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Classificação JEL codes: F1, F2, H2, H7

Keywords: Tax Competition; Foreign Direct Investment; Spatial Econometrics

Abstract

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1. Introduction

There is no doubt that one of the foremost policy issues surrounding public finance in the European Union (EU) – and the world beyond – is the issue of tax competition. There have been long-standing concerns that as nations compete for mobile investment that this has resulted in a race to the bottom in taxes, resulting in underprovision of public goods as well as potential distortions in firm decisions. As illustrated in Figure 1, which shows average tax rates across a number of developed countries, there is a clear downward trend in taxes, potentially indicative of such a race to the bottom. IMF Deputy Director Murilo Portugal (2007) verbalizes these fears stating "there is equally little doubt that globalization is likely to have a substantial effect on countries' ability to sustain tax revenues". These concerns have grown alongside the expansion of the EU, with the belief that falling trade barriers between members may have led to an intensification of tax competition. This view has been vigorously championed by current French president Nicolas Sarkozy who has repeatedly blasted the new accession countries for cutting their tax rates shortly after joining the EU and threatened their EU aid payments saying that "nations can't claim to be rich enough to do away with taxes while also claiming to be poor enough to ask other nations to provide funds for them" (Crumley, 2004).

The goal of this paper is to empirically investigate whether tax competition has intensified as a result of EU expansion. In doing so, we utilize the model of Baldwin and Krugman (2004) which indicates that the importance attached to a nation's tax rate depends on its market potential (which includes the domestic market and exports). This builds from the growing trade literature incorporating the importance of geography and third country effects into trade models.[1] In addition, we examine the extent to which countries respond to one another differently depending on EU membership. Our estimates provide robust evidence of tax competition consistent with the race to the bottom. Furthermore, we find that the extent of competition depends on EU membership, with EU members responding more competitively to tax cuts by EU members than by non-members. This then provides support for the above-noted fears since our estimates suggest that if the new accession countries had lowered their taxes but remained outside the EU, that EU member tax rates would have been 1.85%, or just over one percentage point, higher.

Despite the large theoretic literature on international tax competition and an equally voluminous public debate on the topic, the empirical evidence on the international interdependence of taxes is remarkably limited.[2] To fill this void, researchers have begun to employ spatial econometric methods to gain insight into how the tax set in one country affects that set in another. This method involves using an instrumented value for the weighted average of other nations' taxes as an explanatory variable for a given country tax. The weighting scheme is an assumption that implies that some external tax rates matter more than others. For example, weighting by distance supposes that proximate countries' taxes matter more than distant ones because of the ease of investment relocating from country *i* to country *j* for tax purposes to export back to country *i*. Another alternative is weighting by GDP, which is intuitive when FDI is

[1] Examples of this literature include Anderson and van Wincoop (2003), Feenstra (2004), and Ekholm, Forslid and Markusen (2007) among many others.

[2] Wilson (1999), Gresik (2001), and Fuest, Huber, and Mintz (2005) survey the theory literature on tax competition as well as the empirical work on how firms respond to taxation. Note that this latter issue is quite distinct from evidence of tax competition as it shows how agents respond to taxes, not how taxes in one country depend on those set in another.

attracted to larger domestic markets, meaning that investment is more willing to relocate from i to j than to k when j is larger than k. As such the taxes of large countries matter more to country i when choosing its tax than those of small ones.

Devereux, Lockwood, and Redoano (2008) utilize data on OECD countries and find that, depending on the weights, they obtain a significant spatial lag (the term used for the coefficient on the other nations' taxes). In particular, when weighting by GDP, they find a positive spatial lag, i.e. higher taxes elsewhere imply a higher tax in a given country. In game theoretic terms, this is equivalent to evidence of strategic complementarity, a key requirement for the oft-discussed race to the bottom. Other weighting schemes provide less robust results. Altshuler and Goodspeed (2007) weight by distance and find some evidence that two year changes in a country's tax rate are positively correlated with the comparable change in other nations' taxes. Overesch and Rinke (2008) and Klemm and van Parys (2009) also weight by distance and find similar results for the level of taxes for European and developing countries respectively. Similarly, Crabbe and Vandenbussche (2008) examine the taxes of the EU15 countries as they depend on the taxes of the new accession countries, finding a positive correlation for nations adjacent to the new accession countries.[3] Redoano (2007) uses both distance and GDP weights, finding positive lags for each.[4] Using a sample of OECD countries,

[3] It is important to note that their investigation differs from ours in two critical ways. First, they only consider the EU members; we consider a broader selection of nations. Second, they only allow the new member taxes to affect the taxes of the EU15. Thus, they do not consider whether EU15 taxes depend on other EU15 taxes, nor whether new member taxes depend on EU15 taxes. This is therefore a very different approach to the issue than the one we take here. One notable contribution of their work, however, is that they estimate a response specifically for the new accession countries.

[4] Redoano (2007) also includes a weighting scheme in which only EU members are given positive weights. When doing so, however, she assumes that both EU members and non-members respond identically to these nations and that no countries respond to non-members. We relax both of these assumptions and find that the latter is soundly rejected by the data. Redoano (2010) follows our method of separate distance-weighted spatial lags for EU and non-EU nations, applying it to a sample of European countries from 1970-

Exbrayat (2009) finds no significant spatial lags when weighting by GDP or distance, but does when weighting by a bilateral trade integration measure. Finally, several studies, including Garretsen and Peeters (2007), Dreher (2006), and Haufler, Klemm, and Schjelderup (2006), utilize equal weights (i.e. the simple average of other nations' taxes) with mixed results.

Although the above weighting schemes are intuitive as it is natural to expect that countries pay more attention to large players or to neighbors, they miss a critical aspect of FDI: access to third markets. In the trade literature, an increasing number of papers illustrate the importance of a country's economic geography in its attractiveness to FDI. As discussed theoretically by Ekholm, Forslid, and Markusen (2007), so called export platform FDI from country *i* will be attracted to country *j* even if *j* is small when *j* has export access to an important third country *k*. Empirical work supporting the existence of export platform FDI is provided by Head and Mayer (2004), Blonigen, Davies, Waddell, Naughton (2007), and Baltagi, Egger, and Pfaffermayer (2007). Export platform issues are likely to be a particularly important aspect of FDI in a free trade area such as the EU, something confirmed in the estimates of Blonigen, et. al (2007). Baldwin and Krugman (2004) develop a model that brings this notion to the tax competition literature. Using an economic geography model that illustrates the importance of market potential – that is access not only to the local market but also all of the foreign ones – for FDI, they show that because export platform FDI is more attracted to nations with larger market potentials such countries will have higher Nash tax rates. An additional implication is

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1999, finding results similar to our Europe-only regressions. These results are broadly similar to those reported here.

that, because multinationals are more responsive to high market potential countries' taxes, so too are other nations competing for those firms.

