union (EU), and India, have developed their own initiatives to deal with the challenges posed by electronic commerce and the taxing of the digital economy. The recent EU Commission ruling in a case that saw Ireland granting undue tax benefits of up to €13 billion to Apple (European Commission, 2016) has given renewed attention to the relationship between tax avoidance and the digital economy. The EU Commission concluded that Apple was setting up their sales operations in Europe in such a way that customers were contractually buying products from Apple Sales International in Ireland, rather than from the shops that physically sold the products to customers. The EU Commission is still investigating other similar tax rulings (Wessel, 2016).

Electronic commerce or e-commerce is the trading or facilitation of the trading of products or services using computer networks, such as the internet or online social networks (Buettner, 2017). Since its inception, the development of e-commerce has enabled firms to circumvent conventional stages of taxation in multiple jurisdictions (Frecknall Hughes & Glaister, 2001). E-commerce firms have the advantage that location does not condition their activity to the extent that it does that of traditional firms with physical locations. Given that a permanent establishment is not required (Yapar, Bayrakdar, & Yapar, 2015), the internet environment facilitates the allocation of transactions to the most convenient jurisdiction to save taxes. As such, cost minimization through tax avoidance is the expected behavior of these firms.

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term without entering into a discussion of its meaning. In this paper, we use tax avoidance in this broad sense.

Research on tax avoidance has advanced dramatically in recent years, but research on its association with the digital economy remains scarce. The relationship between taxes and e-commerce has been analyzed using different approaches in related fields, including law and public economics. For example, Hale and McNeal (2011) perform an empirical analysis of interstate and government practices in the US to tackle the taxation difficulties that typify e-commerce. The impact of e-commerce on the loss in revenue from sales taxes in the US has also been studied using aggregate data (Alm & Melnik, 2010; Bruce & Fox, 2000). Alm (2012) claims that tax avoidance in on-line commerce is especially important in the case of cross-border transactions.

E-commerce has increased dramatically in recent years, usually as a consequence of strategic business decisions and its perceived advantages over traditional commerce in terms of factors such as economic and information efficiency, coordination, and market impact. To the best of our knowledge, no empirical study has found firms reporting that they actually opt for e-commerce in a deliberate attempt to avoid paying taxes.

It could be argued that e-commerce has no influence on tax avoidance, that it is a strategic business model based on sound economic tenets facilitated by the technological possibilities of the digital era, where tax avoidance may, or may not, be a mere sporadic and unintended by-product of this business model. There are even some authors who identify the beneficial effects of this type of business for tax collection at an aggregate level. Emamverdi et al. (2013) report that the development of e-commerce is associated with increasing tax revenues in developing countries. However, this is probably not the true influence of e-commerce, but rather an indirect effect of a country's economic growth thanks to e-commerce. The most common concern among academics and policymakers is that e-commerce creates conditions that favor tax avoidance.

Yet, studies conducted from a business or accounting perspective on the influence of e-commerce on tax avoidance remain scarce. To the best of our knowledge, there is virtually no empirical research testing the existence of an economic advantage for e-commerce firms, with respect to traditional retail firms, in relation to corporate tax avoidance. Hoopes, Thornock, and Williams (2016) deal with value added taxes (VAT), but not with corporate tax. They find empirical evidence of the existence of a competitive tax advantage for e-traders with respect to traditional retail firms. They infer this influence from market reactions to changes in legislative proposals, but they do not use explicit tax measures for traditional and e-commerce retail firms. Klassen, Laplante, and Carnaghan (2014) find an interaction effect between e-commerce and foreign income on tax

avoidance. However, their study is more concerned about firms with high levels of foreign income than with the impact of e-commerce, and their analysis focuses on business-to-business (B2B) e-commerce transactions. In contrast, in our study we analyze firms that sell exclusively via business-to-consumer (B2C) e-commerce transactions. It is our contention that this provides a more focused analysis of the effects of e-commerce on tax avoidance, given that e-commerce is the core business of these firms. Moreover, we analyze all firms independently of their level of foreign income.

Europe is an exceptionally interesting setting for analyzing tax avoidance, given that most countries have experienced a considerable decrease in statutory and effective corporate tax rates, as well as the introduction of tax exemptions following the expansion of the EU in terms of both its membership and the size of its economic zone. Indeed, individual member state governments have specifically implemented such measures in order to compete with the more favorable tax and wage conditions of the EU's newer members (Fuest, Peichl, & Siegloch, 2015; Genschel, Kemmerling, & Seils, 2011; Overesch & Rincke, 2011). Moreover, the European context provides an interesting multinational setting for this analysis.

Using AMADEUS, this study draws on a sample of consolidated accounting financial statements published by European retail firms from 22 different countries. We find that e-commerce firms are significantly more tax avoidant than traditional firms. Over the period studied, they avoided around 5 percentage points more of corporate taxes than traditional retail firms. However, as the latter have increasingly sought to avoid taxes, the gap between the two firm types has been reduced, and, as a result, e-commerce firms have progressively lost their former competitive advantage as regards tax avoidance. Various factors may have contributed to reduce this differential tax behavior, including the cut in statutory corporate tax rates in most countries, the increasing importance of intangible assets and multinational trade in all types of firm, and a learning effect whereby traditional firms are adopting e-commerce and behaving in a tax avoidant manner. Our results are robust to different specifications of tax avoidance, time, and sample selection criteria.

Our study makes several contributions to the published literature on tax avoidance. First, it contributes to what is an almost non-existent business literature on the association between e-commerce and tax avoidance. Second, we shed light on tax avoidance in the European context, which, despite being an exceptionally interesting setting for such an analysis, has been considerably less studied than the US context in empirical studies on

tax avoidance. Finally, we are able to describe the trend taken by the tax avoidance behavior of these firms in recent years in Europe.

The rest of this paper is organized as follows. Following on from this introduction, we present, first, the hypotheses motivating the study; second, an explanation of the research methods; and, third, an overview of sample selection. We then present and discuss our results, and finally, offer our concluding remarks.

2. Hypotheses Development

Basu (2007, p.104-105) claims that in taxation you first have to identify the tax base and then enforce the tax; yet, the anonymity and mobility associated with e-commerce complicates both of these tasks. In e-commerce, the possibilities of concealing a transaction are enormous, while the possibilities of identifying the parties to a transaction are, more often than not, almost non-existent. Basu goes onto argue that the two prevailing approaches to direct taxation, source- and residence-based, are more elusive in the context of e-commerce. The former requires that authorities determine the geographical source of income, while the latter requires information about the identity and residency status of those engaged in income-producing activities. However, e-commerce breaks down any clear connection between territory and commerce, and makes this type of information more difficult to obtain, thus, complicating the task of taxing income based on source or residence (Basu 2007, p. 108-110).

Tax enforcement is also more difficult in the e-commerce environment because the residence-based approach favors the possibility of basing activities in off-shore locations, which makes tax withholding more difficult and favors tax evasion (Cockfield, 2001). A company only needs to incorporate itself in a tax haven and then control and supply its business operations from another country. Moreover, if we take into account the empirical evidence showing that multinational firms allocate profits according to differences in statutory corporate tax rates (Huizinga & Laeven, 2008), e-commerce firms will find even greater opportunities to behave in this way.

