

Crabbé, Karen; Vandenbussche, Hylke

**Working Paper**

## Are your firm's taxes set in Warsaw? Spatial tax competition in Europe

LICOS Discussion Paper, No. 216

**Provided in Cooperation with:**

LICOS Centre for Institutions and Economic Performance, KU Leuven

*Suggested Citation:* Crabbé, Karen; Vandenbussche, Hylke (2008) : Are your firm's taxes set in Warsaw? Spatial tax competition in Europe, LICOS Discussion Paper, No. 216, Katholieke Universiteit Leuven, LICOS Centre for Institutions and Economic Performance, Leuven

This Version is available at:

<https://hdl.handle.net/10419/74948>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



LICOS Centre for Institutions and Economic Performance

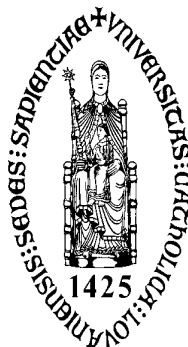
Centre of Excellence

## LICOS Discussion Paper Series

Discussion Paper 216/2008

### **Are your firm's taxes set in Warsaw? Spatial tax competition in Europe**

*Karen Crabbé and Hylke Vandenbussche*



**Katholieke Universiteit Leuven**

LICOS Centre for Institutions and Economic  
Performance  
Huis De Dorlodot  
Deberiotstraat 34 – mailbox 3511  
B-3000 Leuven  
BELGIUM

TEL: +32-(0)16 32 65 98  
FAX: +32-(0)16 32 65 99  
<http://www.econ.kuleuven.be/licos>

# Are your firm's taxes set in Warsaw?

## Spatial tax competition in Europe

K. Crabbé (Lessius, KULeuven) and H. Vandenbussche (KULeuven, UCL)\*

September 22, 2008

### Abstract

Corporate tax rates in Europe have been falling rapidly; as a consequence tax competition within the EU is 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. 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.

Keywords: Spatial tax competition, Corporate taxes, fiscal reaction function

JEL classification: H25, H77, H39

Address for correspondence: Naamsestraat 69, 3000 Leuven, Belgium

email: [karen.crabbe@econ.kuleuven.be](mailto:karen.crabbe@econ.kuleuven.be)

---

\*We thank the Research Council of the Catholic University of Leuven for funding this research. A special thanks goes to Pascal Raimondos-Møller, Jozef Konings, Wim Moesen and Christophe Croux for providing useful feedback on this project.

# 1 Introduction

In 2004, ten new European member states (NMS) joined the EU. They include Poland, Czech Republic, Slovakia, Slovenia, 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 (EU-15<sup>1</sup>) Their accession did not trigger tax competition, but intensified the already existing tax competition in Europe. We expect that tax competition will not be equally fierce between all countries of Western Europe (EU-15), but that the level of tax competition will depend on the geographical location of the country vis-à-vis the new member states. Therefore, we will divide Western Europe (EU-15) into "neighbors" i.e. countries of the former EU-15 that share a land or water border with any of the new member states (NMS) and "non-neighbors" who do not share a border with the new member states.

To understand the apparent different tax behavior of "neighbor" and "non-neighbor" countries, the purpose of this paper is to analyze 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 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 "neighboring" country Germany than say on the firm-level tax rate of a "non-neighboring" 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 4 of this paper we develop a simple theoretical model that offers an

---

<sup>1</sup>EU-15= Belgium, the Netherlands, Luxembourg, France, Germany, UK, Ireland, Spain, Portugal, Greece, Italy, Finland, Sweden, Denmark and Austria

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 traveling 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 in sections 5 and 6. The analysis suggests an asymmetric response whereby the EU-15 "neighbors" respond to taxes set by the new member states, but not to other EU-15 countries.

Surprisingly, we fail to find evidence of a fiscal reaction function of the "neighbors" to tax rates set by the "non-neighbors". 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 find an asymmetric fiscal reaction function for "non-neighbors". Their tax rates do not appear to be affected by the NMS, but they do respond to those set by "neighbors". This result suggests that the tax rate of France is not significantly affected by that of Poland, but it is by that of Germany. This result may explain the result obtained earlier by Ruiz & Gerard (2007) who find only weak evidence of tax mimicking behavior 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 EU-15 or in the OECD (Devereux et al.

(2008); Altshuler & Goodspeed (2002); Redoano (2003); Ruiz & Gerard (2007)). The study closest to ours is the one by Ruiz & Gerard (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 interdependent 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.

