Spoor A3:

Are your Firm's taxes set in Warsaw?

Spatial tax competition in Europe

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Augustus 2008

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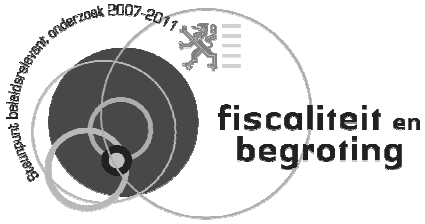

SBOV Fiscaliteit en Begroting
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I. Introduction

In 2004, ten new European member states (NMS) joined the EU. They include Poland, Czech Republic, Slovenia, Slovakia, Estonia, Latvia, Lithuania, Hungary, Malta and Cyprus. At the time of their entry, the average corporate tax rate in these countries was 10.5 percentage points lower than in the rest of Europe (EU15[1]). This is illustrated in Figure 1. While the average EU-15 tax rate was around 31%, the average for the NMS around the time of entry was about 21%. Figure 1 illustrates another important stylized fact i.e. that tax competition had started already much earlier than that. From the mid-nineties onwards tax rates[2] throughout the OECD countries started to slide. But where this process halted for non-EU OECD countries with average tax rates stabilizing after the year 2000, tax rates in Europe continued to fall.

The entry of the NMS did not trigger tax competition, but Figure 1 shows that it seems to have intensified the already existing tax competition in Europe. In fact, casual empiricism suggests that former EU-15 countries geographically close to the NMS such as Germany and Italy experienced tax rates falling faster than those EU-15 countries further away from the former Central-European countries. This can be seen from Figure 2 where we divide the former EU-15 countries into two separate groups. On the one hand we plot average tax rate changes for "neighbouring" countries i.e. countries of the former EU-15 that share a land or water border with any of the countries of former Central-Europe. And on the other hand we show the evolution of the average tax rate of the "non-neighbouring" EU countries. From Figure 2, it can be noted that the average nominal tax rate of "neighbours" fell more sharply than that of "non-neighbours" where changes were less drastic over time. In this comparison we excluded Ireland which seems to behave very differently from the rest of the EU-15 with tax rates falling even below those of the NMS as early as 1999. Despite the fact that we classify "neighbours" and "non-neighbours" somewhat arbitrarily, tax reforms seem to have evolved distinctly different across these two sets of countries. Figure 3 visualizes which countries have been included in each group with the black areas referring to the NMS, the dark grey ones to the "neighbouring" EU-15 countries and the light grey area to the remaining EU-15 "non-neighbouring" countries.

To understand the apparent different tax behaviour of "neighbour" and "non-neighbour" countries, the purpose of this paper is to analyse how "distance to a low tax region" like the NMS affects countries' tax reaction functions. Could it be that countries close to the low tax region are subject to more intense tax competition than others? That is essentially the research question that we pose

[1] EU15= Belgium, the Netherlands, France, Germany, UK, Ireland, Luxembourg, Sweden, Denmark, Austria, Italy, Spain, Greece, Finland and Portugal.

[2] In this study we focus on nominal tax rates instead of effective tax rates or tax bases. One reason is that investor surveys tend to show that multinationals deciding on a location tend to short list potential countries of interest by their nominal tax rate. Tax base and effective tax rates are less transparent and less known and therefore more difficult to compare across locations.

here. Put differently, we wonder whether the firm-level tax rate of the Polish government in Warsaw has more of an effect on the tax rate in the "neighbouring" country Germany than say on the firm-level tax rate of a "non-neighbouring" country like Belgium? Our results suggest that this is indeed the case. The tax reaction function of the German government with respect to tax rates set in Central-Europe appears to be much stronger than the tax reaction function of the Belgium government with respect to Central-European tax rates.

In section 2 of this paper we develop a simple theoretical model that offers an explanation for why the German rather than the Belgian government will be more subject to tax competition from say Poland. The reason is that "distance" matters. An intuitive way to think about this is to make the comparison with the product space. In a Hotelling type of model with travelling costs it is a well known result that when firms locate physically further apart, price-competition is less fierce and firms are less affected by price cuts of rival firms. In our model countries have a fixed geographical position but footloose firms can move freely between them. It will become clear that countries closer to a low tax region are more subject to tax competition and everything else equal will set a lower tax rate than countries further away.