E-commerce exacerbates the problems associated with the interrelation of a variety of disparate tax systems (Li, 2003), while electronic transactions highlight the complexities concerning the principles of taxation. As international taxation cannot be considered in isolation from national tax laws, in the case of e-commerce it becomes especially difficult to determine how, where, and by whom income is earned, and

consequently where to allocate the tax jurisdiction. Many problems have to be considered, including the country in which the company has its headquarters, the physical servers that host its web domain and online presence, where the effective management operates, where the office processed the order, and where the product(s) or service(s) are delivered. Due to the increased use of information and communication technologies, it has become more and more difficult to identify the source of income, and moreover the source is increasingly susceptible to manipulation or obfuscation (Schäfer & Spengel, 2002).

A further issue of relevance is the characterization of income, because, in accordance with international tax rules, different types of income are taxed differently. In e-commerce, the proper characterization of transactions with respect to things such as products, services, royalties, rents, and use licenses is a task fraught with significant difficulties (Basu, 2007; Li, 2003; Tadmore, 2004). This issue is especially crucial for VAT authorities. Digitalized products downloaded from a site outside the EU may generate no tax revenue or liability for VAT reimbursement (Basu, 2007). In these circumstances, businesses develop and advance considerable tax strategizing efforts. Basu (2007) identifies clear incentives to move internet service provider (ISP) activities offshore so as to "blur responsibility" for paying or collecting VAT, and indeed some European ISP activities are set up in low-tax jurisdictions. The loss of tax revenues in the US is widely studied (Alm & Melnik, 2010; Bruce & Fox, 2000).

Hoopes, Thornock, and Williams (2016) argue that internet purchasing is a means of evading sales taxes, and after events that indicate an increased likelihood of federal sales tax legislation, report empirical evidence of abnormal stock returns for 'e-tail' firms. They suggest that this points to the existence of a competitive advantage for e-commerce retail firms with respect to traditional retail firms, and is attributable to the ease with which they can engage in tax evasion practices. Likewise, Klassen et al. (2014) report empirical evidence that e-commerce reduces the costs of income shifting to favorable tax jurisdictions.

Transfer pricing is a well-known method of tax avoidance. In e-commerce, tax avoidance practices are characterized by the fact that elements of taxation can be easily changed or moved. Digital products and services tend to be highly integrated and intangible in nature, as well as difficult to value. In this regard, e-commerce presents increasing difficulties for governments to detect the use of transfer pricing for the purposes of tax avoidance (Basu, 2007, p. 135). Cockfield (2001) argues that e-commerce exacerbates many of the problems associated with international transfer pricing.

Given the possibilities that e-commerce benefits from extant loopholes in the international tax system, we formulate the following hypothesis:

H1. E-commerce business practices influence higher rates of tax avoidance.

Some factors influencing tax avoidance have also become progressively beneficial for traditional firms. First, traditional firms previously had fewer opportunities than e-commerce firms to exploit tax avoidance practices. However, in recent years traditional firms benefited more from the reductions in statutory corporate tax rates than their e-commerce counterparts.

Second, intangible assets became more widespread and constitute an increasing share of total assets in both e-commerce and traditional firms (Brand Finance, 2016; OECD, 2006).

Third, the global financial crisis that broke out in 2008 was less acute for e-commerce firms, and their sales trend was more favorable than that of traditional firms (Falk & Hagsten, 2015; Nelson & Leon, 2012). Consequently, e-commerce firms bore lower losses during this financial crisis, and they also had the subsequent lower loss compensation in the recovery phase.

Fourth, traditional firms have progressively incorporated e-sales, despite maintaining their traditional business practices and physical locations (Falk & Hagsten, 2015).

Fifth, both traditional and e-commerce firms are progressively becoming more globalized members of the international economy. On the understanding that globalization and international transactions between subsidiaries serve as an opportunity for tax avoidance, traditional commerce firms have progressively closed the tax avoidance gap with their e-commerce counterparts.

Sixth, governments have been studying and implementing procedures and legislations to address and control tax avoidance. For example, in the EU, transfer pricing legislation has progressively been implemented (Lohse & Riedel, 2012), undermining the former general advantage enjoyed by e-commerce firms over traditional commerce. The anti-tax avoidance package on the European Commission's agenda, as well as the common consolidated corporate tax base under study (Roggeman, 2015), are examples of the current EU concern on this issue. Likewise, measures against tax avoidance are being considered as part of the OECD/G20 (2015a) BEPS project and within the report prepared by the Indian Government's Committee on Taxation of E-Commerce (2016), among others.

Finally, tax avoidance innovations, as with all innovations, are quickly imitated by competitors, however, this results in the loss of the initial advantage provided to early adopters (Kinney & Wempe, 2002). For example, it has been reported that domestic firms are developing similar tax avoidance strategies and practices to those of multinational companies (Dyreng et al., 2017).

As a consequence of this changing scene, the comparative ability of e-commerce firms to avoid taxes with respect to traditional firms should be progressively reduced. Therefore, we formulate the following hypothesis:

H2. The influence of e-commerce business practices on tax avoidance is progressively decreasing over time.

3. Empirical Model

Extant research has employed a variety of variables to explain tax avoidance, depending on the specific goal of each study and the data available to them. In line with the specific characteristics and purposes of our study, we formulate the following empirical model:

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\begin{aligned}
TAXAV_{i,t} = \ & \beta_0 + \beta_1 \cdot ECOM_{i,t} + \beta_2 \cdot ECOMYEAR_{i,t} + \beta_3 \cdot YEAR_{i,t} + \beta_4 \cdot LDEBT_{i,t} \\
& + \beta_5 \cdot \log REV_{i,t} + \beta_6 \cdot TAFIXA_{i,t} + \beta_7 \cdot INV_{i,t} + \beta_8 \cdot RGROWTH_{i,t} \\
& + \beta_9 \cdot INTFA_{i,t} + \beta_{10} \cdot VINTFA_{i,t} + \beta_{11} \cdot ROA_{i,t} + \beta_{12} \cdot BIG4_{i,t} + \beta_{13} \\
& \cdot NUMSUB_{i,t} + \beta_{14} \cdot NOLREV_{i,t} + \sum \beta_k \cdot COUNTRIES_{k,i,t} \\
& + \varepsilon_{i,t} \hspace{5cm} (1)
\end{aligned}
$$

This model includes our variables of interest, as well as control variables (*CONTROLS*) that prior literature considered important as determinants of tax avoidance, subject to data availability[2]. Each observation refers to firm *i* in year *t*, *β* are the parameters to be estimated, and *ε* is the error term. The appendix shows a brief description of all variables.

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[2] We include neither foreign income nor research and development (R&D) expenditure, because the former is not available in our data source, and the latter is only available for a small number of firms. We exclude the market-to-book ratio, because most firms in our database are non-listed. Given that we use consolidated

TAXAV (tax avoidance) is operationalized as one of two dependent variables: *ETR* (effective tax rate) and *ABETR* (abnormal effective tax rate). *ETR* is defined as the ratio of tax expense to pre-tax income, and is one of the most commonly used measures of tax avoidance in the literature (e.g. Christensen et al., 2015; Higgins, Omer, & Phillips, 2015; Lanis & Richardson, 2012), where the higher the ratio, the lower the tax avoidance. *ABETR* is defined, following the literature (Armstrong et al., 2015; Balakrishnan, Blouin, & Guay, 2019; Kim & Zhang, 2016), as the country- and size-matched ETR less the firm's ETR. The country- and size-matched ETR is the average ETR for the portfolio of firms in the same quintile of revenues and the same country. We use revenues instead of total assets as a more appropriate measure of size. Given the nature of their business, e-commerce firms usually present a lower level of investment in tangible fixed assets. High values of this variable indicate a greater deviance from the firms' matched counterpart tax compliance and, consequently, the higher its value, the higher the level of tax avoidance.