Note that while GDP is certainly correlated with the size of the domestic market and net exports, it under-weights small countries that import a great deal from other countries. As shown in Figure 2, in our data the percentage difference between GDP and market potential is indeed greatest for small countries, which are also those that tend to have lower tax rates. Thus a GDP weighting scheme under-represents the countries with the lowest taxes. Similarly, distance is correlated with trade between two countries but, as a wealth of trade regressions indicate, it only explains a portion of trade levels. Furthermore, using distance between, say, Ireland and the UK when determining the UK tax rate ignores the ability of Ireland to export to other nations. A comparable problem exists for the trade integration weighting of Exbrayat (2009). As discussed in papers such as Head and Mayer (2004) and Blonigen, et. al (2007, 2008), failure to account for proximity to other markets gives a poor measure of market potential, indicating the weakness of this weight. Anselin (1988) highlights the importance of the weighting scheme, cautioning that improper specification can yield misleading and spurious results. In addition to ignoring third countries, using a weight such as GDP is problematic because if FDI affects GDP and taxes affect FDI, then the weight itself is endogenous to the tax rate. As such, as discussed below, the constructed instrument does not resolve the endogeneity problem spatial econometrics is intended to solve. The measure of market potential we utilize avoids both of these pitfalls.

An additional contribution of this paper is to relax the standard assumption that all countries respond in identical fashions to others' taxes. In the current context, the existing literature imposes the restriction that a country responds equally to EU and non-EU countries' taxes. Further, the typical approach assumes that EU and non-EU countries respond identically to others taxes. With the above noted policy maker concerns in mind, we relax these assumptions. Our analysis rejects both of these restrictions. In particular, we find robust evidence that all countries respond more to EU taxes than to non-EU taxes with this difference being greatest for EU members. This does indeed suggest that as the EU expands, it forces existing members to respond more to the low taxes of new members than they did previously.

In the next section, we describe our empirical approach and our data. Results are contained in Section 3. Section 4 concludes.

2. Empirical Specification and Data

In this section, we outline our empirical approach and describe our data.

2.1 Empirical Specification

We begin with the "workhorse" regression specification adopted by Devereux, Lockwood, Redoano (2008), Altshuler and Goodspeed (2007), and Overesch and Rincke (2008). This baseline specification takes the form:

$$t_{l,t} = \beta X_{l,t} + \rho \sum_{k \neq l} \omega_{lk,t} t_{k,t} + \varepsilon_{l,t} \tag{1}$$

where $t_{l,t}$ is the tax rate in country l in year t, $X_{l,t}$ is a vector of control variables specific to country l, $\sum_{k \neq l} \omega_{lk,t} t_{k,t}$ is the spatial lag which is a weighted-sum of other countries' tax rates, and $\varepsilon_{l,t}$ is an i.i.d. error term. We modify this by allowing for two spatial lags, one for non-EU countries and one for EU countries:

$$t_{l,t} = \beta X_{l,t} + \rho^{non-EU} \sum_{k \neq l, k \notin EU} \omega_{lk,t} t_{k,t} + \rho^{EU} \sum_{k \neq l, k \in EU} \omega_{lk,t} t_{k,t} + \varepsilon_{l,t} \quad (2)$$

where the first weighted sum is just across non-EU members and the second is just across EU members.[5] This specification will permit us to test whether nations respond differently to EU and non-EU members. In addition to exploring whether countries respond differently to EU and non-EU countries, doing so provides an additional econometric benefit. As discussed in detail by Overesch and Rincke (2008), as the number of countries in the sample grows, the weight given to any given country becomes small, leading the spatial lag to become roughly constant across countries. Separating the countries into groups as we do reduces this problem since it increases the magnitude of the weight assigned to each individual country.[6]

Since taxes are interdependent, the spatial lags are endogenous and are instrumented for using the weighted sum of other nations' exogenous variables, i.e. by estimating:

$$\sum_{k \neq l} \omega_{lk,t} t_{k,t} = \tilde{\beta} \sum_{k \neq l} \omega_{lk,t} X_{l,t} + \tilde{\varepsilon}_{l,t} . \quad (3)$$

This is done separately for the EU and non-EU countries. In these weighted sums, $\omega_{lk,t}$ is the weight that the tax rate in country k gets in country l's observation for year t.[7] As is common, we row-standardize so that the weights sum to one in each category for each observation.[8] For our weights, we use $\textit{Market Potential}_{k,t}$ which equals the sum of *k*'s

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[5] Redoano (2007) also considers estimates with an EU-only spatial lag. However, in doing so she does not include a non-EU spatial lag, implicitly assuming that countries do not respond to non-EU nations.

[6] When we separate our countries, the smallest non-EU weight is .03 and the smallest EU weight is .025. Alternatively, one might suppose that the least important countries should receive zero weights. With this in mind, in unreported results, we reset the weights of countries with calculated weights less than or equal to .03 to zero. This did not change the qualitative nature of the results.

[7] It should be noted that Altshuler and Goodspeed (2007) use the *t-1* value of *k*'s tax in some regressions and that Overesch and Rincke (2008) use this in all their specifications.

[8] See Anselin (1988) on details of row standardization.

GDP and imports in year *t*. Our rationale for this follows the model of Baldwin and Krugman (2004) who consider tax competition in an economic geography setting (a simplified version of which is presented in the appendix). Their model indicates that larger countries have an advantage in attracting investment since a firm will prefer to supply this large market locally thereby avoiding trade costs. In addition, the model shows that countries with low transport costs to the rest of the world are also attractive to investment since a firm's profits depends on its ability to access the global market as well as the local one. This idea is particularly important for the issue of taxation in the EU where (often low tax) periphery nations are able compete for investment on the basis of their easy access to other EU members. Both of these factors increase the elasticity of investment to the tax rate of such large, well-situated economies. In turn, this increases the slope of the best response of other nations to such economies' tax rates. Our measure of market potential, the sum of domestic consumption plus gross exports, thus mirrors the results of Baldwin and Krugman (2004).[9]

If tax competition takes place for mobile, exporting firms, it must be recognized that market potential is potentially endogenous. This is particularly troublesome for small periphery countries such as Ireland for whom export platform FDI comprises a significant share of the economy. We therefore construct exogenous proxies for the weights in order to estimate (3), otherwise the right-hand side control variables will not be exogenous to country *l*'s tax. Specifically, for country *i* in year *t*, we estimated :

$$MarketPotential_{i,t} = \eta_0 + \eta_1 Population_{i,t} + \eta_2 Population_{i,t}^2 + \eta_3 EU_{i,t} + \eta_4 Trend_t + \eta_i + \varepsilon_{i,t} \quad (4)$$

[9] Contrast this to GDP which is the sum of domestic consumption and *net* exports. It is worth noting that GDP weights are lower for countries that import a lot relative to the size of their economies, countries that in our sample also tend to be low tax ones. Bilateral distance between countries, another common weight, is also potentially misleading because it ignores both the size of the local market and access to third countries.

i.e. *Market Potential*$_{i,t}$, as a function of population and its square, EU membership, a time trend, and country specific fixed effects.[10] The use of fixed effects controls for proximity to other markets.[11] The results from this regression which has an R2 of 0.72 are found in the Appendix. This regression was then used to construct a proxy is used for the weights for spatial lag term.

