Tax Competition in an Expanding European Union†

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Abstract: This paper empirically examines whether expansion of the EU has increased international tax competition. To do so, we use a simple model of tax competition to determine how a given country weights the taxes of others when choosing its own tax. This indicates that the market potential of a country (which includes both domestic consumption and exports) is the appropriate weight. This is an improvement on the ad-hoc and often endogenous weighting schemes used elsewhere. Unlike those studies, we find robust evidence for tax competition. In particular, our estimates suggest that EU membership affects responses with EU members responding more to the tax rates of other members. This lends credence to the above-noted concerns.

JEL Codes: F1, H2, H7

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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 advance the empirical tax competition literature in two ways. First, we use the first theory-driven weighting scheme, one in which the importance attached to a nation's tax rate depends on its market potential (which includes the domestic market and exports). As noted by Anselin (1988), specification of this scheme is of paramount importance in this type of analysis. Second, 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.[1] 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 implies that proximate countries' taxes matter more than distant ones whereas weighting by GDP implies that taxes of large countries matter more 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

[1] 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.

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) also weight by distance and find similar results for the level of taxes. 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.[2] Using a sample of OECD countries, 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), Redoano (2007), Dreher (2006), and Haufler, Klemm, and Schjelderup (2006), utilize equal weights (i.e. the simple average of other nations' taxes) with mixed results.

These weighting schemes suffer from two shortcomings. First, they are ad-hoc. While economic motivations for the importance of proximity or size can be made, the lack of a model indicating why they are important can lead to deceptive results. As discussed by Anselin (1988), the weighting scheme is of paramount importance and that

[2] 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, and more importantly, 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.

improper specification can yield misleading and spurious results. Using a simple economic geography model of firm location akin to that of Baldwin and Krugman (2004), we find that countries with large market potentials receive the greatest weight. Here, market potential includes not only the domestic market, but also those that can be served by exporting from this country.[3] The intuition is straightforward. If another country lowers its tax, will firms choose to move there? The answer lies in how profitable this location is. Large countries tend to be profitable since they have many consumers that can be served locally, thereby avoiding trade costs. Similarly, countries that have easy access to other markets are attractive because of their export platform capabilities. Thus, these two factors combine to provide a theory-motivated weighting scheme. 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 lot 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 Irish tax rate ignores the ability of the UK to export to other nations. A similar 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.

[3] This is akin to the export-platform FDI literature. 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).

In addition to the above problem, 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, the constructed instrument does not resolve the endogeneity problem spatial econometrics is intended to solve. We find that in our data, even when using our market potential weighting scheme, failure to control for endogeneity leads to coefficient estimates that are biased towards zero.

An additional limitation of the existing literature is that it assumes that all countries respond in identical fashions to others' taxes. Thus, it imposes the assumption that a country responds equally to those in the EU and those without. This may not be the case if the perceived risk of a country falls when it joins the EU. Further, it assumes that EU and non-EU countries respond identically to others taxes. Our analysis rejects both restrictions. In particular, we find robust evidence that EU countries respond more to other member nations' taxes. 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 provide a simple model of tax competition to motivate our weighting scheme. Section 3 describes our empirical approach and our data. Results are contained in Section 4. Section 5 concludes.

2. A Simple Model of Tax Competition

In this section, we present a very simple, stylized model of tax competition. This model lacks many of the complicating features of more advanced models, however, its parsimony allows us to derive in a straightforward manner a set of results that yields theory-motivated weights describing the relative slopes of best response functions.

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.[4] The inverse demand curve in country l is:

$$p_l(i) = A_l - \frac{\alpha}{2} q_l(i) \tag{1}$$

where $q_l(i)$ is the amount firm i sells in country l.[5] 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 combine to form the firm's taxable profits which, when firm i locates in country l, are:

$$\sum_{j=1}^{3} p_j(i) q_j(i) - w_l \sum_{j=1}^{3} q_j(i) - \sum_{j=1}^{3} c_{l,j} q_j(i). \tag{2}$$

Investment in a country, however, carries some risk, where with probability $1-\psi_l$, the profits in (2) fall to zero. This can be thought of as, among other things, the risk of expropriation by the government (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

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[4] 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. An alternative method of arriving at this equilibrium setup is to allow the possibility but, as in Markusen, introduce fixed costs of constructing additional plants. When these fixed costs are sufficiently large, firms will endogenously choose this purely exporting structure.

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

industrial or environmental regulation, and the like).[6] The firm pays tax rate t_l on its expected taxable profits. In addition, when located in country l, firm i receives an additional amount of untaxable income $\sigma_l(i)$. 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:

$$\pi_l(i) = (1-t_l)\psi_l\left(\sum_{j=1}^{3} p_j(i)q_j(i) - w_l\sum_{j=1}^{3} q_j(i) - \sum_{j=1}^{3} c_{l,j}q_j(i)\right) + \sigma_l(i).^{7} \tag{3}$$

Defining $\Phi_{l,j} \equiv A_j - w_l - c_{l,j}$, the profit maximizing quantity produced in l and sold in j is

$$q_j = \alpha^{-1}\Phi_{l,j}.^{8} \tag{4}$$

As a result, expected equilibrium profits in location l are:

$$\pi_l(i) = (1-t_l)\psi_l 2^{-1}\alpha^{-1}\sum_{j=1}^{3}\Phi_{l,j}{}^{2} + \varepsilon_l(i) \tag{5}$$

or defining (expected) market potential (also the tax base) as $\Pi_l = \psi_l 2^{-1}\alpha^{-1}\sum_{j=1}^{3}\Phi_{l,j}{}^{2}$

$$\pi_l(i) = (1-t_l)\Pi_l + \varepsilon_l(i). \tag{6}$$

[6] 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 this broad definition of expropriation.

