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Who Competes with Whom? The Structure of International Tax Competition

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Abstract

Corporate tax rates around the world have considerably decreased in the last decades. While tax competition among countries has been widely accepted as the driving force of this trend, it has remained unclear which countries compete with whom. This paper focuses on country size as a determinant of tax competition. My empirical analysis yields two main results: First, the structure of tax competition is based on a country's size as large countries compete with other large countries and small countries compete with small ones. Second, there is a qualitative difference as large countries compete worldwide with each other whereas small countries orientate towards geographically close other small states.

Keywords: Corporate taxation, tax competition, strategic interactions, structure

JEL Classification: F23, H25, H87

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1 Introduction

"Germany has lowered its corporate tax rate to 30 per cent, but in Japan it is still 38 per cent. The way we look at the question is: can Japan cope with international competition?"¹

Japan's prime minister Shinzo Abe

Statutory corporate tax rates have considerably decreased in almost all countries: the average statutory rate of all countries that were OECD members in 2014 has declined from 38 percent in 1985 to 25 percent in 2014 (see Mintz and Weichenrieder, 2010 and KPMG, 2014). The main explanation for this trend is tax competition. Countries compete for the location of internationally mobile capital through their corporate tax rate. Another reason for the downward trend in corporate tax rates is the possibility of multinational firms to shift their profits to low tax countries (see e.g. Devereux et al., 2008).

A typical example is Japan, which has recently cut its corporate tax rate. Since the country's prime minister Shinzo Abe made the announcement mentioned above, Japan indeed reduced the corporate tax rate to around 35 percent in 2014 (KPMG, 2014) and recently announced a further cut by 2.5 percentage points for 2015 (The Japan Times, 2014). The interesting question that arises is: why does Japan's prime minister explicitly orientate to Germany? At a first glance we might guess that especially neighboring countries' tax rates matter when a country decides on own reforms as capital movements intensify the closer the countries are located. But Japan's neighbors all had considerably lower tax rates than Germany in 2013 (Russia 20%, South Korea 24%, Taiwan 17%).

Which states build the reference group to which a country orientates when deciding on the own corporate tax rate is still an open question in literature. While existing studies find strong empirical evidence for the existence of corporate tax competition as yet we do not know much about its precise structure. This paper empirically analyzes who competes with whom with a focus on country size as the essential determinant of the corporate tax competition structure. For this purpose I use a worldwide dataset of 50 countries for the years 2003 to 2013.

My results suggest that the structure of corporate tax competition depends on country size: large countries compete with other large countries whereas small coun-

¹quoted from: Financial Times, October 6th, 2013.

tries compete with other small countries. Simultaneous interactions from small to large countries or vice versa are weak. Moreover, there is a qualitative difference between large and small countries' tax competition: whereas large countries compete worldwide with all other large countries, small countries' competition is regional as they orientate to geographically close small countries. These results are quite well illustrated by Shinzo Abe's announcement mentioned above: Japan orientates to Germany rather than neighboring countries because, like Japan, Germany is also a large country.

The question arises why countries behave in this way. I propose that large states compete in corporate taxes predominantly to hold their national champions' cost structures competitive. As most big firms in key industries have their headquarters in large countries the reference set to which a large state orientates consists of other large countries. By contrast, most small countries do not host such global firms. Thus they mainly compete for regionally mobile FDI and/or profits.

Whereas most previous empirical research uses data on European countries (or on the set of OECD countries, which mainly consists of European states) my dataset of 50 countries involves only 21 European states. My results suggest that tax competition and the competition patterns I found are not solely a European phenomenon.

My analysis relates to previous empirical research in capital tax interactions. Among the first who show the presence of competition in statutory tax rates are Besley et al. (2001). Further empirical research has added some significant insights as to the determinants of tax competition. Devereux et al. (2008) find that countries predominantly orientate towards high-GDP-countries when setting their own corporate tax rate. Several studies find that geographical proximity enhances tax interactions: Cassette and Paty (2008), Kammas (2011), Overesch and Rincke (2011) and Redonao (2014) find competition in tax rates between closely located states. Finally, several studies have focused on tax competition in Europe: Davies and Voget (2011) and Redoano (2014) confirmed this prediction whereas Crabbé (2013) only finds weak evidence for tax competition in Europe. Altshuler and Goodspeed (2014) show that the United States act as a Stackelberg leader in tax setting of OECD countries. For emerging and developing countries Abbas and Klemm (2013) find also a decline in effective tax rates, which corresponds to the downward trend in developed countries.

Methodologically my work is related to empirical studies that investigate different competition structures between different groups of countries. For instance Davies and Naughton (2014) show that strategic responses in environmental treaty participation differ between OECD and non-OECD countries. Davies and Vadlamannati (2013) find that international competition in labor standards also differs between these two sets of countries.