We cannot consider cash ETRs, as commonly employed elsewhere (e.g. Dyreng, Hanlon, & Maydew, 2008; Hope, Ma, & Thomas, 2013), because AMADEUS does not provide data on paid taxes. However, the strength of our results are backed up by using the two aforementioned measures of tax avoidance.

Our database does not provide information on the share of e-commerce performed at the firm level. Instead, we use the dummy variable *ECOM* indicating with a value of one if a given firm belongs to the retail trade and performs its business exclusively via internet in our data source, and zero otherwise. This variable distinguishes between two clearly distinct business orientations: 1) firms using e-commerce as a merely additional business resource that was more or less gradually adapted from a brick-and-mortar background; and 2) firms whose entire business is built around selling via the internet, a characteristic that shapes the whole organization, including its opportunities for tax avoidance. We use *ECOM* as the best means to test hypothesis H1.

The persistent fall in statutory corporate tax rates over time has been widely documented in the OECD countries (Dyreng et al., 2017), the US (Bruce & Deskins, 2012; Bruce & Fox, 2000), and the EU, where they have especially markedly dropped (Genschel et al., 2011). Moreover, most countries, especially those in the EU, have extended their loss carryforward periods, with an unlimited number of years being

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financial statements, we deemed it relevant to include intra-firm transactions, which we measure through the number of subsidiaries in the group.

allowed for loss compensation in most of the largest EU member states (Martens-Weiner, 2006, p. 20; EUROSTAT, 2015). This has had the effect of increasing tax avoidance over time.

YEAR is the generic variable name in equation 1, but is operationalized in two forms: *YEARdata* and *YEARdummy*. *YEARdata* is a variable with a range from 1 to 7, corresponding to the number of each calendar year, from 2009 to 2015, for which data for each firm in our sample is available. *YEARdummy* are dummy variables that equal one when an observation belongs to a specific year. The continuous value of *YEARdata* allows for a more precise analysis of the time trend than when using the dummy variable version of *YEAR*.

ECOMYEAR is the interaction variable between *ECOM* and *YEAR*, both *YEARdata* and *YEARdummy,* which allows us to test hypothesis H2.

Leveraged firms are likely to exploit the tax deductibility of interest payments and loan fees to shift debt among variably taxed jurisdictions (Hines & Rice, 1994; Newberry & Dhaliwal, 2001; Rego, 2003; Taylor, Richardson, & Lanis, 2015; Taylor, Richardson, & Taplin, 2015). Firms with high leverage tend to be more tax aggressive than more highly capitalized firms (Bernard, Jensen, & Schott, 2006; Dyreng, Hanlon, & Maydew, 2008; Gupta & Newberry, 1997). According to Clemente-Almendrosa and Sogorb-Mira (2018), the tax benefits of leverage should be balanced by its costs. The long-term debt to total assets (*LDEBT*) ratio provides a better reflection of a firm's long-term strategies than does its total debt to total assets ratio. Both leverage measures, total and long-term debt, are highly correlated in our sample (0.8 Pearson correlation coefficient, significant at $p<0.01$). Consequently, we use long-term debt as the control variable in our model, and expect it to have a positive relationship with tax avoidance.

Previous studies discussed the influence of size on tax avoidance (e.g. Conover & Nichols, 2000; Jacob, 1996; Taylor, Richardson, & Lanis, 2015). Taylor and Richardson (2013) suggest that larger firms have more opportunities to engage in transfer pricing manipulation when they operate in different countries, due to the differences in tax rates between the parent country and foreign group entities. However, small firms benefit from tax avoidance practices as well. In this vein, Hanlon (2005) reports that both private and public companies are associated with tax noncompliance. As previously mentioned, we use revenues as a more appropriate measure of size, but given the distributional characteristics of this variable, we use log-transformed values (log*REV*). We have no defined expectation for this variable.

Tangible fixed assets serve as another opportunity for tax avoidance, given the different treatment afforded to depreciation in tax and financial reporting (Hope, Ma, & Thomas, 2013), as well as the accelerated depreciation charges that can be applied to asset lives (Lanis & Richardson, 2011; Stickney & McGee, 1982; Taylor & Richardson, 2013). It has also been argued that inventory intensity is a substitute for capital intensity and, consequently, inventory-intensive firms should be less tax avoidant than capital-intensive firms. Monterrey Mayoral and Sánchez Segura (2017) find a strong relationship between investment and tax avoidance. We measure capital and inventory intensity through the ratios of tangible fixed assets and inventories to total assets (*TAFIXA* and *INV*, respectively), and expect a positive and negative relationship, respectively, for these variables with tax avoidance.

Lanis and Richardson (2011) and Edwards, Schwab, and Shevlin (2016) used measures of firm growth, assuming that growth offers opportunities to engage in non-compliant tax behavior, and reflects changes in size. We also include growth in our model to ensure that any association between the variables of interest and tax avoidance are not influenced by a change in economic activity. In line with Badertscher, Katz, and Rego (2013), Hoi, Wu, and Zhang (2013), and Frank, Lynch, and Rego (2009), we use the ratio of revenues at year *t* to revenues at year *t*-1 (*RGROWTH*). We have no defined expectation regarding the sign of this variable.

Intangibles assets are among the main drivers of profit shifting (Grubert & Altshuler, 2008). They provide a significant opportunity for tax avoidance through transfer pricing because there are usually no comparable products that can offer a price benchmark. They provide further opportunities for tax avoidance because the tax treatment of intangibles and similar assets, for example new inventions, differs greatly in different jurisdictions (Dyreng, Hanlon, & Maydew, 2008; Higgins, Omer, & Phillips, 2015; Shackelford & Shevlin, 2001). We use the ratio of intangible fixed assets to total assets (*INTFA*), as well as the change in this ratio from the current to previous year (*VINTFA*), and expect a positive relationship with tax avoidance

Profitability plays an important role in tax avoidance, because profitable firms have greater incentives than unprofitable firms to engage in aggressive tax schemes or arrangements to avoid corporate taxes (Gupta & Newberry, 1997; Jacob, 1996; Taylor, Richardson, & Lanis, 2015; Taylor, Richardson, & Taplin, 2015). The greater the profitability, the greater is the marginal benefit of tax avoidance. We use return on assets

(*ROA*), defined as pre-tax income to previous year's total assets, as an indicator of profitability, and expect a positive relationship with tax avoidance.

Lisowsky (2010) found a significant positive influence of big-five auditing services on engagement in tax shelter transactions, suggesting that auditors act as advisers and promoters of tax shelter design, with the big-five being the most skilled for this purpose. In contrast, Lanis and Richardson (2015) argued that the use of a big-four audit firm may help to reduce the tax avoidance activities via enhanced monitoring and higher quality audit services. Empirical research on auditing relates big auditors with audit independence, being more conservative, and favoring accounting quality (Becker et al., 1998; Francis, Maydew, & Sparks, 1999), and similar assumptions can be made with respect to their influence on tax avoidance. However, other studies failed to report a significant effect of auditor type on accruals, or found mixed results (Carey & Simnett, 2006; Chen, Lin, & Lin, 2008; Myers, Myers, & Omer, 2003). We use a dummy variable (*BIG*4) indicating with a value of one (and zero otherwise) that the auditor of a given firm is Deloitte & Touche, PricewaterhouseCoopers, Ernst & Young, or KPMG. We have no defined expectation with respect to the sign of this variable.

