Int Tax Public Finance
DOI 10.1007/s10797-012-9248-6

Corporate tax competition between firms

Simon Loretz · Padraig J. Moore

Abstract Firms' tax planning decisions, similar to their other operational decisions, are made in a competitive environment. Various stakeholders observe the tax payments and evaluate these against the relevant peer group. This implies firms might not simply minimise their tax burden, but also consider their competitors behaviour when deciding about tax planning. Empirically this creates interdependencies in the tax planning activities of firms. Introducing the concept of a reputational loss we show the positive interdependence in a theoretical model and test it in a spatial econometric model. Empirical evidence suggests that benchmarking takes place both within countries and within industries, however for the latter it is important to include firms in large non-EU OECD countries.

Keywords Corporate taxation · Benchmarking · Tax competition · Spatial econometrics

JEL Classification C33 · H25 · M40

Electronic supplementary material The online version of this article (doi:10.1007/s10797-012-9248-6) contains supplementary material, which is available to authorized users.

S. Loretz (✉)
University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth, Germany
e-mail: Simon.Loretz@uni-bayreuth.de

S. Loretz
Oxford University Centre for Business Taxation, Park End Street, OX1 1HP Oxford, UK

P.J. Moore
Institute for International Integration Studies, Trinity College, Dublin, Ireland
e-mail: padraig.moore@db.com

Published online: 29 August 2012

1 Introduction

One of the perpetuating forces of tax competition is based on the desire of (multinational) firms to reduce the burden of taxation on profits. This force is not only responsible for shifts of capital across borders, but also motivates the multitude of strategies that firms adopt to lower their effective tax rate (*ETR*).[1] However, despite the widespread belief that extensive tax planning takes place, there is rather little economic research concerned with the underlying determinants of the *ETR*.[2] This paper argues that firms' tax planning decisions, similar to their other operational decisions, are made in a competitive environment. Various stakeholders of the firm can observe tax payments and evaluate these against the relevant peer group, leading to interdependencies in the tax planning activities of firms.

In this paper we capture this dynamic in a theoretical model which introduces a reputational loss. Managers have to balance the benefits of a reduced tax burden against the costs of a loss in reputation if they deviate too much from the behaviour of their peer group. This is neatly summed up in the introduction of the tax benchmarking studies done by the international accountancy firm PriceWaterhouseCoopers (2009, p. 2.) stating "a current challenge for the tax professional is to identify the right balance when planning for taxes. On the one side of the balance, taxes are a significant cost to the corporation and should be controlled and managed in the quest to create shareholder value and maximise earnings per share. On the other side, the amount of tax paid by large corporations is coming under increasing scrutiny and stirring public debate."

This statement highlights some of the complexity of this benchmarking process. In consequence we see the concept of the reputational loss as a multifaceted phenomenon, as various stakeholders pursue conflicting interests. Shareholders are likely to prefer a low *ETR*, analysts might be concerned with sustainability of the *ETR*, while the tax authorities and critical consumers want to see the corporation pay its 'fair share' of income taxes. However, all of these stakeholders have only limited information about the firms' true situation. Therefore they evaluate the observable tax payments relative to the peer group. This leads to a yardstick-like form of competition where managers anticipate their competitors moves and optimise their own behaviour. This in turn creates a positive interdependence in their tax planning, which we can test empirically.

Using a spatial econometric approach we find evidence for interdependence in the *ETR*. Our results confirm the existence of positive spatial interdependence between firms in the same country and between firms in the same industry. However, in the latter case, significantly positive reaction functions are only found if the OECD countries are included. Furthermore, in line with our predictions we find a stronger interdependence for firms, which have a high *ETR*.

The rest of the paper is organised as follows. Section 2 summarises the strands of literature we build our analysis on. Section 3 provides a small theoretical model

[1] Throughout the paper *ETR* denotes various ratios of tax payments or liabilities to pre-tax profit. For a survey and discussion of early empirical evidence, see Hines (1999).

[2] The big exception is the accounting literature where a number of recent papers have investigated tax aggressiveness. See Hanlon and Heitzman (2010) for a comprehensive survey.

showing the spatial dependence, which is empirically tested in Sect. 4. Section 5 concludes.

2 Previous literature

Income taxes and the avoidance thereof have been in the focus of the academic discussion for some time. Hence a lot of the features we include in our model can be found in some form in earlier literature. In consequence this section aims only to summarise the most important strands of literature rather than to provide a complete review of the related literature.

The earlier contributions deal with evasion of personal income tax and build on the economic analysis of crime of Becker (1968).[3] In a seminal article Allingham and Sandmo (1972) model the decision of how much taxes to evade as a function of the probability of being audited and penalised. While all of these early contributions only modelled the behaviour of the tax payer, Reinganum and Wilde (1986) also analyse the auditing decisions of the tax authorities. They introduce the idea that the auditing probability depends on the reported income and that revenue authorities create 'audit classes'. The latter implies some evaluation against other—similar—tax payers to overcome the problem of asymmetric information about the true income. In a different context Shleifer (1985) introduces the concept of yardstick competition, which models the use of peer group comparison to infer about the true situation of the firms. Translating these two ideas into our model, we assume that the tax authorities compare the reported income of companies with the relevant peer group in order to decide which firms will come under scrutiny. For example in the United Kingdom, the tax authorities (HMRC) are introducing a risk rating for the biggest corporations based on a combination of organisational features and past tax behaviour.[4] Another aspect of HMRC as a stakeholder is that it can easily prove to be beneficial for the firm to pay more taxes today in order to be in the 'good book' and have a better stance in influencing future tax policy making.

Levenson (1999, p. 16) directly mentions a further stakeholder evaluating corporate tax behaviour, stating "[t]his reduction [in the *ETR*] translates to higher earnings per share and ultimately places companies in a more favourable light with analysts when compared to competitors." Along these lines Abarbanell and Bushee (1998) and Swenson (1999) expect that a lower *ETR* sends positive signals to the stock market.

More recent contributions, mostly by economists, find mixed evidence for a negative relationship between *ETR* and stock market valuation. For example, Desai and Hines (2002) analyse corporate inversions where the headquarter is relocated to a tax haven. They find that in the longer run these aggressive tax planning activities lead to a reduced stock price. The subsequent discussion of Slemrod (2004) concludes that corporate tax planning needs to be analysed in a larger framework including the shareholders. Crocker and Slemrod (2005) and Chen and Chu (2005) provide formal theoretical principal–agent models of corporate income tax evasion with agency

[3] See Slemrod (2007) for a review of the literature on personal income tax evasion.

[4] See Freedman et al. (2009) for a discussion of this risk rating.

costs. Desai and Dharmapala (2006a, 2006b) find evidence for these models of tax sheltering and managerial diversion. They conclude that increased corporate tax sheltering increases the firms value only in combination with good corporate governance. Otherwise the increased opportunities for diversion of profits dominate the tax saving effect.[5]

A different strand of literature aims to explain the tax paying behaviour of corporations. The earliest contributions can be found in the accounting literature.[6] Firm size is identified as an important determinant, as large firms have more resources to optimise their tax planning, which implies a lower *ETR*. At the same time large corporations are expected to be audited more often, creating higher political costs of tax planning for larger firms.[7] Subsequently, more determinants of the *ETR* were introduced into the analysis. Wilkie (1988) discusses the importance of the profitability, Gupta and Newberry (1997) find that the asset mix and leverage matters, which is confirmed by Mills et al. (1998). Further, Leblang (1998) argues that firms with more multinational activity have more tax planning opportunities.[8] More recently, Graham and Tucker (2006) analyse 44 tax-sheltering cases and identify firm size and profitability as determinants of firms which are using tax sheltering. Focusing on the agency problems in family firms Chen et al. (2010) find that non-tax costs like the loss of reputation might constrain firms from being overly tax aggressive. However, in contrast to our paper, they are not concerned with the reputational loss itself but rather with the resulting differences in tax aggressiveness.

Finally, a small number of authors have addressed the impact of society on tax paying behaviour. Posner (2000) discusses the impact of social norms on income tax compliance, and Weisbach (2002) considers this idea for corporate tax compliance as well. However, he dismisses the idea that social norms are able to explain the absence of more tax avoidance and concludes with a 'undersheltering puzzle'. In contrast, we argue in this paper that social norms, or more generally pressure from the wider public, add into the reputational loss and mitigate the benefits from tax sheltering. For example the newspaper "The Guardian" ran an investigation into the tax payments of the FTSE 100 companies and commented on the *ETR* of the biggest companies.[9]

Consequently, firms may increasingly face an 'outrage constraint' when deciding about their tax payments. The term 'outrage constraint' was coined by Bebchuk and Fried (2004), who argue that managers cannot get away with too high executive compensation because shareholders and/or consumers will simply not tolerate this. Similar things are expected to occur in the case of corporate tax payments. Hanlon and Slemrod (2009) use media reports about corporate tax shelters to evaluate the stock market reaction to tax aggressiveness. They find that firms with higher effective tax rates are usually performing better after being in the news for tax avoidance reasons.