A further line in related literature theoretically models international tax competition. Janeba and Osterloh (2013) model that cities compete inter-regionally with each other while hinterlands compete intra-regionally with other hinterlands and a city in their neighborhood. Transferred to an international level this model is in line with my empirical results. More generally my paper relates to the theoretical work on tax competition, in general (Wilson, 1986, Zodrow and Mieszkowski, 1986 and Wildasin, 1988), and in particular on tax competition between countries of different size (Bucovetsky, 1991, Wilson, 1991 and Haufler and Wooton, 1999).

The paper is organized as follows: Section 2 explains the empirical specification. Section 3 presents the estimations results. In Section 4 I consider if tax competition is predominantly present in Europe. Section 5 discusses the results. Section 6 concludes.

2 Testing for country size as a determinant of tax competition

My empirical analysis is based on the sequential tax competition model of Janeba and Osterloh (2013) transferred to cross-country tax competition. In their local tax competition model Janeba and Osterloh (2013) define metropolitan areas consisting of one large urban municipality, which is surrounded by an equal number of small hinterland jurisdictions. Tax competition for mobile capital takes place at two levels: first large jurisdictions set their tax rates competing for inter-regionally mobile capital. After this capital has located across cities, small municipalities set their tax rates, competing with each other for the capital inside a metropolitan region and taking the taxation decision of the city as given. Analyzing an increase of the number of metropolitan areas (which reflects the increase in competition through globalization) the authors show that cities are affected more than hinterlands by increasing competition as they lower their capital tax rates more than small municipalities do.

I replace cities by large countries and hinterlands by small countries to test Janeba and Osterloh's (2013) theory in an international setting. In my basic regressions I divide my sample of countries into two parts: I perform regressions separately for the subsample of large countries and the subsample of small countries to test the diverging structures of tax competition between these two groups. I cannot test the Stackelberg leadership of large jurisdictions proposed by Janeba and Osterloh (2013) as the reaction time of small countries is unknown and might even be heterogeneous across countries.

2.1 Empirical specification

My basic regression regresses a country *i*'s corporate tax rate τ_{it} on the unweighted average tax rate of all (other) large countries and all (other) small countries ($\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$). This regression tests if countries respond to tax rate changes of small and/or large countries worldwide. The regression equation is

$$\tau_{it} = \beta_1 \tau_{it-1} + \beta_2 \overline{\tau}_{it}^{large} + \beta_3 \overline{\tau}_{it}^{small} + \eta X_{it} + T_t + \epsilon_{it} , \qquad (1)$$

where X_{it} is a vector of control variables discussed below, τ_{it-1} is the lagged statutory tax rate of country *i* and T_t is a variable equal to the year of the observation, capturing a common time trend. ϵ_{it} is the error term. A significantly positive estimate for β_2 suggests that a country competes with (other) large countries in corporate taxes and a significantly positive β_3 indicates tax competition with (other) small countries.

 X_{it} consists of several control variables that are usually used in the tax competition literature. Gordon and MacKie-Mason (1995) suggest that the capital tax is a backstop for personal taxes, hence I add country *i*'s highest marginal income tax rate to X_{it} . Haufler and Wooton (1999) suggest that a larger country size allows a government to levy higher corporate taxes. Hence I use the ratio of country *i*'s GDP to the US GDP as measure for country *i*'s size as a control variable. Moreover, I control for *i*'s government expenditure as share of GDP as this might influence τ_{it} via the related revenue requirement. Moreover, demographic characteristics can influence the government's revenue requirement and its corporate tax rate. Therefore, I also use *i*'s share of young population below 14 years and the share of old above 65 as controls. Borck and Pflüger (2006) suggest that if the mobile factor is agglomerated in a region, the country can tax the resulting agglomeration rents. Therefore I also add the share of *i*'s urban population to X_{it} . A crucial question is which countries I consider as "large". I consider countries with a GDP that is at least 7 percent of the US GDP to be large, with the remainder being small.² Moreover, I follow Devereux et al.'s (2008) suggestion that the absence of capital controls is a prerequisite for corporate tax competition by dropping all observations characterized by considerable capital controls. As an indicator for those I use the index for a country's capital account openness developed and calculated for a variety of countries by Chinn and Ito (2008). Observations are dropped if this index is below zero (indicating a capital account openness below the mean in Chinn and Ito's (2008) set of countries). Table A.1 shows an overview of which countries in the dataset are classified as large and which are dropped because of a negative Chinn-Ito-Index.

In two further regressions I test whether countries compete predominantly with close countries. Hence I also perform a regression where the inverse geographical distance weighted average tax rates of (other) large and (other) small countries are used for $\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$ in eq. (1). This weighting scheme assigns higher weights to other countries the closer they are located to country *i*. Hence $\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$ predominantly represent the tax rates of close large and close small countries.