It is usually argued that multinationals, or firms with greater international exposure, have more opportunities to avoid corporate taxes than domestic firms (Dyreng, Hanlon, & Maydew, 2008; Rego, 2003). There is broad evidence that multinationals use transfer pricing to shift income across different tax jurisdictions to minimize tax burdens (Clausing, 2009; Gravelle, 2005; Klassen & Laplante, 2012; Taylor, Richardson, & Lanis, 2015;). We approach the possibility of transfer pricing through the number of subsidiaries (*NUMSUB*), expecting a positive relationship with tax avoidance.

Our database only provides data on auditing firms and on the number of subsidiaries for the last available year. Therefore, for any given firm in our panel data, we apply the same value for these variables (*BIG*4 and *NUMSUB*) to all previous years.

In line with previous studies (e.g. Edwards, Schwab, & Shevlin, 2016; Gallemore & Labro, 2015), the existence of previous losses is an obvious control variable in our model, given that prior losses can reduce taxes on current profits. We do not have information on the carrying amount of losses in our database, so we measure it through the sum of profits in the last four years, the current year included, scaled by revenues (*NOLREV*). We expect a negative influence of this variable on tax avoidance, indicating that higher carrying amounts of losses reduces the taxes the company will pay in the current year. We consider only the last four years, given our limited panel database of ten years. It is

our belief that this variable is more appropriate than a simple dummy indicating the existence of previous losses, which some studies use in their models (e.g. Frank, Lynch, & Rego, 2009; Hoi, Wu, & Zhang, 2013). Rather than the mere existence of previous losses, the amount of these losses influences tax income. Davis et al. (2016) used a similar variable in their study.

Finally, given the existence of different statutory corporate tax rates and tax jurisdictions in our sample, we include country control dummy variables indicating with a value of one, and zero otherwise, the country in which the parent company is located. However, when the dependent variable is *ABETR*, we remove these dummies because it is defined as the deviance from country- and size-matched ETR values.

To ensure our tests are not influenced by a few influential observations, we winsorize our dependent variables *ETR* at [0,1], calculate *ABETR* with this transformed variable, and also winsorize all independent continuous variables at the 1st and 99th percentiles, as is common practice in previous studies (e.g. Brown, Drake, & Martin, 2016; Dyreng, Hoopes, & Wilde, 2016; Gallemore & Labro, 2015).

4. Sample Selection

The purpose of this study is to analyze the influence of the characteristics of e-commerce business practices on tax avoidance. We consider that Europe, and particularly the EU, is an especially interesting setting for this study, because firms operate across different countries with different statutory corporate income tax rates. Indeed, some of these countries have implemented special tax regimes. Within this context minimizing taxes may be a considerable competitive advantage. We do not restrict our analysis to listed firms because most European firms are not publicly registered in stock exchange markets.

As we know of no source providing specific data on the share of e-commerce sales at the firm level, we opt to distinguish between firms selling exclusively through e-commerce from those that sell through both e- and traditional commerce. The Statistical Classification of Economic Activities in the EU, known as NACE, together with the US Standard Industry Classification, classifies firms that sell their products or services exclusively via internet (four-digits NACE code 4791) inside the two-digits code 47, which include all retail trade firms, except motor vehicles and motorcycles.

We start with the data available from 2006 to 2015 for all firms with consolidated accounts in Europe in the two-digits NACE code 47 in the European AMADEUS database. This give us an initial 13,710 and 950 firm-year observations belonging to 1,371 and 95 traditional and e-commerce retail trade firms, respectively (see Panel A in Table 1). However, when considering the necessary lags and data to build our variables, our sample ranges from 2009 to 2015, with 3,598 and 183 firm-year observations, corresponding to 920 and 51 firms, respectively, which present all the necessary data for our study (see Panel B in Table 1). Consistent with prior literature (Christensen, Dhaliwal, Boivie, & Graffin, 2015; Dyreng, Hoopes, & Wilde, 2016; Edwards, Schwab, & Shevlin, 2016; Gallemore & Labro, 2015), we remove observations with negative income. Therefore, we have a final sample of 3,015 firm-year observations; that is, 142 and 2,873 from 42 and 817 e-commerce and traditional firms, respectively (see Panel C in table 1).

Insert Table 1 about here

As can be seen in Table 1, 1,101 (38.3%) and 49 (34.5%) of the available firm-year observations in our sample belong to traditional and e-commerce firms, respectively, with the parent company in the UK. These figures correspond to a similar share of UK parent companies with their consolidated accounts in the retail sector (NACE code 47) in AMADEUS. Our final sample contains just seven countries with retail e-commerce parent companies compared to 22 countries with traditional retail parent companies. When only using data for the seven countries with e-commerce firms, we obtain a smaller sample of 2,289 and 142 firm-year observations from 656 and 42 traditional and e-commerce firms, respectively (see Panel D in Table 1).

To test our hypotheses, in line with Cameron, Gelbach, and Miller (2011) and Gow, Ormazabal, and Taylor (2010), we estimate our model using a linear regression with standard errors adjusted by a two-dimensional cluster at the firm and year levels, considering the likely correlation of the residuals across firm and/or over time. We estimate Equation 1 for our two dependent variables, as well as for different samples. First, we perform estimations for the final sample of firms with available data and positive income. We additionally restrict our sample to observations from countries with e-commerce firms.

5. Results

Table 2 shows the descriptive statistics for our sample. The two groups of firm differ with respect to our independent variables. Although there are no significant differences, at $p<0.1$, in terms of intangible asset levels and previous losses, the e-commerce firms in our sample are less indebted, bigger, and more profitable, and the share of their inventories and intangible assets are higher. However, many significant differences were found, as e-commerce firms have a lower share of tangible fixed assets, operate with more subsidiaries, are more frequently audited by one of the big-4 auditors (60% of firm-year observations vs. 40%), and grow more than traditional firms (All differences significant at $p<0.01$, with the exceptions of profitability and indebtedness being significant at $p<0.05$ and $p<0.10$, respectively). Insert Table 2 about here

Surprisingly, and contrary to hypothesis H1, the median *ETR* is significantly higher for e-commerce than it is for traditional firms at $p<0.01$, indicative of lower tax avoidance in e-commerce firms. However, the higher *ABETR* for traditional firms (significant at $p<0.05$), points to higher tax avoidance in e-commerce firms, when contextual factors, such as statutory corporate tax rates, and firm characteristics, such as size, are taken into consideration. A plausible explanation for these univariate results are that most of the e-commerce observations in our sample belong to firms with parent companies in the largest EU countries; that is, those with higher statutory corporate taxes than most of the other countries.

Table 3 provides details of statutory corporate tax rates in the countries providing data for our sample over the period studied. As seen in panel A, the largest economies in the EU – Germany, France, and Italy – and the countries contributing e-commerce observations to the sample have the highest statutory corporate tax rates for the period. The UK, the one exception to this rule, has a statutory corporate tax rate above the mean for all countries in 2009 (28% versus 24.5%), and yet following a sharp decrease in the rate levied, has a value that is below this mean in 2015 (20% versus 23.5%). The average statutory corporate rates in countries with e-commerce observations are greater at 28.5% than the corresponding averages in countries without e-commerce observations at 21.8% over the whole period (see panel B in Table 3). Similarly, the weighted (to the number of observations in the sample) means of statutory corporate tax rates are higher for e-commerce than for traditional retail firms (see panel C in Table 3).