[5] For further evidence for this hypothesis see Desai et al. (2007) and Desai and Dharmapala (2009).

[6] See Rego (2003) for a summary and discussion of this literature.

[7] See Zimmerman (1983) and Omer et al. (1993) for a discussion and early evidence for the political cost hypothesis.

[8] Collins and Shackelford (1999) find only inconclusive evidence for this hypothesis.

[9] See www.theguardian.co.uk/taxgap. For further examples of political pressure from the wider public, see the publications of Citizen for Tax Justice (United States) or Tax Justice Network International.

This indicates the diverse and complex nature of the stakeholders and highlights that both an inexplicably high or very low *ETR* might lead to 'outrage'.

3 Theoretical model

Before we introduce our stylised model, a clarification about the use of our notation is apposite. Note that we use the term *potential gross profit* in a rather wide and abstract way. Given the previous discussion of the multifaceted problem of the reputational loss, the concept of a potential gross profit could be used somewhat interchangeably with the term *firm value*. The use of *firm value* implies an easier interpretation of some aspects of the reputational costs, e.g. via the channels of a lower evaluation by analysts, the loss of potential consumers or the fact of not having a good relationship with the tax authorities. In contrast, under the name *potential gross profit* the modelling of the tax sheltering is more intuitive and other aspects of the costs are easily implementable, e.g. the cost of tax audits and the tax-sheltering costs themselves. In sum, we will use the term *potential gross profit* henceforth as it leaves us with a more coherent stylised model.[10] Nevertheless the reader should bear in mind the various possible interpretations of the term.

Consider a world with two firms, denoted with the subscripts i and j. Each firm has a potential gross profit of π_i. Of this profit the firm can shelter the fraction θ_i from corporate taxes t. However, tax planning involves two types of costs. First there is the cost of tax planning itself C and secondly there is a reputational loss of R depending on its own tax planning activities relative to those of its competitor. The net profit Π_i of firm i is therefore

$$\Pi_i = \big(1 - t(1 - \theta_i)\big)\big[\pi_i - C(\theta_i)\big] - R(\Delta\theta_{ij}) \tag{1}$$

where $\Delta\theta_{ij} = \theta_i - \theta_j$ and $i \neq j$.

We assume that the tax-sheltering costs C are increasing and convex in θ_i. In order to provide an analytical solution to the model, we choose a simple functional form with the necessary properties. More specifically, we set

$$C(\theta_i) = \alpha\frac{\theta_i^2}{2} \quad \text{where } \alpha > 0. \tag{2}$$

Further the firm incurs a reputational loss depending on its tax planning in comparison to its competitor's tax planning. Again, we assume that the reputational loss is increasing and convex in the absolute difference between θ_i and θ_j, and use the simple functional form of

$$R(\Delta\theta_{ij}) = \beta\frac{(\theta_i - \theta_j)^2}{2} \quad \text{where } \beta > 0. \tag{3}$$

[10] See also Moore (2008) for a different theoretical approach to tax benchmarking, where managers optimise the *ETR* in order to avoid being voted off by the shareholders.

Note that the reputational loss is not tax-deductible, since the cost of increased scrutiny by the revenue authorities or a negative reaction in the stock market are not likely to be deductible from taxes.[11]

Each firm chooses its fraction of tax sheltering in order to maximise their after-tax profit. The alternative interpretation would be that a manager maximises firm value, which can be motivated by compensation linked to the stock market performance. Inserting (2) and (3) into (1) and partially deriving with respect to θ_i yields

$$\frac{\partial \Pi_i}{\partial \theta_i} = t\left[\pi_i - \alpha\frac{\theta_i^2}{2}\right] - \alpha\theta_i\big(1 - t(1-\theta_i)\big) - \beta(\theta_i - \theta_j). \tag{4}$$

The first term represents the marginal tax savings and the second term the marginal costs of sheltering more profits from taxation and the third term represents the change in the reputational loss. Optimally θ_i is chosen so that marginal tax savings equal the sum of the two other terms. Solving for the optimal θ_i yields

$$\widetilde{\theta}_i = \frac{1}{3\alpha t}\left[\alpha(t-1) - \beta + \sqrt{\big[\alpha(t-1)+\beta\big]^2 + 6\alpha t(\pi_i t + \beta\theta_j)}\right]. \tag{5}$$

Note that this reaction function only holds if $(3t/\alpha) \neq 0$. For $t = 0$ the reaction function collapses to $\widetilde{\theta}_i = \beta\theta_j/(\alpha+\beta)$ which implies an equilibrium at $\theta_i = \theta_j = 0$.

Proposition 1 *There is a positive interdependence in the tax-sheltering behaviour of firms.*

Proof Deriving the first order condition in (4) with respect to θ_i and θ_j yields

$$-\alpha t\theta_i\, d\theta_i - \alpha\big[1 - t(1-\theta_i)\big]d\theta_i - t\alpha\theta_i\, d\theta_i - \beta\, d\theta_i + \beta\, d\theta_j = 0, \tag{6}$$

which can be simplified to

$$\frac{d\theta_i}{d\theta_j} = \frac{\beta}{\alpha(1 - t + 3\theta_i t) + \beta} \tag{7}$$

which is unambiguously positive. □

Proposition 2 *With a higher corporate tax rate, firms shelter a bigger fraction of profits against taxation.*

Proof The partial derivative of (5) with respect to t captures the direct effect of a change in the tax rate, which is given through

$$\frac{\partial\widetilde{\theta}_i}{\partial t} = \frac{(\alpha+\beta)}{3\alpha t^2}\left[1 - \frac{(\alpha+\beta)[\alpha(1-t)+\beta] + 3\alpha\beta t\theta_j}{(\alpha+\beta)\sqrt{[(\alpha(1-t)+\beta)]^2 + 6\alpha t[\beta\theta_j + \pi_i t]}}\right]. \tag{8}$$

[11] However, the results do not change qualitatively if the reputational loss is tax-deductible. The calculations are available from the authors by request.

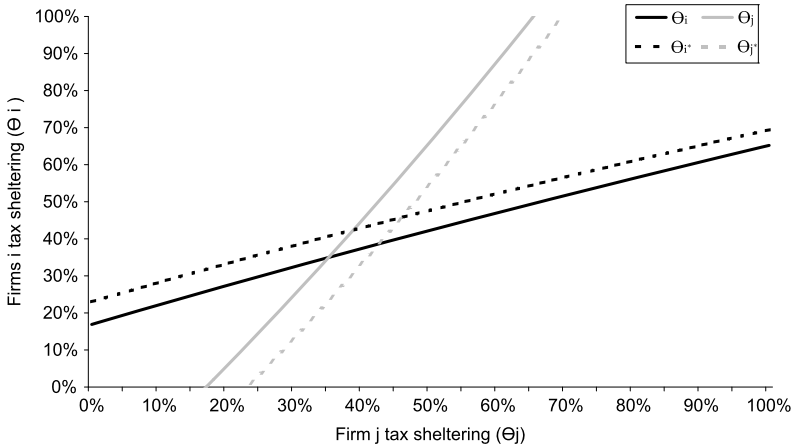

Fig. 1 Reaction functions in the symmetric equilibrium ($\alpha, \beta, \pi = 1, t = 0.3, t^* = 0.4$)

This expression is unambiguously positive, as the denominator is positive and larger than the numerator. This ensures that the value of the fraction is positive but smaller than unity, which ensures that the term in the brackets is positive. This implies that each firm, ceteris paribus, increases its tax-sheltering activity in response to an increase of the tax rate. Proposition 1 further states a positive response to an increase in the other firms' tax-sheltering activities. Hence this tax effect is intensified and unambiguously positive. □

Proposition 3 *Firms with higher profits shelter a bigger fraction of profits against taxation.*

Proof Deriving (5) with respect to the profit π_i yields

$$\frac{\partial \widetilde{\theta_i}}{\partial \pi_i} = \frac{t}{\sqrt{[(\alpha(1-t)+\beta)]^2 + 6\alpha t(\beta\theta_j \pi_i t)}}, \tag{9}$$

which is unambiguously positive. Therefore, all else equal, firms with larger profits shelter a bigger fraction against corporate taxes. □

Under the assumption of identical cost functions for both firms, equivalent reaction functions for firm j can be derived. Parameterising the model, Propositions 1 and 2 are illustrated in Fig. 1. The solid black line displays the optimal $\widetilde{\theta}$ for firm i and the grey line shows the equivalent for firm j. The dotted lines show the changed reaction functions for an increase in the statutory tax rate.

An increase in the profit of a firm (π_i) would lead to a shift of the reaction function, similarly to the shift of one firm because of a change in the tax rate. In consequence, the other firms will also—although to a lesser extent—increase their tax planning because of a change in the reputational costs. In contrast, a change in the cost function parameters (α or β) would rotate the reaction functions.