With these inverse geographical distance weighted average tax rates a significantly positive estimate for β_2 suggests that countries mainly orientate to (other) closely located large countries and a positive β_3 indicates a country to mainly orientate to (other) close small countries.

These basic regressions follows a consistency check. Rather than splitting up my sample in two subsamples of small and large countries, I use dummies for whether a country is small or large and interact them with both the average tax rate of (other) small and of (other) large countries. The regression equation writes

$$\tau_{it} = \beta_1 \overline{\tau}_{it}^{large} * small + \beta_2 \overline{\tau}_{it}^{large} * large + \beta_3 \overline{\tau}_{it}^{small} * small + \beta_4 \overline{\tau}_{it}^{small} * large + \beta_5 \overline{\tau}_{it-1} + \eta X_{it} + T_t + \epsilon_{it} ,$$

$$(2)$$

where *small* and *large* are dummies equal to one if country i is a small or a large country respectively. I run this model both with unweighted and inverse geographical distance weighted average tax rates of other countries. This specification allows some

 $^{^{2}}$ This implies that Spain (46 million inhabitants) as a large country in all years is closest to the threshold from above, whereas the Netherlands (17 million inhabitants) as a small country are closest to the threshold from below.

additional statistical tests on the differences in tax rate responses of small and large countries.

2.2 Econometric issues

To account for the problem of all left out variables that are constant over time for a specific country I estimate the models with country fixed effects. Moreover, the use of year as an explanatory variable captures a time trend in corporate tax rates that affects all countries in the same way. Another potential source of endogeneity is simultaneity. According to the model country *i*'s tax rate also influences the independent tax variables. The other countries compete with *i*, hence τ_{it} influences $\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$. An instrumental variable approach accounts for this source of endogeneity.

The choice of instruments follows Devereux et al. (2008): the (weighted) average of other countries' control variables. More precisely in eq. (1) $\overline{\tau}_{it}^{large}$ is instrumented by the (weighted) average of control variables of all (other) large countries, $\overline{\tau}_{it}^{small}$ by the (weighted) average of all (other) small countries using the same weights that are used for calculation of $\overline{\tau}_{it}^{small}$ and $\overline{\tau}_{it}^{large}$. In the consistency check regressions that use interaction terms with dummies for small and large countries I also interact the instruments with these dummies.

As argued above the controls are all likely to have an influence on a country's corporate tax rate. Then the (weighted) average of several countries' controls should also have an influence on these countries' (weighted) average tax rate. Indeed in my first stage regressions that use the statutory corporate tax rate the R^2 is at least 0.89. Moreover, a F-test shows that the instrumental variables are highly jointly significant in the first stage regressions (with an F-statistic of at least 47.3). This suggests that the instruments indeed explain a substantial part of the variation in the endogenous tax variables and hence are relevant. The other condition for a valid instrument - exogeneity - means in this specific context that once controlling for the (weighted) average tax rate of other countries the (weighted) average of other countries' controls has no influence on τ_{it} . The government expenditure and share of young and old population of a country are thought to influence the tax rate via the related revenue requirement - an effect on another country's tax rate other than via tax competition is indeed unlikely. Also the backstop function for personal taxes affects only the own tax rate and should not have an influence on a foreign country's

tax rate except via tax competition. A higher share of urban population provides only country i with agglomeration rents that allow i's government to levy higher taxes - a direct effect on other countries is not plausible. All in all it is reasonable to assume the validity of the instrument set.

I cluster standard errors in countries and use a lagged dependent variable to account for persistence in corporate tax rates resulting from a political non-feasibility of abrupt tax changes.

2.3 Data

I use data on an annual base for the period from 2003 to 2013. I collect statutory tax rates for the years 2003 to 2007 from Mintz and Weichenrieder (2010, pp.158-161), for the period from 2008 to 2013 from the corporate tax rates table provided online by KPMG (2015). The data on control variables comes from the IMF World Economic Outlook Database, the United Nations Conference on Trade and Development (UNCTAD), the World Bank World Economic Indicators and from KPMG's Individual Income Tax and Social Security Rate Surveys. I use Chinn and Ito's (2008) financial openness index to select only observations which are above the mean value of zero and hence have sufficiently low capital controls.³ This selection process leads to a drop of all observations of Argentina, Belarus, China, India, Morocco, Thailand, South Africa, Ukraine, Venezuela and Vietnam as these countries have a negative Chinn-Ito-Index in all years. The resulting sample used for my empirical analysis consists of 50 countries.⁴ Table A.1 in the Appendix gives an overview of the drop of observations and the size classification of countries. Moreover, I use effective bilateral distances provided by Mayer and Zignano (2011) for measuring distances between countries. They weigh geographical distances between the biggest cities by the share of these cities in the country's population. The resulting measure captures better the geographic distribution of the population than distances between capitals.