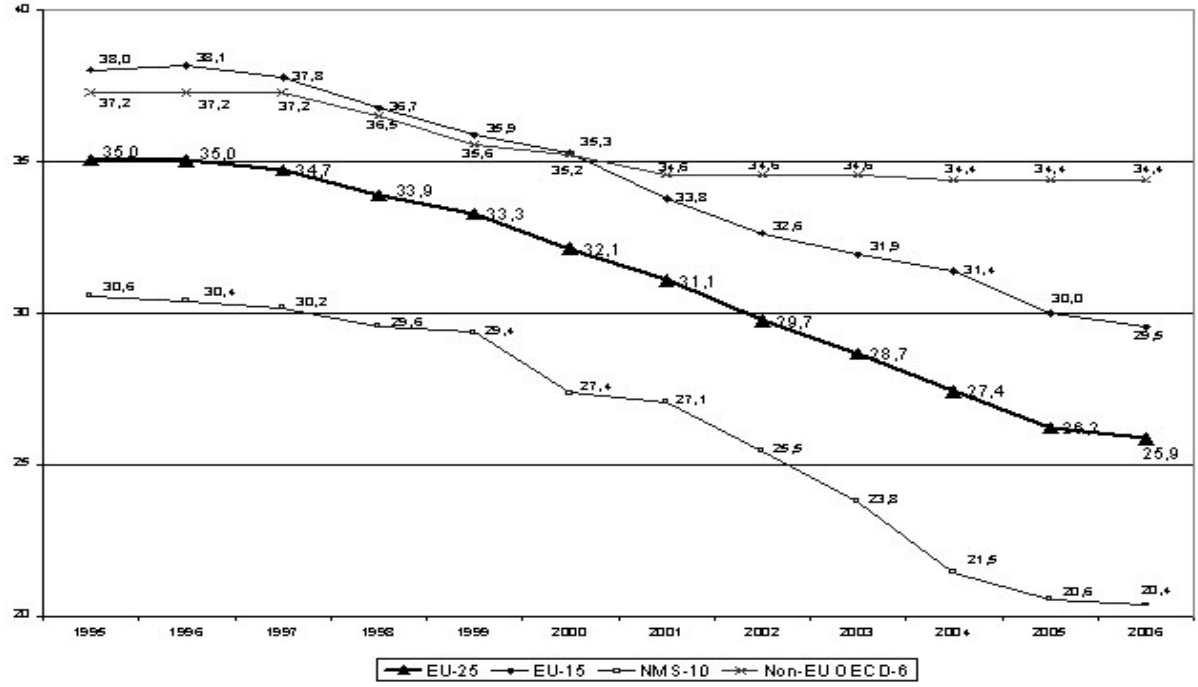
Empirically, this seems to be confirmed by the results we obtain. Using a spatial reaction function approach, we provide evidence of the fiscal reaction functions between groups of countries in Europe. The analysis suggests an asymmetric response whereby the EU-15 "neighbours" respond to taxes set by the new member states, but not vice versa

Surprisingly, we fail to find evidence of a fiscal reaction function of the "neighbours" to tax rates set by the "non-neighbours". In other words, Germany while strongly affected by the tax rates set in say Poland, in contrast does not seem to be significantly affected by the tax rates set by France. Hence tax competition in Germany seems predominantly to come from countries located to its right not to its left.

Also, we fail to find a fiscal reaction function for "non-neighbours". Their tax rates do not appear to be affected by the NMS. Neither do they respond to those set by "neighbours". This result suggests that the tax rate of France is not significantly affected neither by that of Poland nor by that of Germany. This result appears to correspond with the result obtained earlier by Gerard and Ruiz (2007) who find only weak evidence of tax mimicking behaviour amongst EU-15 countries.