4 Empirical analysis

4.1 Data

Most of the stakeholders described in the previous two subsections have only access to publicly available data. This suggests that the correct data set should be the published annual accounts, since it is these accounts that shareholders and analysts or the wider public will use to benchmark the company's performance. And in anticipating this, it will be these *ETR* measures which the managers set at the optimal level. The tax authorities do have further information about how much the firms actually paid in their country; however, if they wish to compare the tax behaviour of multinational companies in other countries, they are also restricted to publicly available data. We, therefore, use accounting data for our empirical analysis. More specifically, we use the Compustat Global data set which contains the consolidated accounts of publicly traded companies.[12] Using only consolidated accounts is not too restrictive, because for the research question at hand the overall tax position of the corporate group is relevant rather than the tax burden of an individual subsidiary. Furthermore, we think the concept of a reputational loss is more applicable to large corporations. This reflects the fact that most stakeholders focus their attention on the biggest companies, rather than on small and medium sized firms.

We define two different versions of our dependent variable. ETR_{total} is defined as the ratio of total income taxes and the profit and loss before tax, both of them as reported in the financial accounts. ETR_{current} is the ratio of current income taxes over profit and loss before taxes. Additionally the measure ETR_{payable} based on income taxes payable is available. However, since this measure is very likely to be driven by the varying installment requirements in the individual countries, we will only use this variable for an extended robustness check.[13] One further complication is that measures of the *ETR* will only be properly defined if the pre-tax profit is positive. We therefore exclude all observations with a misleading outcome. We set the *ETR* to zero if the reported tax payments are equal to zero, but the *ETR* would be undefined because of non-positive pre-tax profits. Alternatively, one could exclude all loss-making companies on the grounds that they face a different optimisation problem. However, this would increase the truncation of the data set even more. We will return to the issue of the loss-making companies in the sensitivity analysis.

We also include the following control variables from ORBIS. Firm size (*SIZE*) is measured as the logarithm of total assets. Profitability is measured through the return on assets (*ROA*), defined as operating income divided through total assets. Potential interest deductibility is captured by leverage (*DEBT*), which we measure as the total liabilities as a share of total assets.[14] We also control for capital intensity

[12] See the working paper version of this paper for a version which uses ORBIS, provided by Bureau van Dijk, which covers more companies with less detailed accounting information.

[13] In particular, the requirement to pay the taxes in installments upfront may lead to a negative correlation between the actual tax burden and the tax payable in the case of losses. We are grateful to an anonymous referee for highlighting this problem. The results using the ETR_{payable} measure can be found in the Online Appendix at the authors' website.

[14] This also includes current liabilities; see also Huizinga et al. (2008) for a similar approach.

(*CAPINT*), defined as the share of tangible fixed assets in total assets, and intangibles assets (*INTANG*), defined as the share of intangible assets in total assets. Finally we include a measure of total accruals in order to distinguish between tax planning and earnings management. Specifically, we follow Jones (1991) and define total accruals (*ACCRUAL*) as the logarithm of the absolute value of the change in current assets, minus the change in current liabilities, the change in cash and total depreciation.[15]

In order to avoid problems because of outliers, we drop the top and bottom percentile of all variables.[16] The exclusion of the loss-making companies and the cleaning process leave us with a highly unbalanced panel for the years 1990 to 2006. We then use only those firms for which we have at least 4 contiguous observations on each firm, and at least ten firms per country. This leaves us with a still unbalanced sample of 65,008 observations in 8512 firms, with country coverage as described in Table 1. The values in brackets describe the number of firms and observations if we pick the largest balanced panel, which leaves us with a subsample of 1573 firms in 32 different countries for the years 1998 to 2006, resulting in a total of 14,157 observations.

As the distinction into geographical regions in Table 1 already suggests, the spectrum of countries in our sample is very broad and it is likely to be misleading if we include all firms in the same regressions. We therefore split our sample according to this geographical breakdown. This also implies that we think that firms do not compare themselves—nor are they compared to each other by various stakeholders—to firms in completely different geographical regions.

Table 2 provides descriptive statistics for the balanced subsample in the three geographical groups.[17] Not surprisingly, firms are rather similar in the OECD and the EU subsample. However, there is a clear distinction between these two subsamples and the firms in other countries. Most notably, the firms in the OECD countries have a higher average ETR_{total} of approximately 35 per cent, in contrast to non-OECD firms with an average ETR_{total} of only 20 per cent. For all subsamples the ETR_{current} is somewhat lower, with the difference most pronounced for the non-OECD firms. The ETR_{payable} is significantly lower for the OECD and European subsamples with an average of just 20 per cent. Interestingly, for the non-OECD firms there is hardly any difference between ETR_{current} and ETR_{payable}.

In terms of other characteristics, the firms in the non-OECD countries are slightly larger on average, and have a markedly lower return on assets. Furthermore, firms in the OECD and EU have a much larger share of intangibles, and have a larger average share of debt of approximately 52 per cent. In comparison, firms headquartered in other countries have only 13 per cent of debt on average.

[15] We are grateful to Dhammika Dharmapala for pointing us in this direction.

[16] We also eliminate all observations with a leverage bigger than unity. A complete description of the cleaning process is available from the authors upon request.

[17] The corresponding descriptive statistics for the full unbalanced sample are very similar and are available in the Online Appendix on the authors' website.

Table 1 Country coverage

Country	Firms		Observations	
European countries				
Austria	58	(13)	480	(117)
Belgium	64	(n.a.)	522	(n.a.)
Denmark	89	(19)	836	(171)
Finland	75	(25)	673	(225)
France	375	(99)	3224	(891)
Germany	327	(61)	2846	(549)
Greece	57	(15)	421	(135)
Ireland	31	(13)	322	(117)
Italy	125	(27)	958	(243)
Netherlands	109	(24)	1020	(216)
Norway	60	(11)	472	(99)
Poland	13	(n.a.)	84	(n.a.)
Portugal	27	(n.a.)	208	(n.a.)
Spain	98	(22)	828	(198)
Sweden	118	(35)	992	(315)
Switzerland	149	(39)	1291	(351)
United Kingdom	699	(105)	5782	(945)
Non-European OECD countries				
Australia	271	(37)	1885	(333)
Canada	25	(n.a.)	180	(n.a.)
Japan	1291	(147)	8597	(1323)
Mexico	42	(23)	368	(207)
New Zealand	47	(n.a.)	361	(n.a.)
South Korea	114	(18)	733	(162)
Turkey	27	(n.a.)	154	(n.a.)
United States	1563	(301)	12,949	(2709)

4.2 Empirical strategy

To test for the existence of spatial interdependence, we specify a spatial autoregressive model that can estimate the relationship between an individual firm's *ETR* and that of its competitors. In (10) the individual firm's $ETR_{i,t}$ is a function of its competitors' *ETR*s:

$$ETR_{i,t} = \rho \sum_{i \neq j} \omega^{c}_{ij,t} ETR_{j,t} + \beta X_{i,t} + \gamma \tau_{k,t} + \mu_i + \lambda_t + \varepsilon_{i,t}. \tag{10}$$

Competitors' *ETR*s are contained in $\sum_{i \neq j} \omega^{c}_{ij,t} ETR_{j,t}$ and $\omega^{c}_{i,j,t}$ selects the appropriate competitors for each firm i in each period t from the vector of all firms' *ETR*s ($ETR_{j,t}$). The set of competitors c varies by year and across firms (we discuss

Table 1 (*Continued*)

Country	Firms		Observations	
Other emerging markets				
Argentina	11	(n.a.)	77	(n.a.)
Bermuda	154	(26)	1121	(234)
Brazil	59	(12)	382	(108)
Chile	58	(16)	417	(144)
China	716	(177)	4867	(1593)
Colombia	13	(n.a.)	106	(n.a.)
Cayman Islands	64	(n.a.)	383	(n.a.)
Hong Kong	70	(25)	624	(225)
Indonesia	74	(16)	509	(144)
India	195	(75)	1651	(675)
Israel	18	(n.a.)	103	(n.a.)
Malaysia	380	(75)	2971	(675)
Pakistan	24	(n.a.)	161	(n.a.)
Peru	13	(n.a.)	94	(n.a.)
Philippines	39	(15)	302	(135)
Singapore	200	(28)	1468	(252)
South Africa	118	(22)	863	(198)
Taiwan	265	(20)	1317	(180)
Thailand	187	(32)	1406	(288)
Total	*8512*	*(1573)*	*65,008*	*(14,157)*

Notes: Values in brackets refer to the balanced subsample

the selection of competitors later). The estimate of the parameter ρ will tell us the sign, size and significance of competitors' *ETR*s in determining the firm's *ETR*. We also include a set of firm-level control variables $X_{i,t}$ consistent with the literature discussed in Sect. 2. Further, we include the statutory corporate tax rate $\tau_{k,t}$ in country k, where k denotes the residence country of firm i, along with a set of firm fixed effects μ_i and time fixed effects λ_t. The statutory tax rate and the year fixed effects will capture common shocks which will apply to all firms in a given year and the big country-time specific shock due to tax rate changes.