[7] Note that we do not permit the possibility of setting up foreign subsidiaries. If these were allowed, it would be necessary to take account of other nations' taxes both in the location choice (where we would have to account for repatriation taxes and double taxation conventions) and a country's chosen tax rate (since this would include impacts on subsidiaries located within it). Although these issues are clearly of importance when discussing multinational firms and taxation, since our goal is to illustrate the motivation for our weighting scheme in as transparent a manner possible, we omit them here.

[8] We assume that this is positive for simplicity. If not, no production occurs in the country.

Each firm locates in the region offering it the greatest expected equilibrium profits. Similar to the derivation of the Logit estimator (see Greene, 2007, for details), the probability that any given firm i locates in country l (denoted P_l) is:

$$P_l = \frac{\exp\left[\left(1-t_l\right)\Pi_l\right]}{\sum_{j=1}^{3}\exp\left[\left(1-t_j\right)\Pi_j\right]}. \tag{7}$$

Note that:

$$\frac{dP_l}{dt_l} = \left(P_l - 1\right)P_l\Pi_l < 0 \tag{8}$$

i.e. as a country's tax rises, the probability of hosting a given firm falls. Conversely:

$$\frac{dP_l}{dt_j} = P_l P_j \Pi_j > 0 \tag{9}$$

i.e. 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:

$$t_l P_l N \Pi_l. \tag{10}$$

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

$$t_l = \left(1-P_l\right)^{-1}\Pi_l^{-1} \tag{11}$$

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 $k \neq l$:

$$\frac{dt_l}{dt_k} = \frac{P_l P_k \Pi_k}{\left(1-P_l\right)^2 \Pi_l} > 0 \tag{12}$$

i.e. tax rates are strategic complements.[9] Comparing this between countries j and k for country l, we see that:

$$\frac{dt_l / dt_j}{dt_l / dt_k} = \frac{P_j \Pi_j}{P_k \Pi_k} = \left(\frac{\exp\left[\left(1-t_j\right) \Pi_j \right] \Pi_j}{\exp\left[\left(1-t_k\right) \Pi_k \right] \Pi_k} \right). \tag{13}$$

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 factors feed into the relative profitability of a given location represented by the dependency of the tax base on three 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

[9] 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 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.

a particular host.[10] Finally, there is the probability of expropriation $1-\psi_l$. A location which is less risky will, all else equal, be the more preferred location.

Note that these latter two terms are one of major interest for us since the expansion of the EU would indicate a rise in the relative sensitivity of old EU countries to the new member's tax rates as new members gain better access to EU markets. This may occur for two reasons. The first, and most obvious, is that a country may lower its trade costs by joining a free trade area such as the EU. This variation in trade costs, both across different countries and for a given country over time, should affect the weight that its tax receives in other countries' decision problems. 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, if joining to the EU works as such, this would increase a country's attractiveness to firms and its importance to other nations' taxes.[11] As such, our model would then lend theoretic credence to the concerns that expanding the EU to the low-cost east will force western nations to respond to their tax regimes. Examine such possibilities is the goal of our empirical investigation.

3. Empirical Specification and Data

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

3.1. Empirical Specification

[10] 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).

[11] 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.

Given that (11) indicates that the tax depends on the product of various terms, we linearize our model by taking the natural log of all non-binary variables. Thus, following Devereux, Lockwood, Redoano (2008), Altshuler and Goodspeed (2007), and Overesch and Rincke (2008), our log-linear baseline specification takes the form:

$$t_{l,t} = \beta X_{l,t} + \rho \sum_{k \neq l} \omega_{lk,t} t_{k,t} + \varepsilon_{l,t} \tag{14}$$

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 *Spatial Lag*$_{l,t}$ which is a weighted-sum of other countries' tax rates, and $\varepsilon_{l,t}$ is an i.i.d. error term. Since taxes are interdependent, this second control is endogenous and is instrumented for using the weighted sum of other nations' exogenous variables, i.e. by estimating:

$$\sum_{k \neq l} \omega_{lk,t} t_{k,t} = \tilde{\beta} \sum_{k \neq l} \omega_{lk,t} X_{l,t} + \tilde{\varepsilon}_{l,t} \, . \tag{15}$$

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.[12] As is common, we row-standardize so that the weights sum to one in each observation.[13] Thus, using the result from (13) indicating that relative weights are proportional to market potential, we construct our weights so that:

$$\omega_{lj,t} = \frac{\ln \Pi_{j,t}}{\sum_{k \neq l} \left(\ln \Pi_{k,t} \right)} \tag{16}$$

[12] 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. As discussed by Altshuler and Goodspeed, the interpretation of this coefficient would be the slope of the best response in a Stackelberg game as opposed to the simultaneous move one in Section 2.

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

which is modified from the model so that the terms can vary over time.[14] Thus, our theory motivated weighting scheme is the relative market potential of a given country.

To construct these weights, it is tempting to use a variable such as GDP. This, however, is problematic on two counts. First, GDP is the sum of domestic consumption plus *net* exports. Market potential, however, is domestic consumption plus *gross* exports. Since one reason for a firm to choose a given host is that doing so replaces imports, it is necessary to account for this. Second, GDP depends on the number of firms attracted and is therefore endogenous. We must therefore construct exogenous proxies for the weights in order to estimate (14), otherwise the right-hand side control variables will not be exogenous. Likewise, a variable such as distance, although exogenous, does not account for access to third markets. If firms make location decisions based on the ability to serve several markets from an existing location, then bilateral distance (which itself is but one component of trade costs) is not the most appropriate weight. Finally, since market potential clearly varies by country, it is inappropriate to utilize equal weights across countries. This then highlights the importance of using a theory-motivated weighting scheme as the results in the next section make clear.