Finally, we will allow the slope of the best response for country *l* with regards to country *k*'s tax to depend not only on whether *k* is an EU member or not, but also on whether *l* is. This specification is given by:

$$\begin{aligned} t_{l,t} = \beta X_{l,t} + \rho^{non-EU} \sum_{k\neq l, k\notin EU} \omega_{lk,t} t_{k,t} + EU_{l,t}\rho^{non-EU} \sum_{k\neq l, k\notin EU} \omega_{lk,t} t_{k,t} \\ + \rho^{EU} \sum_{k\neq l, k\in EU} \omega_{lk,t} t_{k,t} + EU_{l,t}\rho^{EU} \sum_{k\neq l, k\in EU} \omega_{lk,t} t_{k,t} + \varepsilon_{l,t} \end{aligned} \quad (5)$$

which adds an interaction term between $EU_{l,t}$, a dummy variable equal to 1 when *l* is an EU member in year *t*, and the two spatial lags to the specification of (2).

2.2 Data

Our data is an unbalanced panel of countries spanning 1980-2005. The list of countries and years they first appear in our sample is found in Table 1.[12] Note that since some of the countries do not enter until the second half of our sample (particularly the eastern European ones), one of our robustness checks will be to re-estimate the model using just the years 1995-2005 so that we have a balanced panel. All non-binary variables are measured in logs.[13]

For the majority of the presented results, we use the effective average tax rate (EATR). As argued in Devereux and Griffith (1998, 2003), if the firm is making an

[10] Here, the EU dummy is intended to help control for the lower trade costs EU members may enjoy.
[11] As found by Blonigen, Davies, Waddell, and Naughton (2007), this is typically sufficient to control for this factor when predicting FDI activity.
[12] The sample of countries is determined by the availability of tax rate data.
[13] This includes the variables used to estimate (4).

extensive location decision, the EATR is the relevant measure of taxation. We utilize their approach along with the data of Loretz (2008) to calculate our EATR measure. The appendix gives additional detail on the construction of the EATR. In addition to this tax measure, in robustness checks we instead use the statutory rate.

Seven variables comprise the vector of exogenous explanatory variables $X_{l,t}$. For our measure of a nation's market potential, $Market\ Potential_{l,t}$, we use the constructed version discussed above, which is measured in millions of constant US dollars (base year 2000). In line with Baldwin and Krugman, as well as other studies that find a positive coefficient on GDP in tax regressions, we anticipate a positive coefficient. In addition we include $Gov.\ Expenditures_{l,t-1}$ which is government expenditures as a share of GDP. Note that we are assuming that although GDP and government expenditures might vary with the tax rate, the ratio of the two does not. As additional insurance against endogeneity, we use the lagged value of this variable.[14] Consistent with the expectation that governments with large expenditure requirements will have less ability to lower taxes to compete for investment, we anticipate a positive coefficient. We also include two demographic variables. $Urban_{l,t}$ is the percentage of the population living in urban areas. $Dependency_{l,t}$, is the ratio of the dependents to the working age population. Given the results of Devereux, et al. (2008), we anticipate a negative coefficient for the dependency ratio. All of the above mentioned variables were obtained from the 2008 World Development Indicators.[15]

In addition to these, we constructed $Openness_{l,t}$, which is the ratio of exports to market potential and is intended to mirror a similar variable used in other papers. Here,

[14] In unreported results, we used the contemporaneous value of government expenditures, with little change in our results.
[15] The World Bank Data can be found at http://www.worldbank.org/data

not only must we deal with the endogeneity of market potential, but also exports. Thus, to construct exogenous predictions for exports, we estimate a gravity model of the form[16]:

$$Exports_{l,j,t} = \kappa_0 + \kappa_{l,j} + \kappa_1 Population_{l,t} + \kappa_2 Population_{l,t}^2 + \kappa_3 Population_{j,t} + \kappa_4 Population_{j,t}^2 + \kappa_5 Regional_{l,j,t} + \eta_6 Trend_t + \varepsilon_{l,t} \quad (6)$$

where $\kappa_{l,j}$ is a direction-pair specific fixed effect and $Regional_{l,j,t}$ is a dummy variable equal to 1 when the countries are both members of a regional trade agreement.[17] This latter variable was obtained from Rose (2005). Export data come from the IMF's Direction of Trade Statistics and population data again come from the World Bank. Full details of this regression can be found in the appendix.

We include a dummy variable $EU_{l,t}$ for EU membership. Since EU membership grows over time, our robustness checks include a set of regressions where rather than utilizing EU membership, we use a dummy variable equal to one only for the EU15 countries, a categorization which includes the major members of the EU but does not vary in size over time. Table 1 indicates the countries that fall into this category. Finally we include a time trend and, in most specifications, country-specific fixed effects. Fixed effects are useful in filtering out the impact of country specific but time invariant factors such as geography, placement in physical space on the globe, national attitudes towards taxation, and the like.

Summary statistics for our variables are found in Table 2. As a final note, due to the construction of explanatory variables, we bootstrap our error terms fifty times in all regressions.

[16] For details on gravity models, which are the standard for estimating trade levels, see Rose (2005). Note that, again due to concerns over the endogeneity of GDP, we utilize population rather than GDP to estimate exports.

[17] Note that this fixed effect controls for common trade predictors such as distance, island/landlocked status, shared colonial history, and common language.

3. Results

3.*1 Baseline Results*

Table 3 presents our baseline results. Column 1 utilizes our set of control variables without any spatial lag. This is in order to compare our results to those typically found in the literature. We find that, as expected, countries with larger market potentials have higher taxes. This would be consistent with the notion that these countries have advantages that allow them to set higher taxes without deterring firms from locating there. Consistent with other studies, we also find that countries with high government expenditures relative to GDP, urban populations, and low dependency ratios all have higher taxes. In addition, we find that EU members tend to have lower taxes. Although it is not always significant, similar to other studies we find more open countries have higher taxes. Finally, our trend term highlights the oft-discussed downward trend in taxes. Comparing these estimates across specifications in this and subsequent tables shows that the findings for our control variables are generally consistent across specifications.

Column 2 introduces our two spatial lags, one for EU members and one for non-members, each of which is the constructed market potential weighted sum of the relevant set of taxes. As column 2 reports, both spatial lags are significantly positive. To correctly interpret the estimated coefficients, it is important to recognize what they capture. The regression estimates the correlation between the tax rate of country l and the weighted tax rate of country k. The size of the marginal effect of k's tax is the product of the estimated coefficient and its weight (k's share of its group's total market potential). The average over the sample for total EU market potential is 161.1, roughly half that of total non-EU market potential of 266.1.[18] Thus, moving country *k* from a non-EU country to an EU country increases its weight by 1.65 (i.e. 266.1/161.1). Therefore, even if the estimated coefficients were the same across the two groups of countries, since EU countries have greater $\omega_{lk,t}$s the slope of the best response is larger for EU than non-EU countries. Put differently: EU and non-EU countries would have a similar impact if $1.65\rho^{EU} = \rho^{non\text{-}EU}$. This hypothesis is rejected with a p-value of less than 0.1 percent.

These results indicate that tax rates are strategic complements – i.e. as other countries lower their EATRs the country in question lowers its own as well. In addition, given the discussion above, nations respond more fiercely to tax changes by EU members than non-members all else equal. Finally, note that in this and subsequent regressions, we fail to reject the hypothesis that the coefficient on the EU spatial lag is less than one. Thus, we cannot reject the null that an increase in all EU taxes of 1% leads to a less than 1% change in this country's tax, suggestive of a stable Nash equilibrium.