## 2 Corporate taxes in Europe: stylized facts

At the time of their entry, the average corporate tax rate of the new member states (NMS) was 10.5 percentage points lower than in the rest of Europe (EU-15). 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 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 "neighboring" countries i.e. countries of the former EU-15 that share a land or water border with

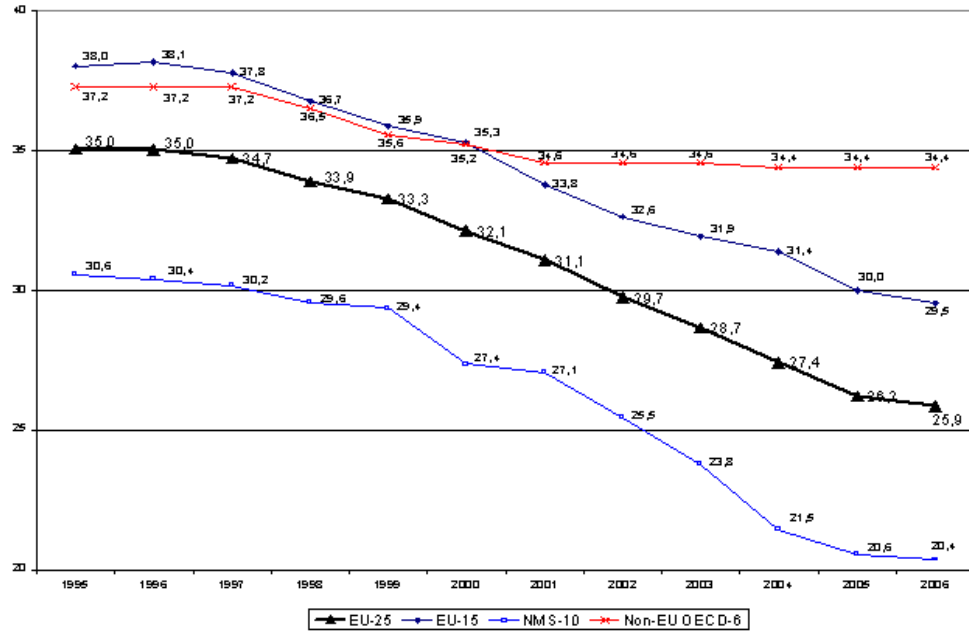


Figure 1: Evolution tax rates in OECD and EU, 1995-2006

Source: European Commission

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-neighboring" EU countries. From Figure 2, it can be noted that the average nominal tax rate of "neighbors" fell more sharply than that of "non-neighbors" 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 "neighbors" and "non-neighbors" somewhat arbitrarily, tax reforms seem to have evolved distinctly different across these two sets of countries. Figure 3 in the appendix visualizes which countries have been included in each group.

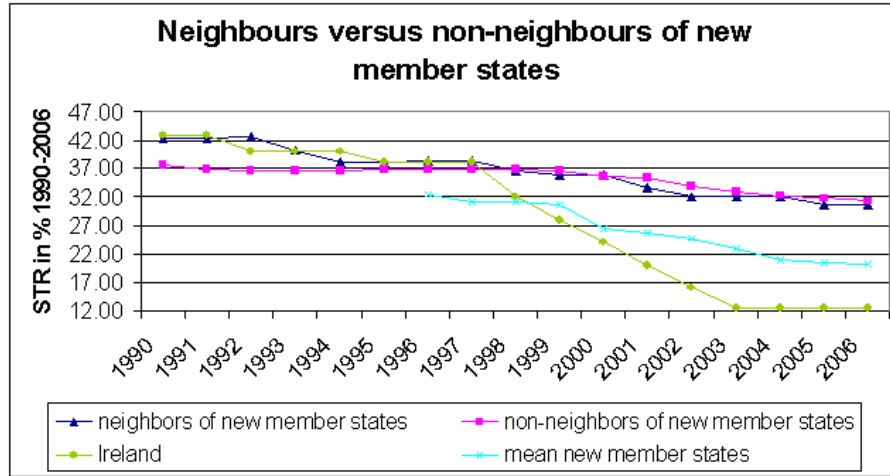


Figure 2: Tax Rate of the neighbors versus non-neighbors of the new member states

Neighbors: Germany, Austria, Denmark, Finland, Sweden, Italy and Greece; Non-neighbors: Spain, France, UK, Netherlands, Belgium, Luxembourg and Portugal

The STR is not weighed. Source: Vandenbussche & Crabbé (2006), extra data included for 2005 and 2006.

### 3 Related Literature on Fiscal Reaction Functions

Countries mimic their neighbors' policies even when this is not the best solution for their economic situation (Mukand & Rodrik 2005). This mimicking behavior is also found in their (corporate) tax policy. Theoretical and empirical work point out that countries or regions do not set their tax rate independently, but take into account the tax rates in related countries or regions. Countries or regions do this in accordance with two reasons: yardstick competition and capital tax competition. The first theory poses that voters judge policy-makers on their performance by comparing tax rates of neighboring countries. Therefore, politicians, to ascertain their re-election, will 'tax mimic' their neighbors' tax rate. The second theory argues that countries compete over their tax rate to attract capital. It is not always clear whether the presence of 'tax mimicking' comes from yardstick or tax competition, since the empirical method for both theories is the same (Brueckner 2003). But Devereux



et al. (2008) argue that with regard to corporate taxes, yardstick competition can be eliminated as a possible explanation. The reason is that corporate taxes are not a critical topic for voters to evaluate policy-makers, certainly because most voters do not even know the domestic corporate tax rate.

