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Working Paper

## Rate Cutting Tax Reforms and Corporate Tax Competition in Europe

ZEW Discussion Papers, No. 08-028

**Provided in cooperation with:**

Zentrum für Europäische Wirtschaftsforschung (ZEW)

Suggested citation: Heinemann, Friedrich; Overesch, Michael; Rincke, Johannes (2008) : Rate Cutting Tax Reforms and Corporate Tax Competition in Europe, ZEW Discussion Papers, No. 08-028, <http://hdl.handle.net/10419/24723>

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## Non-Technical Summary

Rate cutting reforms of the corporate income tax are the outcome of complex political decision making processes. Therefore, governments tend to choose their tax rate at one point in time to then keep it constant for a couple of years. The tax setting behavior of governments therefore can be described as a discrete choice decision problem. We offer a simple empirical framework that relates a government's decision whether to cut its corporate tax rate to the country's own inherited tax and taxes in neighboring countries. Thus, our approach directly addresses the discrete political decisions that eventually has lead to what is one of the most intensely debated issues in corporate taxation in Europe: national governments being engaged in a step-by-step process of cutting the statutory corporate income tax rate.

Using comprehensive data on corporate tax reforms in 32 European countries since 1980, our empirical results indicate that the probability for tax rate reductions among European countries strongly depends on a country's relative position in terms of the tax burden on corporate income. In particular, high tax countries are significantly more likely to reduce their tax rates. Moreover, we find striking evidence for a direct effect of tax rates set by competing countries on a given country's willingness to reduce its own tax. If other countries cut their taxes, a given country's probability to react by cutting its own tax is increased. A further insight relates to the political economic dimensions of tax rate adjustments. Our results indicate that corporate tax cuts are significantly more likely during election campaigns, suggesting that they are part of popular economic programmes.

Taken together, our findings strongly support the view that part of the recent downward trend in corporate tax rates in Europe is induced by direct interaction among governments in setting corporate income tax rates. Most importantly, the results show that national policies regarding rate cutting tax reforms in Europe since 1980 are strongly affected by pressures resulting from

tax policies of other countries. The main advancement relative to previous empirical work is that, by using a discrete choice decision framework and focusing on rate cutting tax reforms rather than statutory tax rates, we provide direct evidence on a step-by-step process of cutting statutory rates.

## Zusammenfassung (Summary in German)

Steuerreformen, die zur Absenkung des Unternehmensteuersatzes führen, sind Ergebnisse komplexer politischer Entscheidungsprozesse. Daher tendieren Regierungen dazu, einen einmal gewählten Steuersatz für eine längere Zeit beizubehalten. Die Wahl des optimalen Unternehmensteuersatzes kann daher als ein diskretes Entscheidungsproblem betrachtet werden. Diese Untersuchung basiert auf einem empirischen Modell, welches den Zusammenhang zwischen der Entscheidung einer Regierung, ob sie den Steuersatz senken solle, mit dem bestehenden eigenen Steuerniveau und den Steuersätzen der benachbarten Staaten analysiert. Dieser Ansatz betrachtet folglich direkt die politischen Entscheidungen, welche möglicherweise zu dem intensiv diskutierten Phänomen geführt haben, wonach sich die Regierungen in Europa in einem Prozess der schrittweisen Senkungen ihrer Unternehmensteuersätze befinden.

Die Analyse basiert auf einem umfangreichen Datensatz von Unternehmensteuerreformen im Zeitraum 1980 bis 2007 in bis zu 32 europäischen Staaten. Die empirischen Ergebnisse zeigen, dass die Wahrscheinlichkeit für Senkungen des tariflichen Unternehmensteuersatzes stark von der relativen Position der Unternehmensteuerbelastung eines Landes abhängt. Insbesondere Hochsteuerländer sind deutlich eher geneigt ihren Unternehmensteuersatz zu senken. Zudem findet sich starke Evidenz für einen direkten Effekt der Höhe der Steuersätze in konkurrierenden Standorten auf die Wahrscheinlichkeit einer Steuersatzsenkung. Falls andere konkurrierende Länder ihren Steuersatz senken, dann steigt die Wahrscheinlichkeit einer Steuerreform in einem gegebenen Land signifikant an. Des weiteren verdeutlichen die Ergebnisse einen polit-ökonomischen Aspekt von Steuerreformen. Senkungen der Unternehmensteuer sind viel wahrscheinlicher in Zeiten des Wahlkampfes, was darauf hindeutet, dass solche Reformen vielfach Teil von populären Wirtschaftsprogrammen in Wahlkämpfen sind.

Zusammenfassend unterstützen unsere Ergebnisse die Sichtweise, dass der ak-

tuelle Trend hin zu niedrigeren Unternehmenssteuersätzen in Europa teilweise durch direkte Interaktionen zwischen der Steuerpolitik der einzelnen Regierungen erklärt werden kann. Die Ergebnisse zeigen deutlich, dass die Politik der europäischen Einzelstaaten im Bezug auf Steuersatzsenkungen unter dem Druck der Steuerpolitik konkurrierender Staaten steht. Der Fortschritt der vorliegenden empirischen Analyse ist insbesondere darin zu sehen, dass durch die explizite Berücksichtigung des diskreten Charakters von Steuerreformentscheidungen und der klaren Fokussierung auf Senkungen der tariflichen Steuersätze direkte Evidenz zum schrittweisen Senkungsprozess der Unternehmenssteuersätze herausgearbeitet wird.

# Rate Cutting Tax Reforms and Corporate Tax Competition in Europe

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April 2008

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## Abstract

While there is a large and growing number of studies on the determinants of corporate tax rates, the literature has so far ignored the fact that the behavior of governments in setting tax rates is often best described as a discrete choice decision problem. We set up an empirical model that relates a government's decision whether to cut its corporate tax rate to the country's own inherited tax and taxes in neighboring countries. Using comprehensive data on corporate tax reforms in Europe since 1980, we find evidence suggesting that the position in terms of the tax burden imposed on corporate income relative to geographical neighbors strongly affects the probability of rate cutting tax reforms. Countries are particularly likely to cut their statutory tax rate if the inherited tax is high and if they are exposed to low-tax neighbors.