In column 3, we examine not only whether a given country responds differently to EU and non-EU taxes, but also on whether its response to a given set of countries depends on whether it is itself an EU member. One reason is that trade between EU members may be particularly streamlined relative to trade between a member and a non-member or between non-members. This could impact the tax sensitivity of investment leading to a difference between and EU member response to a given tax rate and the response of a non-member. Another is that since many economic policies (such as trade and immigration) are coordinated among EU members, EU members may respond differently than non-members when setting unilateral policies such as corporate tax rates.

[18] The market potential of a country is measured in log billions of constant 2000 US dollars as are these totals.

To this end, we now interact our two spatial lag terms with the EU membership dummy variable as per (5).

For the non-interacted spatial lags, we find results similar to those in column 2, namely that taxes are strategic complements. However, not all countries respond in the same way. As before, the coefficients on *Non-EU Spatial Lag*$_{l,t}$ and *EU Spatial Lag*$_{l,t}$ imply that non-EU countries respond more to EU members, however the difference in these magnitudes is smaller with a mere 34 percent difference (as compared to the 60 percent difference in column 2). This difference, however, is significantly larger for EU members since their response to non-member taxes is only half as large with a point estimate of .328 (i.e. the sum of *EU*$_{l,t}$ * *non-EU Spatial Lag*$_{l,t}$, and *non-EU Spatial Lag*$_{l,t}$). Furthermore, given the point estimate on *EU*$_{l,t}$ * *EU Spatial Lag*$_{l,t}$, EU members respond more to EU taxes than non-members do (although the coefficient is not statistically significant). As shown in column 4, this result is robust to the inclusion of country-specific fixed effects. Therefore, given the less stringent assumptions of the fixed effects approach, we will utilize it as our preferred specification in subsequent regressions.

These estimates give credence to the concern that as countries switch into the EU that it forces other countries – and in particular existing EU members – to respond more fiercely to their tax cuts. Using the weighted average of the 2004 values for new accession countries' taxes (that is, those after the reduction blasted by Sarkozy) and simulating a switch of these countries from an EU to a non-EU status implies that the tax rates of EU countries would rise by 1.85%, an increase of 1.02 percentage points. This gives a rough idea of the importance of EU membership for the strategic interdependence of taxes.

3.2 Robustness Checks

Table 4 reassesses these results with respect to three aspects of our data: that it includes countries from around the globe, that it is an unbalanced panel, and that EU membership has only grown. Column 1 repeats the preferred fixed effects specification of Table 3 column 4 but utilizes only European countries.[19] Since EU countries are in Europe, it may be that the difference in response rates arises due to the fact that EU members are more geographically concentrated. Thus, the results may be driven by the different locations of the two groups rather than impacts on trade engendered by their EU status. As the estimates indicate, however, this is not the case as our results are very similar to those in Table 3. To deal with the unbalanced panel, column 2 repeats the preferred specification but restricts the time series to 1995-2005, a restriction that creates balance within our panel. Here, we again find results qualitatively the same as those above with the exception that the $EU_{l,t}$ * *non-EU Spatial* $Lag_{l,t}$, interaction is now insignificant, potentially the result of our sample size being cut in half. Thus, our evidence for that countries respond to EU taxes is robust to these subsamples of the data.

Column 3 addresses a different time series aspect of our data, namely that EU membership has grown over time. Thus, one might be concerned that the differences found between EU and non-EU countries may result from changes in the composition of membership over time rather than the increased sensitivity to one another's taxes membership in the EU might create. To address this, in column 3 rather than defining our spatial lags and interactions according to EU membership, we define them according to whether or not a country is an EU15 nation. As this does not change over time, countries do not change categories and these difference are not driven by changes in membership.

[19] The countries that fall into this group are listed in Table 1.

Here we find largely comparable results, although we find no significant response to EU15 countries' taxes. Since we are using country fixed effects and EU15 status does not change over time, this insignificance when relying exclusively on time series variation is not particularly surprising. In unreported results without fixed effects, we found a positive, significant coefficient for this variable. Thus, the use of EU15 status alleviates concerns that our results are driven solely by increasing EU membership.[20]

Table 5 considers four additional robustness checks. First, in column (1), rather than using a time trend we include year dummies. This is not our preferred method because using year dummies compares countries' taxes to the mean within a year. Since the EU spatial lag does not vary across EU countries and the non-EU one does not vary across EU countries, inclusion of year dummies eliminates much of the variation within a given year. Klemm and van Parys (2009) provide for a detailed discussion of this issue in the context of spatial estimation of tax competition. Nevertheless, when doing so, we find comparable results for the non-EU spatial lag and interaction, although the magnitude of the non-interacted lag increases. Turning to the EU spatial lags, we find a similar sign pattern however we do not find significance for *EU Spatial Lag*$_{l,t}$.

In column (2) we use first differences in all of our variables excepting the EU dummy.[21] We do this for three reasons. First, there is a degree of persistence in the tax rates over time within a country. Second, issues of tax competition are often phrased as

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[20] In unreported results, we utilized a Eurozone dummy that was equal to one when a country had the Euro and zero otherwise. We found little evidence that indicated a difference in the reaction to Eurozone taxes as compared to non-Eurozone. While this suggests little impact of Euro membership on tax competition (or that these stable countries differ little from similar non-Euro ones), the short time frame of the data after the creation of the Euro likely limits our ability to obtain significant results. Therefore, this may be a fruitful area of research after additional time series data become available.

[21] When we also used a first difference for the EU dummy, we found comparable results. Note that the interpretation to this unreported regression would be that the differences in the spatial lags occur only in the year a country joins the EU.

one in which a *change* in one country's tax is driven by the *change* in another, that is changes are correlated not necessarily levels. Third, it allows us to compare our results to those of Altshuler and Goodspeed (2007) who use tax rate changes. When doing so, we find sign patterns similar to those above, however, we only find significance for the non-interacted spatial lags. As before, the estimated coefficient on the EU spatial lag is larger than that one for non-EU taxes. This suggests that all nations (EU and non- EU countries) respond more to *changes* in EU taxes.

Column (3) of Table 5 utilizes an alternative weight:

$$\omega_{lj,t} = \frac{d_{jl}^{-1} \ln \Pi_{j,t}}{\sum_{k \neq l} \left(d_{kl}^{-1} \ln \Pi_{k,t} \right)} \tag{7}$$

i.e. the market potential of country j which is itself discounted by the inverse distance between j and l. Since FDI is generally found to decline in the distance between the parent and host countries, one might expect that firms initially located in l might be willing to relocate to a country with a higher market potential with a particular preference for such countries that are near to their initial location. Thus, l would need to be cognizant of both neighbors with somewhat smaller market potentials as well as distant countries with large market potentials. Nevertheless, as shown in column (3), this alternative approach yielded results very similar to those using non-distance weighted market potentials.

Finally, column (4) repeats the preferred specification but uses the statutory tax rate rather than the effective average tax rate. Here, we find a similar story as above: positive spatial lags across groups with EU members responding more to EU member taxes than non-member taxes. Thus, as in Devereux, Lockwood, and Redoano (2008) and

Overesche and Rinke (2008), we find competition in both effective and statutory tax rates.