Empirical studies estimate a fiscal reaction function of a certain country which relates the tax rate of this country to its own characteristics and to the tax rate in competing countries. When tax rates are chosen strategically, the reaction function has a nonzero slope indicating that competitors' tax rates influence the given country's choice. The sign of the slope can be positive or negative depending on the specific parameter values. If strategic interaction is absent, the slope of the reaction function is not significantly different from zero (Brueckner & Saavedra 2001). This methodology has been used in many articles on local property, business or personal taxes across jurisdictions within one country (Besley & Case (1995), Bordignon et al. (2002), Heyndels & Vuchelen (1998), Brueckner (1998), Brett & Pinkse (2000), Brueckner & Saavedra (2001), Carlsen et al. (2005), Buettner (2001), Ladd (1992), Allers & Elhorst (2005), Hayashi & Boadway (2001), Allers & Elhorst (2005), etc) and government expenditure levels (Ollé (2003), Figlio et al. (1999), Revelli (2003), Case et al. (1993), Geys (2006), Baicker (2005), Werck et al. (2007), etc) <sup>2</sup>.

Also tax rates' interdependence among countries has been studied already. Devereux et al. (2008) analyze strategic tax competition in 21 OECD countries in the period 1982-1999. They find that countries strategically compete over the statutory tax rate and EATR<sup>3</sup> and that countries with relatively high effective tax rates react more strongly to tax rates in other countries. The first study using only EU countries is Altshuler & Goodspeed (2002). They find that EU countries strategically compete with geographically close countries using corporate tax revenues over GDP, but not using personal income tax revenues. They also conclude that since the US tax reform

---

<sup>2</sup>See Brueckner (2003) for an overview of empirical studies on strategic interaction

<sup>3</sup>EATR= effective average tax rate calculated using the forward looking method, see Devereux et al. (2002).

of 1986, European countries compete to a lesser extent with the US on corporate tax rates. A second study using exclusively European countries is Redoano (2003). She shows that tax competition mainly occurs between geographically close countries using statutory tax rates for 13 European countries during the period 1980-1995. Finally, Ruiz & Gerard (2007) find empirical evidence of limited ‘tax mimicking’ between neighboring EU-15 countries using statutory and effective tax rates during the period 1989-2001. They argue that possible converging tax rates in the EU-15 can explain their weaker result of spatial tax competition.

This paper will extend the limited number of studies using fiscal reaction functions on exclusively European Union countries by looking at heterogeneity in corporate tax rate changes between EU-15 countries as a function of their proximity to the EU-10 new member states.

## 4 The 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 & 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 (EU-15) 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<sup>4</sup> and fixed costs are assumed to be equal in

---

<sup>4</sup> 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.

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

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

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

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 that the U.S MNE does not reinvest its equilibrium profits 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<sup>5</sup>. In this case, country B acts as a FDI export platform<sup>6</sup>. Welfare in each of the two options

---

<sup>5</sup>It can be verified that  $CS_1 > CS_2$  and is reported in Appendix. 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.

<sup>6</sup>A FDI export platform means that FDI is attracted to country B that is located near other valuable markets such as country A, because country B makes a good platforms for reaching country A and is usually cheaper in location (taxes, labour costs, etc) (Bloningen et al. 2007).

is summarized below:

$$\begin{aligned}
\text{Option 1 : } t_A < t_A^* &\Rightarrow W_{A1} = CS_1 + t_A \frac{\pi_A^*}{1 - t_A} \\
\text{Option 2 : } t_A > t_A^* &\Rightarrow W_{A2} = CS_2 \\
&\Rightarrow W_{A1} > W_{A2}
\end{aligned} \tag{6}$$

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  $\xi$  below the 'indifference' tax rate, to attract the multinational:

$$t_A^* = \frac{2cx(M - m) + t_B(m^2 + (M - cx)^2)}{M^2 + (m - cx)^2} - \xi. \tag{7}$$

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 observed stylized facts. For instance, it can be noted 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. As stated above it can be verified that region A will 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 always ask a (positive) tax premium compared to region B<sup>7</sup>. 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, leaving everything else constant, shows that the tax premium of region A increases with the distance

---

<sup>7</sup> 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.

between both regions ( $\frac{\partial t_A}{\partial x} > 0$ ). Or the inverse, the closer region A is to region B (the smaller  $x$ ), the smaller the tax premium it can set. This is the result we focus on and the one we want to test empirically in the next section.