³This paper uses Chinn and Ito's (2008) updated version of Financial Openness Indexes, which is available online up to the year 2013 on http://web.pdx.edu/~ito/Chinn-Ito_website.htm. Unfortunately the Chinn-Ito-Index is not available for Luxembourg, but as the country is a member of the European Economic Area that guarantees low capital controls I assume a positive value for Luxembourg.

⁴More precisely I use data on Australia, Austria, Belgium, Bulgaria, Brazil, Canada, Chile, Costa Rica, Croatia, the Czech Republic, Germany, Denmark, Ecuador, Egypt, Spain, Finland, France, Greece, Guatemala, Hong Kong, Hungary, Indonesia, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia, Mexico, Malta, Netherlands, Norway, New Zealand, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovak Republic, Sri Lanka, Sweden, Switzerland, Turkey, Uruguay, the United Kingdom und the United States.

Table A.2 in the Appendix shows an overview of the data sources and summary statistics of all variables.

3 Results

The following section summarizes the results of the regressions for the subsamples of large and small countries. Afterwards I perform a consistency check using the full sample and including dummies for whether a country is large or small.

Table 1 shows my basic estimation results. In the first column I regress large countries' statutory corporate tax rates on the unweighted average tax rates of small and of other large countries. Both yield significantly positive coefficients with the first coefficient suggesting that a 1 percentage point decrease in the average statutory tax rate of other large countries induces a large country to also cut its own statutory rate by 0.73 percentage points. As this coefficient is about three times larger than that for the small countries' average tax rate this provides evidence that large countries mainly orientate towards other large countries when deciding on their own corporate tax rate.

But is this tax competition of large countries predominantly between close states? The second regression uses the inverse distance weighted instead of the unweighted average tax rates of other large and small countries. This leads to considerably smaller and no longer significant coefficients. Hence tax competition between large countries is indeed inter-regional.

The last two columns in Table 1 show the results of an estimation of these two models for the subsample of small countries. Results are reversed compared to large countries. In the regression with unweighted average tax rates the average rate of other small countries yields a significantly positive coefficient of 0.98 that is significantly larger than the coefficient for the average statutory rate of large countries. Thus small countries seem to orientate predominantly towards other small countries. The last column in Table 1 presents results of the same regression but with inverse distance weighted average tax rates. Again the coefficient of other small countries' average tax rate is positive and now even more significant than with unweighted averages. By contrast, large countries' inverse distance weighted average tax rate is not significant at all. Hence small countries' mainly refer to proximate other small countries. Small countries' tax competition seems to be of a regional nature.

Dep. variable: $ au_{it}$	large countries		small countries	
	unweighted av.	inv. dist. w.	unweighted av.	inv. dist. w.
$\overline{ au}_{it}^{large}$	0.728^{**} (2.204)	$0.270 \\ (0.731)$	0.433^{***} (2.723)	0.182 (1.245)
$\overline{ au}_{it}^{small}$	0.236^{**} (2.280)	-0.005 (-0.029)	0.978^{***} (3.126)	0.876^{***} (4.080)
$ au_{it-1}$	0.655^{***} (7.474)	0.663^{***} (6.692)	0.413^{***} (3.590)	0.394^{***} (3.430)
Gov.exp./GDP	0.126^{**} (2.386)	$0.106 \\ (1.335)$	0.085^{**} (2.140)	0.088^{**} (2.060)
$GDP_{lt}/GDP_{USA,t}$	-0.110 (-0.994)	-0.148 (-1.406)	-0.122 (-0.248)	0.115 (0.209)
Personal tax rate	$0.000 \\ (0.058)$	-0.004 (-0.320)	0.020 (0.393)	$0.012 \\ (0.240)$
Proportion young	-0.789*** (-3.233)	-0.629** (-2.362)	-0.416* (-1.899)	-0.513** (-2.167)
Proportion old	-1.043*** (-3.088)	-0.762^{**} (-2.321)	-0.566^{*} (-1.744)	-0.601^{*} (-1.716)
Proportion urban	0.620^{***} (3.009)	0.556^{*} (1.726)	$0.103 \\ (0.462)$	-0.043 (-0.172)
Year	0.005^{**} (2.040)	-0.001 (-0.247)	0.007^{***} (3.384)	0.004^{**} (2.150)
Country dummies Observations	yes 109	yes 109	yes 398	yes 398
R^2	0.809	0.808	0.408	0.420
Hansen J (p-val)	0.258	0.472	0.478	0.368

Notes:

1. Parentheses contain t-statistics robust to clusters in country.

2. ***, ** and * denote significance level at 1, 5 and 10 percent levels resp.