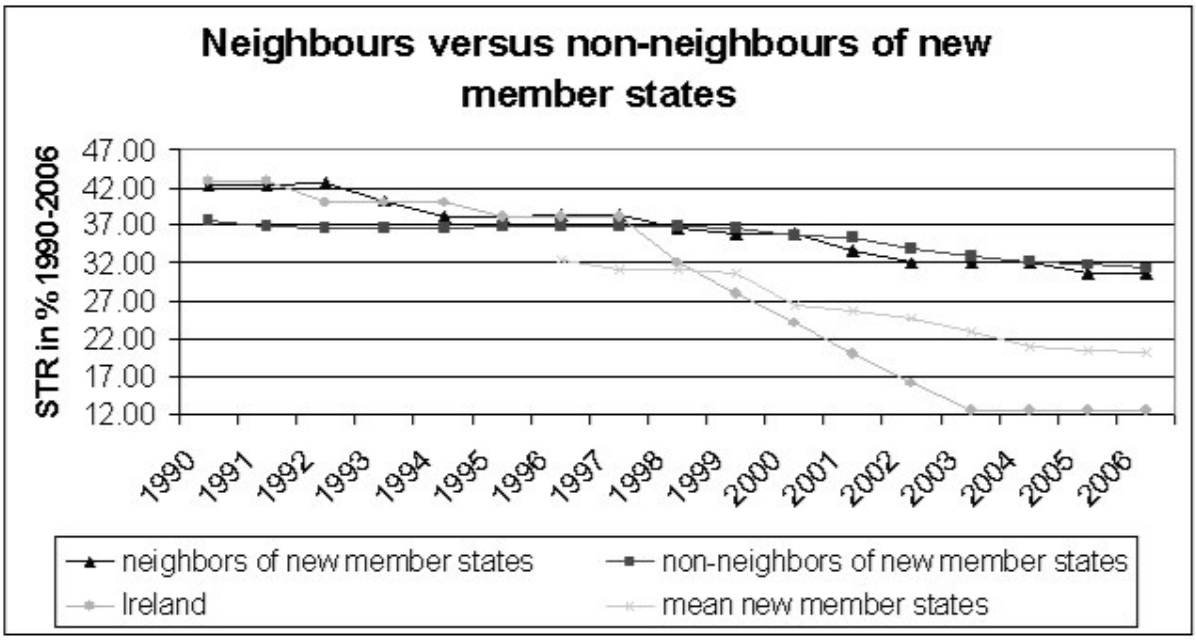
Indeed we are not the first to look at spatial reaction issues. Earlier studies have looked at tax rates interdependence in the EU15 or in the OECD (Devereux et al., 2008; Altshuler and Goodspeed, 2002; Redoano, 2003; Ruiz and Gerard, 2007). The study closest to ours is the one by Gerard and Ruiz (2007), but they exclusively focus on tax interdependence of the EU-15 and find only weak evidence. The results we obtain in this paper shed some additional light on their findings. While we confirm the absence of tax interdepence amongst the countries of "old Europe", there seems to be heterogeneity amongst this group of countries in the way they respond to the low tax rates in the new member states. Our contribution lies in documenting an asymmetric response between countries based on proximity to the low tax region in the East.

Figure 1: The evolution of average statutory corporate tax rates in the EU25, EU15, new member states (NMS) and non-OECD6, 1995-2006



Source: European Commission
Note: OECD6= Australia, Canada, Japan, Mexico, New Zealand and USA
NMS= Belgium, the Netherlands, France, Germany, UK, Ireland, Luxembourg, Sweden, Denmark, Austria, Italy, Spain, Greece, Finland and Portugal

Figure 2: Evolution of corporate tax rates in the EU25, 1990-2006



Source: Vandenbussche and Crabbé (2006) and Amadeus (Bureau Van Dijck)
Note: neighbors of NMS= Denmark, Finland, Germany, Austria, Greece, Italy and Sweden

Non-neighbors of NMS= Belgium, France, Spain, Portugal, UK, the Netherlands and Luxembourg

Figure 3: Map of EU25

Note: black area = new member states (NMS), grey area= neighbors of NMS, light grey area = non-neighbors of NMS

II. Tax competition model

In this section we develop a simple theoretical model that can explain some of the stylized facts outlined in the introduction The set up is similar to Haufler and Wooton (2001) but additionally introduces spatial 'distance' into the model. The assumptions are carefully chosen in order to keep the model as tractable as possible and with a focus on the main point we want to make i.e. that distance matters for tax competition. We assume that a foreign say U.S. multinational (MNE) intends to invest in Europe. It has the choice of locating in one of two regions: region A (EU15) or region B (NMS). Region A is the larger market of the two. If the MNE decides to set up in one region, it will face a transport cost (c) when exporting to the other region, while there are no transport costs to distribute the good *within* the country. Marginal production costs [3] and fixed

[3] It is true that wages costs in Central Europe are lower but studies have shown that productivity is also lower which to a large extent offsets their wage advantage. Therefore for simplicity we assume that these things cancel out and that marginal production costs are equal.

costs are assumed to be equal in both regions and are dropped from the analysis. The staging of events is as follows:

1. Regions A and B set their tax rates (t_A, t_B) simultaneously in order to maximize regional welfare.
2. The multinational chooses to locate in A or B, taking into account the tax rate and transportation cost.
3. The multinational decides on local output and exports to the other region to maximize after-tax profits.