## 5 Methodology and Data

The theoretical framework above has shown that distance matters and that tax premia 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); Bordignon et al. (2002); Brueckner (2003)). We start by testing the reaction of the EU-14 countries (Ireland excluded from the EU-15) 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 interdependence:

$$\begin{aligned}
 TAX_{iEU14,t} = & \beta_1 \left( \sum_{i \neq j} w_{ij} TAX_{jNMS,t} \right) \\
 & + \beta_2 X_{iEU14,t} + \alpha_{iEU-14} + \varepsilon_{iEU14,t}
 \end{aligned} \tag{8}$$

The dependent variable  $TAX_{iEU14,t}$  represents the vector of individual corporate tax rates of all EU-14 countries (Ireland excluded) which are assumed to be a function of the right hand side variables in (8) including 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  $\alpha_i$ . 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 since a higher country income is related to higher demands for public services and thus higher corporate tax rates to finance these public services (Altshuler & Goodspeed 2002), the population younger

than 14 and older than 65 years to control for the active population. 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 weight used is the inverse distance between the capital cities of any EU-14 country and the relevant country of NMS<sup>8</sup>. This implies that any NMS closer to a EU-14 country will have a larger weight in the analysis. Significance of the coefficient  $\beta_2$  implies that the tax rates of EU-14 countries respond to a change in the tax rates of NMS. In the robustness checks, we will also use other weights than distance to control for other relations between countries such as trade partners.

A simple OLS estimation of the specification in (8) encounters some methodological problems. For one, the weighted tax rates of the NMS ( $\sum w_{ij} TAX_{jNMS,t}$ ) 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 used in the literature (Brueckner (2003); Altshuler & Goodspeed (2002); Redoano (2003); Heyndels & Vuchelen (1998); Brett & Pinkse (2000); Carlsen et al. (2005), etc.). In a first stage of this IV-approach, we regress the endogenous ( $\sum w_{ij} TAX_{jNMS,t}$ ) variables on a set of instruments and the exogenous control variables as follows.

$$\sum_{i \neq j} w_{ij} TAX_{jNMS,t} = \alpha_1 \sum_{i \neq j} w_{ij} X_{jNMS,t} + \alpha_2 X_{iEU14,t} + \alpha_j + \rho_{jt} \quad (9)$$

The set of instruments ( $X_{jNMS,t}$ ) we choose are similar to the literature and include the proportion of population younger than 14 years, the proportion of population older than 65 years and GDP per capita. The vector  $X_{iEU14,T}$  is the same set of control variables as in equation (8) and  $\alpha_j$  controls for the a country-specific effects. In a second stage, equation (8) is then estimated using the fitted values of  $\sum w_{ij} TAX_{jNMS,t}$  from the first stage. Second, we need to control for the level of

---

<sup>8</sup>Distance data is collected from the CEP II database based on the "great circle formula" which uses latitudes and longitudes of cities and incorporates the internal distance of the country (Head & Mayer 2002). Other weights are possible such as in Bloningen et al. (2005), but are expected to give similar results.

the tax rates of the EU-14 countries in the previous year (autocorrelation). But including a lagged dependent variable in a fixed effects model would result in multicollinearity since fixed effects are time invariant (Woolridge 2003). Therefore, we will use a fixed effects model with a disturbance term of first order autocorrelation<sup>9</sup>.

## 6 Results

The results of the estimations are reported in Table 1. In all columns we instrument the weighted tax rates in the new member states ( $\sum w_{ij} TAX_{jNMS,t}$ ) 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 result and is suggestive of a positive fiscal reaction function.

In column (2) where we only consider the tax rates of the "neighboring" EU-14 countries, however, we find the coefficient on the fiscal reaction function to be much stronger and significant at the 10% level<sup>10</sup>. The result indicates that a decrease in the tax rates of the NMS by 10%, will lead to a decrease of 5.7% in the tax rates of the "neighbors". In column (3) where we only consider the tax rates of "non-neighbors" 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 neighboring countries that are geographically close, but not in countries that are further away. It also suggests that the result on the EU-14 wide fiscal reaction function is likely to be driven by the "neighboring" countries only since when taking the "non-neighbors" separately, they do not respond to the corporate tax policy in new member states. This might explain why Ruiz & Gerard (2007) found only weak

---

<sup>9</sup>This is the 'Xtregar' command in Stata which takes into account an AR(1) disturbance term:  $e_{it} = \rho * e_{i,t-1} + z_{it}$  with  $z_{it}$  independent and identically distributed.

<sup>10</sup>The significance level is low, but this is probably due to the low number of observations.



evidence of spatial tax competition in the EU-15.

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-neighbors" do not seem to affect the tax rates of "neighbors". While column (3) shows that the tax rates of "non-neighbors" apparently are influenced by tax rates of "neighbors". This suggests a wave of tax competition from the East to the West of Europe.