Insert Table 3 about here

Given the contradictory results for the two dependent variables, as well as the differences in the independent variables for e-commerce and traditional firms – factors

that we assume influence tax avoidance – a more conclusive and multivariate analysis is required.

Table 4 displays Pearson correlations between the independent variables. For the sake of simplicity, we do not include the dummy variables for countries in this table. *ECOM* and *ECOMYEAR* are strongly and significantly correlated, as is usual with interaction variables. However, the variance inflation factors (VIFs) of these variables are 5.96 and 5.9, respectively, the highest for the independent variables in the model. But these are well below the critical value of 10 proposed by Kutner, Nachtsheim, Neter, and Li (2005, p. 409). As for the remaining variables, the highest coefficients are for *BIG*4 and log*REV* (0.469) and for log*REV* and *NUMSUB* (0.555). The VIFs for these variables are between 1.47 and 2.25, which suggests our results are not seriously affected by collinearity.

Insert Table 4 here

Table 5 shows estimations with their standard errors adjusted by a two-dimensional cluster at the firm and year levels for Equation (1). Results in columns 1 and 2 refer to the dependent variables *ETR* and *ABETR,* respectively, for the whole sample, and columns 3 and 4 to the sample restricted to the seven countries with headquarters of e-commerce firms for both dependent variables. The small number of observations for Turkey and Portugal did not allow us to calculate the dependent variable *ABETR* for these two countries, resulting in fewer observations in columns 2 and 4. All estimations present a significant goodness-of-fit. R-squared ranges from 0.062 to 0.259, with higher values for the dependent variable *ETR* than for *ABETR*.

Insert Table 5 here

The coefficients of time (*YEARdata*), intangible assets (*INTFA*), the change in this ratio (*VINTFA*), and return on assets (*ROA*) are the control variables with the most persistent influence on tax avoidance, as all are significant in all four estimations at $p<0.01$. Surprisingly, the sign for the ratio of intangible fixed assets (*INTFA*) is contrary to expectations, but the change in this ratio (*VINTFA*) is consistent to expectations in all cases. The signs of *ROA* and *YEARdata* meet expectations. When the sample is restricted to countries with e-commerce firms (see columns 3 and 4), size (log*REV*) and inventories (*INV*) significantly influence lower tax avoidance (at $p<0.05$), although size is significant only in column 3. Coefficients in columns 3 and 4 indicate that audits by one of the big four auditors (*BIG4*) are associated with greater tax avoidance. Inventories (*INV*) are also significant at $p<0.1$ in column 2. The coefficients of *NUMSUB* and *NOLREV* present the expected sign, but are only significant in column 2, at $p<0.1$.

Dummy estimates for countries are not displayed in Table 5 for the sake of simplicity. Twelve and four of these dummy variables, respectively (from a total of 21 and 6, respectively) are significant (at $p<0.01$ in most cases) in the ETR estimations (columns 1 and 3 respectively). Firms in the UK, the Netherlands, and Sweden are more tax avoidant, while firms in Italy are less tax avoidant than firms in the default country (Germany), which is in accordance with the top statutory corporate tax rates in these countries. Dummies for countries are excluded from the model when the dependent variable is *ABETR*, because this variable is already adjusted by country.

The most important and persistent result for the purposes of our study are that our variables of interest in Table 5 provide support for our hypotheses in all cases. The significant (at $p<0.001$ in columns 1 and 2, and at $p<0.05$ in columns 3 and 4) signs presented by the variable *ECOM* indicate that e-commerce influences higher tax avoidance and, thus, provides support for hypothesis H1.

The significant (at $p<0.01$ in column 1 and at $p<0.5$ in the remaining columns) coefficients and signs of the interaction variable *ECOMYEARdata* indicate that time moderates the tax avoidant effect, which although more than 5 percent points higher in e-commerce firms than in traditional firms, has fallen over the years. The combined effect of the two variables (*ECOM* and *ECOMYEARdata*), significant in all cases at $p<0.05$, provides support for hypothesis H2 (see panel B in Table 5).

The significant (at $p<0.01$) coefficients and signs of *YEARdata* in all estimations indicate that tax avoidance has, as expected, increased over the years. Given the results for the interaction term *ECOMYEARdata*, these negative signs show that tax avoidance has actually increased more for traditional retail firms. However, the combined effects of *YEARdata* and *ECOMYEARdata* (*YEARdata+ECOMYEARdata*) indicate that tax avoidance has decreased for e-commerce firms (see panel B in Table 5). Indeed, the increasing trend of tax avoidance becomes a decreasing one in the case of e-commerce, thus lending support for hypothesis H2. These results suggest that traditional retail firms are increasingly engaged in tax avoidance, and in all likelihood are adopting methods of e-commerce in their business and its corresponding tax avoidance practices. As a result, the tax avoidance gap between the two types of firm narrowed over the period studied.

According to the estimates presented in column 1 in Table 5, firms exclusively engaged in e-commerce retail avoided around 5 percentage points more of corporate tax (the coefficient of *ECOM*) than their traditional retail trade counterparts. While the latter presented a decreasing corporate tax trend of about 0.5 percentage points per year (the

coefficient of *YEARdata*), the rate paid by the former increased by about 1 percentage points per year (the combined effect of both coefficients, *YEARdata* and *ECOMYEARdata*: -0.00559+0.0149) during our study period. The corresponding results in Columns 2 to 4 reveal a similar behavior, considering the different subsamples of firms under study.

Table 6 displays estimations for Equation 1 with *YEARdummy* defined with the dummy variables (*YEAR*2010 to *YEAR*2015: value 1 for observations belonging to the corresponding years, and zero otherwise) and the corresponding interactions with *ECOM* (*ECOMYEAR*2010 to *ECOMYEAR*2015). The first year (2009) presenting all available data is the default year. Results are essentially the same as those in Table 5 with respect to these variables of interest.

Insert Table 6 here

The signs of *ECOM* (significant at p<0.01 in columns 1, 2, and 4, and at p<.0.5 in column 3) provide reinforced support for H1 on the influence of e-commerce on tax avoidance. In line with the results in Table 5, the significant positive signs for most interaction variables in all columns reveal a moderating effect of e-commerce on their previously higher rates of tax avoidance over time. The joint significance (at p<0.01 in all columns) of *ECOM* and the interaction variables *ECOMYEARdummy* also provides reinforced support for H2 on the decreasing tax avoidance advantage enjoyed by e-commerce firms over the years (see panel B in Table 6). All tests for the combined effect of the pairs of variables *ECOM* and the corresponding interaction *ECOMYEARdummy* are significant at p<0.05 (not displayed for sake of simplicity). The signs of the coefficients of dummies for *YEARdummy* (significant at p<0.01 in most cases) reveal lower effective tax rates for traditional retail firms in most years with respect to our first year of data (2009). The combined signs and significances of *YEARdummy* and *ECOMYEARdummy* once again suggest that the higher tax avoidance of e-commerce compared to traditional firms is decreasing over time. We do not display the sum of the coefficients in Panel B in Table 6, because it is meaningless.

The signs and significances of the control variables and dummies for countries in columns 1 and 3 of Table 6 (not displayed for sake of simplicity) are also very similar to those of the corresponding columns in Table 5. Assuming that some contextual factors may also affect our results, we rerun estimations for *ABETR* (columns 2 and 4 of Tables 5 and 6) including dummy variables for countries, and all results (not displayed for sake

of simplicity) are very similar to those in columns 2 and 4 in Tables 5 and 6, with none of these country dummies being significant at $p<0.1$.