Specifying the weighting matrix In this study, we would like to choose the competitor firms which represent the most likely benchmark set of firms that stakeholders will use. This requires some judgement as there is no obvious best way to choose competitors. For this reason, we specify a number of alternative weighting matrices to test between which corporations the interaction is strongest.

The weights in the weighting matrix are designed to select the most important competitors for each firm. To this end we define a dummy variable δ_{ij}^{c} which takes a positive value if the competitor is in the same reference group c and zero otherwise. Specifically, we use three different sets of reference groups, all firms in the same

Table 2 Descriptive statistics: balanced subsample

Variable	Minimum	Median	Maximum	Average	Std. Dev.
OECD (19 countries/9306 observations)					
ETR_{total}	−0.51	0.35	1.58	0.34	0.13
ETR_{current}	−0.08	0.32	1.92	0.31	0.20
ETR_{payable}	−0.04	0.11	3.38	0.17	0.23
SIZE	2.57	7.02	11.75	7.19	1.92
ROA	−0.02	0.08	0.33	0.09	0.07
CAPINT	0.00	0.19	1.00	0.24	0.21
INTANG	0.00	0.03	0.84	0.11	0.15
DEBT	0.00	0.47	1.00	0.43	0.27
ACCRUAL	−2.43	3.34	7.65	3.29	1.79
Europe (14 countries/4572 observations)					
ETR_{total}	−0.51	0.31	1.58	0.32	0.13
ETR_{current}	−0.08	0.29	1.72	0.26	0.18
ETR_{payable}	−0.04	0.11	3.38	0.16	0.24
SIZE	2.57	6.51	11.73	6.53	1.65
ROA	−0.02	0.08	0.33	0.09	0.06
CAPINT	0.00	0.21	1.00	0.25	0.20
INTANG	0.00	0.05	0.84	0.10	0.14
DEBT	0.00	0.57	1.00	0.52	0.25
ACCRUAL	−2.43	3.24	7.62	3.19	1.86
Other (13 countries/4851 observations)					
ETR_{total}	−0.46	0.20	1.46	0.21	0.14
ETR_{current}	−0.08	0.08	1.84	0.13	0.15
ETR_{payable}	−0.05	0.09	3.17	0.17	0.27
SIZE	3.41	7.36	11.70	7.47	1.49
ROA	−0.01	0.01	0.31	0.02	0.03
CAPINT	0.00	0.07	0.95	0.10	0.12
INTANG	0.00	0.00	0.43	0.01	0.03
DEBT	0.00	0.08	0.99	0.13	0.15
ACCRUAL	−2.42	2.70	7.56	2.63	1.70

country, all firms in the same NACE 2-digit industry and all firms in the same industry *or* within the same country. In the first two cases δ_{ij}^{c} is unity if the competitor is in the same country or industry, respectively. In the third specification of the weighting matrix the dummy is unity if the competitor is either in the same country or in the same industry. If the competitor is both in the same industry and the same country, the dummy is added up and takes the value two.

Further, we think it is unrealistic that companies are compared or are comparing themselves to hundreds of competitors. Therefore we also include a dummy $\kappa_{ij,t}^{c}$ which is set equal to unity if the competitors are similar in size. Namely, we allow the

20 companies closest in size to have a positive weight in the weighting matrix. The specified weighting matrix allows for the firms competitors to vary over time. However, we think it is more realistic that a firm has a set of competitors it is benchmarked against, which is not changing very frequently. We therefore use the 20 companies which are closest in size over the complete period observed. The only reason why the competitors will change over time is if they are not present in data set for a given year in the unbalanced sample.

The sparse design of the weighting matrix also has the benefit that the weighted competitors tax rates have more cross-sectional variation which helps to distinguish their impact from a common shock or pure time effect. This is especially important as we have a large cross section of firms.[18] We finally allocate each competitor a specific weight, which is defined as a quadratic inverse distance between the average size of the current firm and the competitor in question. The inverse distance measure ensures that similarly sized firms get greatest weight and the quadratic form allows firms to be similar in size if they are larger or smaller than the current firm.[19] Formally, the weights are defined as

$$\omega_{ij,t}^{c} = \delta_{ij}^{c} \kappa_{ij,t}^{c} \left| \overline{SIZE}_i - \overline{SIZE}_j \right|^{-0.2}. \tag{11}$$

We further normalise the weights to sum to unity.[20]

4.2.1 Econometric issues

Estimation of (10) using OLS will yield biased and inconsistent estimates of ρ because the weighted competitors' *ETR*s will be correlated with each firm's error term ε_{it}. Correcting for this spatial endogeneity problem has been approached in a number of ways.[21] We follow a standard approach as proposed by Kelejian and Robinson (1993) and Kelejian and Prucha (1998),[22] and use a 2-stage least-squares procedure in which spatially lagged explanatory variables are used to instrument for the spatially lagged dependent variables. In our particular case this implies that we instrument the competitors *ETR*s with the competitors explanatory variables like their size or profitability. While it appears reasonable to assume that these variables are exogenous, the case is even stronger for the statutory tax rate of foreign competitors. A change in the statutory corporate tax rate in a foreign country should only affect a firms' *ETR* via the change in the (foreign) competitors' *ETR* but not directly influence the tax burden.

A further issue arising with our empirical specification is that some of the control variables are endogenous. This is most obvious for our measure of the profitability (*ROA*) as a measure of the pre-tax profit is used in both the dependent and independent

[18] See Overesch and Rincke (2009) for a discussion of this problem.

[19] The results are qualitatively similar without the size weighting. The full set of results is included in the Online Appendix on the authors' website.

[20] See Anselin (1988) for a discussion about row standardisation.

[21] See Brueckner (2003) for a discussion of this issue.

[22] See also Anselin et al. (2008).

variables. We therefore also instrument for profitability (*ROA*) using the market power of the company and the industry concentration. For the market power we use market share and market share squared. Market share is defined as the operating revenues of the companies in the year t as a fraction of the sum of operating revenues of all firms within the same country in the year t. For industry concentration we use the Herfindahl–Hirschmann Index, defined as the sum of the squared market shares within country and 2-digit NACE industry.[23]

4.3 Baseline results

Following the definition of δ_{ij}^{c} we use (11) to construct three weighting matrices. First, we include all firms in the weighting matrix with their domicile in the same country. Our rationale for this weighting matrix is that competition may take place among, for example, FTSE 100 companies irrespective of their industry. The second specification includes all firms that operate in the same industry. This captures the idea that firms are evaluated against similar companies across borders, which is in line with the benchmarking studies PWC is conducting. And finally, we combine the first two weighting matrices and include companies within the same industry or country, with an increased weight if both criteria are fulfilled.

With three different weighting matrices, three measures for our dependent variable and geographic subsamples, there are a large number of possible specifications. We start with the ETR_{current} measure as the baseline case. In contrast to ETR_{total} this measure does exclude deferred income taxes and we prefer it over ETR_{payable} because it is not affected by the timing of the tax payments.

We run the regression as specified in (10) for the complete data set and each geographic subsample separately with three different measures of the competitors' *ETR*s. Table 3 reports the results for the balanced subsample. Table 4 presents the same results for the full unbalanced sample. A comparison between the two tables shows that the results do not change qualitatively. Therefore we will concentrate for the rest of the paper on the results based on the balanced subsample. This has the benefit that we can fix the set of competitors for each firm and therefore clearly interpret the spatial lag as the reaction to a given set of competitors.[24]

The first line represents the reaction to the *ETR*s of competitors within the same country. In line with the theoretical prediction of Proposition 1, the coefficient is significantly positive for the complete and for all the geographical subsamples. The second line presents the results for benchmarking within 2-digit-NACE industries and regardless of the location of the headquarter. While the coefficient is still significantly positive for the complete (balanced) data set and for the OECD countries, the significance is reduced or disappears if we only consider firms in the European subsample, or outside the OECD. Given the large overlap of the European subsample with the OECD subsample, where we can observe some evidence for tax benchmarking, this appears counterintuitive at first. There is, however, a potential simple

[23] See Cowling and Waterson (1976) or Machin and Van Reenen (1993) for evidence on the connection between market share, industry concentration and profitability.

[24] See also Kelejian and Prucha (2010) for a more detailed discussion of the problem of unbalanced data in a spatial setting.