As described in more detail below, this baseline specification is modified in several ways to obtain a more nuanced picture of the extent of tax competition. In particular, we split the spatial lag into one for EU members and one for non-members. One reason for doing so is to test whether, as suggested by Sarkozy, nations are more responsive to the taxes of EU members than to those of non-members. Doing so, however, brings several econometric benefits. The first two of these relate to our measure of market potential. In the theory, firms consider the expected market potential of a

[14] Note that since the tax rates are endogenous, we do not use them in the construction of the weights.

location and take into account expropriation risk (ψ_l). If ψ_l is the same for all countries, then when row standardizing it would fall out of the weight in (16). Alternatively, suppose that it differs between two groups, groups that are differentiated according to EU membership (as one might expect if membership acts as a policy anchor). In this case, separating the countries into these two groups and row standardizing within groups yields a potentially more accurate weight.[15]

Second, our measure of market potential is based on contemporaneous economic activity. However, if firms are forward looking when deciding where to locate, this may not be the best measure of expected future market potential. In particular, one might expect this to be an issue for new EU members where expected future opportunities are only partially captured in current activity as firms slowly ramp up their investment in response to the policy change. Thus again, separating countries according to EU membership may improve accuracy.

A third advantage is that if firms follow a sequential location decision – i.e. first deciding to locate somewhere within the EU and then deciding which member to locate in – combining members and non-members may be inappropriate. Finally, 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

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

this problem since it increases the magnitude of the weight assigned to each individual country.[16]

As a natural extension of splitting the spatial lag in EU-/ non-EU components, we will subsequently also allow the slope of the best response to differ conditional on the dependent variable relating to an EU- or non-EU country.

3.2 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.[17] 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.

The primary limit to the scope of our sample is the availability of tax rate data. For the majority of the presented results, we use the effective average tax rate (EATR). Since the firms' choice of location in our model is an inframarginal investment decision, as argued in Devereux and Griffith (1998, 2003) 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 some robustness checks we instead use the statutory rate rather than this average effective rate.

[16] When we separate our countries, the smallest non-EU weight is .03 and the smallest EU weight is .025. 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.

[17] Tax rate data were also available for India beginning with 1998 and Russia beginning with 2003. Due to the late start of their data, they are excluded from the presented results. However, in unreported results using them, similar estimates are found.

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 sum of domestic consumption and exports, measured in millions of constant US dollars (base year 2000). For each country-year, this is constructed by using the corresponding GDP, which is domestic consumption and net exports, and adding a nation's total imports back into this, and then taking the natural log.[18] In order to construct exogenous proxies of market potential for country *i* in year *t*, we estimated the following equation:

$$MarketPotential_{l,t} = \eta_0 + \eta_1 Population_{l,t} + \eta_2 Population^2_{l,t} + \eta_3 EU_{l,t} + \eta_4 Trend_t + \eta_l + \varepsilon_{l,t} \quad (17)$$

i.e. *Market Potential*$_{l,t}$, as a function of (logged) population and its square, EU membership, a time trend, and country specific fixed effects. The use of fixed effects is intended to control for proximity to other markets. As found by Blongien, Davies, Waddell, and Naughton (2007), this is typically sufficient to control for this factor when predicting FDI activity. The results of this regression are found in the Appendix. Here, we simply note two items. First, the R^2 from this regression was .994, suggesting that the bulk of the variation is captured. Second, the significance of fixed effects indicates that using population instead of predicted market potential leaves out important information. This proxy is then used as both a control variable as well as to construct the weights for spatial lag term. Given the evidence found elsewhere indicating a positive correlation between GDP and tax rates and the ability of countries with large market potentials to attract investment even with higher tax rates, we anticipate a positive coefficient for this variable.

[18] According to the theory, we would prefer to have market potential interacted with one minus the risk of expropriation. As noted above, since we do not have data on this probability, we will separate our countries based on whether or not their policies are anchored by the EU or not.

In addition to *Market Potential*$_{l,t}$, as controls in (14), 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, that the ratio of the two does not. As additional insurance against endogeneity, we use the lagged value of this variable.[19] 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 with the exception of EU membership information, which was obtained from wikipedia.org.[20]

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, 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[21]:

$$\begin{aligned} Exports_{l,j,t} = \kappa_0 + \kappa_{l,j} + \kappa_1 Population_{l,t} + \kappa_2 Population^2_{l,t} + \kappa_3 Population_{j,t} \\ + \kappa_4 Population^2_{j,t} + \kappa_5 Regional_{l,j,t} + \eta_6 Trend_t + \varepsilon_{l,t} \end{aligned} \tag{18}$$

[19] In unreported results, we used the contemporaneous value of government expenditures, with little change in our results.

[20] The World Bank Data can be found at http://www.worldbank.org/data

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

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.[22] 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. While the full details of this regression can be found in the appendix, here we merely note that the R^2 for predicting exports is .954.

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 some specifications, 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.

4. 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

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

found in the literature. We find that, as expected, countries with larger (instrumented) 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 these findings are generally consistent across specifications.

Column 2 introduces the spatial lag in which countries are weighted according to their market potential. In particular, this column uses endogenous market potential, not that derived from estimating (17), as well as the actual tax rates, not the constructed values. We do this in order to highlight the potential biases that might arise from failure to account for the endogeneity of taxes. Somewhat surprisingly, Column 2's estimates include a negative spatial lag, indicative of strategic substitutes. This is not in line with the standard thinking in tax competition theory in which tax rates at home are positively correlated with those abroad. Column 3 corrects for the endogeneity of taxes (but not the weights). This results in no significant spatial lag (a result that persists when country specific fixed effects are added to the model).

In column 4, we repeat the estimations of 3 (that correct for endogenity of taxes but not weights) allowing for different coefficients for the weighted sum of non-EU and EU tax rates. As discussed above, we do this as an indirect method of controlling for policy anchors in calculating expected market potential that are not sufficiently reflected in measure of market potential, either because the measure is backward looking or because it abstracts from the risk of expropriation. If the expected market potential rises when a country joins the EU and this increase has the same proportion for all EU-members, separating the two groups into two spatial lags is the simplest method of dealing with this.