The model can be solved with backwards induction. In stage 3, the multinational decides on output and exports to maximize after-tax profits. We assume the inverse demand functions of region A and B to be respectively, $P_A = (M - Q_A)$ and $P_B = (m - Q_B)$, where the market size M is substantially larger than the market m. The after-tax profit of the multinational when choosing to locate in A is:

$$\pi_A = ((M - Q_A)Q_A + ((m - Q_{AB})Q_{AB} - cxQ_{AB})(1 - t_A) \quad (1)$$

The first term represents the sales in region A, the first part in the second term between brackets is the export quantity to region B and the second part between brackets is the transport cost (c) of shipping the exported quantity (Q_{AB}) over distance x where x reflects the distance between region A and B. And t_A is the profit tax rate in region A.

The expression for the after-tax profit of the multinational when locating in B is similar:

$$\pi_B = ((m - Q_B)Q_B + (M - Q_{BA})Q_{BA} - cxQ_{BA})(1 - t_B). \quad (2)$$

The main purpose for us to study this model is to understand the tax dynamics. Therefore our focus lies on the analysis of government's tax reaction functions and the role of distance between the two regions rather than on the equilibrium tax rates.

For that we start by deriving the "indifference tax rate". The multinational will be indifferent between locating in region A or B when its after-tax profits in region A equals its after-tax profit in region B. This applies when

$$t_A^{Indiff} = \frac{2cx(M - m) + t_B\left(m^2 + (M - cx)^2\right)}{M^2 + (m - cx)^2} \quad (3)$$

or

$$t_B^{Indiff} = \frac{2cx(m - M) + t_A\left(M^2 + (m - cx)^2\right)}{\left(m^2 + (M - cx)^2\right)} \quad (4)$$

Taking into account that M > m, it can be verified from the expressions above that the larger region A will always set a higher tax rate than region B at the indifference point. Since our main interest in the empirical section is to study the tax reaction function of the high tax regions in Europe our focus here is on the reaction function of region A. We define the welfare objective function of each region as the sum of consumer surplus (CS) and tax income (tax on profits before tax) provided the MNE locates in its region. To simplify things we assume the U.S MNE does not reinvesting its equilibrium profits (π^*_i) in Europe but shifts all its profits back to the US which is why its profits are not included in a region's

welfare function even when it locates there. Therefore each region's welfare in the presence of the MNE can be represented as follows:

$$W_i = CS_i + t_i \frac{\pi_i^*}{1-t_i} \quad (5)$$

Moving to stage 1 of the tax game, region A has the option of setting its tax rate either below or above the 'the indifference' tax rate. By setting its tax rate just below the indifference rate, region A will attract the multinational and its welfare will be as in (5). A tax rate above the indifference rate however will tilt the MNEs preference in terms of location towards the other region in which case region A would loose the tax revenue and would also have a lower consumer surplus[4]. Welfare in each of the two options is summarized below:

$$\left.\begin{array}{ll} \text{Option 1: } t_i < t_i^{Indiff} \text{ implies } & W_{i1} = CS_1 + t_i \frac{\pi_i^*}{1-\pi_i} \\ W_{i1} > W_{i2} & \\ \text{Option 2: } t_i > t_i^{Indiff} \text{ implies } & W_{i2} = CS_2 \end{array}\right\} \quad (6)$$

It can be easily verified that welfare in option 1 is larger than in option 2, therefore region A will prefer to set a tax rate a fraction ξ below the 'indifference' tax rate, to attract the multinational:

$$t_A^{Indiff} - \xi = \frac{2cx(M-m) + t_B\left(m^2 + (M-cx)^2\right)}{M^2 + (m-cx)^2} - \xi \quad (7).$$