3. Countries with a GDP $\geq 7\%$ of the US GDP are defined as large, others as small.

3. Countries with a GDF $\geq 7\%$ of the OS GDF are defined as large, others as small. 4. $\overline{\tau}_{it}^{large}/\overline{\tau}_{it}^{small}$ is the average statutory rate of (other) large/small countries, unweighted in col. 1 and 3 and inverse geographical distance weighted in col. 2 and 4. 5. $\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$ are instrumented by the unweighted/inv. dist. weighted averages of control variables of small/large countries respectively.

What conclusions can we draw from the control variables? The significantly positive lagged statutory tax rate of country i indicates that there is remarkable persistence in corporate tax rates. The regressions tentatively suggest that large countries finance higher government expenditures by higher corporate taxes with a significant coefficient in three of the four regressions. Both the relative GDP and the personal income tax rate are not significant in the models for both subsamples. The demographic variables yield significant coefficients in almost all regressions: both the proportion of young and of old yield have a negative impact on a country's corporate tax rate. The significantly positive coefficients for the urban population in the large countries' estimates may come from taxable agglomeration rents.

Additionally, by estimating eq. (2) I perform a consistency check of the above results by using the full sample of countries (rather than splitting it into two subsamples of small and large countries) and then interacting the average tax rates of both small and large countries with dummies whether country i itself is small or large. Again I perform the regression using both unweighted average tax rates and inverse geographically distance weighted averages. Table 2 presents results of these specifications.

These full sample regressions confirm my previous results. In the first column the large countries' unweighted average tax rate yields a considerably larger and more significant coefficient when interacted with the *large* dummy rather than the *small* dummy. A Wald test indicates that this difference is significant (p-value 0.009), confirming that large countries respond stronger to other large countries than small countries do. By contrast, the unweighted average tax rate of small countries has a significantly positive coefficient only if country i itself is a small country. A Wald test for whether the forth coefficient is larger than the third rejects this hypothesis with a p-value of 0.008. In the second regression in Table 2 I weigh again tax rates by inverse geographical distances such that the average tax rates mainly represent the tax rates of close countries. Results confirm that the response of small countries to close other small countries is significantly stronger (p-value 0.030) than the response of large countries. Furthermore, large countries also seem not to react to close, other large countries as the weighted average tax rate of those is considerably smaller than in the first regression in Table 2 that uses unweighted averages. Hence my full sample regressions confirm that large countries compete inter-regionally with other large countries whereas small countries compete with close other small countries.

My analysis empirically finds a structure in international corporate tax competi-

	full sample	
Dep. variable: $ au_{it}$	unweighted av.	inv. dist. w.
$\overline{ au}_{it}^{large}$ * small	0.360^{**} (2.409)	0.046 (0.369)
$\overline{\tau}_{it}^{large} * large$	0.865^{***} (3.550)	0.354^{**} (2.152)
$\overline{\tau}_{it}^{small}$ * small	0.934^{***} (3.191)	0.667^{***} (3.464)
$\overline{\tau}_{it}^{small}$ * large	$0.246 \\ (1.270)$	0.255 (1.155)
$ au_{it-1}$	0.443^{***} (4.137)	0.433^{***} (4.044)
Gov.exp./GDP	0.089^{***} (2.608)	0.084^{**} (2.335)
$GDP_{lt}/GDP_{USA,t}$	-0.036 (-0.271)	-0.045 (-0.310)
Personal tax rate	0.009 (0.267)	0.004 (0.117)
Proportion young	-0.396^{**} (-2.417)	-0.456** (-2.410)
Proportion old	-0.623*** (-2.786)	-0.527** (-2.114)
Proportion urban	0.293^{*} (1.766)	0.252 (1.449)
Year	0.006^{***} (3.348)	$\begin{array}{c} 0.001 \\ (0.752) \end{array}$
Country fixed effects Observations	yes 507	yes 507
R^2	0.459	0.467
Hansen J (p-val)	0.640	0.466

Table 2: Full sample regressions

Notes:

1. Parentheses contain t-statistics robust to clusters in country.

2. ***, ** and * denote significance level at 1, 5 and 10 percent levels resp.

3. Countries with a GDP $\geq 7\%$ of the US GDP are defined as large, others as small.

4. $\overline{\tau}_{it}^{large}/\overline{\tau}_{it}^{small}$ is the average statutory rate of (other) large/small countries, unweighted in col. 1 and inverse geographical distance weighted in col. 2.

5. small / large are dummies equal to one if country is small/large.