As column 4 shows, these changes are important enough to improve the significance of the estimated spatial lag. In particular, we now find significantly positive coefficients. This indicates that combining EU and non-EU countries is not appropriate as would result if the risk of expropriation differs across the two categories. Therefore, for the rest of the paper, we will estimate spatial lags for these two groups separately. Column 5 alters the estimation of 4 by including country specific fixed effects. As is often found in spatial lag estimations, inclusion of fixed effects results in an insignificant spatial lag. In columns 6 and 7, we utilize the specifications of 4 and 5 with one key difference: we replace the endogenous market potential with the constructed value when creating the spatial lag. This then protects us against any endogeneity bias arising from endogenous weights. Comparing 4 and 6, we see that this makes relatively small changes in the magnitude of our spatial lags although their significance increases. As in column 5, the inclusion of fixed effects is sufficient to eliminate significance of the spatial lags although it is worth noting that correcting for the endogeneity of the weights is sufficient to move the point estimates from negative to positive.

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, it responds much more fiercely to tax changes by EU members than non-members, a difference that is statistically significant at the 1% level. Finally, note that we fail to reject they hypothesis that the coefficient on the EU spatial lag is less than one, implying that an increase in all EU taxes of 1% leads to a less than 1% change in this country's tax. If this is an equilibrium, then in game theoretic terms this result implies stability of the Nash equilibrium. Finally, since the inclusion of fixed effects eliminates the significance of the spatial lags, this suggests that the bulk of the results are driven by cross-sectional variation rather than time series variation.[23] As will be shown below, however, this does not hold true when we allow for different responses by EU and non-EU countries to a given country's tax.

Table 4 further analyzes our choice of weighting matrix by comparing our results from Table 3, column 6 (which are repeated in Table 4, column 1) with those that would be reached when using an alternative weighting scheme. In column 2, we weight countries by their GDPs ala Devereux, Lockwood, and Redoano (2008). In column 3, following Altshuler and Goodspeed (2007) and Overesch and Rinke (2008), we instead weight countries by their distance from country l. Finally, along the lines of Garretsen and Peeters (2007), Redoano (2007), Dreher (2006), and Haufler, Klemm, and Schjelderup (2006), column 4 uses the simple average of tax rates. In each case, rather than finding the theory-consistent, significantly positive spatial lags our market potential weights yield, we find insignificantly positive spatial lags for non-EU taxes and

[23] This naturally raises the question of whether or not to include fixed effects. A quick inspection of R^2s shows that they do increase the fit of the estimation specification. However, if the variable of interest varies primarily in cross-section than over time, this better fit may well have to be sacrificed in order to examine the question at hand. This is often a tradeoff in international settings where items such as geography do not change, requiring one to omit fixed effects in order to examine, for example, the impact of distance on trade.

significantly negative spatial lags for EU taxes. In unreported results using fixed effects, these weighting schemes continued to yield these unexpected results. Restricting our sample of countries to more closely resemble those of other papers yields similar estimates, although the significance of the non-EU lag generally increased (see the Appendix A.4 for these results as well as more direct comparisons to their methodology). This illustrates the importance of properly specifying the weighting scheme since these other schemes yield results at odds with both the theory and the widely-held belief that taxes are positively correlated across borders.[24] Outside of this, the estimates for the other control variables remain largely comparable across specifications.

Thus, when using exogenous values for market potential and omitting fixed effects, we find results that are in line with those predicted by theory. In particular, we find that it is important to distinguish between EU and non-EU taxes when estimating spatial lags. In Table 5, 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. To this end, we now interact our two spatial lag terms with the EU membership dummy variable. In column 1, we find results similar to those above, namely that taxes are strategic complements. However, not all countries respond in the same way. For a non-EU member, this slope of the best response is statistically equal between EU and non-EU countries (i.e. *Non-EU Spatial* $Lag_{l,t}$ and *EU Spatial* $Lag_{l,t}$ have statistically equal coefficients). In comparison to the above results, the difference in these magnitudes is smaller, with a mere 34 percent

[24] In unreported results, we repeated the specifications of Table 4 but combine the taxes of EU and non-EU countries. For the analog to column 1, we find a significantly negative spatial lag, thus mirroring the differences between when doing so with endogenous market potential in Table 3. Unlike Table 3, this is robust to the inclusion of fixed effects. The other three schemes in Table 4 resulted in insignificant spatial lags.

difference (as compared to the 60 percent difference in Table 3). EU members, however respond quite differently to the two groups. While members respond the same to EU taxes as non-members do (since the coefficient on the interaction $EU_{l,t}$ * *EU Spatial* $Lag_{l,t}$, is insignificant), their response to non-member taxes is only half as large with a point estimate of .328. Furthermore, there is a significant difference in how EU members respond to the tax of other members as to the tax of non-members. As illustrated by column 2, this difference is robust to the inclusion of fixed effects. This is a marked difference from the results of Table 3, column 7. This shows that there is indeed important time series variation in tax competition, but that this is masked by restricting the responses of EU and non-EU countries to be the same. Furthermore, our estimates give credence to the concern that as countries switch into the EU that it forces existing 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.

Table 6 reassesses these results with respect to two aspects of our data: that it includes countries from around the globe and that it is an unbalanced panel. Columns 1 and 2 repeat the estimates of Table 5 but utilize only European countries.[25] 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

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

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 5 (although significance declines slightly as the number of observations declines). To deal with the unbalanced panel, columns 3 and 4 repeat Table 5 but restrict the time series to 1995-2005, a restriction that creates balance within our panel. Here, we again find results qualitatively the same as those in Table 5 both with and without fixed effects.[26] Thus, our evidence for tax competition is robust to these subsamples of the data.