*Keywords:* Tax reform, tax competition, corporate taxes

*JEL Classification:* H20, H25, H71.

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## 1 Introduction

During the last decades, corporate income tax policies in European countries have been characterized by frequent rate cutting tax reforms, resulting in a significant downward trend in statutory tax rates. In that movement, the new member states of the EU have been among the pioneers of an aggressive low tax policy. While these facts are hardly disputable, the driving forces behind what is often perceived as a ‘race to the bottom’ in corporate tax rates are less clear. Two fundamentally different explanations exist.

First, the downward trend of corporate taxes observable in the EU over the last 25 years may reflect increased competitive pressure on national tax policies. The literature has discussed several forms of competition leading to cross border links in tax policies, ranging from capital mobility and the mobility of profits to yardstick competition (see, e.g., Devereux, Lockwood, and Redoano (2008) and Fuest, Huber, and Mintz (2005) for a general discussion and Besley and Case (1995), Revelli (2001), Revelli (2002), Bordignon, Cerniglia, and Revelli (2003) and Vermeir and Heyndels (2006) for work addressing yardstick competition among states and local jurisdictions). These explanations have in common that they imply a strategic interaction between national governments so that tax policy decisions of one country trigger reactions of other countries with a more or less pronounced spatial pattern.

Second - and fundamentally different - the downward trend could equally well mirror phenomena unrelated to any cross-border links of tax policies among European countries. The downward trend in corporate tax rates might, for example, simply express a common intellectual trend regarding the perceived role of low corporate taxes for national growth and welfare. A further explanation is related to the economic backwardness of new EU member countries from Central and Eastern Europe. For such economies with an initially low public and private capital stock, setting low corporate tax rates could reflect

the fact that investors need to be compensated for otherwise rather disadvantageous country characteristics. If this were the major reason behind the pronounced low-tax policies of the new EU member states, falling corporate tax rates for the EU average would (at least to some extent) mirror the larger economic diversity of the enlarged Community and the need for more differentiated national tax policies.

Understanding the forces behind the downward trend in corporate taxes is crucial for many important policy issues in the EU like the introduction of minimum taxes and tax harmonization in general. Therefore, our study aims at testing for the existence of cross-border links in corporate tax policy decision making. While a sizable part of the empirical tax competition literature has dealt with the correlation between a given country's tax rate and taxes of other countries, we focus on actual decisions of national governments to cut their country's corporate tax rate. Compared to the estimation of tax reaction functions our approach more directly addresses the discrete political decisions that eventually has lead to what is one of the most intensely debated issues in corporate taxation in Europe: national governments being engaged in a step-by-step process of cutting the statutory corporate income tax rate from an average of well above 45% in 1980 to merely 24% in 2007.

While controlling for a number of country characteristics and unobserved heterogeneity, our empirical model relates an indicator for rate cutting reforms to a country's own tax rate and neighbors' taxes. We therefore test to what degree a country's position in terms of the tax burden on corporate income relative to its geographical neighbors affects the probability of rate cutting tax reforms. Focusing on rate cutting tax reforms is advantageous for a simple reason: Since they are the outcome of complex political decision making processes, tax rates are characterized by substantial inertia, i.e. in many countries they do not change very frequently. From a practical point of view, the tax setting behavior of governments should therefore be described as a discrete choice decision problem rather than a process of continuous adjustment of

taxes to optimal levels. Moreover, if governments tend to choose their tax rate at one point in time to then keep it constant for a couple of years, one might well overstate the actual degree of interaction in the choice of the tax rate by collecting data over many years and treating observations for a given country as independent observations.

To the best of our knowledge, we provide the first analysis of the determinants of rate cutting tax reforms. However, our study is closely related to other contributions to the well established and fast growing literature on the determinants of corporate tax policy. A first strand of relevant literature deals with the impact of increased economic integration on corporate tax rates. Rodrik (1997), Swank and Steinmo (2002), Slemrod (2004), Winner (2005), Schwarz (2007) and Ghinamo, Panteghini, and Revelli (2007) all find that increased openness is associated with lower levels of company tax rates<sup>1</sup>, thus providing suggestive evidence on the role of international tax competition in shaping national tax policies.

Compared to the abovementioned literature, studies which explicitly test for interaction in national tax policies are relatively scarce. The common approach taken in this second strand of literature is to directly estimate tax reaction functions. Recently, Devereux, Lockwood, and Redoano (2008) have dealt with competition in statutory tax rates as well as tax levels attributable to marginal investments among OECD countries. As Redoano (2007), they find that tax levels are positively related to other countries' taxes. Similarly, Egger, Pfaffermayr, and Winner (2007) find positively sloped reaction functions for both corporate and personal income taxes. Hauffer, Klemm, and Schjelderup (2006) discuss the effect of capital mobility on the ratio between corporate income tax to labor income tax and report evidence suggesting that

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<sup>1</sup>Swank and Steinmo (2002) and Bretschger and Hettich (2002, 2005) estimate insignificant effects of capital market liberalization on company tax rates computed in accordance with the Mendoza, Razin, and Tesar (1994) methodology. These results are, however, compatible with the tax competition hypothesis since high tax base elasticities can lead to higher tax revenues despite a decline of tax rates.

the relative level of a country's corporate tax develops in accordance to the worldwide average of corporate tax rates over time.