6. All interacted tax variables are instrumented by the unweighted/inv. dist.

weighted averages of control variables of the same set of countries contained in the respective average tax rate, interacted by small/large.

tion that depends on country size: large countries compete worldwide with all other large countries. Small countries interact with other small countries located close to them. My proposal for why competition of small and of large countries differs in this manner is as follows: most large firms in key industries have their headquarters in large countries (according to the list of the 500 largest firms of the world of the Fortune magazine the average number of these biggest firms of the world in large countries is 29 whereas for small countries it is only 1. Also when divided by the size of a country's population, large countries have on average 0.26 Global 500 firms per 1 million inhabitants compared to 0.14 in small countries). These national champions are usually deep-rooted in their home countries (e.g. Boeing in the US and Airbus in France and Germany). So the motivation for large countries to lower corporate tax rates might not be competition for FDI but rather holding their national champions' cost structures competitive with other large countries' big firms. This could explain the observed inter-regional interactions in large countries' corporate tax rates.

By contrast, most small countries do not have such big global firms. Hence they only engage in tax competition based on the two mechanisms discussed in literature: competition for FDI and/or profits. As both is more mobile the closer the considered countries are, tax competition between small countries is mainly regional.

4 Is tax competition a European phenomenon?

Almost all empirical studies that consider tax competition structures use data on European countries or on a sample that mainly consists of European countries (such as the set of OECD countries in Devereux et al., 2008). Davies and Voget (2011) explicitly focus on the influence of EU membership on corporate tax competition. By weighting tax rates of other countries by their market potential they find that all countries respond stronger to tax rates of EU members, with an even larger effect if the considered country is itself an EU member. Redoano (2014) confirms these results by using inverse geographical distance weighted average tax rates of other countries. Moreover, she shows that countries which joined the EU responded stronger to other EU countries after joining the EU than before. Thus empirical literature suggests that the creation of a single capital market and the related high capital mobility has enhanced tax competition between EU members.

In this section I investigate if particularly European countries engage in tax competition. To test this question, I repeat the regressions in Table 2 and divide the sample into two subsamples: the first contains all countries that are members of the European Economic Area (EEA) whereas the second contains only countries that are not EEA members.⁵ As the EEA provides a framework for high capital mobility the average tax rates should yield particularly large and significant coefficients in the regressions for the EEA countries.

Dep. variable: $ au_{it}$	EEA countries		non-EEA countries	
	unweighted av.	inv. dist. w.	unweighted av.	inv. dist. w.
$\overline{\tau}_{it}^{large}$ * small	0.351^{**} (2.060)	0.167 (1.284)	0.274 (1.358)	-0.155 (-0.736)
$\overline{\tau}_{it}^{large}$ * large	0.894^{***} (3.509)	0.735^{**} (2.441)	0.639^{**} (2.350)	$0.005 \\ (0.030)$
$\overline{\tau}_{it}^{small} * small$	0.602^{***} (2.845)	0.765^{***} (3.830)	1.063^{**} (2.321)	0.760^{**} (2.419)
$\overline{\tau}_{it}^{small}$ * large	$0.060 \\ (0.296)$	0.187 (0.721)	0.565^{*} (1.813)	0.550^{*} (1.717)
Control variables	yes	yes	yes	yes
Time trend	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Observations	228	228	279	279
R^2	0.067	0.748	0.034	0.356
Hansen J (p-val)	0.794	0.732	0.397	0.423

Table 3: Results for EEA specification

Notes:

1. Parentheses contain t-statistics robust to clusters in country.

2. ***, ** and * denote significance level at 1, 5 and 10 percent levels resp.

3. Countries with a GDP $\geq 7\%$ of the US GDP are defined as large, others as small.

4. $\overline{\tau}_{it}^{large}/\overline{\tau}_{it}^{small}$ is the average statutory rate of (other) large/small countries,

unweighted in col. 1 and inverse geographical distance weighted in col. 2.

5. small / large are dummies equal to one if country is small/large.

6. All interacted tax variables are instrumented by the unweighted/inv. dist. weighted averages of control variables of the same set of countries contained in the

respective average tax rate, interacted by small/large.

Table 3 presents results for the estimation of eq. (2) for the two subsamples of EEA and non-EEA countries. For both EEA and non-EEA countries the average tax rate of small countries interacted with the *small* dummy is significantly positive, both for unweighted and inverse geographical distance weighted average tax

⁵The set of EEA countries in my sample consists of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden and the United Kingdom.

rates. This indicates that the small countries' regional tax competition is not only a European phenomenon - also for small non-EEA countries I find significant tax responses to other small countries.

The large countries' unweighted average tax rate interacted with the *large* dummy yields significantly positive coefficients in the first and the third regression in Table 3. Thus also the large countries' tax competition is not only a European phenomenon. In the second regression for EEA countries, the inverse distance weighted average tax rate of other large countries interacted with the *large* dummy leads also to a significantly positive coefficient. This might come from the fact that a lot of large countries are located quite close to each other in Europe.

All in all my results for the two subsamples of EEA and non-EEA countries show that the tax competition patterns found in the previous section are not only a European phenomenon but also arise for non-European countries.