Table 7 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 Union might create. To address this, in Table 7 rather than defining our spatial lags according to EU membership, we define them according to whether or not a country is an EU15 nation. We also change our interactions in this way, were EU membership is replaced by a dummy variable indicating EU15 status. As this does not change over time, countries do not change categories and these difference are therefore not driven by changes in membership. Columns 1 and 2 repeat the final two columns of Table 3. Here we find largely comparable results. This gives some indication that our results are not spuriously driven by increasing EU membership. Columns 3 and 4 introduce our interactions as in Table 5. Again, we find results largely similar to those before although we find no significant response to EU15 countries' taxes when including fixed effects. Since EU15 status does not change over time, this insignificance when

[26] It should be noted that column 3 is the sole specification where spatial lags are significantly greater than 1.

relying exclusively on time series variation is not particularly surprising. In any case, the use of EU15 status alleviates concerns that our results are driven solely by increasing EU membership. [27]

Table 8 considers two other approaches to time issues as well as an alternative weighting scheme. First, in columns (1) and (2), 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. This can disguise interdependence since the year mean itself can change as a result of competition, information that is lost when using this approach. Nevertheless, in column (1) we find results comparable to those above although the magnitudes of the non-interacted lags' coefficients increase. When also including country dummies in column (2), we find comparable results for the non-EU spatial lag. For the EU spatial lags, we find a similar sign pattern however we only obtain significance for the interacted term. In columns (3) and (4), we use first differences in all of our variables excepting the EU dummy.[28] We do this for two 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 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. When doing so, we find sign patterns similar to those above, however, we only find significance for

[27] In unreported results, we also included a Euro dummy that was equal to one when a country had the Euro and zero otherwise. This Euro dummy was significantly positive only in the equivalent of column 1 of Table 7. When, rather than interacting the EU dummy with the EU/non-EU spatial lags we interacted the Euro dummy with these, the interactions were never significant and caused only slight change in the non-interacted spatial lag. 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.

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

the non-interacted spatial lags for the non-EU countries and then only when fixed effects are omitted. However, as before, the estimated coefficient on the EU spatial lag is larger than that on for non-EU taxes.

Finally, the last two columns of Table 8 utilize an alternative weight:

$$\omega_{lj,t} = \frac{d_{jl}^{-1} \ln \Pi_{j,t}}{\sum_{k \neq l} \left(d_{kl}^{-1} \ln \Pi_{k,t} \right)} \tag{19}$$

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 columns (5) and (6), this alternative approach yielded results very similar to those using non-distance weighted market potentials.

Table 9 repeats the results of Table 5 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. The only notable difference is that we also find a significantly positive coefficient on the $EU_{l,t}$ **EU Spatial* $Lag_{l,t}$ interaction, again suggesting increases sensitivity to other members' taxes. Excepting this latter result, these results hold even with the inclusion of fixed effects. Thus, as in Devereux, Lockwood, and Redoano (2008) and Overesche and Rinke (2008), we find competition in both effective and statutory tax rates.

Finally, Table 10 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 columns (1) and (2), we utilize the domestic market scheme, finding results comparable in sign and significance to those using market potential. Columns (3) and (4) use 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, columns (5) and (6) use 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.[29] 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).

5. 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, rather than rely on the ad-hoc methods used elsewhere, we use theory to derive a weighting scheme for use in estimation. The theory indicates that

[29] This correlation is also manifested in the domestic market and export control variables. In opposition to the routinely positive and significant market potential, only the domestic market is significant and then only when using fixed effects.

market potential, that is the size of the domestic market combined with access to foreign markets, is the appropriate weight. Utilizing this weight, we find reasonably robust evidence of tax competition. In particular, we find that while non-EU members respond equally to other countries regardless of membership, EU members distinguish between the two with a greater response due to other members' taxes. 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)	(5)	(6)	(7)
Weight:		*Endo. Mkt. Pot.*	*Endo. Mkt. Pot.*	*Endo. Mkt. Pot.*	*Endo. Mkt. Pot.*	*Exo. Mkt. Pot.*	*Exo. Mkt. Pot.*
Spatial Lag$_{l,t}$		-0.664***	0.006				
		(0.176)	(0.255)				
Non-EU Spatial Lag$_{l,t}$				0.538**	-0.074	0.547***	0.106
				(0.211)	(0.120)	(0.176)	(0.086)
EU Spatial Lag$_{l,t}$				1.384***	-0.200	1.342***	0.311
				(0.507)	(0.299)	(0.454)	(0.219)
Market Potential$_{l,t}$	0.087***	0.086***	0.087***	0.087***	1.251***	0.087***	1.381***
	(0.015)	(0.016)	(0.013)	(0.014)	(0.230)	(0.013)	(0.259)
Gov. Expenditures$_{l,t-1}$	0.298***	0.292***	0.298***	0.304***	-0.240**	0.313***	-0.211*
	(0.060)	(0.054)	(0.050)	(0.058)	(0.108)	(0.055)	(0.111)
Urban$_{l,t}$	0.520***	0.526***	0.520***	0.639***	0.310*	0.630***	0.319*
	(0.091)	(0.085)	(0.068)	(0.086)	(0.186)	(0.080)	(0.193)
Dependency$_{l,t}$	-1.140***	-1.175***	-1.141***	-1.176***	-0.782***	-1.216***	-0.792***
	(0.246)	(0.219)	(0.210)	(0.219)	(0.163)	(0.213)	(0.129)
EU$_{l,t}$	-0.076***	-0.065**	-0.076***	-0.084***	-0.260***	-0.084***	-0.263***
	(0.027)	(0.027)	(0.022)	(0.028)	(0.036)	(0.023)	(0.038)
Openness$_{l,t}$	0.010*	0.010	0.010*	0.009	0.229	0.008	0.283**
	(0.006)	(0.007)	(0.006)	(0.006)	(0.148)	(0.006)	(0.136)
Trend$_t$	-0.027***	-0.056***	-0.026**	0.034	-0.081***	0.036*	-0.066***
	(0.002)	(0.009)	(0.011)	(0.021)	(0.017)	(0.019)	(0.015)
Constant	-5.730***	-6.028***	-5.727***	-4.955***	-15.977***	-5.068***	-16.953***
	(0.697)	(0.646)	(0.550)	(0.719)	(2.424)	(0.556)	(2.700)
Observations	680	680	680	680	680	680	680
R-squared	0.403	0.418	0.403	0.409	0.860	0.413	0.861
Fixed Effects	No	No	No	No	Yes	No	Yes