Table 3 Baseline results for $ETR_{current}$, balanced subsample

	All countries			OECD countries			European countries			Other emerging markets		
Competitors $ETR_{current}$ same country	0.862 (0.084)**			0.595 (0.165)**			0.841 (0.181)**			1.202 (0.235)**		
Competitors $ETR_{current}$ same industry		0.613 (0.213)**			0.883 (0.233)**			0.507 (0.236)*			0.097 (0.233)	
Competitors $ETR_{current}$ same country *or* industry			1.111 (0.090)**			0.915 (0.175)**			0.903 (0.200)**			1.110 (0.160)**
$ROA_{i,t}$	–0.377 (0.100)**	–0.352 (0.113)**	–0.320 (0.103)**	–0.448 (0.110)**	–0.257 (0.121)**	–0.381 (0.122)**	–0.447 (0.142)**	–0.208 (0.178)	–0.472 (0.183)**	–0.241 (0.182)*	–0.354 (0.274)	–0.391 (0.240)
$SIZE_{i,t}$	–0.001 (0.004)	0.005 (0.005)	–0.001 (0.005)	0.001 (0.005)	0.006 (0.007)	–0.001 (0.006)	0.007 (0.006)	0.006 (0.008)	0.004 (0.007)	–0.009 (0.007)	–0.012 (0.008)	–0.010 (0.007)
$CAPINT_{i,t}$	–0.080 (0.027)**	–0.089 (0.032)**	–0.085 (0.027)**	–0.060 (0.030)*	–0.073 (0.035)*	–0.070 (0.029)*	–0.027 (0.033)	–0.027 (0.040)	–0.024 (0.035)	–0.193 (0.060)**	–0.178 (0.069)**	–0.164 (0.062)**
$INTANG_{i,t}$	–0.062 (0.035)	–0.117 (0.038)**	–0.039 (0.035)	–0.050 (0.036)	–0.031 (0.038)	–0.046 (0.035)	0.030 (0.042)	0.048 (0.040)	0.041 (0.043)	0.113 (0.215)	0.236 (0.190)	0.122 (0.196)
$DEBT_{i,t}$	0.113 (0.024)**	0.114 (0.027)	0.092 (0.023)**	0.104 (0.026)**	0.093 (0.030)**	0.092 (0.026)**	0.106 (0.035)**	0.058 (0.034)	0.095 (0.033)	0.149 (0.043)**	0.137 (0.056)*	0.176 (0.048)**
$ACCRUAL_{i,t}$	0.001 (0.001)	0.002 (0.001)	0.002 (0.001)	0.004 (0.002)*	0.003 (0.002)	0.005 (0.002)**	0.000 (0.002)	0.001 (0.002)	0.001 (0.002)	–0.003 (0.001)	0.000 (0.001)	–0.003 (0.001)
$\tau_{k,t}$	0.103 (0.104)	0.648 (0.093)**	0.106 (0.093)	0.167 (0.117)	0.425 (0.099)	0.088 (0.116)	0.072 (0.123)	0.293 (0.111)**	0.056 (0.120)	–0.099 (0.222)	0.463 (0.254)	0.191 (0.199)

Table 3 (*Continued*)

	All countries			OECD countries			European countries			Other emerging markets		
rk Wald F-statistic	12.781	7.830	8.549	6.952	4.046	4.621	8.699	4.115	9.271	4.729	1.390	10.076
Hansen statistic	10.250	8.520	18.093	8.525	4.693	16.067	13.053	11.728	14.591	9.904	22.477	16.989
p-value	0.673	0.808	0.154	0.808	0.981	0.246	0.444	0.550	0.334	0.702	0.048	0.200
Observations	14,157	14,157	14,157	9288	9288	9288	4473	4473	4473	4824	4824	4824
Firms	1573	1573	1573	1032	1032	1032	497	497	497	536	536	536

Notes: All regressions include firm-level and year specific fixed effects. At the country-industry level clustered standard errors in brackets. Estimated using WX and W^2X as instruments, the GMM option of the xtivreg2 stata procedure, provided by Schaffer (2007). *rk* Wald F-statistic refers to the Kleibergen and Paap (2006) weak identification test statistics

** Significant at the 1 per cent level

* Significant at the 5 per cent level

Table 4 Baseline results for $ETR_{current}$, unbalanced subsample

	All countries			OECD countries			European countries			Other emerging markets		
Competitors $ETR_{current}$ same country	0.770 (0.128)**			0.477 (0.167)**			1.254 (0.276)**			0.897 (0.234)**		
Competitors $ETR_{current}$ same industry		0.104 (0.075)			0.339 (0.107)**			0.036 (0.219)			–0.145 (0.191)	
Competitors $ETR_{current}$ same country *or* industry			0.476 (0.101)**			0.639 (0.107)**			0.340 (0.273)			0.617 (0.200)**
$ROA_{i,t}$	–0.383 (0.061)**	–0.256 (0.064)**	–0.445 (0.083)**	–0.368 (0.060)**	–0.258 (0.068)**	–0.336 (0.074)**	–0.332 (0.075)**	–0.246 (0.082)**	–0.484 (0.102)**	0.059 (0.168)**	–0.134 (0.157)	–0.316 (0.193)
$SIZE_{i,t}$	–0.003 (0.002)	0.002 (0.003)	–0.002 (0.003)	0.002 (0.003)	0.004 (0.003)	0.001 (0.003)	0.006 (0.004)	0.005 (0.004)	0.001 (0.004)	–0.007 (0.004)	–0.007 (0.004)	–0.009 (0.004)*
$CAPINT_{i,t}$	–0.052 (0.015)**	–0.031 (0.015)**	–0.041 (0.015)**	–0.026 (0.016)	–0.019 (0.016)	–0.030 (0.015)*	–0.014 (0.019)	–0.004 (0.019)	–0.004 (0.019)	–0.134 (0.036)**	–0.068 (0.037)	–0.092 (0.036)**
$INTANG_{i,t}$	–0.001 (0.020)	–0.031 (0.020)	–0.029 (0.019)	0.007 (0.020)	0.011 (0.020)	–0.012 (0.019)	0.048 (0.023)*	0.035 (0.025)	0.013 (0.023)	0.137 (0.061)*	0.098 (0.061)	0.129 (0.053)*
$DEBT_{i,t}$	0.066 (0.011)**	0.062 (0.012)**	0.078 (0.011)**	0.068 (0.012)**	0.062 (0.013)**	0.068 (0.012)**	0.073 (0.017)**	0.050 (0.017)**	0.074 (0.016)**	0.083 (0.027)**	0.072 (0.027)**	0.100 (0.027)**
$ACCRUAL_{i,t}$	0.002 (0.001)**	0.002 (0.001)**	0.002 (0.001)**	0.003 (0.001)**	0.004 (0.001)**	0.003 (0.001)**	0.001 (0.001)	0.002 (0.001)*	0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)	–0.001 (0.001)
$\tau_{k,t}$	0.078 (0.052)	0.179 (0.051)**	0.113 (0.047)*	0.046 (0.059)	0.144 (0.057)*	0.036 (0.051)	0.082 (0.067)	0.220 (0.062)**	0.182 (0.071)**	0.118 (0.100)	0.262 (0.118)*	0.190 (0.094)*

Table 4 (*Continued*)

	All countries			OECD countries			European countries			Other emerging markets		
rk Wald F-statistic	11.710	25.596	12.151	8.703	12.243	12.851	7.598	4.170	5.338	3.445	4.386	6.254
Hansen statistic	50.317	14.357	43.207	30.589	15.697	40.520	16.065	18.097	26.712	14.783	25.423	24.698
p-value	0.000	0.349	0.000	0.004	0.266	0.000	0.246	0.154	0.014	0.321	0.020	0.025
Observations	65,008	65,008	65,008	48,473	48,473	48,473	21,633	21,633	21,633	19,812	19,812	19,812
Firms	8512	8512	8512	5852	5852	5852	2469	2469	2469	2653	2653	2653

Notes: All regressions include firm-level and year specific fixed effects. At the country-industry level clustered standard errors in brackets. Estimated using WX and W^2X as instruments, the GMM option of the xtivreg2 stata procedure, provided by Schaffer (2007). *rk* Wald F-statistic refers to the Kleibergen and Paap (2006) weak identification test statistics

** Significant at the 1 per cent level

* Significant at the 5 per cent level

explanation for the reduced significance (or lack thereof) of the coefficient in the European Union subsample. If the benchmarking within the industry does involve the industry leader—which incidentally is very often located in the United States or Japan—then the set of potential competitors might be too small, if only the European Union countries are included.

The third line displays the reaction functions between firms within the same country *or* the same for the 2-digit-NACE industries. This is basically a combination of the two first weighting matrices with the added benefit that it overcomes border problems. If we estimate the reaction functions of firms within the same country, we are in fact estimating a number of independent systems, because the reaction functions do not spill across country borders. In contrast, the spatial model with competitors in the same industry *or* country allows for influences across borders. Intuitively one would expect coefficients to either lie somewhere between the coefficients for benchmarking only within the country or only within the industries or be even higher than these two. For most of the subsamples this holds, most notably for the whole data set or the OECD subsample. In contrast, for the non-OECD countries or for the whole sample in the large unbalanced data set, combining the country and industry weighting matrices results in a smaller and less significant coefficient. In other words, adding more potential competitors results in less observed benchmarking, which can be interpreted as evidence that these additional competitors are not relevant for the setting of the *ETR* in this subsample. This result highlights once more the fact that industry benchmarking appears to be driven by important firms in the largest OECD countries.