Overall, Tables 5 and 6 provide support for hypotheses H1and H2, and are robust to our two different measures of tax avoidance, as well as to different specifications of time and sample selection criteria. However, as a final robustness test, we define the dependent variable as long-run ETR, calculated as three-years tax expenses divided by three-years pre-tax income, and rerun estimate Equation 1 (results not displayed). But the signs of our variables in this case are not significant. Therefore, our results are not robust to this long-run definition of ETR.

6. Discussion

Our results show a statistical association between e-commerce business practices and tax avoidance. However, we have yet to perform an in-depth analysis of the specific actions implemented by these firms to achieve these tax benefits. Some initial observations might, however, be made about the difference in tax avoidance strategies adopted by traditional and e-commerce firms.

One of the main problems concerning the possibilities of e-commerce opting for tax aggressive practices (especially when this involves business in different countries) is that business profits are attributable to enterprises with a permanent establishment in a given country. This recognition of a permanent establishment typically requires the existence of a physical presence, more often than not focused on a local market, while e-commerce is more usually oriented to the global market. Traditional brick-and-mortar firms have comparatively more difficulties than e-commerce firms to circumvent their tax responsibilities, because their business is more dependent on their physical presence. However, e-commerce, and the digital economy in general, have the possibility of doing business while avoiding this requirement of a physical presence. E-commerce firms can undertake their business in a given country and reap their corresponding profits, while avoiding the need for a physical presence in unfavorable tax jurisdictions. Meanwhile they can divert any profits to a more convenient jurisdiction, which is the normal behavior of e-commerce firms to avoid taxes.

The recognition of these practices, and the corresponding concern to prevent the artificial avoidance of a permanent establishment status, are the main concerns of Action 7 of the OECD BEPS. Similarly, the European Commission acknowledges that

businesses are able to operate across borders without having a physical presence. Thus, it proposed Council Directive (2018/72(CNS)) to ensure a fair and efficient corporate taxation within the EU. This directive seeks to revert the rule of a physical presence into a significant digital and profit allocation rule, based on certain indicators of economic activity such as the existence of thresholds of revenues, users, and contracts. It is expected that an effective development and implementation of this project and proposal, as well as their application across member states, would help mitigate the use of these tax avoidant strategies in the digital economy by e-commerce businesses.

As previously discussed, intangible assets are important drivers of profit shifting. Their different tax treatment, legal status, and conceptualization across tax jurisdictions, the ease with which they can be transferred, and the infrequent existence of benchmark references for their transfer prices provide great opportunities for earnings management and/or tax avoidance. The fact that intangibles are core assets and important means of value creation in the digital economy, and more specifically in e-commerce firms, generates comparatively greater possibilities of tax avoidance in such firms compared to traditional firms. While the increasing importance of intangible assets in all types of firm suggests the growing opportunities that traditional firms have to use them for tax avoidance purposes, the difference still persists in e-commerce firms.

An additional comparative tax avoidance strategy used by e-commerce firms with respect to traditional trade firms is associated with the greater possibilities they have of exploiting non-standard employment (NSE) agreements. There is considerable evidence of the widespread use of NSE agreements all over the world, and especially in the digital economy where they frequently replace standard agreements to obtain advantages, such as flexible employment agreements and limited legal protection (International Labour Organization, 2016). The most notorious characteristic of NSE agreements is that they offer lower social security coverage. In this way, firms can benefit from higher profits thanks to the reduction in their social security contributions, and so shift their increased profits to the most convenient tax jurisdiction. The blurred physical presence of e-commerce firms enables them to enter into more NSE agreements than traditional firms, and to make up their manpower with more flexible, cheaper employment agreements with employees in locations that minimize their labor costs. They may also allocate work in order to shift profits to the most favorable tax jurisdiction.

7. Conclusions

This paper examined the influence that e-commerce business practices have on tax avoidance. Using a panel data sample of European retail firms, we find strong empirical evidence that e-commerce does result in higher rates of tax avoidance in Europe. However, we also find that the tax avoidance rates of traditional retail firms have increased over time, thereby reducing the gap between the two types of firm, presumably as the former have increased the share of e-commerce in their total sales. These results are persistent and robust to different sample selection procedures, to the two measures of tax avoidance used in this study, and to different time specifications.

This study has notable academic, social, and economic implications. From an academic point of view, the results expand our understanding of tax avoidance as it relates specifically to e-commerce. From a social point of view, e-commerce represents a new tool for doing business – facilitated by technological developments within the digital economy and careful planning decisions. Yet, while it has had marked social and business benefits, it also favors the socially undesirable byproduct of tax avoidance. This loss of government tax revenues has a negative effect on society, since it deprives states of the resources needed to fund public necessities, citizen welfare, and social cohesion. From an economic point of view, e-commerce has the effect of distorting competition between firms, putting traditional firms at a disadvantage because of their higher tax bills. The empirical evidence of this effect highlights the need to take actions to prevent it.

This study has a number of limitations. One of our variables of interest is a simple dummy variable indicating that a firm is coded as performing sales via internet in the retail trade. While this dummy variable allows us to distinguish between the tax avoidance behaviors of firms that have built their businesses around internet sales and firms employing traditional retail practices, it does not allow us to identify a more direct and specific effect of e-commerce on tax avoidance. Today, it can be assumed that most firms also perform a certain proportion of their sales via internet. However, the percentage of firms' sales made via internet is not currently available in the AMADEUS database and, to the best of our knowledge, there is no information available at the firm level in alternative databases.

Yet, our study was able to identify firms for whom all their B2C sales are made via the internet. As these firms embody the nature and spirit of e-commerce business behavior, it should not constitute a significant problem for our study, but we stress we have not used B2B e-commerce sales data as they are not available at the firm level. An additional limitation of our study is that some data – the name of the audit firm and the

number of subsidiaries – are only available for the last year in our database and so we have applied these data to the earlier years in our sample. Our results are not robust to a long-run definition of ETR, which is also a limitation of this study. Larger samples are needed to obtain more concluding results.

In future studies, it would be interesting to analyze the effects of e-commerce using: 1) more precise information about the share of internet sales with respect to total sales; 2) more complete data on the number of firm subsidiaries for all years making up the sample; 3) more detailed information about the firms' foreign sales; and 4) a wider array of industries and B2C and B2B e-commerce transactions. Further analyses in different settings and countries and under different market conditions and larger samples would also be of interest. All these ideas represent obvious avenues for future research.

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Table 1.
Sample and data screening. Number of observations and firms.

	Traditional	E-commerce	Total
Panel A. Initial available sample in AMADEUS (2006 to 2015)			
Total firm-year observations	13,710	950	14,660
Total number of firms	1,371	95	1,466
Panel B. Observations with available data and considering the necessary lags (2009 to 2015)			
Total firm-year observations	3,598	183	3,781
Total number of firms	920	51	971
Panel C. Final sample (available data and positive pre-tax income) by country (2009 to 2015)			
Belgium	54	0	54
Cyprus	10	0	10
Denmark	15	0	15
Finland	230	0	230
France	171	9	180
Germany	165	19	184
Greece	45	0	45
Hungary	17	0	17
Iceland	26	0	26
Italy	202	31	233
Latvia	27	0	27
Lithuania	7	0	7
Netherlands	127	4	131
Norway	345	21	366
Poland	53	0	53
Portugal	4	0	4
Russian Federation	6	0	6
Spain	83	0	83
Sweden	178	9	187
Switzerland	6	0	6
Turkey	1	0	1
United Kingdom	1,101	49	1,150
Total firm-year observations	2,873	142	3,015
Total number of firms	817	42	859
Panel C. Available data, positive pre-tax income and only observations from 7 countries with e-commerce firms (2009 to 2015)			
Total firm-year observations	2,289	142	2,431
Total number of firms	656	42	698

Table 2.
Final sample (3,015 firm-year observations[1]) median values.