3.3 Domestic market versus exports

Finally, Table 6 attempts to provide some insight into the relative importance of the two components driving market potential – the domestic market and total exports. To do so, we create one weight using the domestic market (GDP minus exports plus imports, instrumented in the fashion described above for market potential) and one weight using exports (again constructed as above). In column (1), we utilize the domestic market scheme, finding results comparable in sign and significance to those using market potential. Column (2) uses the export scheme. Here, although we find similar signs to the market potential weighting scheme, the only significant spatial lag is for the interaction indicating that EU countries respond less to non-EU countries. Finally, column (3) uses both. Given the high degree of correlation between the export weighted lag and the domestic market weighted lag, it is not surprising that we find little of significance.[22] Nevertheless, the pattern of coefficients continues for the domestic market lags. Taken as a whole, these estimates suggest that of the two, domestic market size might hold more sway than exports in tax competition. This result might be anticipated if FDI is more geared towards domestic sales than exporting, a result found by Markusen and Maskus (2002), Blonigen, Davies and Head (2003), and Davies (2008).

[22] This correlation is also manifested in the domestic market and export control variable with only the domestic market is significant.

4. Conclusion

The goal of this paper has been to investigate whether any evidence can be found to support the notion that expansion of the European Union has exacerbated tax competition. To do so, as motivated by Baldwin and Krugman (2004) we utilize market potential, that is the size of the domestic market combined with access to foreign markets, as the weighting scheme. Utilizing this weight, we find robust evidence of tax competition. In particular, we find that while both EU members and non-EU members respond more to member taxes with this difference even greater for EU members. This then lends credence to the concerns expressed in policy circles that expansion of the EU may lead to more aggressive tax competition.

Note that these findings say nothing about whether such tax competition is inherently bad. While there exist many models in which tax competition results in inefficient equilibria (either because it implies underprovision of public goods or because it distorts investment locations), there also exist models in which tax competition is beneficial. Therefore our results should be interpreted as providing evidence on the existence and extent of the phenomenon, not its welfare implications. Nevertheless, we hope that they provide a useful context for further research and enhanced policy making.

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Table 1: Countries in the Sample

Country	First Year in Sample	Year Joined the EU	Country	First Year in Sample	Year Joined the EU
Australia	1982	-	Korea	1996	-
Austria*†	1982	1995	Latvia*	1996	2004
Belgium*†	1982	1957	Lithuania*	1996	2004
Bulgaria*	1994	2007	Luxembourg*†	1991	1957
Canada	1980	-	Malta*	1989	2004
China	1991	-	Mexico	1995	-
Cyprus*	1994	2004	Netherlands*†	1980	1957
Czech Republic*	1991	2004	New Zealand	1991	-
Denmark*†	1986	1973	Norway*	1982	-
Estonia*	1994	2004	Poland*	1992	2004
Finland*†	1982	1995	Portugal*†	1982	1986
France*†	1980	1957	Slovak Republic*	1991	2004
Germany*†	1980	1957	Slovenia*	1995	2004
Greece*†	1980	1981	Spain*†	1980	1986
Hungary*	1991	2004	Sweden*†	1982	1995
Iceland	1992	-	Switzerland*	1982	-
Ireland*†	1980	1973	UK*†	1980	1973
Italy*†	1980	1957	United States	1980	-
Japan	1980	-			

* denotes European country. † denotes EU15 country.

Table 2: Summary Statistics

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Minimum*	*Maximum*
Effective Average Tax Rate$_{l,t}$	680	-1.254246	.3674647	-2.615606	-.6329393
Statutory Tax Rate$_{l,t}$	680	-1.085281	.3581699	-2.302585	-.4827252
Market Potential$_{l,t}$	680	12.21358	2.029293	8.243695	19.12246
Gov. Expenditures$_{l,t-1}$	680	2.914555	.2331098	2.265194	3.399302
Urban$_{l,t}$	680	4.252471	.1920743	3.339322	4.577799
Dependency$_{l,t}$	680	-.7028915	.08965	-.9404324	-.3581957
EU$_{l,t}$	680	.4470588	.4975553	0	1
Openness$_{l,t}$	680	-3.083244	4.421151	-11.63395	9.444099

Table 3: Baseline Results

	(1)	(2)	(3)	(4)
Non-EU Spatial Lag$_{l,t}$		0.547***	0.783***	0.257**
		(0.176)	(0.146)	(0.112)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$			-0.455***	-0.158*
			(0.134)	(0.087)
EU Spatial Lag$_{l,t}$		1.342***	1.196***	0.678**
		(0.454)	(0.413)	(0.307)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$			0.479	-0.163
			(0.355)	(0.252)
Market Potential$_{l,t}$	0.087***	0.087***	0.093***	1.818***
	(0.015)	(0.013)	(0.013)	(0.326)
Gov. Expenditures$_{l,t-1}$	0.298***	0.313***	0.304***	-0.110
	(0.060)	(0.055)	(0.059)	(0.084)
Urban$_{l,t}$	0.520***	0.630***	0.655***	0.412**
	(0.091)	(0.080)	(0.077)	(0.203)
Dependency$_{l,t}$	-1.140***	-1.216***	-1.235***	-0.753***
	(0.246)	(0.213)	(0.200)	(0.158)
EU$_{l,t}$	-0.076***	-0.084***	0.046	-0.636***
	(0.027)	(0.023)	(0.324)	(0.237)
Openness$_{l,t}$	0.010*	0.008	0.010*	0.227
	(0.006)	(0.006)	(0.005)	(0.159)
Trend$_{t}$	-0.027***	0.036*	0.038**	-0.070***
	(0.002)	(0.019)	(0.015)	(0.015)
Constant	-5.730***	-5.068***	-5.205***	-22.468***
	(0.697)	(0.556)	(0.683)	(3.289)
Observations	680	680	680	680
R-squared	0.403	0.413	0.440	0.869
Fixed Effects	No	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.1 Robust, bootstrapped standard errors in parentheses.

Table 4: Alternative Samples

	(1)	(2)	(3)
	Only European Countries	*Only 1995-2005*	*EU15 Designation*
Non-EU Spatial Lag$_{l,t}$	0.481***	0.786*	0.329***
	(0.178)	(0.473)	(0.110)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.230*	-0.074	-0.176**
	(0.126)	(0.115)	(0.070)
EU Spatial Lag$_{l,t}$	0.796**	1.290*	0.323
	(0.376)	(0.684)	(0.214)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	0.063	-0.281	0.042
	(0.325)	(0.199)	(0.206)
Market Potential$_{l,t}$	3.432***	2.274***	1.796***
	(0.805)	(0.757)	(0.319)
Gov. Expenditures$_{l,t-1}$	-0.093	-0.598***	-0.207*
	(0.127)	(0.166)	(0.121)
Urban$_{l,t}$	0.188	0.563	0.384*
	(0.299)	(0.448)	(0.219)
Dependency$_{l,t}$	-0.977***	0.261	-0.797***
	(0.162)	(0.319)	(0.141)
EU$_{l,t}$	-0.559**	-0.755***	-0.314***
	(0.282)	(0.217)	(0.040)
Openness$_{l,t}$	0.229	0.318	0.311*
	(0.273)	(0.237)	(0.173)
Trend$_{t}$	-0.108***	-0.050	-0.073***
	(0.033)	(0.050)	(0.016)
Constant	-38.940***	-24.943***	-21.922***
	(8.530)	(7.221)	(3.366)
Observations	516	395	680
R-squared	0.878	0.877	0.866
Fixed Effects	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1 Robust, bootstrapped standard errors in parentheses.