Profitability, measured through the return on assets ($ROA_{i,t}$), exhibits the expected (significantly) negative sign for all subsamples. However, there is a further important issue potentially driving the results. It is now a widely held belief that firms aim to control and smooth the income stream. Given the nature of our measures of the *ETR*, i.e. tax charges in the accounts defined as the share of pre-tax profit, any form of earnings management is expected to influence the *ETR* and in consequence the spatial interdependence. To alleviate these concerns we have included a measure of total accruals ($ACCRUAL_{i,t}$). However, the variable itself appears to be insignificant, probably reflecting that firm-specific fixed effects capture most of the variations.[25]

The firm size variable turns out insignificant for all specifications. Linking this back to the literature suggests that we can neither support the political costs hypothesis nor that large companies appear to be able to use their size for better tax planning. The leverage of firms exhibits a significantly positive coefficient for all specifications, which is counterintuitive at first sight. A possible explanation is the inclusion of firm-specific fixed effects. This implies that the coefficients describe the effect of changes rather than in levels. Therefore one could interpret the positive coefficients in the way that firms with increasing *ETR*s and low initial debt levels increase their debt share to benefit from more deductible interests in the future. The capital intensity ($CAPINT_{i,t}$) has a significant negative sign, reflecting that firms with more tangible

[25] An additional complication lies in the variety of accounting standards which are used by firms. While we aim to control for different accounting standards by the inclusion of firm fixed effects, time fixed effects and the inclusion of the statutory corporate tax which varies at the country-year level, there might be other idiosyncratic effects associated with the accounting standards.

assets can reduce their *ETR* via capital allowances. Interestingly, the only regressions where the coefficient is insignificant is the European subsample, which could reflect the frequent rate cut cum base broadening tax reforms in Europe.

In most specifications the coefficient for the statutory corporate tax rate ($\tau_{k,t}$) in the headquarter country is positive but insignificant. Only for the specification with the industry competitors the statutory tax rate turns out to be significantly positive. Even with our sparse weighting matrices the spatial lag will be considerably correlated with statutory tax rate in the country for all weighting matrices which include (mainly) competitors in the same country. This reflects the main role of the inclusion of this variable, namely to control for country-year specific shocks to the tax system which would otherwise be contained in the coefficient of the spatial lag.

4.4 Sensitivity analysis—further results

Different measure of the effective tax rates Various stakeholders might have different access to accounting data, or different views about the informational content of the *ETR* measures. Therefore we repeat the regressions from above with an alternative definition of the dependent variable. Table 5 displays the results for the regressions with ETR_{total} as effective tax rate measure. This reflects that firms might be benchmarked over the total income taxes they report, rather than only the current tax charge.

By and large the results from the baseline regression carry through to the specifications with the alternative measures of the *ETR*. The results confirm a significant positive strategic interaction in both measures of the *ETR* and for all geographical subsamples. Again, for the specification with the industry-only competitors, the positive interaction vanishes if one excludes the Non-EU OECD countries. The spatial interaction is roughly of the same magnitude for the ETR_{current} in the baseline results and the ETR_{total}. The most interesting difference is that the coefficients for profitability are much smaller and less significant for the regressions on ETR_{total}. This reflects that the amount of total taxes is less closely linked to the current earnings or profitability because of the inclusion of deferred tax charges.

Asymmetric reactions We stress the multifaceted nature of the concept of a reputational loss. It is therefore likely that managers do not follow competitors' *ETR*s upwards and downwards to the same extent. In fact, the specification of the theoretical model even suggests a stronger downward adjustment for firms with *ETR*s above their peer group, as the tax saving effect and the reduction of the reputational loss work in the same direction then. Therefore, we want to investigate the possibility of asymmetric responses to the benchmark *ETR*. Given that the relative tax position of a firm, i.e. whether its *ETR* is higher or lower than the average of the relevant peer group, is the result of the spatial interdependence so far, this distinction is endogenous and cannot be used to estimate asymmetric reaction functions. To avoid this problem, we use the statutory corporate tax rate as the threshold value. Intuitively, this seems to be a critical value, as it appears to be difficult for anyone to argue that a firm is not paying its fair share of taxes if it has an *ETR* equal to, or higher than, the statutory tax rate. Following the line of argument above, we would expect a larger coefficient for the competitors *ETR* if the firm itself had an *ETR* higher than the statutory tax rate.

Table 5 Further results for ETR_{total}, balanced subsample

	All countries			OECD countries			European countries			Other emerging markets		
Competitors ETR_{total} same country	0.963 (0.108)**			0.615 (0.222)**			0.864 (0.195)**			1.095 (0.270)**		
Competitors ETR_{total} same industry		0.656 (0.200)**			0.626 (0.165)**			–0.005 (0.234)			0.402 (0.212)	
Competitors ETR_{total} same country *or* industry			1.047 (0.077)**			0.578 (0.200)**			1.092 (0.308)**			1.359 (0.237)**
$ROA_{i,t}$	–0.125 (0.071)	–0.066 (0.083)	–0.181 (0.072)*	–0.097 (0.075)	–0.076 (0.080)	–0.139 (0.080)	–0.338 (0.104)**	–0.263 (0.144)	–0.259 (0.141)	–0.144 (0.220)	–0.788 (0.262)**	–0.075 (0.290)
$SIZE_{i,t}$	0.000 (0.003)	0.006 (0.003)	–0.001 (0.003)	0.005 (0.003)	0.005 (0.004)	0.003 (0.004)	0.000 (0.005)	0.001 (0.005)	0.000 (0.005)	–0.014 (0.007)*	–0.022 (0.008)**	–0.014 (0.007)
$CAPINT_{i,t}$	–0.005 (0.021)**	0.012 (0.023)	–0.003 (0.021)	0.026 (0.022)	0.026 (0.023)	0.025 (0.022)	0.020 (0.025)	0.030 (0.027)	0.014 (0.025)	–0.090 (0.072)	–0.079 (0.076)	–0.122 (0.072)
$INTANG_{i,t}$	0.022 (0.025)	–0.034 (0.027)	0.009 (0.024)	0.039 (0.024)	0.043 (0.025)	0.025 (0.023)	0.069 (0.033)*	0.057 (0.036)	0.047 (0.031)	–0.078 (0.139)	–0.221 (0.144)	–0.059 (0.140)
$DEBT_{i,t}$	0.062 (0.016)**	0.078 (0.018)**	0.050 (0.016)**	0.059 (0.017)**	0.060 (0.017)**	0.060 (0.017)**	0.059 (0.024)*	0.042 (0.025)	0.050 (0.023)*	0.125 (0.052)*	0.223 (0.066)**	0.128 (0.054)*
$ACCRUAL_{i,t}$	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)**	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	–0.002 (0.002)	–0.001 (0.002)	–0.002 (0.002)
$\tau_{k,t}$	0.229 (0.130)	0.669 (0.051)**	0.209 (0.078)**	0.046 (0.059)	0.446 (0.081)**	0.318 (0.104)	0.121 (0.114)	0.375 (0.101)**	0.088 (0.120)	–0.173 (0.268)	0.707 (0.215)**	0.054 (0.215)

Table 5 (*Continued*)

	All countries			OECD countries			European countries			Other emerging markets		
rk Wald F-statistic	16.531	6.215	29.926	9.782	6.306	7.073	13.093	2.328	7.411	5.642	1.749	6.525
Hansen statistic	8.514	4.995	10.755	4.167	10.068	12.525	6.944	12.154	11.067	5.136	11.892	9.496
p-value	0.809	0.975	0.631	0.989	0.688	0.485	0.905	0.515	0.605	0.972	0.537	0.735
Observations	14,157	14,157	14,157	9288	9288	9288	4473	4473	4473	4824	4824	4824
Firms	1573	1573	1573	1032	1032	1032	497	497	497	536	536	536

Notes: All regressions include firm-level and year specific fixed effects. At the country-industry level clustered standard errors in brackets. Estimated using WX and W^2X as instruments, the GMM option of the xtivreg2 stata procedure, provided by Schaffer (2007). *rk* Wald F-statistic refers to the Kleibergen and Paap (2006) weak identification test statistics