Variables	Traditional			E-commerce			
	mean	median	Std. dev.	mean	median	Std dev.	
ETR	0.2921	0.2641	0.1915	0.3451	0.2902	0.2285	***
ABETR	-0.0003	0.0122	0.1680	0.0061	0.0292	0.2133	**
LDEBT	0.1278	0.0767	0.1547	0.1075	0.0444	0.1391	*
log*REV*	5.0231	4.8852	0.7522	5.1399	5.1454	0.6591	***
TAFIXA	0.3122	0.2749	0.2201	0.1141	0.0776	0.1060	***
INV	0.2273	0.1779	0.1664	0.2832	0.2670	0.1981	***
RGROWTH	1.0759	1.0513	0.1677	1.1171	1.0936	0.1923	***
INTFA	0.0943	0.0199	0.1516	0.1128	0.0609	0.1508	***
VINTFA	-0.0032	-0.0004	0.0264	-0.0023	-0.0001	0.0410	
ROA	0.0927	0.0664	0.0908	0.1188	0.0890	0.1131	**
*BIG*4	0.3996	0.0000	0.4899	0.5915	1.0000	0.4933	***
NUMSUB	11.0453	4.0000	21.2378	15.5704	10	22.6823	***
NOLREV	0.1672	0.1249	0.1841	0.1522	0.1297	0.1540	

Notes: Significant differences at *** $p<0.01$, ** $p<0.05$ and * $p<0.1$ with Mann-Whitney tests. 1. Only 3,010 firm-year observations for *ABETR* after removing the 5 observations for Turkey and Portugal. See variable descriptions in the appendix.

Table 3.
Percent of statutory corporate tax rates in sample countries

	2009	2015	mean 2009 to 2015
Panel A. Detail by country			
Belgium	34	34	34
Cyprus	10	12.5	11.07
Denmark	25	23.5	24.71
Finland	26	20	23.86
France	34.4	38	36.43
Germany	30.2	30.2	30.2
Greece	35	29	25.71
Hungary	21.3	20.6	20.7
Iceland	15	20	19
Italy	31.4	31.4	31.4
Latvia	15	15	15
Lithuania	20	15	15.71
Netherlands	25.5	25	25.14
Norway	28	27	27.71
Poland	19	19	19
Portugal	26.5	29.5	29.79
Russian Federation	20	20	20
Spain	30	28	29.71
Sweden	26.3	22	24.46
Switzerland	18.96	17.92	18.28
Turkey	20	20	20
United Kingdom	28	20	24.29
Panel B. Average statutory corporate tax rates of the above listed countries			
Countries with e-commerce observations	29.11	27.66	28.52
Countries with no e-commerce observations	22.38	21.6	21.77
All countries	24.53	23.53	23.92
Panel C. Mean weighted (to the number of observations in the sample) statutory corporate tax rates			
Observations of e-commerce firms	29.44	25.77	27.74
Observations of traditional firms	28.39	22.9	26.17
Total firms	28.44	23.07	26.18

Table 4.
Pearson correlations (whole sample with 22 countries).

	ECOM	YEARdata	ECOMYEARdata	LDEBT	logREV	TAFIXA	INV	RGROWTH	INTFA	VINTFA	ROA	BIG4	NUMSUB	NOLREV
ECOM	1													
YEARdata	-0.005	1												
ECOMYEAR	0.906***	0.088***	1											
LDEBT	-0.028	-0.04**	-0.025	1										
logREV	0.033*	-0.046**	0.035*	0.079***	1									
TAFIXA	-0.191***	-0.011	-0.175***	0.214***	0.176***	1								
INV	0.07***	0.001	0.073***	-0.181***	-0.194***	-0.369***	1							
RGROWTH	0.052***	0.003	0.035*	0.006	0.052***	-0.072***	0.071***	1						
INTFA	0.026	-0.001	0.034*	0.253***	0.112***	-0.255***	-0.251***	0.017	1					
VINTFA	0.007	-0.029	0.006	-0.044**	0.039**	0.041**	0.018	0.058***	-0.031*	1				
ROA	0.06***	-0.007	0.045**	-0.195***	-0.046**	-0.2***	0.129***	0.243***	-0.122***	-0.019	1			
BIG4	0.083***	-0.07***	0.07***	0.088***	0.469***	0.042**	-0.096***	0.045**	0.107***	0.013	-0.041**	1		
NUMSUB	0.045**	-0.057***	0.041**	0.089***	0.555***	0.04**	-0.142***	0.012	0.16***	0.036**	-0.038**	0.282***	1	
NOLREV	-0.017	-0.02	-0.019	-0.153***	-0.071***	-0.045**	-0.013	-0.067***	-0.145***	0.023	0.429***	-0.036**	0.063***	1

Notes: Significant differences at *** $p<0.01$, ** $p<0.05$ and * $p<0.1$. Dummy variables for countries not displayed for sake of simplicity. See variable descriptions in the appendix.

Table 5.
Estimations for tax avoidance depending on e-commerce, time, and control variables in
Equation 1. Standard errors (in parenthesis) clustered by firm and year.

Variables	(1) *ETR* all 22 countries	(2) *ABETR* all 22 countries	(3) *ETR* E-com countries	(4) *ABETR* E-com countries
Panel A: Estimates				
ECOM	-0.0570***	0.0588***	-0.0477**	0.0549**
	(0.0208)	(0.0227)	(0.0189)	(0.0220)
ECOMYEARdata	0.0149***	-0.0140**	0.0135**	-0.0134**
	(0.0057)	(0.00604)	(0.0057)	(0.00628)
YEARdata	-0.00559***	0.00516***	-0.00513***	0.00506***
	(0.0013)	(0.00128)	(0.0016)	(0.00182)
LDEBT	0.0408	-0.0419	0.0655	-0.0753**
	(0.0363)	(0.0287)	(0.0418)	(0.0344)
log*REV*	0.00054	-0.00510	0.0143**	-0.00840
	(0.0065)	(0.00485)	(0.0068)	(0.00546)
TAFIXA	-0.0374**	0.0309*	-0.0203	0.0288
	(0.0181)	(0.0169)	(0.0190)	(0.0194)
INV	0.0429	-0.0491*	0.0551**	-0.0579**
	(0.0264)	(0.0257)	(0.0269)	(0.0268)
RGROWTH	0.0285	-0.0248	0.0315	-0.0301
	(0.0309)	(0.0303)	(0.0314)	(0.0304)
INTFA	0.124***	-0.111***	0.1423***	-0.117***
	(0.0341)	(0.0324)	(0.0363)	(0.0346)
VINTFA	-0.447***	0.441***	-0.426***	0.418***
	(0.115)	(0.119)	(0.122)	(0.114)
ROA	-0.397***	0.369***	-0.3952***	0.371***
	(0.0470)	(0.0477)	(0.0492)	(0.0529)
*BIG*4	-0.00820	0.00826	-0.0206**	0.0202*
	(0.00930)	(0.00742)	(0.0101)	(0.0104)
NUMSUB	-0.000452	0.000430*	-0.00045	0.000392
	(0.00035)	(0.000261)	(0.00035)	(0.000402)
NOLREV	0.0155	-0.0190*	0.00238	-0.00326
	(0.0129)	(0.0115)	(0.0152)	(0.0150)
COUNTRIES	Yes		Yes	
Constant	0.376***	0.0114	0.252***	0.0344
	(0.0772)	(0.0402)	(0.0549)	(0.0428)
Observations	3,015	3,010	2,431	2,431
R-squared	0.259***	0.062***	0.254***	0.071***
Firms	859	856	698	698
Panel B: Sum of coefficients and joint significance (chi-square test) of variables				
ECOM & *ECOMYEAR*	-0.0421**	0.0448**	-0.0342**	0.0415**
YEARdata & *ECOMYEARdata*	0.00931***	-0.00884***	0.00837***	-0.00834***
ECOM, YEARdata & *ECOMYEARdata*	-0.04769***	0.04996***	-0.03933***	0.04656***