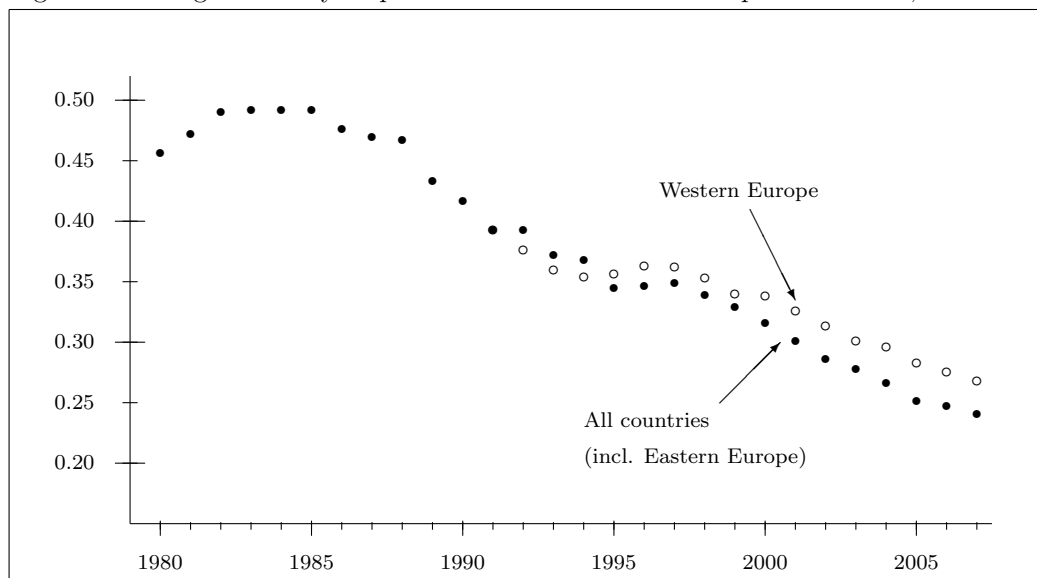
Our results indicate that the probability for tax rate reductions among European countries strongly depends on a country's relative position in terms of the tax burden on corporate income. In particular, high tax countries are significantly more likely to reduce their tax rates. Across various specifications and estimators, we find a country to be 2.1 to 2.6 percentage points more likely to cut its tax rate if the actual rate is one percentage point higher compared to a country that is identical in all other respects. Moreover, we find striking evidence for a direct effect of tax rates set by competing countries on a given country's willingness to reduce its own tax. If other countries cut their taxes by one percentage point on average, a given country's probability to react by cutting its own tax is increased by 1.5 to 3.2 percentage points. Taken together, our findings strongly support the view that part of the recent downward trend in corporate tax rates in Europe is induced by direct interaction among governments in setting corporate income tax rates.

The paper proceeds as follows. Section 2 gives a short overview of the trends in corporate taxation in Europe since 1980. In Section 3, we discuss our empirical approach and the data. The empirical results are presented in Section 4, and Section 5 concludes.

## **2 Corporate taxation and tax reforms in Europe, 1980-2007**

The statutory corporate income tax rate (*STR*) is the most prominent measure for a country's tax burden on corporate income. It affects effective average and effective marginal tax rates, which are relevant for location and, respectively, investment decisions of firms (see Devereux and Griffith, 2003; Devereux

Figure 1: Average statutory corporate income tax rate in European countries, 1980-2007



Graph shows unweighted average of statutory corporate income tax rates. Western European countries considered (period): AT (81-07), BE (80-07), CH (80-07), CY (91-07), DK (80-07), ES (91-07), FI (80-07), FR (80-07), DE (80-07), GR (90-07), IE (80-07), IS (90-07), IT (80-07), LU (80-07), MT (94-07), NL (80-07), NO (90-07), PT (90-07), TR (96-07), SE (82-07), UK (80-07). Eastern European countries: BG (93-07), CZ (92-07), EE (95-07), HR (95-07), HU (92-07), LV (95-07), LT (95-07), PL (92-07), RO (94-07), SI (95-07), SK (92-07).

and Lockwood, 2006).<sup>2</sup> Furthermore, the *STR* directly impacts multinational companies' incentives to shift paper profits among affiliates.

Figure 1 depicts average statutory corporate income tax rates in Europe since 1980.<sup>3</sup> The graph covers up to 32 countries including the 27 EU member states and, in addition, Croatia, Iceland, Norway, Turkey, and Switzerland.

<sup>2</sup>The statutory tax rate neglects any difference in the determination of the tax base and the existence of non-income taxes. Although these provisions of a tax system are also important determinants of effective tax rates, a cut of the statutory tax rate leads to lower effective tax rates holding other things equal provided that the provisions determining the tax base are not outstandingly favorable.

<sup>3</sup>We use the headline tax rates of the corporate income tax adjusted for surcharges and typical local income taxes, which are imposed on the same or a similar tax base. The computation of the *STR* accounts for local income taxes as the *IRAP* in Italy or the *Gewerbesteuer* in Germany.

In 1980, the mean statutory tax rate based on 11 Western European countries was 45.6%. By 2007, the mean statutory tax rate among 32 European countries has decreased to 24.1%.

The Eastern European countries have been particularly aggressive in reducing statutory rates.<sup>4</sup> The Czech Republic has reduced its statutory rate nine times since 1992, followed by Bulgaria and Poland with eight and seven reforms, respectively. On average, the 11 Eastern European countries considered in this study have reduced their tax rates from 31.5% in 1996 to 18.9% in 2007. During the same period, the 21 considered Western European countries have lowered their mean statutory tax rate from 36.3% to 26.8%.