** Significant at the 1 per cent level

* Significant at the 5 per cent level

Table 6 Results for asymmetric reactions in ETR_{current}, balanced subsample

	High tax firms			Low tax firms		
Competitors ETR_{current} same country	0.842 (0.127)**			0.724 (0.082)**		
Competitors ETR_{current} same industry		0.859 (0.298)**			0.024 (0.188)	
Competitors ETR_{current} same country *or* industry			1.024 (0.139)**			0.783 (0.104)**
$ROA_{i,t}$	–0.699 (0.121)**	–0.632 (0.149)**	–0.548 (0.132)**	0.347 (0.103)**	0.375 (0.122)**	0.320 (0.107)**
$SIZE_{i,t}$	–0.008 (0.006)	0.002 (0.008)	–0.005 (0.007)	0.009 (0.004)*	0.009 (0.004)*	0.008 (0.004)
$CAPINT_{i,t}$	–0.069 (0.041)	–0.098 (0.051)**	–0.097 (0.040)*	–0.088 (0.024)**	–0.106 (0.027)**	–0.098 (0.025)**
$INTANG_{i,t}$	–0.072 (0.046)	–0.087 (0.046)**	–0.048 (0.044)	–0.015 (0.035)	–0.154 (0.041)**	–0.046 (0.039)
$DEBT_{i,t}$	0.110 (0.035)**	0.113 (0.038)**	0.102 (0.139)**	0.052 (0.017)**	0.053 (0.020)**	0.044 (0.018)*
$ACCRUAL_{i,t}$	0.003 (0.002)	0.002 (0.002)	0.002 (0.002)	–0.002 (0.001)*	–0.001 (0.001)	–0.001 (0.001)
$\tau_{k,t}$	0.064 (0.145)	0.551 (0.128)**	0.122 (0.119)	0.340 (0.126)**	0.892 (0.116)**	0.459 (0.131)**
rk Wald F-statistic	9.110	5.976	7.087	11.192	4.964	7.586
Hansen statistic	12.215	11.574	21.913	20.701	12.703	20.910
p-value	0.510	0.563	0.057	0.080	0.471	0.075
Observations	6944	6944	6944	6994	6994	6994
Firms	910	910	910	841	841	841

Notes: High (low) tax firms refers to firms with $ETR_{\text{current}_{i,t}} > t_{k,t}$ in at least (less than) three years. All regressions include firm-level and year-specific fixed effects. At the country-industry level clustered standard errors in brackets. Estimated using WX and W^2X as instruments, the GMM option of the xtivreg2 stata procedure, provided by Schaffer (2007). *rk* Wald F-statistic refers to the Kleibergen and Paap (2006) weak identification test statistics

** Significant at the 1 per cent level

* Significant at the 5 per cent level

Table 6 presents some of the results, if we allow for asymmetric responses. Specifically, the first three columns report the results for the firms which have an ETR_{current} which is higher than the statutory tax rate in at least three years. The second half of Table 6 reports the results for the other companies, i.e. those with an ETR_{current} lower than the statutory tax rate in at least seven out of the nine years.

Starting with the first three columns one can clearly see that the positive reaction to the competitors *ETR* is remarkably similar to the baseline case in Table 3 for the companies with high *ETR*s. Columns four to six show the results for the firms which have an *ETR* below the statutory tax rate in most years. While the coefficient for the spatial interactions are somewhat lower, they remain significantly positive for the specifications with country competitors. Only for the benchmarking within the same industry the positive reaction vanishes.

The sign for the profitability variable turns significantly positive for the firms with a low *ETR* while the coefficient remains negative and increases in size for those firms with a high *ETR*. This suggests that in the group of firms with a low *ETR* the first-stage regression is potentially dominated by large negative outliers, i.e. loss-making companies. Given the difficulties that arise from potential loss carry-forwards we will discuss the issue of losses in a subsequent robustness check.

The other variable which shows significantly different signs depending on which subset of firms we are looking at is the statutory corporate tax rate τ. The statutory corporate tax rate displays a large and significantly positive coefficient for firms with a lower *ETR*. This potentially reflects that firms with a lower effective tax rate are more constrained by the statutory tax rate.

The potential role of loss-making companies Firms with a negative taxable profit usually do not receive an immediate tax rebate but can carry these tax losses forward to reduce future tax burdens. Therefore they face a potentially different optimisation problem, as they are, at least from a legal perspective, entitled to a lower effective tax rate. Unfortunately we do not have the necessary information about the stock of loss carry-forwards to properly account for this factor. To overcome this problem we take the approach to exclude all the companies with a non-positive ETR_{current} during the period observed. This implies that all observations with either a negative pre-tax profit or a non-positive tax payment are dropped.[26]

The left half of Table 7 shows the results of this robustness check. As expected, the results remain relatively unaffected by the exclusion of these companies. Comparing the results to the baseline results in Table 3 shows that the coefficients are similar in size and slightly more significant. This is very much in line with our expectations, since this robustness check is in fact excluding those companies for which our theory least applies.

Distinguishing between common fundamentals and spatial interaction One concern with a spatial interaction model is, whether it is possible to distinguish between a

[26] An alternative approach would be to (partly) collapse the panel into a cross section, which would mitigate the time dimension issue of the loss carry-forward. In fact, we have collapsed the firm data into four points of time and reran the regression on this sample. The results change only quantitatively and a similar conclusion can be drawn.

Table 7 Further robustness checks ETR_{current}, balanced subsample

	Only firms with positive ETR_{current} in all years			OECD countries	European countries	Other countries
Competitors ETR_{current} same country	0.803 (0.149)**					
Competitors ETR_{current} same industry		0.629 (0.222)**				
Competitors ETR_{current} same country *or* industry			1.184 (0.119)**			
Competitors ETR_{current} random weights				0.097 (0.147)	0.403 (0.305)	0.157 (0.158)
$ROA_{i,t}$	–0.140 (0.161)	–0.130 (0.160)	–0.415 (0.167)*	–0.370 (0.147)*	–0.462 (0.191)*	–0.912 (0.333)**
$SIZE_{i,t}$	–0.010 (0.010)	–0.002 (0.010)	–0.022 (0.008)**	0.003 (0.007)	0.005 (0.007)	–0.020 (0.008)*
$CAPINT_{i,t}$	–0.122 (0.042)**	–0.070 (0.036)	–0.124 (0.035)**	–0.063 (0.035)	–0.008 (0.041)	–0.164 (0.066)*
$INTANG_{i,t}$	–0.043 (0.048)	–0.047 (0.047)	–0.078 (0.047)	–0.064 (0.038)	0.030 (0.042)	0.086 (0.165)
$DEBT_{i,t}$	0.089 (0.030)**	0.094 (0.030)**	0.086 (0.028)**	0.097 (0.031)**	0.061 (0.039)	0.187 (0.066)**
$ACCRUAL_{i,t}$	0.004 (0.002)	0.006 (0.002)	0.004 (0.002)*	0.004 (0.002)*	0.001 (0.002)	–0.001 (0.001)
$\tau_{k,t}$	–0.203 (0.170)	0.318 (0.123)**	–0.203 (0.136)	0.475 (0.102)**	0.346 (0.109)**	0.389 (0.238)*
rk Wald F-statistic	6.041	3.955	7.068	43.419	12.127	24.145
Hansen statistic	20.710	11.486	12.432	13.960	8.804	18.304
p-value	0.079	0.570	0.493	0.377	0.788	0.146
Observations	6246	6246	6246	9288	4473	4824
Firms	694	694	694	1032	497	536

Notes: The random weights are constructed on a random draw from a standard normal distribution. All regressions include firm-level and year specific fixed effects. At the country-industry level clustered standard errors in brackets. Estimated using WX and W^2X as instruments, the GMM option of the xtivreg2 stata procedure, provided by Schaffer (2007). *rk* Wald F-statistic refers to the Kleibergen and Paap (2006) weak identification test statistics

** Significant at the 1 per cent level

* Significant at the 5 per cent level

reaction to competitors behaviour and a common reaction to a change in fundamental underlying causes.[27] We include year fixed effects and the statutory tax rate which (potentially) varies at the country year level, to alleviate this concern. Additionally, the right part of Table 7 displays the results when we allocate the competing firms on the basis of a random variable. Firms following a common underlying cause would create a positive spatial interaction even if we choose and weight the competitors on a random basis. However, the results in right part of Table 7 are all insignificant indicating that the spatial interaction we find in the results above is not driven by an unobserved common cause.

5 Conclusion

In this paper we argue that firms' tax planning decisions are made in a competitive environment. Stakeholders with various and partly competing objectives observe tax payments and evaluate these against the relevant peer group. As an example, tax authorities are interested in an adequate tax payment, while shareholders probably would prefer to have lower tax payments in order to increase the potential dividend payments. Deviation from the behaviour of comparable firms therefore triggers some sort of reputational loss. Firms anticipate this benchmarking and incorporate the consequences into their tax planning strategy which creates interdependencies in the *ETR*s of firms.

We aim to capture this influence in a theoretical model which introduces a reputational loss. We see the concept of the reputational loss as a multifaceted phenomenon, as various stakeholders pursue conflicting interests. In consequence, managers have to balance the benefits of a reduced tax burden against the costs of a loss in reputation if they deviate too much from the behaviour of their peer group. Anticipating this, managers incorporate their peer groups tax planning into their own decision process. This in turn creates a positive interdependence, which we can test empirically.