5 Discussion

Devereux et al. (2008) argue that if tax interactions are due to an alternative explanation (common intellectual trend or yardstick competition) they should not depend on the presence of capital controls. Indeed they find that tax interactions are only present between countries with sufficiently low capital controls, speaking for tax competition as the driving mechanism. Tables B.1 and B.2 in the Appendix show results of my regressions without excluding observations with a negative Chinn-Ito-Index. Thus the regressions use all years for all countries in the sample. Compared to the data used in the previous sections this leads to an inclusion of twelve additional countries (Argentina, Belarus, China, Colombia, India, Malaysia, Morocco, South Africa, Thailand, Ukraine, Venezuela, Vietnam) dropped in the previous regressions due to a negative Chinn-Ito-Index in all years from 2003 to 2013.

For the large countries' regressions I find that the tax coefficient of other large countries that was significant in the first regression in Table 1 is now smaller and less significant. Hence interactions between large countries depend on the presence of sufficiently high capital mobility. This speaks in favor of competition for mobile capital to be the driving mechanism behind the observed interactions. Also in small countries' regressions all coefficients for other (close) small countries' tax rates are smaller. Hence tax interactions between small countries are more intense for the subset of countries with low capital controls. This provides evidence that also tax interactions between small countries are due to competition for mobile capital rather than to alternative explanations.

The same results arise when repeating the full sample regressions in Table 2 for all countries, including those with a negative Chinn-Ito-Index. The small countries' average tax rate interacted with the *small* dummy now yields lower coefficients, both if unweighted and weighted with inverse distances. The interaction of large countries' average tax rate with the *large* dummy is no longer significant, again indicating that this interaction was due to competition for mobile capital rather than an alternative explanation. Nevertheless, the small countries' average tax rate interacted with the *large* dummy leads now to a significantly positive coefficient in the regression using inverse distance weights. This interaction might indicate the presence of yardstick competition with neighboring countries.

6 Conclusion

In this paper I have investigated country size as a determinant of tax competition and its spatial structure. The results suggest that large countries (defined by a GDP of at least 7 percent of the US GDP) compete inter-regionally with all other large countries in corporate taxes. By contrast small countries' tax interactions are intraregional: they mainly respond to other small countries' tax rates located close to them. There is no convincing evidence for simultaneous tax interactions between small and large countries or vice versa.

I also show that the tax competition patterns I found are not only a European phenomenon. Furthermore, I confirm Devereux et al.'s (2008) finding that tax competition takes place only between countries without capital controls: tax interactions were larger between countries with a positive Chinn-Ito-Index (which indicates sufficiently low capital controls).

I propose that the observed tax competition between small countries is due to regional competition for mobile FDI and/or profits. My proposal for the observed tax competition patterns of large countries is that large countries compete in corporate tax rates mainly to hold their national champions' cost structures competitive. As most big firms have their headquarters based in large countries this might explain the observed tax interactions among large countries. The direct validation of this explanation approach maybe an issue for further research, perhaps by including data on the countries' firm structures into the empirical approach.

Appendix

A Summary statistics

Table A.1: Size Classification and Chinn-Ito-Index of countries in the sample

Country	Large with GDP $\geq 7\%$ of US GDP in years	Dropped because of negative Chinn-Ito-Index in years
Argentina	-	all
Australia	2008, 2010-2013	-
Austria	-	-
Belarus	-	all
Belgium	-	-
Brazil	2006-2013	2003, 2004, 2011-2013
Bulgaria	-	2003-2005
Canada	all	-
Chile	-	-
China	all	all
Colombia	-	all
Costa Rica	-	-
Croatia	-	-
Czech Republic	-	-
Denmark	-	-
Ecuador	-	-
Egypt	-	2013
Finland	-	-
France	all	-
Germany	all	-
Greece	-	-
Guatemala	-	-
Hong Kong	-	-
Hungary	-	-
India	2007-2013	all
Indonesia	-	2011-2013
Ireland	-	-
Italy	all	-
Japan	all	-
Latvia	-	-
Lithuania	-	-
Luxembourg	-	-
Malaysia	-	all
Malta	-	2003

Mexico	2007,2008,20112013	-
Morocco	-	all
Netherlands	-	-
New Zealand	-	-
Norway	-	-
Peru	-	-
Philippines	-	2010-2013
Poland	-	-
Portugal	-	-
Romania	-	-
Russia	2006-2013	2003-2008
Saudi Arabia	-	-
Singapore	-	-
Slovak Republic	-	-
South Africa	-	all
South Korea	2007, 2011, 2013	2003-2007
Spain	all	-
Sri Lanka	-	2013
Sweden	-	-
Switzerland	-	-
Thailand	-	all
Turkey	-	2003-2007
Ukraine	-	all
United Kingdom	all	-
United States	all	-
Uruguay	-	-
Venezuela	-	all
Vietnam	-	all