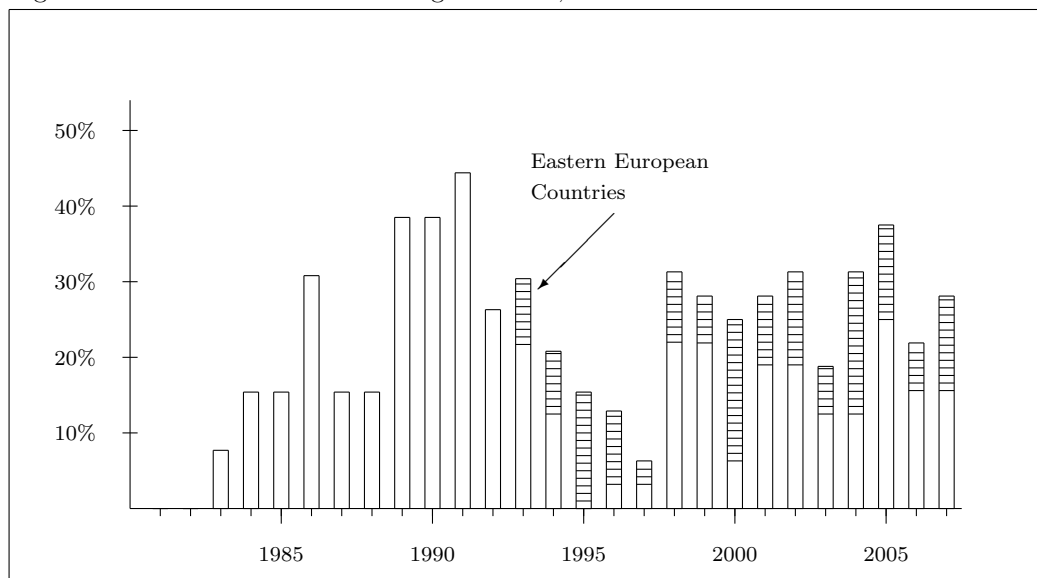
Note that our definition of a tax rate cut accounts for institutional features of the corporate tax system in countries where the observed overall tax burden on corporate income may vary even if there is no change in national tax policies. In particular, in countries with local business income taxes, we only consider countrywide reforms of the local tax, but we do not consider changes which are merely modifications at the local level. With this definition, in the 32 countries considered 148 tax rate cuts occurred between 1981 and 2007. On average, national governments have cut their corporate tax rate every four years.

Figure 2 depicts, for all years considered, the fraction of countries that actually lowered their tax rate. Particular intensive rate cutting activities have occurred between 1989 and 1994 and since 1998. In contrast, during the mid 1990s only very few tax rate cuts were observed. Only the transformation economies in Eastern Europe intensively reduced their statutory tax rates. Since 1998, our data show a general tendency towards intensified rate cutting activities with no particular geographical pattern.

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<sup>4</sup>See Devereux (2007) for further evidence and related discussion and Bellak and Leibrecht (2008) for evidence on FDI flows induced by low-tax policies by Eastern European countries.

Figure 2: Fraction of tax rate cutting countries, 1981-2007



The bars depict the fraction of tax rate cutting countries in all countries for which tax data are available. For details on sample composition see notes below Figure 1.

### 3 Empirical approach and data

#### 3.1 Empirical model

Our empirical analysis aims at identifying the key determinants of rate cutting tax reforms among European countries. As discussed above, a sizable recent literature has analyzed the determinants of countries' business tax rates, focussing on the forces of globalization in general and other countries' tax policies in particular. Most contributions come to the conclusion that international competition for firms and capital investment has significantly contributed to the remarkable decline of statutory tax rates in Europe since the 1980s. If this claim is correct, we should be able to go one step further and model a government's discrete decision to implement a rate cutting tax reform (or not to implement such a reform) as a function of the country's relative position in terms of the tax burden on corporate income.<sup>5</sup> Based on the available

<sup>5</sup>Note that there are 23 cases in our sample where countries actually increased their corporate tax rate. Since we are interested in the determinants of tax cutting reforms, we treat them as 'no-reform' cases.

empirical evidence on international tax competition, we expect to find support for two key hypotheses. First, governments of high tax countries should be more likely to reduce taxes. Second, governments should react to taxes set by neighbors. In particular, a country that is exposed to neighbors with low taxes is expected to cut its own tax rate with higher probability than an otherwise identical country exposed to high-tax neighbors.

We take a straightforward approach to test these hypotheses and model the policies of national governments regarding corporate taxation as being subject to adjustment pressure originating from various sources. Among them, there are external forces such as other countries' tax policies and the changing degree of mobility of relevant tax bases. Internal forces result from the political-economic situation (such as the ideology of the parties in power or pressure related to the timing of elections) or socio-economic factors such as, for instance, the demographic situation. The model is based on the idea that an adjustment of the tax rate occurs if the adjustment pressure exceeds a critical level.

Formally, a government's decision to reduce the country's business tax rate is modeled as a discrete choice decision problem and captured in an econometric model using a standard latent variable framework. Suppose that the observable decision to either cut the corporate tax rate,  $y_{it}$ , or not to do so is related to the latent predisposition towards lowering taxes,  $y_{it}^*$ , according to

$$y_{it} = 1[y_{it}^* > 0], \quad i = 1, \dots, N; \quad t = 1, \dots, T \quad (1)$$

where  $1[\cdot]$  is the indicator function. Suppose furthermore that a government's predisposition towards reducing the statutory tax rate in country  $i$  and period  $t$  is a function of the corporate tax rate inherited from the previous period,  $\tau_{i,t-1}$ , and of a linear combination of other countries' corporate tax rates in  $t-1$ ,  $\tau_{-i,t-1} = \sum_j w_{ij} \tau_{j,t-1}$ , where the  $w_{ij}$ 's are predetermined weights complying to  $w_{ii} = 0$  and  $\sum_j w_{ij} = 1$ . Adding a vector of exogenous country or government characteristics  $x_{i,t-1}$ , a common period-specific effect  $\eta_t$ , an un-



observable country-specific effect  $c_i$  and a residual  $u_{it}$  and choosing a linear specification for the latent variable provides us with

$$y_{it}^* = \alpha\tau_{i,t-1} + \beta\tau_{-i,t-1} + x_{i,t-1}\gamma + \eta_t + c_i + u_{it}, \quad (2)$$

where  $\alpha$ ,  $\beta$  and  $\gamma$  are the (vectors of) coefficients to be estimated. Note that the explanatory variables all enter the estimation equation with a one-period lag relative to the dependent variable. This is to account for the fact that implementing a tax reform is likely to involve some time lag. Note furthermore that including a common period-specific effect as well as an unobservable country-specific effect is arguably the most promising way to ensure that our estimates are robust to the likely presence of common trends in tax reform policies as well as unobserved heterogeneity among countries.