The expression above indicates that the tax reaction function of region A is a function of the transport cost between A and B, the distance between the two regions, the tax rate of the other region B and the market size of both regions.
This reaction function has some features that explain the stylized facts. For instance, it can be noted from (7) that the tax rates of region A and B are strategic complements since t_B enters the reaction function of t_A with a positive sign and vice versa. This implies that a drop (rise) in the tax rate of region B will be met by a drop (rise) in the tax rate of region A. This seems to confirm the facts presented in Figure 2 where all European tax rates are more or less falling together. Expression (7) also shows that region A will always set a higher tax rate than region B as a result of its larger market size (M> m). The larger market of region A implies that it can set a (positive) tax premium compared to region B.[5] But most importantly for our purposes, a comparative static of the tax reaction function of region A wrt the distance between region A and the low tax region B, everything else constant, shows that the tax premium of region A

[4] It can be verified that $CS_1 > CS_2$ but will not be shown here for brevity. The reason is that when the MNE locates in region B, consumers of region A will have to pay an additional transport cost which would not be the case if the MNE locates in A.
[5] For completeness we should point out that under the assumptions we made we can not exclude a negative tax. In other words the model shows that region A in equilibrium gives a lower subsidy to the MNE than region B.

increases with the distance between both regions ($\frac{\partial t_A}{\partial x} > 0$). This is the result we focus on and the one we want to test empirically in the next section.

III. Spatial fiscal reaction functions: method and results

III.A. Methodology

The theoretical framework above has shown that distance matters and that a tax premium will be lower the closer a high-tax country is to a low tax area. In this section we empirically test this hypothesis using spatial regression analysis to uncover the existence of fiscal reaction functions between groups of countries. This method links the tax rate of one country to the tax rate of other countries taking into account the distance between these countries (Besley & Case, 1995; Bordingon et al., 2002; Brueckner, 2003). We start by testing the reaction of the EU14 countries (Ireland excluded from the EU15) on the tax rates of the new member states (NMS) during the period 1993-2006. Based on the literature we use the following specification to test for the existence of tax interdependance:

$$TAX_{iEU14,t} = \beta_0 + \beta_1 TAX_{iEU14,t-1} + \beta_2 \left(\sum_{i \neq j} w_{ij} TAX_{jNMS,t}\right) + \beta_3 X_{iEU14,t} + \alpha_{iEU14} + \varepsilon_{iEU14,t} \quad (8)$$

The dependent variable $TAX_{iEU14,t}$ represents the vector of individual corporate tax rates of all EU14 countries (Ireland excluded) which are assumed to be a function of the right hand side variables in (8) including their own lagged corporate tax rate; corporate tax rates of the new member states ($TAX_{jNMS,t}$) where each of the latter is weighted by its distance to the individual EU-14 country (w_{ij}); a set of additional country control variables $X_{iEU-14,t}$ and country-specific effects α_i. The country control variables that we include are: the personal income tax rates mainly to allow for shifts in the tax burden from firms to workers; the GDP per capita to control for business cycles and the population density of each of the EU14 countries.
Of all the right hand side variables, the coefficient on the weighted corporate tax rate of the NMS is our main variable of interest. The weights used are similar to what has been used in earlier literature i.e. the inverse distance between the capital cities of any EU14 country and the relevant country of NMS.[6] This implies that any NMS closer to a EU14 country will have a larger weight in the analysis. Significance of the coefficient β_2 implies that the tax rate of EU14 countries respond to a change in the tax rates of NMS.

A simple OLS estimation of the specification in (8) encounters methodological problems. For one, including a lagged dependent variable in a fixed effects model results in a correlation since fixed effects are time invariant (Woolridge, 2003). Taking first differences offers a solution but introduces another problem

[6] CEP II database which uses the "great circle formula" which uses latitudes and longitudes of cities and incorporates the internal distance of the country based on areas (Head and Mayer, 2002).

i.e. a correlation between the lagged dependent variables in differences and the error term in differences, thus the lagged dependent variable in differences should be instrumented with lags of two periods or more.

Also the variable of interest ($\Sigma w_{ij} TAX_{j,NMS,t}$) in (8) can be endogenous. While tax rates of the NMS may affect tax rates in EU-14 countries, the inverse may also hold. To address this problem we apply an IV-approach (2SLS) often applied in the literature (Brueckner, 2003; Altshuler and Goodspeed, 2002; Redoano, 2003; Heyndels and Vuchelen, 1998; Brett and Pinkse, 2000; Carlsen et al. 2005, etc.). In this IV-approach, in a first stage we regress[7] the endogenous ($\Sigma w_{ij} TAX_{j,NMS,t}$) variables on a set of instruments and the exogenous control variables. The set of instruments we choose are similar to the literature and include proportion of population younger than 14 years, population density and the number of active residents. In a second stage, equation (8) is than estimated using the fitted values of $\Sigma w_{ij} TAX_{j,NMS,t}$ from the first stage, the instrument for the lagged dependent variable and the exogenous control variables that we discussed earlier (personal income tax rate, GDP per capita and population density)[8].