Using a spatial econometric approach we find evidence for interdependence in the *ETR*. In general, the positive spatial interdependence between the *ETR*s of firms is significant between firms in the same country. This evidence holds by and large for companies in the OECD, in the European Union and other countries. There is also evidence for strategic interaction within the same industry, however this is only apparent if firms in OECD countries are included. This could be interpreted as evidence of the importance of industry leaders in tax benchmarking. Firms with a high *ETR* respond slightly stronger to their peer groups *ETR*, which is in line with our theoretical predictions since in this case the reduction of the reputational loss coincides with a reduction of the tax burden.

So far the analysis concentrates on the largest publicly traded companies, for which we think the benchmarking is most important since they are at the centre of both the public debate and the scrutiny of the tax authorities. It also seems reasonable to assume that the largest companies would engage in sophisticated tax planning

[27] For example, a common shock could be enforcement strategies which vary across jurisdictions as discussed in De Waegenaere et al. (2006).

as they have the biggest tax departments. In conclusion, this paper argues that especially the largest firms, who were so far expected to be most able to optimise their tax affairs, are constrained in their tax planning through potential reputational losses.

Acknowledgements We are indebted to the European Tax Policy Forum for financial support. Further, we would like to thank the participants of the workshop 'Taxes and the Financial and Legal Structure of Firms' in Vienna, the Meeting of the European Tax Policy Forum in Dublin, the conference of the European Tax Policy Forum in London, the annual meeting of the Austrian Economic Association in Linz, the III Workshop of Fiscal Federalism in Barcelona, and the research seminar in Salzburg for valuable comments and discussion. The paper has further benefited from research assistance from Clara Welteke and Joschka Wanner and insightful discussions with Michael Devereux, Dhammika Dharmapala, Peter Egger, Mario Larch, Jan Mutl and Johannes Voget.

References

Abarbanell, J., & Bushee, B. (1998). Abnormal returns to a fundamental analysis strategy. *The Accounting Review*, *13*(1), 19–45.

Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: a theoretical analysis. *Journal of Public Economics*, *1*, 323–338.

Anselin, L. (1988). *Spatial econometrics: methods and models*. Boston: Kluwer Academic.

Anselin, L., Le Gallo, J., & Jayet, H. (2008). Spatial panel econometrics. In L. Mátyás & P. Sevestre (Eds.), *The econometrics of panel data*. Berlin: Springer.

Bebchuk, L. A., & Fried, J. M. (2004). *Pay without performance: the unfulfilled promise of executive compensation*. Cambridge: Harvard University Press.

Becker, G. S. (1968). Crime and punishment: an economic approach. *The Journal of Political Economy*, *76*(2), 169–217.

Brueckner, J. K. (2003). Strategic interaction among governments: an overview of empirical studies. *International Regional Science Review*, *26*(2), 175–188.

Chen, K.-P., & Chu, C. Y. C. (2005). Internal control versus external manipulation: a model of corporate income tax evasion. *The RAND Journal of Economics*, *36*(1), 151–164.

Chen, S., Chen, X., Cheng, Q., & Shevlin, T. (2010). Are family firms more tax aggressive than non-family firms? *Journal of Financial Economics*, *95*(1), 41–61.

Collins, J., & Shackelford, D. (1999). Writers challenge claim of favorable cross-border taxation. *Tax Notes*, *82*(4), 131–134.

Cowling, K., & Waterson, M. (1976). Price-cost margins and market structure. *Economica*, *43*, 267–274.

Crocker, K. J., & Slemrod, J. (2005). Corporate tax evasion with agency costs. *Journal of Public Economics*, *89*, 1593–1610.

Desai, M. A., Dyck, A., & Zingales, L. (2007). Theft and taxation. *Journal of Financial Economics*, *84*(3), 591–623.

Desai, M. A., & Dharmapala, D. (2006a). Corporate tax avoidance and high powered incentives. *Journal of Financial Economics*, *79*, 145–179.

Desai, M. A., & Dharmapala, D. (2006b). *Earnings management and corporate tax shelters*. Harvard Business School Working Paper No. 884812.

Desai, M. A., & Dharmapala, D. (2009). Corporate tax avoidance and firm value. *The Review of Economics and Statistics*, *91*(3), 537–546.

Desai, M. A., & Hines, J. R. Jr. (2002). Expectations and expatriations: tracing the causes and consequences of corporate inversions. *National Tax Journal*, *55*(3), 409–441.

De Waegenaere, A., Sansing, R. C., & Wielhouwer, J. L. (2006). Who benefits from inconsistent multinational tax transfer-pricing rules? *Contemporary Accounting Research*, *23*(1), 103–131.

Freedman, J., Loomer, G., & Vella, J. (2009). Corporate tax risk and tax avoidance: new approaches. *British Tax Review*, 74–116.

Graham, J. R., & Tucker, A. (2006). Tax shelters and corporate debt policy. *Journal of Financial Economics*, *81*, 563–594.

Gupta, S., & Newberry, K. (1997). Determinants of the variability in corporate effective tax rates: evidence from longitudinal data. *Journal of Accounting and Public Policy*, *16*(1), 1–34.

Hanlon, M., & Heitzman, S. (2010). A review of tax research. *Journal of Accounting and Economics*, *50*(2–3), 127–178.
Hanlon, M., & Slemrod, J. (2009). What does tax aggressiveness signal? Evidence from stock price reactions to news about tax shelter involvement. *Journal of Public Ecnomics*, *93*, 126–141.
Hines, J. R. Jr. (1999). Lessons from behavioral responses to international taxation. *National Tax Journal*, *52*(2), 305–322.
Huizinga, H., Laeven, L., & Nicodeme, G. (2008). Capital structure and international debt shifting. *Journal of Financial Economics*, *88*(1), 80–118.
Jones, J. J. (1991). Earnings management during import relief investigations. *Journal of Accounting Research*, *29*(2), 193–228.
Kelejian, H. H., & Robinson, D. P. (1993). A suggested method of estimation for spatial interdependent models with autocorrelated errors, and an application to a county expenditure model. *Papers in Regional Science*, *72*, 297–312.
Kelejian, H. H., & Prucha, I. (1998). A generalized spatial two-stage least squares procedures for estimating a spatial autoregressive model with autoregressive disturbances. *Journal of Real Estate Finance and Economics*, *17*, 99–121.
Kelejian, H. H., & Prucha, I. R. (2010). Spatial models with spatially lagged dependent variables and incomplete data. *Journal of Geographical Systems*, *12*, 241–257.
Kleibergen, F., & Paap, R. (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of Econometrics*, *127*(1), 97–126.
Leblang, S. (1998). International double nontaxation. *Tax Notes International*, *134*(10), 181–183.
Levenson, A. (1999). Worldly planning for global firms. *Electronic News*, *16*.
Machin, S., & Van Reenen, J. (1993). Profit margins and the business cycle: evidence from UK manufacturing firms. *Journal of Industrial Economics*, *41*(1), 29–49.
Mills, L., Erickson, M., & Maydew, E. (1998). Investments in tax planning. *The Journal of the American Taxation Association*, *20*, 1–20.
Moore, P. J. (2008). *Tax planning by firms and tax competition by governments*. PhD thesis, Trinity College, Dublin.
Omer, T., Molloy, K., & Ziebart, D. (1993). An investigation of the firm size-effective tax rate relation in the 1980s. *Journal of Accounting, Auditing, and Finance*, *8*(2), 167–182.
Overesch, M., & Rincke, J. (2009). *What drives corporate tax rates down? A reassessment of globalization, tax competition, and dynamic adjustment to shocks*. CESifo Working Paper No. 2535.
Posner, E. A. (2000). Law and social norms: the case of tax compliance. *Virginia Law Review*, *86*, 1781–1819.
PriceWaterhouseCoopers (2009). *Tax benchmarking survey for the transportation & logistics industry 2008/2009*. New York: PriceWaterhouseCoopers.
Rego, S. O. (2003). Tax avoidance activities of U.S. multinational corporations. *Contemporary Accounting Research*, *20*(4), 805–833.
Reinganum, J. F., & Wilde, L. L. (1986). Equilibrium verification and reporting policies in a model of tax compliance. *International Economic Review*, *27*(3), 739–760.
Schaffer, M. E. (2007). *xtivreg2: stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models*.
Shleifer, A. (1985). A theory of yardstick competition. *Rand Journal of Economics*, *16*(3), 319–327.
Slemrod, J. (2004). The economics of corporate tax selfishness. *National Tax Journal*, *57*(4), 877–899.
Slemrod, J. (2007). Cheating ourselves: the economics of tax evasion. *Journal of Economic Perspectives*, *21*(1), 25–48.
Swenson, C. (1999). Increasing stock market value by reducing effective tax rates. *Tax Notes*, *83*, 1503–1505.
Weisbach, D. (2002). Ten truths about tax shelters. *Tax Law Review*, *55*, 215–253.
Wilkie, P. (1988). Corporate average effective tax rates and inferences about relative tax preferences. *The Journal of the American Taxation Association*, *10*(2), 75–88.
Zimmerman, J. (1983). Taxes and firm size. *Journal of Accounting and Economics*, *5*(2), 119–149.