In the following section we report results for probit, fixed effects logit and linear probability models. Applying the linear probability model to discrete choice decision problems may not seem appropriate from a technical perspective.<sup>6</sup> However, from a practical point of view it is worth mentioning that in most applications the linear probability model tends to give marginal effects that are very close to those derived from more sophisticated models for discrete responses. We will discuss the choice of the estimator in more detail in Section 4.

Equation (2) employs spatial weights that for each country determine the tax rate of a composite neighbor, i.e. a weighted average of other countries' statutory tax rates. It is common in the empirical tax competition literature to define the weights according to some inverse measure of distance.<sup>7</sup> The most common inverse distance measure is the common border criterion. Unfortunately, some European countries do not have any contiguous neigh-

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<sup>6</sup>For a thorough discussion of the various approaches to estimate discrete response models see Maddala (1983).

<sup>7</sup>A distinctive advantage of weighting schemes relying on some measure of geographical distance (compared to various measures of similarity in terms of country characteristics) is that geographical conditions can safely be regarded as being exogenously given in most applications.

bor, making it impossible to apply the common border criterion to European countries without further assumptions. Furthermore, given the intuition saying that larger countries should exert a stronger influence on other countries' tax policies than smaller countries, and that, at the same time, geographical close neighbors should be more influential than those far apart, we use a simple proximity measure based on geographical distance and adjusted for differences in country size. Note that using weights which are differentiated according to geographical distance is in line with empirical evidence showing that distance negatively affects FDI (Carr, Markusen, and Maskus, 2001; Markusen, 2002). Moreover, geographical distance should also negatively affect the intensity of transactions that are used to disguise pure paper-profit shifting.

Formally, the weights are determined as follows. With  $d_{ij}$  denoting the distance between the capitals of countries  $i$  and  $j$  in kilometers, and  $pop$  being total population, we set  $w_{ij} = 0$  if  $j = i$  and

$$w_{ij} = \frac{\ln(pop_j)/d_{ij}^2}{\sum_{k \neq i} \ln(pop_k)/d_{ik}^2} \quad \forall j \neq i. \quad (3)$$

The denominator scales the  $w_{ij}$ 's such that  $\sum_j w_{ij} = 1$ . Geographical distance is squared to make the weights being more 'selective' in terms of distance, i.e. to differentiate more strongly between geographically close and more distant countries of equal population size as neighbors of a given country. The inclusion of population size ensures that, in terms of their weights in the computation of composite neighbors' taxes, the contribution of very small countries like Luxembourg or Malta is discounted relative to big countries like France or Germany (holding distance fixed).

In order to give two examples for how the weighting scheme works in practice, consider the composite neighbor of Germany according to Equation (3). Sorted according to their weights, it has Poland (19%), the Czech Republic (17%), France (11%), the UK (9%), the Netherlands (6%), Denmark (6%), Italy (5%), and Austria (4%). The remaining 23% are scattered among the remaining countries (weights less than 4%). To give a second example, the com-

posite neighbor of Sweden is headed by Germany (28%), followed by Poland (13%), Finland (7%), the UK (7%), Norway (6%), France (6%), and Denmark (4%), leaving 28% scattered. On average, the weights of the five geographically closest neighbors of a country add up to 75%.

Note that our approach to define the weights differs from the one taken by Devereux, Lockwood, and Redoano (2008) and Redoano (2007), who argue in favor of uniform weights. Apart from economic intuition, there are also technical reasons to prefer differentiated weights. With uniform weights,  $\beta$  is not identified in the presence of common period-specific shocks. Technically, differentiated weights allow for cross-sectional variation of  $\tau_{-i}$ , and a potential impact of neighbors' taxes on a given country's tax policy can be identified even in the presence of common period effects.

### 3.2 Data

Our data cover up to 32 European countries for the period from 1980 to 2007. The sample includes all 27 member states of the European Union and is extended by Croatia, Iceland, Norway, Turkey, and Switzerland. During the 1980s the sample consists of western and northern European countries. The first year with a complete record for all 32 countries is 1996.

As our dependent variable, we employ a binary variable which takes value one in case of a cut in the statutory tax rate and zero in all other cases. Table 1 provides some descriptive statistics.

Our choice of additional control variables is guided by the need to take account of factors which could play a role in increasing or decreasing the pressure to cut the corporate tax rate. First, we consider several general country characteristics. As measures of country size, we include both GDP and population. We expect that the larger a country the less it is subject to forces from ex-

Table 1: Descriptive Statistics

Variable	Definition/Type	Obs.	Mean	Std.Dev.	Min.	Max.
Tax rate cut	Indicator	620	0.239	0.427	0	1
Own tax rate	Statutory corporate income tax rate adj. for surcharges	652	0.348	0.110	0.100	0.659
Composite neighbor's tax rate	Weighted average of other European countries' statutory tax rates	652	0.360	0.080	0.197	0.585
PITR	Personal top income tax rate	648	0.483	0.123	0.160	0.870
GDP	GDP in billions of purchasing power parities (PPP)	648	305.5	435.7	3.1	2,317
Population	Total number of inhabitants in thousand persons	652	19,240	23,698	255	82,520
Population between 15 and 65 years	Fraction of population between 15 and 65 years	652	0.669	0.019	0.588	0.720
Public consumption	Total public consumption as fraction of GDP	635	0.199	0.039	0.095	0.3
Election period	Indicator	595	0.518	0.500	0	1
Government: Left	Indicator	586	0.358	0.480	0	1
Government: Right	Indicator	586	0.423	0.494	0	1
Government: Center	Indicator	586	0.138	0.345	0	1
Government: Other	Indicator	586	0.080	0.272	0	1
Capital mobility	Sum of inward and outward foreign direct investment as proportion of GDP	522	0.114	0.659	-0.079	10.93
Trade openness	Sum of exports and imports as fraction of GDP	652	0.931	0.463	0.357	3.13
Feldstein-Horioka	Diff. between savings and investments as fraction of GDP	566	0.043	0.038	0	0.257