Table 5: Additional Robustness Checks

	(1)	(2)	(3)	(4)
	Year Dummies	*First Differences*	*Distance Weighted Market Potential*	*Statutory Tax Rates*
Non-EU Spatial Lag$_{l,t}$	2.327***	0.355**	0.202*	0.219*
	(0.620)	(0.141)	(0.109)	(0.120)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.125**	0.018	-0.154*	-0.217**
	(0.062)	(0.113)	(0.081)	(0.087)
EU Spatial Lag$_{l,t}$	1.914	0.649***	0.589**	0.388*
	(1.223)	(0.226)	(0.288)	(0.232)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	-0.357**	0.026	-0.168	-0.052
	(0.172)	(0.106)	(0.231)	(0.197)
Market Potential$_{l,t}$	1.738***	0.172	1.796***	1.641***
	(0.278)	(0.236)	(0.303)	(0.318)
Gov. Expenditures$_{l,t-1}$	-0.144	0.236**	-0.118	0.004
	(0.106)	(0.093)	(0.118)	(0.097)
Urban$_{l,t}$	0.787***	1.287	0.396**	0.588***
	(0.232)	(0.964)	(0.186)	(0.213)
Dependency$_{l,t}$	-0.906***	-0.730*	-0.754***	-0.627***
	(0.173)	(0.391)	(0.128)	(0.166)
EU$_{l,t}$	-0.818***	0.032	-0.637***	-0.511***
	(0.169)	(0.020)	(0.220)	(0.146)
Openness$_{l,t}$	0.195	0.087	0.219	0.039
	(0.130)	(0.103)	(0.182)	(0.171)
Trend$_t$		-0.000	-0.074***	-0.068***
		(0.001)	(0.014)	(0.017)
Constant	-21.657***	-0.015	-22.2***	-22.220***
	(3.567)	(0.012)	(3.246)	(3.177)
Observations	680	660	680	680
R-squared	0.875	0.539	0.869	0.880
Fixed Effects	Yes	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1 Robust, bootstrapped standard errors in parentheses. All variables in column (2) are in first differences excepting the EU dummies and the constant.

Table 6: Domestic Market versus Exports

	(1)	(2)	(3)
VARIABLES	Domestic Market Only	Exports Only	Both
Domestic Market Weights			
Non-EU Spatial Lag$_{l,t}$	0.343***		0.607
	(0.127)		(0.383)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.199**		-0.242
	(0.081)		(0.551)
EU Spatial Lag$_{l,t}$	0.679**		1.540*
	(0.286)		(0.814)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	-0.064		0.575
	(0.211)		(0.898)
Export Weights			
Non-EU Spatial Lag$_{l,t}$		0.175	-0.311
		(0.175)	(0.528)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$		-0.173***	0.015
		(0.063)	(0.602)
EU Spatial Lag$_{l,t}$		0.433	-0.970
		(0.303)	(0.851)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$		-0.202	-0.679
		(0.184)	(0.924)
Domestic Market$_{,t}$	1.461***	1.185***	1.486***
	(0.265)	(0.309)	(0.337)
Exports$_{,t}$	-0.273	0.023	-0.279
	(0.324)	(0.350)	(0.398)
Gov. Expenditures$_{l,t-1}$	-0.122	-0.135	-0.113
	(0.110)	(0.101)	(0.111)
Urban$_{l,t}$	0.474**	0.417*	0.436*
	(0.215)	(0.216)	(0.244)
Dependency$_{l,t}$	-0.743***	-0.752***	-0.631***
	(0.168)	(0.111)	(0.199)
EU$_{l,t}$	-0.480**	-0.637***	-0.575*
	(0.190)	(0.187)	(0.296)
Openness$_{l,t}$	0.570	0.222	0.608
	(0.368)	(0.410)	(0.443)
Trend$_{t}$	-0.035**	-0.05***	-0.037*
	(0.014)	(0.015)	(0.020)
Constant	-16.42***	-15.4***	-16.6***
	(2.028)	(2.216)	(2.465)
Observations	680	680	680
R-squared	0.870	0.868	0.871
Fixed Effects	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1 Robust, bootstrapped standard errors in parentheses.

Figure 1: Average Tax Rates over Time

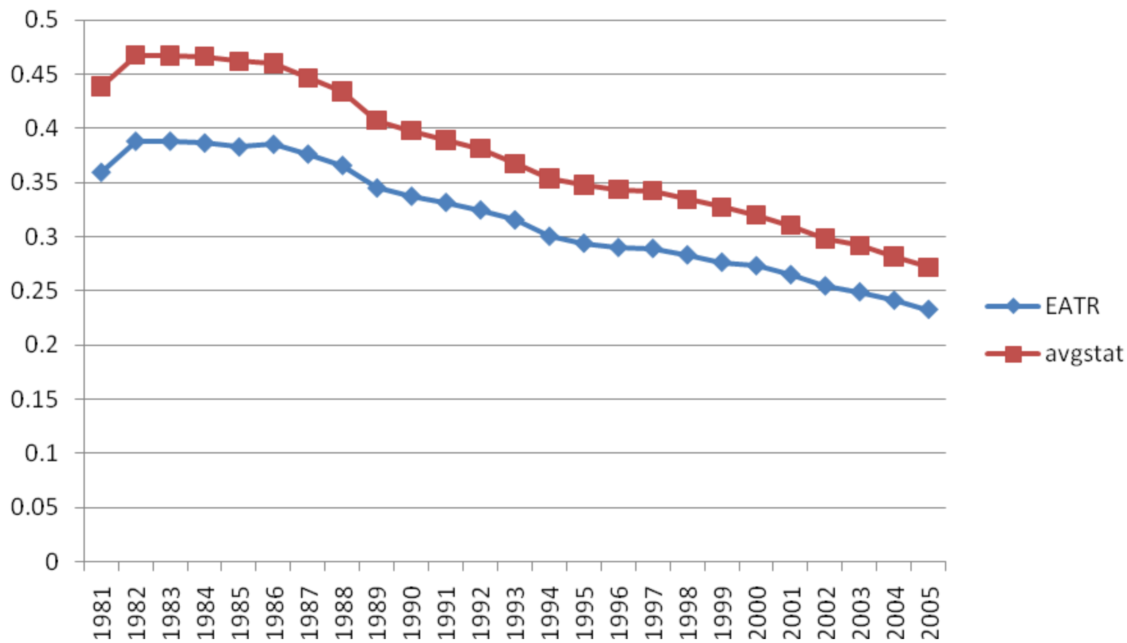
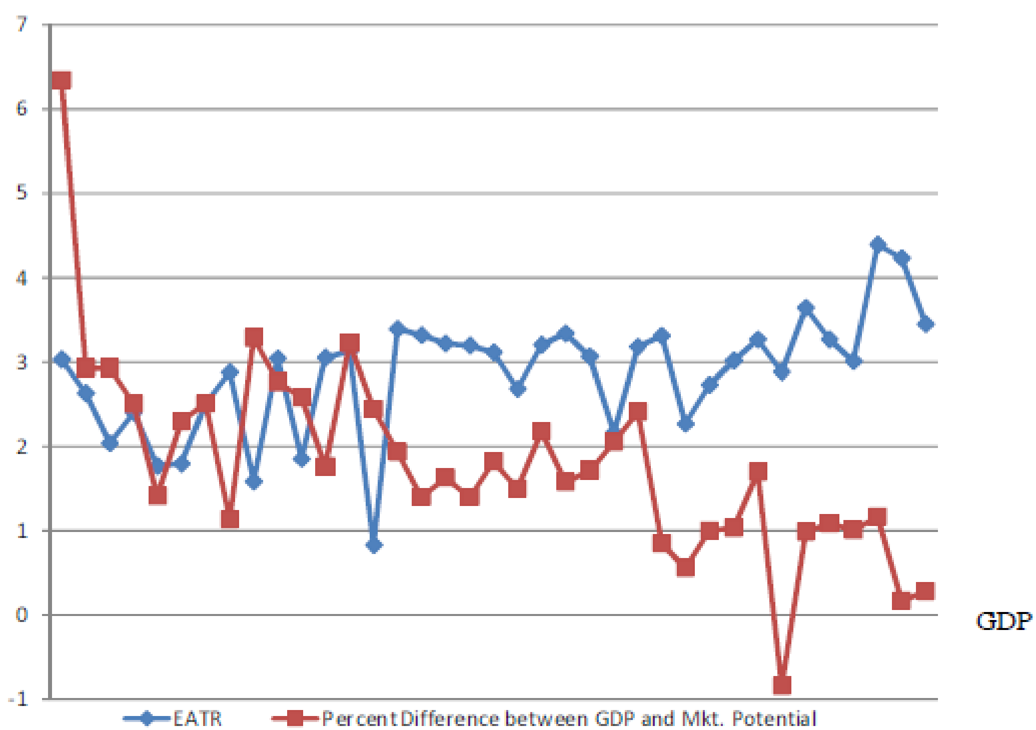