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 coefficient is much smaller and not significant suggesting that the tax regime in Ireland does not affect continental countries compared to 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 EU-14 countries.

Table 2 reports some robustness checks. First, we estimate equation (8) using institutional variables<sup>11</sup> as instruments for the weighted tax rates of the NMS. Column (1) shows that our variable of interest, the weighted tax rates of NMS, is still positive and significant. The other columns test other weights than distance to analyze whether the EU-14 tax rates react to other related groups of countries such as trade partners or countries at a similar level of GDP per capita. Column (2) weights the tax rates of the NMS using a dummy equal to 1 if the NMS has a common border

---

<sup>11</sup>The institutional variables are indices of price liberalization, privatization and enterprise reforms, collected from the EBRD reports.

Table 1: Estimation Results

dep var.=tax <sub>i</sub>	(1)	(2)	(3)	(4)
	EU-14	only neighbors	only non-neighbors	EU-14, Ireland
WTax <sub>NMS,t</sub>	0.57*	0.79*	0.4	-0.001
	(0.32)	(0.46)	(0.25)	(0.001)
WTax <sub>non-neighbors,t</sub>		0.97		
		(1.01)		
WTax <sub>neighbors,t</sub>			-3.01**	
			(1.53)	
Income tax <sub>t-1</sub>	0.2	0.24	0.10	0.3
	(0.21)	(0.52)	(0.25)	(0.26)
population>14	0.63	-1.53	1.09	3.21*
	(1.95)	(2.7)	(2.05)	(1.7)
population<65	-2.1	-6.02***	1.29	-1.7
	(1.38)	(2.2)	(1.39)	(1.42)
gdp per capita	-0.0001	0.001	-0.001***	-0.0002
	(0.0002)	(0.001)	(0.0002)	(0.0002)
constant	33.48***	44.15	26.92	3.88
	(10.33)	(28.77)	(20.53)	(9.44)
Observations	126	56	63	126
R-squared (within)	0.12	0.28	0.39	0.09

Standard errors are in parentheses. The instruments used for  $WTax_{NMS,t}$ : the proportion of the population older than 14 years, proportion of the population younger than 65 years, GDP per capita and the lagged income tax rate of the NMS. These instruments are also weighted with the distance. note:\*\*\*, \*\* and \* denote significance level of estimates at respectively 1, 5 and 10 percent levels.

with the EU-14 country and 0 otherwise. The result is positive and significant indicating that the EU-14 countries adjacent to the NMS are influenced by their tax rates. From columns (3) and (4) it seems that while setting their tax rate, EU-14 countries do not take into account the tax rate of their trade partners in the NMS or NMS with a similar GDP per capita level. These results suggest that being "neighbors", either by distance or by common border, is more important in terms of the corporate tax rate.

Table 2: Robustness Checks

dep var.=tax <sub>EU-14i</sub>	(1)	(2)	(3)	(4)
		W=border dummy	W=exportshare	W= gdp per capita
WTax <sub>NMS,t</sub>	0.25** (0.13)	0.45* (0.27)	0.05 (0.17)	0.34 (0.24)
Income tax <sub>i,t-1</sub>	0.24 (0.2)	0.19 (0.24)	0.16 (0.21)	-0.004 (0.24)
14<population>65	4.41*** (1.26)			
population>14		0.18 (1.92)	2.5 (1.61)	0.81 (1.94)
population<65		-3.39*** (1.47)	-1.82 (1.31)	-1.78 (1.27)
gdp per capita	-0.0002 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0 (0.0002)
income tax <sub>t-1</sub>	0.24 (0.2)	0.19 (0.24)	0.16 (0.21)	-0.004 (0.24)
constant	-246.92*** (24.54)	67.9*** (13.85)	14.34* (8.11)	33.95*** (8.64)
Observations	140	114	140	140
R-squared (within)	0.17	0.15	0.08	0.1

Standard errors are in parentheses. In column (1),  $WTax_{NMS,t}$  is instrumented with institutional variables such as an index of trade liberalization, privatization and enterprise reforms. In columns (2), (3) and (4) the following instruments are used: the proportion of the population older than 14 years, proportion of the population younger than 65 years, GDP per capita and the lagged income tax rate of the NMS. These instruments are also weighted with the distance. note:\*\*\*,\*\* and \* denote significance level of estimates at respectively 1, 5 and 10 percent levels.

## 7 Conclusion

In this paper, we have analyzed 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" (EU-15).

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 "neighboring 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-neighboring countries" (France, Belgium, Netherlands, UK, Spain and Portugal).