Sample includes 32 European countries with observations ranging from 1980 to 2007. Tax variables based on own calculations. Information on countries' tax systems has been collected from several databases provided by the International Bureau of Fiscal Documentation (IBFD), Amsterdam, and from surveys annually provided by Ernst&Young, PwC and KPMG. The information on FDI flows is taken from World Development Indicators of the World Bank. The other control variables are taken from Eurostat and augmented by the World Bank's World Development Indicators. Indicators for government ideology and election years are obtained from the Database of Political Institutions (Beck, 2001).

ternal competition. The size of government is measured as the ratio of public consumption to GDP. If the size of government increases, the leeway for tax cuts shrinks. Hence, we expect a negative coefficient. Furthermore, the age

structure of the population could influence tax policy due to budgetary effects of demographic change. Theory does not, however, suggest a particular sign for the coefficient.

In addition, we consider several politico-economic factors which may influence the probability of a tax reform. In particular, we consider an indicator for election periods.<sup>8</sup> It is well known from the literature on political business and budget cycles that governments tend to be particularly generous in election or pre-election years. In general, this should also hold with respect to the likely timing of tax cuts. However, the election year effect is less clear for corporate tax policy because tax cuts for companies might be criticized by voters from a distributive point of view and thus be less popular in the course of an ongoing election campaign. Hence, the sign prediction is ambiguous. Moreover, government ideology may affect the probability of corporate tax reductions. From the perspective of income redistribution, left parties can be expected to be less inclined to cut taxes for companies.

Finally, we employ three different indicators for openness since previous literature has found more open countries to have lower corporate taxes. Irrespective of how openness is actually measured, the degree of economic integration should matter for tax policies, with the expected sign being positive.

## 4 Results

As mentioned in the previous section, there are various approaches to estimate the coefficients and corresponding marginal effects of our discrete choice model of corporate income tax cuts in Europe. The key difficulty is the likely presence of unobserved country-specific effects, such as, for instance, a gen-

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<sup>8</sup>Technically, the indicator covers both the election and the pre-election year. Tax policy decisions in these two years can be expected to be influenced by similar forces related to a government's reputation and popularity.

Table 2: Corporate income tax cuts and neighbors' taxes: Baseline estimations

	(1) Probit ( $dP/dx$ )	(2) LPM	(3) FE Logit	(4) FE LPM
Own tax rate	1.234*** (0.303)	1.144*** (0.237)	20.05*** (3.003)	2.244*** (0.393)
Composite neighbor's tax rate	-0.535 (0.613)	-0.438 (0.591)	-13.33*** (4.991)	-1.266 (0.769)
Number of observations	597	597	584	597
(Pseudo) $R^2$	0.09	0.09	-	0.13

The table shows marginal effects (slopes evaluated at sample means) in Column (1) and coefficients in Columns (2)-(4). Standard errors in parentheses (Column (1): robust to serial correlation; Column (2) and (4): robust to heteroscedasticity and serial correlation). All estimations include a full series of period effects. Column (4) in addition includes a full series of country effects. All regressions use observations from 1983 to 2007.

\*\*\* 1% significance level.

eral predisposition towards lowering tax rates that cannot be accounted for by observable country characteristics. Unfortunately, the options to account for additive unobserved heterogeneity across countries are somewhat limited in the standard models for discrete responses such as probit and logit. Therefore, we will report results using a variety of estimators, ranging from pooled probit to fixed effects logit and linear probability models. Compared to estimators that are designed to properly account for discrete responses, the linear probability model (LPM) has two attractive features: the parameter estimates are easy to interpret, and the fact that the model is linear allows for the inclusion of country fixed effects.

To get a first impression of the performance of the different models, Table 2 depicts the results of four baseline estimations. Note that we have not included any control variables apart from countries' own and neighbors' taxes. Column (1) reports a simple probit. Since there is no option to account for unobserved heterogeneity in the probit framework, we report a standard probit on the pooled data. Note, however, that we include a full series of year effects. For ease of interpretation, we show average partial effects evaluated at sample means and corresponding standard errors. We note that the simple probit points to a positive impact of a country's inherited tax on the probability to cut the corporate income tax rate. However, the null of no impact of

neighbors' tax rates cannot be rejected. Column (2) repeats the baseline estimation without accounting for country-specific time-invariant effects using a linear probability model. As expected, the results are very similar to those in Column (1).

As unobserved country characteristics can be expected to play an important role in shaping the countries' tax policies, we now add country-specific effects. Column (3) shows coefficients derived from a fixed effects (FE) logit as the standard approach to control unobserved heterogeneity in limited dependent variable models. Note that we can make use of our data only beginning with 1983 as the countries in the sample did not reduce their statutory tax rates in 1981 and 1982. There is only one country, Malta, that kept its tax rate constant over the whole period for which information on the statutory rate is available. These observations cannot be used by the conditional maximum likelihood procedure of the FE logit, reducing the effective sample size to 584 observations. The FE logit has the drawback that one cannot compute average partial effects without specifying a distribution for the unobserved effects. Column (3) therefore provides only qualitative evidence. Interestingly enough, the FE logit baseline estimation uncovers a significant negative effect of neighbors' tax rates on the probability for a tax rate reduction. Thus, the FE logit baseline estimation provides the first piece of suggestive evidence that both expected effects (higher probability of tax cuts for high tax countries and countries exposed to low tax neighbors) might be present in our data. Finally, we also estimated a linear probability model incorporating a full series of country effects, shown in Column (4). Note that both coefficients are significantly larger compared to those reported for the LPM without country effects in Column (2). Moreover, the negative effect of neighbors' tax rates is now close to being significant at the 10% level. From the series of baseline estimations we draw the conclusion that it seems to be of crucial importance to account for unobserved heterogeneity across countries. Given that and the applied nature of our endeavor, we rely on the fixed effects linear probability model

to provide further evidence on the determinants of statutory tax reforms.