Figure 2: Difference between GDP and Market Potential



Appendix

A.1 A Simple Model of Tax Competition

In this appendix, we present a very simple, stylized model of tax competition for exporting firms akin to that of Baldwin and Krugman (2004). As the goal of this model is to motivate the use of market potential as a weighting scheme in as clear a fashion as possible, our model lacks many of the complicating features of more advanced models. This parsimony allows us to derive in a straightforward manner a set of results on the relative slopes of best response functions. We refer the reader to Baldwin and Krugman (2004) as well as the literature summarized by Fuest, Huber, and Mintz (2005) for more detailed theoretic treatments.

Consider a setting in which there are a large number of firms and three countries. The N firms are indexed by i and the countries are indexed by l where $l \in \{1,2,3\}$. Each firm i produces a good in a single country but sells that good in each of the three countries by exporting.[23] The inverse demand curve in country l is:

$$p_l(i) = A_l - \frac{\alpha}{2} q_l(i) \tag{8}$$

where $q_l(i)$ is the amount firm i sells in country l.[24] Production is constant returns to scale in each country l where the local per-unit production cost is w_l. When producing in country l and exporting to country j, the firm incurs a per-unit trade cost of $c_{l,j}$ where $c_{l,l} = 0$. These components result in the firm's taxable profits which, when firm i locates in country l, are:

$$\sum_{j=1}^{3} p_j(i) q_j(i) - w_l \sum_{j=1}^{3} q_j(i) - \sum_{j=1}^{3} c_{l,j} q_j(i). \tag{9}$$

Investment in a country carries some risk, where with probability $1-\psi_l$, the profits in (9) fall to zero. This can be thought of as, among other things, the risk of expropriation (where we utilize the broad notion of expropriation which includes changes in government policy that reduce the value of investment– for example a rise in protectionism resulting in retaliation from other countries, changes in industrial or environmental regulation, and the like).[25] The firm pays tax rate t_l on its expected taxable

[23] Thus, we are not admitting the possibility of horizontal multinationals of the Markusen (1984) type that produce in multiple countries to serve local markets while avoiding trade costs. Alternatively, one could assume that fixed plant-level costs are so high that only one plant per firm arises in equilibrium.

[24] Note that for simplicity, we assume that there are no product or factor market interactions among firms.

[25] The broad definition of expropriation is used in agreements such as NAFTA (see Aisbett, et. al (2006) for discussion). It is notable that whereas in 2009 US responses to the global recession included controversial "buy American" provisions that discriminated against foreign firms, no such attempts were made within the EU. Although many EU governments introduced ``cash for clunkers'' programs to stimulate sales by car manufacturers these did not discriminate in favour of national producers as that would violate EU internal market rules. This illustrates how EU membership can provide a policy anchor not found in other trade agreements that reduces expropriation.

profits.[26] In addition, when located in country l, firm i receives an additional amount of untaxable income $\sigma_l(i)$. One interpretation of this would be idiosyncratic fixed costs (possibly including relocation costs). This term is identically and independently distributed across firms and locations according to a log Weibull distribution with mean zero. Thus, when firm i locates in country l, its total expected after-tax profits are:

$$\pi_l(i) = (1-t_l)\psi_l\left(\sum_{j=1}^{3} p_j(i)q_j(i) - w_l\sum_{j=1}^{3} q_j(i) - \sum_{j=1}^{3} c_{l,j}q_j(i)\right) + \sigma_l(i). \qquad (10)$$

In equilibrium, the expected profits of firm i in location l are:

$$\pi_l(i) = (1-t_l)\psi_l 2^{-1}\alpha^{-1}\sum_{j=1}^{3}\left(A_j - w_l - c_{l,j}\right)^2 + \sigma_l(i) = (1-t_l)\Pi_l + \sigma_l(i) \qquad (11)$$

where expected market potential is $\Pi_l = \psi_l 2^{-1}\alpha^{-1}\sum_{j=1}^{3}\left(A_j - w_l - c_{l,j}\right)^2$. Each firm locates in the region offering it the greatest expected equilibrium profits. Similar to the derivation of the Logit estimator (see Greene, 2007), the probability that firm i locates in country l (denoted P_l) is:

$$P_l = \exp\left[(1-t_l)\Pi_l\right] \Big/ \sum_{j=1}^{3}\exp\left[(1-t_j)\Pi_j\right]. \qquad (12)$$

Note that:

$$\frac{dP_l}{dt_l} = (P_l - 1)P_l\Pi_l < 0 \text{ and } \frac{dP_l}{dt_j} = P_lP_j\Pi_j > 0 \qquad (13)$$

i.e. as a country's tax rises, the probability of hosting a given firm falls whereas a rise in another nation's tax increases l's chance at hosting a given firm.

Aggregating across the large number of firms implies that (at least in expected value) the equilibrium number of firms that location l hosts is P_l and that its tax revenues are:

$$t_lP_lN\Pi_l. \qquad (14)$$

Governments simultaneously choose tax rates in order to maximize their own tax revenues. For country l, this yields an optimal value of its tax:

$$t_l = (1-P_l)^{-1}\Pi_l^{-1} \qquad (15)$$

where P_l depends on all three tax rates. From this, we can calculate the slope of the best response function for country l with respect to the tax rate of country $k \neq l$:

$$\frac{dt_l}{dt_k} = \frac{P_lP_k\Pi_k}{(1-P_l)^2\Pi_l} > 0 \qquad (16)$$

i.e. taxes are strategic complements.[27] Comparing this between countries j and k for country l:

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[26] Note that the firm only pays taxes in the country where it is headquartered. This is in keeping with international tax law where countries do not tax profits earned within their borders unless they are done so through a permanent establishment which, in our model, only exists in the firm's chosen country.