Surprisingly, the analysis suggests an asymmetric response whereby the EU-15 "neighbors" respond to taxes set by the new member states and the "non-neighbors" respond to the taxes set by the "neighbors". We fail to find evidence of a fiscal reaction function of the "neighbors" to tax rates set by the "non-neighbors". 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-neighbors". Their tax rates do not appear to be affected by the NMS, but they do seem to respond to those

set by the "neighbors". This result suggests that the tax rate of France is not significantly affected by that of Poland, but is affected by that of Germany. These asymmetric results may explain why Ruiz & Gerard (2007) find only weak evidence of tax mimicking behavior 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

## References

- Allers, M. & Elhorst, P. (2005). Tax mimicking and yardstick competition among local governments in the Netherlands. *International Tax and Public Finance*, 12, pp 493.
- Altshuler, R. & Goodspeed, T. (2002). Follow the leader? evidence on European and US tax competition. *Rutgers University working papers*, (200226), pp 24.
- Baicker, K. (2005). The spillover effects of state spending. *Journal of Public Economics*, 89, pp 529.
- Besley, T. & Case, A. (1995). Incumbent behavior: vote seeking, tax setting and yardstick competition. *American Economic Review*, (85), pp 25.
- Bloningen, B., Davies, R., Waddell, G. & Naughton, H. (2005). Spacey parents: spatial autoregressive patterns in inbound FDI. *NBER working paper series*, (11466), pp 30.
- Bloningen, B., Davies, R., Waddell, G. & Naughton, H. (2007). FDI in space: spatial autoregressive relationships in foreign direct investment. *European Economic Review*, 51(5), pp 1303.
- Bordignon, M., Cerniglia, F. & Revelli, F. (2002). In search for yardstick competition: property tax rates and electoral behavior in Italian cities. *Journal of Urban Economics*, 54(2), pp 199.
- Brett, C. & Pinkse, J. (2000). The determinants of municipal tax rates in British Columbia. *Canadian Journal of Economics*, 33(3), pp 695.
- Brueckner, J. (1998). Testing for strategic interaction among local governments: the case of growth controls. *Journal of Urban Economics*, 44, pp 438.
- Brueckner, J. (2003). Strategic interaction among governments: An overview of empirical studies. *International Regional Science Review*, 26(2), pp 175.

- Brueckner, J. & Saavedra, L. (2001). Do local governments engage in strategic property-tax competition?. *National Tax Journal*, 54(2), pp 203.
- Buettner, T. (2001). Local business taxation and competition for capital. *Regional Science and Urban Economics*, 31, pp 215.
- Carlsen, F., Langset, B. & Rattsø, J. (2005). The relationship between firm mobility and tax level: empirical evidence of fiscal competition between local governments. *Journal of Urban Economics*, 58(2), pp 273.
- Case, A., Hines, J. & Rosen, H. (1993). Budget spillovers and fiscal policy interdependence. *Journal of Public Economics*, 52, pp 285.
- Devereux, M., Griffith, R. & Klemm, A. (2002). Corporate income tax reforms and international tax competition. *Economic Policy*, 35, pp 451.
- Devereux, M., Lockwood, B. & Redoano, M. (2008). Do countries compete over corporate tax rates. *Journal of Public Economics*, (forthcoming).
- Figlio, D., Kolpin, V. & Reid, W. (1999). Do states play welfare games?. *Journal of Urban economics*, 46(3), pp 437.
- Geys, B. (2006). Looking across borders: a test of spatial policy interdependence using local government efficiency ratings. *Journal of Urban Economics*, 60, pp 443.
- Haufler, A. & Wooton, I. (2001). Country size and tax competition for foreign direct investment. *journal of public economics*, 71(1), pp 121.
- Hayashi, M. & Boadway, R. (2001). An empirical analysis of intergovernmental tax interaction: the case of business income taxes in Canada. *Canadian Journal of Economics*, 34(2), pp 481.
- Head, K. & Mayer, T. (2002). Non-europe: the magnitude and causes of market fragmentation in the EU. *Weltwirtschaftliches Archiv*, 136(2), pp 285.



- Heyndels, B. & Vuchelen, J. (1998). Tax mimicking among Belgian municipalities. *National Tax Journal*, 60, pp 89.
- Ladd, H. (1992). Mimicking of local tax burdens among neighboring counties. *Public Finance Review*, 20, pp 450.
- Mukand, S. & Rodrik, D. (2005). In search of the holy grail: policy convergence, experimentation, and economic performance. *American Economic Review*, (1), pp 374.
- Ollé, A. S. (2003). Electoral accountability and tax mimicking: the effects of electoral margins, coalition government and ideology. *European Journal of Political Economy*, 19, pp 685.
- Redoano, M. (2003). Fiscal interactions among European countries. *Warwick Economic Research papers*, (680), pp 30.
- Revelli, F. (2003). Reaction or interaction? spatial process identification in multi-tiered government structures. *Journal of Urban Economics*, 53, pp 29.
- Ruiz, F. & Gerard, M. (2007). Is there evidence of strategic corporate tax interaction among EU countries. *Working paper University of Mons*, p. 43.
- Vandenbussche, H. & Crabbé, K. (2006). De vennootschapsbelasting: de positie van België in het verruimde Europa, "corporate taxes: the position of Belgium in the enlarged Europe". *Review of Business and Economics*, L1, pp 129.
- Werck, K., Heyndels, B. & Geys, B. (2007). It depends on who you're looking at: neighbourhood effects in local government cultural expenditures. *working paper*, p. 34.
- Wooldridge, J. (2003). *Econometric analysis of cross section and panel data*. Cambridge, MIT press.