III.B. Results

The results of the estimations are reported in Table 1. In all columns we apply first differencing and instrument the lagged dependent variable as well as the tax rates in the New Member States ($\Sigma w_{ij} TAX_{j,NMS,t}$) for reasons outlined in the section above.

In column 1 we test for an EU-14 wide fiscal reaction function with respect to the tax rates in the New Member States (NMS). Our evidence confirms our theoretical results and is suggestive of a positive fiscal reaction function with a coefficient close to 1 and significant at the 10% level.

In column 2 where we only consider the tax rates of the "neighbouring"[9] EU-14 countries, however, we find the coefficient on the fiscal reaction function to be much stronger and significant at the 1% level.

In column 3 where we only consider the tax rates of "non-neighbours"[10] of NMS as dependent variables, the fiscal reaction function wrt tax changes in the low tax region of Central-Europe while positive in sign is *not* significant. This suggests that NMS essentially affect the tax competition in their neighbouring countries that are geographically close, but *not* in countries that are further away.

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[7] The results of this first stage regression are not shown here for brevity but are available from the authors upon request.

[8] Also alternative instruments are used to check robustness of the result, but not reported here. Like a set of institutional variables such as an index of enterprise reforms, trade liberalization and competition policy (collected from EBRD reports) is used and results were the same as in Table 1.

[9] Neighboring EU14 countries = Germany, Italy, Sweden, Denmark, Austria and Greece

[10] non neighboring EU14 countries = France, Belgium, the Netherlands, UK, Spain and Portugal

It also suggests that the result on the EU-14 wide fiscal reaction function is likely to be driven by the "neighbouring" countries only since when taking the "non-neighbours" separately, they do not respond to the corporate tax policy in New Member States.

Another set of relevant results emerging from columns 2 and 3 is that the tax rates within EU-14 countries are set relatively independently. Column 2 shows that the tax rates of "non-neighbours" do not seem to affect the tax rates of "neighbours". While column 3 shows that the inverse also holds i.e. tax rates of "non-neighbours" apparently are not influenced by tax rates of "neighbours".
Thus far we have excluded Ireland from the analysis for reasons explained in the introduction. From Figure 2 it already became clear that Ireland can be considered as a true outlier with tax rates that dropped much faster than for any other EU-14 country. Moreover, ever since 1999 the Irish tax rate has dropped even below the level of NMS countries which is very atypical compared to the rest of EU-14 that show a positive tax premium vis-à-vis the NMS. So in a way, Ireland itself is a low tax region compared to the other EU-14 which is why as an experiment in column 4 of Table 1 we include Ireland in the group of NMS countries. When including Ireland in the group of NMS the fiscal reaction function of the rest of the EU14 is still positive and significant but the coefficient is much smaller suggesting that the tax regime in Ireland affects continental countries much less than the countries of former Central-Europe. This confirms our approach of excluding Ireland from our main analysis as it truly appears to behave very differently than the other EU14 countries.

Table 1: Estimation results of the fiscal reaction function

	(1) EU14	(2) neighbors NMS	(3) non-neighbors NMS	(4) EU14
$TAX_{iEU14,t}$	-0.09 (0.13)	-0.14 (0.22)	-0.06 (0.15)	-0.04 (0.09)
$\sum_{i \neq j} w_{ij} TAX_{iNMS,t}$	1.05* (0.65)	1.55*** (0.75)	0.55 (0.34)	0.01* (0.01)
$\sum_{i \neq j} w_{ij} TAX_{non-neighbours,t}$		-1.2 (1.03)		
$\sum_{i \neq j} w_{ij} TAX_{neighbours,t}$			1.20 (1.7)	
Pers. Income $tax_{iEU14,\ t-1}$	-0.41 (0.31)	-0.23 (0.49)	0.09 (0.23)	-0.15 (0.2)
GDP per $capita_{iEU14,t}$	0.002** (0.001)	0.003 (0.002)	0.0003 (0.001)	0.001 (0.001)
Pop. $Density_{iEU14,t}$	0.38 (0.35)	3.57 (3.23)	-0.02 (0.19)	0.37 (0.29)
Constant	0.68	-1.35	-0.08	-0.18
Observations	156	56	72	165
Sargan test (p-value)	0.8	0.8	0.19	0.06