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

Table 4: Comparison across Weighting Schemes

	(1)	(2)	(3)	(4)
Weight:	*Market Potential*	*GDP*	*Distance*	*Simple Average*
Non-EU Spatial Lag$_{l,t}$	0.547***	0.169	0.117	0.091
	(0.166)	(0.172)	(0.128)	(0.136)
EU Spatial Lag$_{l,t}$	1.342***	-0.332***	-0.274***	-0.277***
	(0.407)	(0.077)	(0.087)	(0.072)
Market Potential$_{l,t}$	0.087***	0.092***	0.090***	0.091***
	(0.013)	(0.013)	(0.016)	(0.016)
Gov. Expenditures$_{l,t-1}$	0.313***	0.284***	0.286***	0.285***
	(0.050)	(0.047)	(0.052)	(0.063)
Urban$_{l,t}$	0.630***	0.530***	0.530***	0.523***
	(0.083)	(0.063)	(0.082)	(0.091)
Dependency$_{l,t}$	-1.216***	-1.104***	-1.117***	-1.108***
	(0.197)	(0.189)	(0.240)	(0.238)
EU$_{l,t}$	-0.084***	-0.439***	-0.373***	-0.372***
	(0.025)	(0.093)	(0.100)	(0.087)
Openness$_{l,t}$	0.008	0.012**	0.011	0.012*
	(0.006)	(0.006)	(0.007)	(0.007)
Trend$_{t}$	0.036**	-0.025***	-0.026***	-0.028***
	(0.017)	(0.009)	(0.008)	(0.009)
Constant	-5.068***	-5.610***	-5.645***	-5.613***
	(0.530)	(0.475)	(0.634)	(0.669)
Observations	680	680	680	680
R-squared	0.413	0.422	0.421	0.421

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

Table 5: EU versus non-EU Responses

	(1)	(2)
Non-EU Spatial Lag$_{l,t}$	0.783***	0.257**
	(0.146)	(0.112)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.455***	-0.158*
	(0.134)	(0.087)
EU Spatial Lag$_{l,t}$	1.196***	0.678**
	(0.413)	(0.307)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	0.479	-0.163
	(0.355)	(0.252)
Market Potential$_{l,t}$	0.093***	1.818***
	(0.013)	(0.326)
Gov. Expenditures$_{l,t-1}$	0.304***	-0.110
	(0.059)	(0.084)
Urban$_{l,t}$	0.655***	0.412**
	(0.077)	(0.203)
Dependency$_{l,t}$	-1.235***	-0.753***
	(0.200)	(0.158)
EU$_{l,t}$	0.046	-0.636***
	(0.324)	(0.237)
Openness$_{l,t}$	0.010*	0.227
	(0.005)	(0.159)
Trend$_{t}$	0.038**	-0.070***
	(0.015)	(0.015)
Constant	-5.205***	-22.468***
	(0.683)	(3.289)
Observations	680	680
R-squared	0.440	0.869
Fixed Effects	No	Yes

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

Table 6: Alternative Samples

	(1)	(2)	(3)	(4)
	Only European Countries		*Only 1995-2005*	
Non-EU Spatial Lag$_{l,t}$	0.805***	0.481***	2.669***	0.786*
	(0.198)	(0.178)	(0.538)	(0.473)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.642***	-0.230*	-0.448*	-0.074
	(0.183)	(0.126)	(0.252)	(0.115)
EU Spatial Lag$_{l,t}$	1.055	0.796**	3.993***	1.290*
	(0.686)	(0.376)	(0.783)	(0.684)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	0.491	0.063	-0.072	-0.281
	(0.534)	(0.325)	(0.327)	(0.199)
Market Potential$_{l,t}$	0.207***	3.432***	0.108***	2.274***
	(0.029)	(0.805)	(0.015)	(0.757)
Gov. Expenditures$_{l,t-1}$	0.422***	-0.093	0.337***	-0.598***
	(0.050)	(0.127)	(0.064)	(0.166)
Urban$_{l,t}$	0.544***	0.188	1.119***	0.563
	(0.125)	(0.299)	(0.137)	(0.448)
Dependency$_{l,t}$	-1.882***	-0.977***	-1.055***	0.261
	(0.261)	(0.162)	(0.204)	(0.319)
EU$_{l,t}$	-0.167	-0.559**	-0.688*	-0.755***
	(0.488)	(0.282)	(0.375)	(0.217)
Openness$_{l,t}$	0.051***	0.229	0.005	0.318
	(0.012)	(0.273)	(0.007)	(0.237)
Trend$_t$	0.019	-0.108***	0.167***	-0.050
	(0.022)	(0.033)	(0.038)	(0.050)
Constant	-6.593***	-38.940***	-3.763***	-24.943***
	(0.791)	(8.530)	(0.672)	(7.221)
Observations	516	516	395	395
R-squared	0.500	0.878	0.424	0.877
Fixed Effects	No	Yes	No	Yes