Notes: significance levels at *** p<0.01, ** p<0.05, * p<0.1. Dummy variables for countries
not displayed for simplicity reasons. See variable descriptions in the appendix.

Table 6.
Estimations for tax avoidance depending on e-commerce, time, and control variables in Equation 1. Standard errors (in parenthesis) clustered by firm and year. *YEAR* defined as *YEARdummy* with dummy variables (2009 the default year).

VARIABLES	(1) ETR all 22 countries	(2) ABETR all 22 countries	(3) ETR E-com countries	(4) ABETR E-com countries
Panel A: Estimates				
ECOM	-0.0568***	0.0577***	-0.0423**	0.0489***
	(0.0185)	(0.0175)	(0.0183)	(0.0177)
ECOMYEAR2010	0.0565***	-0.0578***	0.0476***	-0.0516***
	(0.00851)	(0.00875)	(0.00810)	(0.00816)
ECOMYEAR2011	0.0530***	-0.0450***	0.0394**	-0.0347**
	(0.0172)	(0.0166)	(0.0167)	(0.0165)
ECOMYEAR2012	0.0509	-0.0432	0.0376	-0.0335
	(0.0358)	(0.0349)	(0.0368)	(0.0358)
ECOMYEAR2013	0.0457**	-0.0395	0.0317	-0.0306
	(0.0222)	(0.0243)	(0.0221)	(0.0240)
ECOMYEAR2014	0.0963***	-0.0917***	0.0868***	-0.0872***
	(0.0146)	(0.0139)	(0.0150)	(0.0146)
ECOMYEAR2015	0.145***	-0.143***	0.135***	-0.136***
	(0.0332)	(0.0341)	(0.0336)	(0.0342)
YEAR2010	-0.0116***	0.0107***	-0.00648**	0.00599**
	(0.00243)	(0.00206)	(0.00276)	(0.00273)
YEAR2011	-0.00416	0.00235	0.00471*	-0.00547***
	(0.00279)	(0.00175)	(0.00243)	(0.00190)
YEAR2012	-0.0199***	0.0179***	-0.0104***	0.00970***
	(0.00304)	(0.00213)	(0.00260)	(0.00232)
YEAR2013	-0.0281***	0.0247***	-0.0199***	0.0187***
	(0.00380)	(0.00295)	(0.00438)	(0.00405)
YEAR2014	-0.0311***	0.0289***	-0.0273***	0.0270***
	(0.00412)	(0.00339)	(0.00465)	(0.00430)
YEAR2015	-0.0179***	0.0165***	-0.0133**	0.0126**
	(0.00648)	(0.00506)	(0.00645)	(0.00582)
Controls	Yes	Yes	Yes	Yes
COUNTRIES	Yes		Yes	
Constant	0.376***	0.0130	0.210***	0.0410
	(0.0783)	(0.0407)	(0.0506)	(0.0432)
Observations	3,015	3,010	2,431	2,431
R-squared	0.260***	0.063***	0.256***	0.073***
Firms	859	856	698	698
Panel B: Chi-square test of joint significance of variables				
ECOM & ECOMYEARdummy	541.87***	3,394.55***	478.65***	612.99***
YEAR & ECOMYEARdummy	1,311.73***	3,044.64***	1,456.78***	6,088.63***
ECOM, YEARdummy & ECOMYEARdummy	1,428.75***	8,623.71***	1,588.62***	15,998.97***

Notes: significance levels at *** p<0.01, ** p<0.05, * p<0.1. Control variables and dummies for countries not displayed for simplicity reasons. See variable descriptions in the appendix.

Appendix.
Variable descriptions.

Variable	Definition	Calculation	Expected Sign
Panel A: Dependent variables			
TAXAV	Tax avoidance	Either *ETR* or *ABETR*	
ETR	Effective tax rate	Tax expenses to pre-tax income	
ABETR	Abnormal effective tax rate	Firms' *ETR* less average *ETR* for the portfolio of firms in the same quintile of revenues and the same country	
Panel B: Independent variables			
ECOM	E-commerce firms: firms performing their business exclusively via internet	Dummy variable equalling 1 for firms with NACE code 4791, and 0 otherwise	–
YEAR	Year generic name for two different calculations related to year of the observation: *YEARdata* and *YEARdummy*	See below	+
YEARdata	YEAR (continuous calendar year)	Coded from 1 to 7 depending on the ordinal number of year, from 2009 to 2016, a firm is in the sample.	+
YEARdummy	YEAR (dummies for year)	Dummy variables equalling 1 if observation is from that specific year, and 0 otherwise. Year dummy variables exist for 2010 through 2016, 2009 being the default year: *YEAR*2010 to *YEAR*2016.	+
ECOMYEAR	Interaction variable between *ECOM* and both calculations of *YEAR*:	*ECOM* multiplied by both operationalizations of *YEAR*	–
ECOMYEARdata	Interaction variable between *ECOM* and *YEARdata*	*ECOM* multiplied by *YEARdata*	–
ECOMYEARdummy	Interaction variable between *ECOM* and *YEARdummy*	*ECOM* multiplied by *YEARdummy*	–
LDEBT	Financial leverage	Long-term debt to total assets	–
log*REV*	Size	Logarithm of revenues	?
TAFIXA	Tangible fixed assets	Tangible fixed assets to total assets	–
INV	Inventory intensity	Inventories to total assets	+
RGROWTH	Firm growth	Revenues at year t to revenues at year *t*-1	?

INTFA	Intangible fixed assets	Intangible fixed assets to total assets	–
VINTFA	Change in intangible fixed assets	*INTFA* at year *t* less *INTFA* at year *t*-1	–
ROA	Profitability (return on assets)	Pre-tax income at year t to total assets at year t-1	–
*BIG*4	Audit by a big 4 audit firm	Dummy variable equaling 1 if firm audited by a big 4 audit firm: Deloitte & Touche, PricewaterhouseCoopers, Ernst & Young, or KPMG, and 0 otherwise.	–
NUMSUB	Number of subsidiaries	Number of subsidiaries in the business group	–
NOLREV	Carrying amount of losses	Sum of profits in the last four years scaled by revenues in the current year	
COUNTRIES	Country of the parent company	Different dummies indicating with value 1 the country of the parent company, and 0 otherwise.	