Table 3 summarizes the results of four additional estimations of the FE LPM. The estimations differ in terms of the measure for the openness of countries. As discussed above, a sizable literature has analyzed the effect of openness on corporate tax rates in Europe. When estimating the direct impact of neighbors' tax rates on the decision to cut the statutory tax rate, we certainly need to take account of the potential impact of openness itself. Since many different measures for openness have been proposed, we checked the robustness of our results using various of these measures.

Column (1) reports an estimation with our full set of controls including the common trade-based openness measure, i.e. the sum of exports and imports divided by GDP. In addition, we account for a full series of country and year effects. First of all, the results point to a significant positive impact of the inherited statutory rate on the probability of a tax cut. We estimate a country with an inherited statutory rate being one percentage point higher than that of an otherwise identical country to be 2 percentage points more likely to reduce its tax rate. Hence, high tax countries, all other things equal, are significantly more likely to cut their taxes than low tax countries. Secondly, we note a negative effect of the tax rate of the composite neighbor on a given country's reform probability. A one-percentage point decrease in neighbors' average tax rate makes a statutory tax rate cut 1.5 percentage points more likely. Note, however, that the trade-based openness measure is far from being significant as an independent explanatory variable. Using different openness measures may therefore affect the evidence regarding the impact of tax competition. Column (2) depicts a second set of results, with openness now measured as the difference between total savings and total investment in absolute value divided by GDP, as suggested by Feldstein and Horioka (1980). Note that the Feldstein-Horioka measure turns out to be statistically significant. However, contrary to our expectations, more open economies show a lower probability to cut corporate taxes than less open economies. More importantly, our results



Table 3: Corporate income tax cuts and neighbors' taxes: Linear probability model

	(1)	(2)	(3)	(4)
Own tax rate	2.214*** (0.448)	2.132*** (0.452)	2.101*** (0.473)	2.210*** (0.440)
Composite neighbor's tax rate	-1.533** (0.690)	-1.855** (0.793)	-1.810** (0.799)	-1.704** (0.734)
Public consumption	-0.104 (1.264)	0.247 (1.330)	0.839 (1.386)	-0.427 (1.361)
log(GDP)	0.145 (0.242)	0.418 (0.381)	0.583 (0.386)	0.384 (0.403)
log(POP)	0.530 (0.905)	0.517 (1.029)	0.226 (1.024)	1.332 (0.917)
Population between 15 and 65 years	4.050 (2.629)	0.859 (3.613)	0.440 (3.945)	1.597 (4.067)
Openness <sup>a</sup>	0.161 (0.244)	-2.682*** (0.831)	-3.621*** (1.078)	-0.028 (0.053)
Election period	0.119*** (0.027)	0.122*** (0.028)	0.128*** (0.027)	0.104*** (0.032)
Government: Right	0.053 (0.055)	0.053 (0.057)	0.056 (0.058)	0.050 (0.061)
Government: Center	0.065 (0.095)	0.041 (0.091)	0.041 (0.093)	0.022 (0.102)
Government: Other	0.104 (0.125)	0.117 (0.145)	0.073 (0.147)	0.121 (0.135)
Number of observations	538	482	474	478
R <sup>2</sup> (within)	0.17	0.19	0.19	0.17

Table shows coefficients and standard errors (robust to heteroscedasticity and serial correlation) for the linear probability model. All estimations include a full series of country and period effects. Regression shown by Column (1) use observations from 1983 to 2007, the regressions shown by Columns (2)-(4) use observations from 1983 to 2006 (varying effective sample size is due to missing values in explanatory variables).

<sup>a</sup> Openness measured as: Column (1): sum of exports and imports divided by GDP. Column (2): difference between total savings and total investment in absolute value divided by GDP. Column (3): three-year moving average of difference between total savings and total investment in absolute value divided by GDP. Column (4): sum of inward and outward FDI (annual flows) divided by GDP.

\* 10% significance level.

\*\* Idem., 5%.

\*\*\* Idem., 1%.

regarding the role of own and neighbors' taxes in shaping the willingness to cut the statutory tax rate proves to be highly robust to the alternative measurement of openness. In fact, the partial impact of neighbors' taxes on the probability of reform is now estimated to be even larger.

Further estimations substantiating the previous results are shown in the remaining columns. In Column (3), we use a three-year moving average of the Feldstein-Horioka measure to account for the cyclical movement of savings, investment, and GDP. The results are almost identical to those obtained in

Column (2). Column (4) uses a fourth measure of openness, namely the sum of inward and outward FDI (annual flows) divided by GDP. Again, the results are similar to those discussed before. Even the magnitude of the tax competition effect does not change much across specifications.

Apart from the effects mentioned so far our results also point to an interesting political economy effect on national tax policies: Consistent across all reported specifications, the probability for a cut in corporate taxes is 10 to 13 percentage points more likely in election periods. Thus, the pattern of a generous budgetary policy in election periods is supported with respect to corporate tax cuts. The interpretation of this effect is somewhat difficult, as corporate tax cuts are unlikely to be particularly popular among the electorate. Possibly, however, they are an ingredient of expansionary fiscal packages often observed prior to a general election.

We complete the discussion of our results by some robustness checks. First of all, we need to make sure that our findings are not specific to the linear probability model. As mentioned above, the FE LPM was chosen for the reason that it allows to account for unobserved country-specific effects and, at the same time, gives coefficient estimates which are easy to interpret. Column (1) in Table 4 provides the estimated coefficients of a FE logit that accounts for the full set of controls.<sup>9</sup> Again, we can only provide qualitative evidence on the effects of interest. We note that the FE logit gives highly significant parameter estimates confirming qualitatively our previous findings on the impact of tax competition on the willingness to cut the statutory business tax rate.