[27] Competition for FDI is not the only model that can yield strategic complementarity. One alternative is the yardstick competition model wherein residents of one location compare the taxes set in their region with

$$\frac{dt_l / dt_j}{dt_l / dt_k} = \frac{P_j \Pi_j}{P_k \Pi_k} = \left(\frac{\exp\left[\left(1-t_j\right)\Pi_j\right]\Pi_j}{\exp\left[\left(1-t_k\right)\Pi_k\right]\Pi_k} \right). \tag{17}$$

This corresponds to a greater sensitivity to the tax rate in countries that have greater market potentials. The intuition here is straightforward. If country *j* is an attractive location relative to *k* (in expected value terms), this is because pre-tax profits generated by a firm located there are large compared to those that could be generated in *k*. This then means that a drop in *j*'s tax rate creates a bigger increase in profits than does a comparable fall in *k*'s tax. In turn, this increases the sensitivity of firm location to *j*'s tax than *k*'s, implying that *l* must be more cognizant of *j*'s tax when setting its own.

Several items feed into the relative profitability of a given country represented by the dependency of the tax base on the four factors that vary by location. First, countries with bigger local demands – i.e. a high A_l – are more profitable locations. This is because firms in this location can serve the local market without suffering trade costs. Second, a location with low wage costs (w_l) is advantageous for obvious reasons. Third, a location with easy access to other locations, represented by low $c_{l,j}$ s, are more profitable because of its suitability as an export platform. This is akin to the growing interest in "third market" effects in the FDI literature where research has expanded the notion of market size to include not only the host country itself but also markets that can be accessed from a particular host.[28] Finally, that is is less risky will, all else equal, be the more preferred location. These latter two terms are one of interest for us since the expansion of the EU would increase the sensitivity of other countries to the new members' taxes. This occurs for two reasons. First, a country lowers its trade costs by joining a free trade area such as the EU, raising its market potential. Second, a country that joins the EU may lower its perceived risk of expropriation. This might occur if EU membership acts as a "policy anchor", that is, a commitment or signal that a country is unlikely to unilaterally change its policies in a way detrimental to investment. Thus, joining to the EU this would increase a country's attractiveness to firms and its importance to other nations' taxes.[29]

As a last point, our model relies on *expected* market potential, i.e. a measure that accurately accounts for expropriation risk. If ψ_l is the same for all countries, then when row standardizing it would fall out of the weighting scheme. In this case, using observed market potential ($2^{-1}\alpha^{-1}\sum_{j=1}^{3}\Phi_{l,j}{}^{2}$) is sufficient when constructing weights. Alternatively, suppose that it differs between two groups that are differentiated according to EU

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those elsewhere as a method of judging the extent of local corruption and models of imperfect information where government officials may glean information from the taxes set elsewhere, leading them to revise their taxes when they see those in other countries change.

[28] Theory work in this area includes Ekholm, Forslid, and Markusen (2007) while empirical work includes Head and Mayer (2004), Blonigen, Davies, Waddell, Naughton (2007), and Baltagi, Egger, and Pfaffermayer (2007).

[29] The literature on policy anchors dates back to Kydland and Prescott (1977). Recent examples discussing trade agreements as policy anchors include Francois (1997), Galal and Hoekman (1997), and Tovias and Ugar (2004), with the latter two specifically discussing the EU as a policy anchor. Lane (2008) discusses EU membership as a policy anchor that enhanced financial flows in the new accession countries.

membership (as when membership acts as a policy anchor). In this case, separating the countries into two groups and row standardizing *within groups* again permits the use of observed market potential.[30] This provides an additional rationale for using multiple spatial lags beyond those discussed in the main text.

A.2 Construction of the EATR

The EATR described by Devereux and Griffith (1998, 2003) measures the proportion of total income taken in tax from a hypothetical investment project (requiring one unit of capital for one period). More specifically, it is defined as the difference between the project's net present value in the absence and presence of tax, scaled by the net present value of the pre-tax total income stream, net of depreciation:

$$EATR = \left(R^{*} - R\right) \Big/ \left(\rho / (1+r)\right)$$

The variable ρ represents the project's real financial return, r is the real interest rate, R^{*} is the project's net present value in the absence of tax, i.e. $R^{*} = \left(\rho - r\right) \big/ \left(1+r\right)$.

Abstracting from personal income taxes, the project's net present value in the presence of corporate tax is:

$$R = \left[\left(\rho + \delta\right)\left(1-\tau\right) + \left(r - \delta\right)\left(1 - \frac{\tau\phi}{1+i}\right) \right] \Big/ \left(1+r\right) + F$$

The variable δ denotes the depreciation rate, τ is the statutory corporate income tax rate, i is the nominal interest rate, and ϕ is the rate at which capital expenditure can be offset against tax which is conditional on the type of capital employed. The variable F represents additional costs or benefits due to the source of financing. If the project is completely financed by retained earnings or new equity, $F = 0$. Note that new equity is an equivalent source of finance to retained earnings when abstracting from shareholder taxation and informational asymmetries. If the project is completely financed by debt, $F = \tau i (1 - \tau\phi) / (1+i)$, which is positive due to the deductibility of interest payments. For calculating EATRs , we adopt following assumptions about parameter values from an EU Commission Report (Devereux, et al., 2008): the project's real financial return ρ is 0.2, the real interest rate r is 0.05, and the nominal interest rate i is 0.071. Retained earnings and new equity represent 65 percent and debt 35 percent of the source of financing. Furthermore, we assume that the investment consists of machinery for 50 percent, of buildings for 28 percent, and of inventory for 22 percent. The depreciation rate δ is assumed to be 0.1225 for machinery, 0.0361 for buildings and 0 for inventory. The information about countries' tax parameters τ and ϕ is taken from Loretz's (2008) data. The statutory tax rate τ is the top marginal tax on corporate income including representative local taxes. For each type of capital expenditure, the most favorable available depreciation scheme is assumed to apply when calculating values for ϕ.

[30] Note that relative weights between countries within the same group do not change because the increase in weights is proportional.

A.3 Predicting Market Potential

$Population_{l,t}$	0.835***
	(0.222)
$Population_{l,t}^2$	0.068*
	(0.039)
$EU_{l,t}$	0.093***
	(0.025)
$Trend_t$	0.029***
	(0.001)
Constant	8.889***
	(0.377)
Observations	885
R-squared	0.719

*** p<0.01, ** p<0.05, * p<0.1. Includes country specific fixed effects.

A.4 Predicting Exports

	Our Method
Exporter $Population_{l,t}$	-2.759***
	(0.209)
Exporter $Population_{l,t}^2$	0.269***
	(0.025)
Importer $Population_{j,t}$	-0.933***
	(0.185)
Importer $Population_{j,t}^2$	0.184***
	(0.023)
$RTA_{l,j,t}$	0.265***
	(0.017)
$Trend_t$	0.070***
	(0.001)
Constant	9.016***
	(0.515)
Observations	25942
R-squared	0.259

*** p<0.01, ** p<0.05, * p<0.1. Includes directional, pair-specific fixed effects.