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

Table 7: Using EU15 Designation Instead of EU Membership

	(1)	(2)	(3)	(4)
Non-EU15 Spatial Lag$_{l,t}$	0.560***	0.083	0.749***	0.329***
	(0.160)	(0.103)	(0.191)	(0.110)
EU15$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$			-0.201***	-0.176**
			(0.070)	(0.070)
EU15 Spatial Lag$_{l,t}$	1.012***	0.141	1.099***	0.323
	(0.351)	(0.169)	(0.309)	(0.214)
EU15$_{l,t}$ *EU15 Spatial Lag$_{l,t}$			-0.038	0.042
			(0.071)	(0.206)
Market Potential$_{l,t}$	0.090***	1.359***	0.109***	1.796***
	(0.013)	(0.296)	(0.015)	(0.319)
Gov. Expenditures$_{l,t-1}$	0.296***	-0.221*	0.242***	-0.207*
	(0.045)	(0.114)	(0.065)	(0.121)
Urban$_{l,t}$	0.575***	0.319	0.595***	0.384*
	(0.077)	(0.224)	(0.085)	(0.219)
Dependency$_{l,t}$	-1.156***	-0.775***	-1.310***	-0.797***
	(0.249)	(0.192)	(0.219)	(0.141)
EU$_{l,t}$	-0.091***	-0.266***	-0.289***	-0.314***
	(0.028)	(0.031)	(0.040)	(0.040)
Openness$_{l,t}$	0.009	0.281*	0.019***	0.311*
	(0.006)	(0.164)	(0.007)	(0.173)
Trend$_t$	0.033**	-0.069***	0.041***	-0.073***
	(0.015)	(0.016)	(0.016)	(0.016)
Constant	-5.139***	-16.817***	-5.241***	-21.922***
	(0.569)	(2.981)	(0.596)	(3.366)
Observations	680	680	680	680
R-squared	0.416	0.860	0.457	0.866
Fixed Effects	No	Yes	No	Yes

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

Table 8: Additional Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	Year Dummies		First Differences		Distance Weighted Market Potential	
Non-EU Spatial $Lag_{l,t}$	5.577***	2.327***	0.386***	0.355**	0.630***	0.202*
	(0.538)	(0.620)	(0.133)	(0.141)	(0.168)	(0.109)
$EU_{l,t}$ *Non-EU Spatial $Lag_{l,t}$	-0.242**	-0.125**	-0.001	0.018	-0.437***	-0.154*
	(0.120)	(0.062)	(0.104)	(0.113)	(0.135)	(0.081)
EU Spatial $Lag_{l,t}$	8.065***	1.914	0.655***	0.649***	1.027**	0.589**
	(1.044)	(1.223)	(0.200)	(0.226)	(0.434)	(0.288)
$EU_{l,t}$ *EU Spatial $Lag_{l,t}$	-0.371	-0.357**	0.041	0.026	0.449	-0.168
	(0.301)	(0.172)	(0.094)	(0.106)	(0.362)	(0.231)
Market $Potential_{l,t}$	0.062***	1.738***	0.204	0.172	0.096***	1.796***
	(0.015)	(0.278)	(0.234)	(0.236)	(0.014)	(0.303)
Gov. $Expenditures_{l,t-1}$	0.256***	-0.144	0.244*	0.236**	0.308***	-0.118
	(0.055)	(0.106)	(0.133)	(0.093)	(0.055)	(0.118)
$Urban_{l,t}$	1.481***	0.787***	1.193*	1.287	0.630***	0.396**
	(0.109)	(0.232)	(0.620)	(0.964)	(0.095)	(0.186)
$Dependency_{l,t}$	-2.080***	-0.906***	-0.534	-0.730*	-1.200***	-0.754***
	(0.225)	(0.173)	(0.406)	(0.391)	(0.191)	(0.128)
$EU_{l,t}$	-0.817***	-0.818***	0.016**	0.032	0.036	-0.637***
	(0.277)	(0.169)	(0.008)	(0.020)	(0.331)	(0.220)
$Openness_{l,t}$	-0.019***	0.195	0.103	0.087	0.011	0.219
	(0.007)	(0.130)	(0.113)	(0.103)	(0.007)	(0.182)
$Trend_t$			-0.000	-0.000	0.025	-0.074***
			(0.000)	(0.001)	(0.016)	(0.014)
Constant	-1.324	-21.657***	-0.002	-0.015	-5.27***	-22.2***
	(4.794)	(3.567)	(0.011)	(0.012)	(0.599)	(3.246)
Observations	680	680	660	660	680	680
R-squared	0.520	0.875	0.496	0.539	0.434	0.869
Fixed Effects	No	Yes	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1 Robust, bootstrapped standard errors in parentheses. All variables in columns (5) and (6) are in first differences excepting the EU dummies and the constant.

Table 9: Statutory Tax Rate Competition

	(1)	(2)
Non-EU Spatial Lag$_{l,t}$	0.897***	0.219*
	(0.201)	(0.120)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.513***	-0.217**
	(0.124)	(0.087)
EU Spatial Lag$_{l,t}$	1.247**	0.388*
	(0.521)	(0.232)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	0.529*	-0.052
	(0.273)	(0.197)
Market Potential$_{l,t}$	0.086***	1.641***
	(0.018)	(0.318)
Gov. Expenditures$_{l,t-1}$	0.271***	0.004
	(0.050)	(0.097)
Urban$_{l,t}$	0.593***	0.588***
	(0.090)	(0.213)
Dependency$_{l,t}$	-1.326***	-0.627***
	(0.204)	(0.166)
EU$_{l,t}$	0.040	-0.511***
	(0.201)	(0.146)
Openness$_{l,t}$	0.007	0.039
	(0.008)	(0.171)
Trend$_t$	0.042**	-0.068***
	(0.021)	(0.017)
Constant	-4.864***	-22.220***
	(0.592)	(3.177)
Observations	680	680
R-squared	0.465	0.880
Fixed Effects	No	Yes