T	able A.2: Summary statistics and data so	urces of	all observ	ations	with a	positive Chinn-Ito-Index
Variable	Description	Mean	Std.Dev.	Min	Max	Source
$ au_{it}$	Statutory tax rate	0.261	0.075	0.000	0.420	2003-2007: Mintz and Weichenrieder (2010), 2008-2013: KPMG (2015)
Gov.exp./GDP	General government total expenditure in per- cent of GDP	0.374	0.116	0.121	0.654	IMF World Economic Outlook Database
$GDP_{it}/GDP_{USA,t}$	GDP in percent of the USA's GDP	0.066	0.155	0.001	1.000	Calculated from GDP data of the IMF World Economic Outlook Database
Personal tax rate	Highest personal income tax rate	0.352	0.136	0.000	0.623	KPMG's Individual Income Tax and Social Security Rate Survey
Proportion young	Proportion of population aged less than 14 vears	0.199	0.068	0.117	0.436	World Bank World Economic Indicators
Proportion old	Proportion of population aged more than 65 vears	0.132	0.049	0.029	0.251	World Bank World Economic Indicators
Proportion urban	Proportion of population living in urban ar- eas	0.734	0.162	0.150	1.000	World Bank World Economic Indicators
Chinn-Ito-Index	High values indicating low capital controls	1.975	0.763	0.036	2.422	Chinn and Ito (2008), updated to 2013 on http://web.pdx.edu/~ito/Chinn- Ito_website.htm

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B Regressions including observations with capital controls

	large countries		small countries	
Dep. variable: τ_{it}	unweighted av.	inv. dist. w.	unweighted av.	inv. dist. w.
$\overline{ au}_{it}^{large}$	0.544^{*}	0.303	-0.410	-0.113
	(1.933)	(1.198)	(-1.306)	(-0.584)
$\overline{ au}_{it}^{small}$	0.224	0.311	0.766**	0.507**
	(1.413)	(1.300)	(2.561)	(2.135)
$ au_{it-1}$	0.684***	0.671***	0.616***	0.604***
	(9.770)	(8.960)	(6.464)	(5.973)
Control revishing	woo	waa	wor	
Control variables	yes	yes	yes	yes
Time trend	yes	yes	yes	yes
Country fixed effects	yes	yes	yes	yes
Observations	135	135	547	547
R^2	0.791	0.784	0.538	0.542
Hansen J (p-val)	0.271	0.365	0.385	0.274

Table B.1: Basic regressions including observations with a negative Chinn-Ito-Index

Notes:

1. Parentheses contain t-statistics robust to clusters in country.

2. ***, ** and * denote significance level at 1, 5 and 10 percent levels resp.

3. Countries with a GDP $\geq 7\%$ of the US GDP are defined as large, others as small.

4. $\overline{\tau}_{it}^{large}/\overline{\tau}_{it}^{small}$ is the average statutory rate of (other) large/small countries, unweighted

in col. 1 and 3 and inverse geographical distance weighted in col. 2 and 4.

5. $\overline{\tau}_{it}^{large}$ and $\overline{\tau}_{it}^{small}$ are instrumented by the unweighted/inv. dist. weighted averages of control variables of small/large countries respectively.

	full sample	
Dep. variable: $ au_{it}$	unweighted av.	inv. dist. w.
$\overline{ au}_{it}^{large}$ * small	-0.336 (-1.126)	-0.056 (-0.315)
$\overline{\tau}_{it}^{large}$ * large	0.225 (1.175)	-0.122 (-0.792)
$\overline{\tau}_{it}^{small}$ * small	0.777^{***} (2.673)	0.457^{**} (2.172)
$\overline{\tau}_{it}^{small}$ * large	$0.071 \\ (0.581)$	0.566^{***} (2.806)
$ au_{it-1}$	$\begin{array}{c} 0.627^{***} \\ (6.832) \end{array}$	$\begin{array}{c} 0.615^{***} \\ (6.424) \end{array}$
Control variables	yes	yes
Time trend	yes	yes
Country fixed effects	yes	yes
Observations	682	682
R^2	0.558	0.561
Hansen J (p-val)	0.330	0.639

Table B.2: Full sample regressions including observations with a negative Chinn-Ito-Index

Notes:

1. Parentheses contain t-statistics robust to clusters in country.

2. *** and ** denote significance level at 1 and 5 percent levels resp.

3. Countries with a GDP $\geq 7\%$ of the US GDP are defined as large, others as small.

4. $\overline{\tau}_{it}^{large}/\overline{\tau}_{it}^{small}$ is the average statutory rate of (other) large/small countries,

unweighted in col. 1 and inverse geographical distance weighted in col. 2.

5. small / large are dummies equal to one if country is small/large.

6. All interacted tax variables are instrumented by the unweighted/inv. dist.

weighted averages of control variables of the same set of countries contained in the respective average tax rate, interacted by small/large.

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