## 8 Appendix A

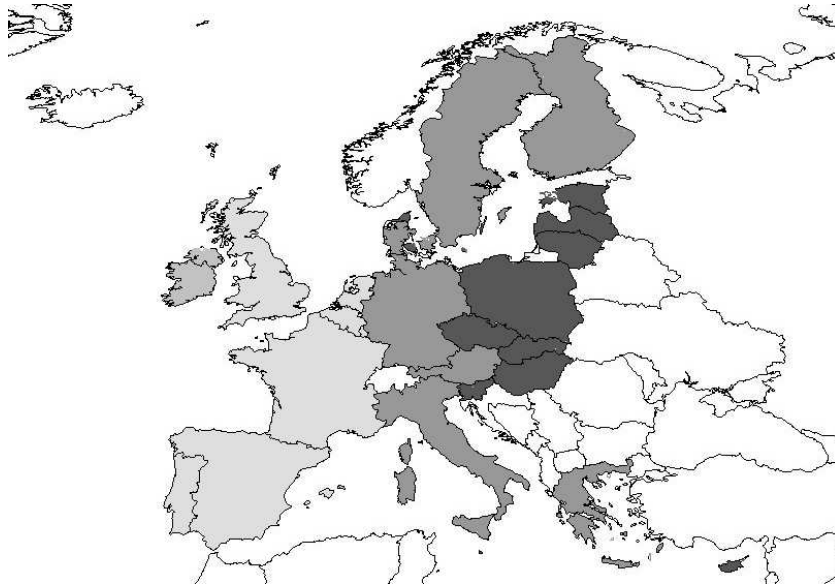


Figure 3: Map of EU25

New member states (EU10= black)= Estonia, Latvia, Lithuania, Poland, Hungary, Czech

Republic, Slovakia and Slovenia

Neighbors of NMS (dark grey)= Sweden, Denmark, Germany, Austria, Italy and Greece

non-neighbors (light grey)= Netherlands, Belgium, France, UK, Spain and Portugal

Ireland (grey)