Note: EU14= EU15 - Ireland. All estimations are in first differences and with an instrumental variable approach accounting for the endogeneity of lagged dependent variable and ($\Sigma w_{ij} TAX_{j,NMS,t}$). Column 2 and 3 split up the dataset of EU14 (Ireland excluded from the EU15) into neighbors and non-neighbors of the new member states (NMS). Column (3) includes the corporate tax rate of Ireland in $\sum_{i \neq j} w_{ij} TAX_{iNMS,t}$. A p-value for the Sargan test larger than 0.1, indicates that we have used a valid instrument. * = significance on 1% level, ** = significance on 5% level, *** = significance on 10% level

I V. Conclusion

In this paper, we have analysed the spatial dimension of corporate tax competition in Europe. Our findings show that the accession of 10 new member states in 2004 has intensified tax competition in Europe. Upon entry, the new member states had an average corporate tax rate that was 10 percentage points below the average tax rate in "old Europe" (EU15).

The purpose of this paper was to investigate whether "old" EU countries closer to former Central and Eastern Europe experienced more tax competition than those countries further to the west of the new member states. A simple theoretical model with differences in country/region size, footloose firms and transport costs demonstrated that a large country's tax reaction function indeed positively depends on its proximity to low tax regions i.e. the further away from a low tax region, the higher the tax premium that can be set.

Using a spatial reaction function approach, we provide empirical evidence of the fiscal reaction functions between groups of countries in Europe. Our analysis suggests that "neighbouring countries" of the new member states, (Germany, Italy, Sweden, Denmark, Austria and Greece) reacted much stronger to changes in the tax rates of the new member states than "non-neighbouring countries", (France, Belgium, Netherlands, UK, Spain and Portugal).

Surprisingly, the analysis suggests an asymmetric response whereby the EU-15 "neighbours" respond to taxes set by the new member states, but not vice versa. We fail to find evidence of a fiscal reaction function of the "neighbours" to tax rates set by the "non-neighbours". In other words, Germany while strongly affected by the tax rates set in say Poland, in contrast does not seem to be significantly affected by the tax rates set by France. Hence tax competition in Germany seems predominantly to come from countries located to its right not to its left.

Also, we fail to find a fiscal reaction function for "non-neighbours". Their tax rates do not appear to be affected by the NMS. Neither do they respond to those set by "neighbours". This result suggests that the tax rate of France is not significantly affected neither by that of Poland nor by that of Germany. This result appears to correspond with the result obtained earlier by Gerard and Ruiz (2007) who find only weak evidence of tax mimicking behaviour amongst EU-15 countries.

While our study leaves many issues unaddressed, if anything our analysis suggests the existence of asymmetric tax responses between EU countries. One of the remaining puzzles is the case of Ireland which does not seem to fit our story very well. Its tax pattern is radically different from any other European country and as such appears to be a stand-alone case. In this paper we have considered Ireland as an outlier and excluded it from the main analysis.

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Vandenbussche H. and Crabbé K. (2006), "De Vennootschapsbelasting: de positie van België in het verruimde Europa", *Review of Business and Economics*, 1, pp.129

Corporate tax rates in Europe have been falling rapidly with tax competition within the EU currently fiercer than in the rest of the OECD. This paper analyzes heterogeneity in corporate tax rate changes between EU-15 countries as a function of the proximity to the EU-10 new member states. The average corporate tax rate in the new member states has always been considerably lower than the average in the EU-15 countries. Their entry into the EU eliminated capital barriers, in principle allowing firms to locate in one of the new EU-10 with full access to the European Market. Our results indicate that EU-15 countries physically closer to Central-Europe experienced more tax competition. We first present some casual empirical evidence suggestive that tax rates have fallen faster in those EU-15 countries that are geographically closer to the countries of former Central and Eastern Europe. Next we use a spatial regression framework to more formally test the hypothesis that distance to a low tax region affects countries' tax reaction functions.

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