A second issue is the potential endogeneity of the tax rate variables on the right hand side of our estimation equation. Although we control for a number of country characteristics as well as year and country effects, there might still be unobserved variables driving a given country's willingness to cut taxes and, at the same time, affecting the country's own as well as neighbors' statutory

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<sup>9</sup>Note that we have used the three-year moving average of the Feldstein-Horioka measure here. Using a different openness measure gives very similar results.

Table 4: Corporate income tax cuts and neighbors' taxes: Fixed effects logit and 2SLS

	(1)	(2)	(3)
Estimator	FE logit	2SLS	2SLS
Own tax rate	27.79*** (4.525)	2.581*** (0.500)	2.078* (1.178)
Composite neighbor's tax rate	-22.93*** (6.647)	-3.184** (1.454)	-2.331* (1.393)
Years	1983-2007	1982-2007	1981-2007
Number of observations	439	453	471
$R^2$ (within)	-	0.20	0.20
IV for $\tau_i$	-	lagged STR	PITR
IV for $\tau_{-i}$	-	neighbors' pop.	neighbors' PITR
<i>First stage results:</i>			
$F$ -Statistic for IVs:	1 <sup>st</sup> stage for $\tau_i$	-	250.1
	1 <sup>st</sup> stage for $\tau_{-i}$	-	38.5
Coefficients of IVs:	IV for $\tau_i$	-	0.81 (0.04)
	IV for $\tau_{-i}$	-	0.14 (0.02)

Table shows estimated coefficients and standard errors (in parentheses, robust for 2SLS). All estimations include a full series of period effects and all additional controls reported in Column (3) of Table 2. Columns (2) and (3) also include a full series of country effects.

\* 10% significance level.

\*\* Idem., 5%.

\*\*\* Idem., 1%.

tax rates. Since such correlation would cast doubt on the consistency of our parameter estimates, we construct instruments for the potentially endogenous variables to be used in first stage regressions of two-stage least squares (2SLS) procedures.

A first set of instruments consists of the one-period lag of the statutory tax rate and neighbors' average population (in logs).<sup>10</sup> As the literature on the determinants of the corporate tax rate has shown, tax rates tend to be positively related to measures of country size. We use population figures to construct the instrument for neighbors' taxes as neighbors' population is arguably exogenous in our tax reform equation. Results from a 2SLS estimation using these instruments are reported in Column (2).

While there seems little reason to doubt the validity of neighbors' population

<sup>10</sup>Recall that all explanatory variables enter the model with a one-period lag relative to the indicator for a tax rate reduction in the current period. Hence, we instrument  $\tau_{i,t-1}$  and  $\tau_{-i,t-1}$  by  $\tau_{i,t-2}$  and  $\ln(pop)_{-i,t-1}$ .

as an instrument for neighbors' taxes, using a country's own lagged tax rate as an instrument for the current tax may be questioned. For instance, if the unobserved factor inducing correlation between the tax rate and the residual is serially correlated, the instrument will no longer be exogenous. We therefore check our estimation results using an alternative set of instruments. In particular, we use a country's lagged top personal income tax rate (*PITR*) and the corresponding weighted average among neighbors. The choice of this set of instruments is motivated by the strong empirical association between the top individual rate and the statutory corporate income tax rate reported, e.g., by Slemrod (2004). Estimation outcomes using *PITR*-related instruments are shown in Column (3) of Table 4.

We find that both instrumental variables estimations confirm our previous results. While the estimated coefficients of a country's own tax are very similar to those obtained from the FE LPM, the effect of neighbors' taxes on the predisposition to cut the statutory tax rate is now estimated to be somewhat larger. Furthermore, for both sets of instruments the relevant coefficients from the first stage regressions show the expected sign and prove to be highly significant, making us confident that we have chosen suitable instruments. Moreover, the  $F$ -statistics of the first stage regressions suggest that we are on the safe side regarding the notorious weak instruments problem.

## 5 Conclusion

Due to substantial implementation costs, governments do not continuously adjust tax rates to optimal levels. Rather, descriptive evidence suggests that governments set taxes to the preferred level in one period and then stick to the rate chosen for some periods. Consequently, the choice of the tax rate involves a discrete choice decision problem that has to date been ignored in the literature dealing with the determinants of corporate tax rates. It is the

purpose of this study to fill part of this gap.

Focusing on statutory corporate taxes in Europe, we have offered a simple empirical framework for the analysis of rate cutting tax reforms in a comprehensive data set covering 32 countries. Our results suggest that the remarkable activity of national governments in Europe since 1980 to implement rate cutting reforms was to a significant part driven by tax competition rather than by alternative explanations such as a common intellectual trend. In particular, we find that high tax countries experience substantial pressure to reduce corporate taxes. Furthermore, our findings point to a significant impact of neighboring countries' tax policies on the probability for tax rate reductions. Thus, countries which are geographically close to low tax countries are substantially more likely to lower their tax rate.

A further insight relates to the political economic dimensions of tax rate adjustments. Our results indicate that corporate tax cuts are significantly more likely during election campaigns, suggesting that they are part of popular economic programmes subject to some sort of a political business cycle.

Taken together, our study provides evidence on international tax competition that is complementary to a number of recent studies. Most importantly, the results show that national policies regarding rate cutting tax reforms in Europe are strongly affected by pressures resulting from tax policies of other countries. The main advancement relative to previous empirical work is that, by using a discrete choice decision framework and focusing on rate cutting tax reforms rather than statutory tax rates, we provide direct evidence on the step-by-step process of cutting statutory rates that has often been claimed to be at the heart of the 'race to the bottom' in international tax competition.

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