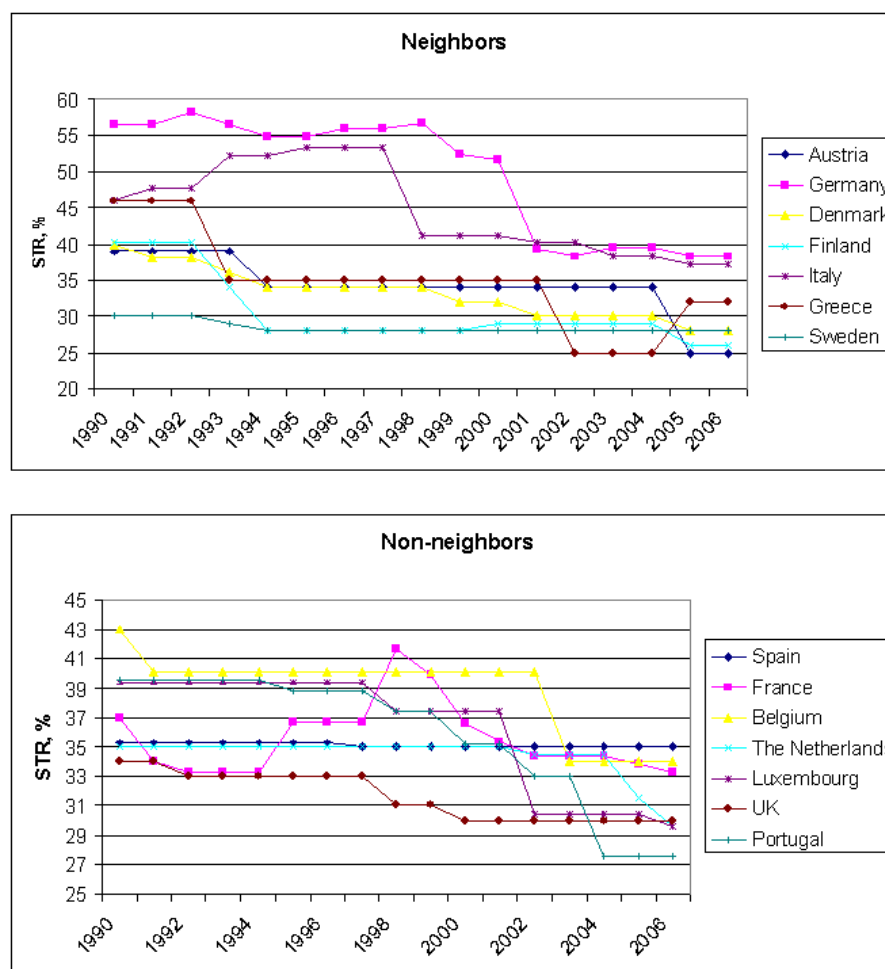


Figure 4: Evolution of Statutory Tax Rates in Europe  
 Neighbors: Germany, Austria, Denmark, Finland, Sweden, Italy and Greece; Non-neighbors:  
 Spain, France, UK, Netherlands, Belgium, Luxembourg and Portugal

The STR is not weighed. Source: KPMG

## 9 Appendix B

The computations of the model in section 4 in more detail:

The inverse demand functions are derived from:

$Q = M - bP$  where for simplicity is assumed that  $b=1$ .  $\Rightarrow P_A = M - Q_A$  and  $P_B = M - Q_B$ .

Using these inverse demand functions, the after-tax profits in country A and B are respectively

$$\begin{aligned}\pi_A &= (M - Q_A)Q_A(1 - t_A) \\ \pi_B &= [(m - Q_B)Q_B + (M - Q_{AB})Q_{AB} - cx^2Q_{AB}](1 - t_B)\end{aligned}\tag{10}$$

Maximizing the after-tax profits leads to the equilibrium output. The maximization is as follows

For A:

$$\begin{aligned}\frac{\partial \pi_A}{\partial Q_A} &= (1 - t_A)(M - Q_A - Q_A) = 0 \\ \Rightarrow Q_A^* &= \frac{M}{2} \\ \text{and} \\ \frac{\delta \pi_A}{\delta Q_{AB}} &= (1 - t_A)((m - Q_{AB}) - Q_{AB} - cx) = 0 \\ \Rightarrow Q_{AB}^* &= \frac{m - cx}{2}\end{aligned}\tag{11}$$

For B:

$$\begin{aligned}
\frac{\partial \pi_B}{\partial Q_B} &= (1 - t_B)(m - Q_B - Q_B) = 0 \\
\Rightarrow Q_B^* &= \frac{m}{2}
\end{aligned} \tag{12}$$

and

$$\begin{aligned}
\frac{\partial \pi_B}{\partial Q_{BA}} &= (1 - t_B)(m - Q_{BA} - Q_{BA} - cx) = 0 \\
\Rightarrow Q_{BA} &= \frac{M - cx}{2}
\end{aligned}$$

Proof:  $CS_1 > CS_2$

$$\begin{aligned}
CS_1 &= \int_0^{Q_A^*} (P_A dQ_A) - P_A Q_A^* = \frac{Q_A^2}{2} \\
CS_2 &= \int_0^{Q_A^*} (P_A dQ_A) - P_A Q_A^* - cx Q_A = \frac{Q_A^2 - 2cx Q_A}{2} \\
&\Rightarrow \frac{Q_A^2}{2} > \frac{Q_A^2 - 2cx Q_A}{2}
\end{aligned} \tag{13}$$

Proof:  $\frac{\delta t_A^*}{\delta M} > 0$

$$\begin{aligned}
\frac{\delta t_A^*}{\delta M} &= \frac{[2cx + t_B 2(M - cx)][M^2 + (m - cx)^2] - 2M(2cx(M - m))}{[M^2 + (m - cx)^2]^2} \\
&\quad - \frac{2M(t_B(m^2 + (M - cx)^2))}{[M^2 + (m - cx)^2]^2} \\
&= \frac{2(1 - t_B)cx[(m - cx)^2 + M(2m - M)]}{[M^2 + (m - cx)^2]^2} > 0
\end{aligned} \tag{14}$$

Table 3: First stage regression of benchmark regression in Table 1, column (1)

	$W_{ij}Tax_{NMS,t}$
$W_{ij}population > 14_{j,t}$	0.81** (0.38)
$W_{ij}population < 65_{j,t}$	-3.57*** (0.69)
$W_{ij}gdp\ per\ capita_{j,t}$	0.00002 (0.00004)
$W_{ij}income\ tax_{j,t-1}$	0.02* (0.01)
population>14 $y_{i,t}$	0.15 (0.38)
population<65 $y_{i,t}$	0.25 (0.4)
GDP per capita $y_{i,t}$	0.00002 (0.0001)
income tax $y_{i,t-1}$	0.04 (0.1)
constant	42.56*** (14.62)
Obs	140
R-squared (within)	0.87

Standard errors are in parentheses. note:\*\*\*, \*\* and \* denote significance level of estimates at respectively 1, 5 and 10 percent levels.