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

Table 10: Domestic Market versus Exports

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Domestic Market Only		Exports Only		Both	
Domestic Market Weights						
Non-EU Spatial Lag$_{l,t}$	0.718***	0.343***			1.514***	0.607
	(0.164)	(0.127)			(0.470)	(0.383)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$	-0.47***	-0.199**			-0.616	-0.242
	(0.137)	(0.081)			(0.866)	(0.551)
EU Spatial Lag$_{l,t}$	1.011**	0.679**			1.423	1.540*
	(0.502)	(0.286)			(1.529)	(0.814)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$	0.523	-0.064			6.175***	0.575
	(0.324)	(0.211)			(1.940)	(0.898)
Export Weights						
Non-EU Spatial Lag$_{l,t}$			0.076	0.175	-1.014	-0.311
			(0.229)	(0.175)	(0.641)	(0.528)
EU$_{l,t}$ *Non-EU Spatial Lag$_{l,t}$			-0.294**	-0.173***	-0.068	0.015
			(0.121)	(0.063)	(0.939)	(0.602)
EU Spatial Lag$_{l,t}$			0.020	0.433	-0.610	-0.970
			(0.612)	(0.303)	(1.712)	(0.851)
EU$_{l,t}$ *EU Spatial Lag$_{l,t}$			-0.022	-0.202	-6.12***	-0.679
			(0.385)	(0.184)	(2.198)	(0.924)
Domestic Market$_{,t}$	0.072	1.461***	-0.083	1.185***	0.157	1.486***
	(0.105)	(0.265)	(0.103)	(0.309)	(0.115)	(0.337)
Exports$_{,t}$	0.009	-0.273	0.200	0.023	-0.123	-0.279
	(0.136)	(0.324)	(0.132)	(0.350)	(0.149)	(0.398)
Gov. Expenditures$_{l,t-1}$	0.294***	-0.122	0.275***	-0.135	0.221***	-0.113
	(0.058)	(0.110)	(0.053)	(0.101)	(0.053)	(0.111)
Urban$_{l,t}$	0.641***	0.474**	0.547***	0.417*	0.393***	0.436*
	(0.093)	(0.215)	(0.083)	(0.216)	(0.067)	(0.244)
Dependency$_{l,t}$	-1.24***	-0.743***	-1.15***	-0.752***	-0.94***	-0.631***
	(0.206)	(0.168)	(0.186)	(0.111)	(0.156)	(0.199)
EU$_{l,t}$	0.092	-0.480**	-0.392	-0.637***	-0.914	-0.575*
	(0.278)	(0.190)	(0.378)	(0.187)	(0.600)	(0.296)
Openness$_{l,t}$	0.015	0.570	-0.195	0.222	0.150	0.608
	(0.148)	(0.368)	(0.144)	(0.410)	(0.162)	(0.443)
Trend$_{t}$	0.028*	-0.035**	-0.030	-0.05***	0.022	-0.037*
	(0.017)	(0.014)	(0.019)	(0.015)	(0.018)	(0.020)
Constant	-5.03***	-16.42***	-5.06***	-15.4***	-4.03***	-16.6***
	(0.608)	(2.028)	(0.780)	(2.216)	(0.823)	(2.465)
Observations	686	686	686	686	686	686
R-squared	0.436	0.870	0.422	0.868	0.479	0.871
Fixed Effects	No	Yes	No	Yes	No	Yes

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

Figure 1: Average Tax Rates over Time

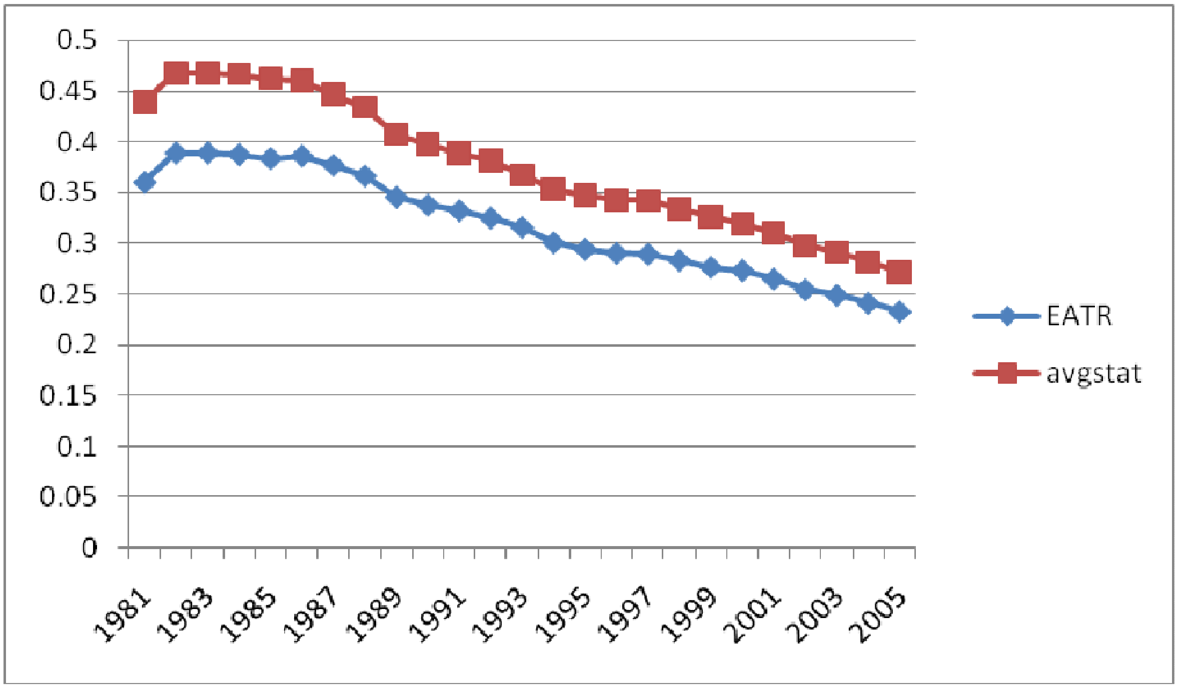
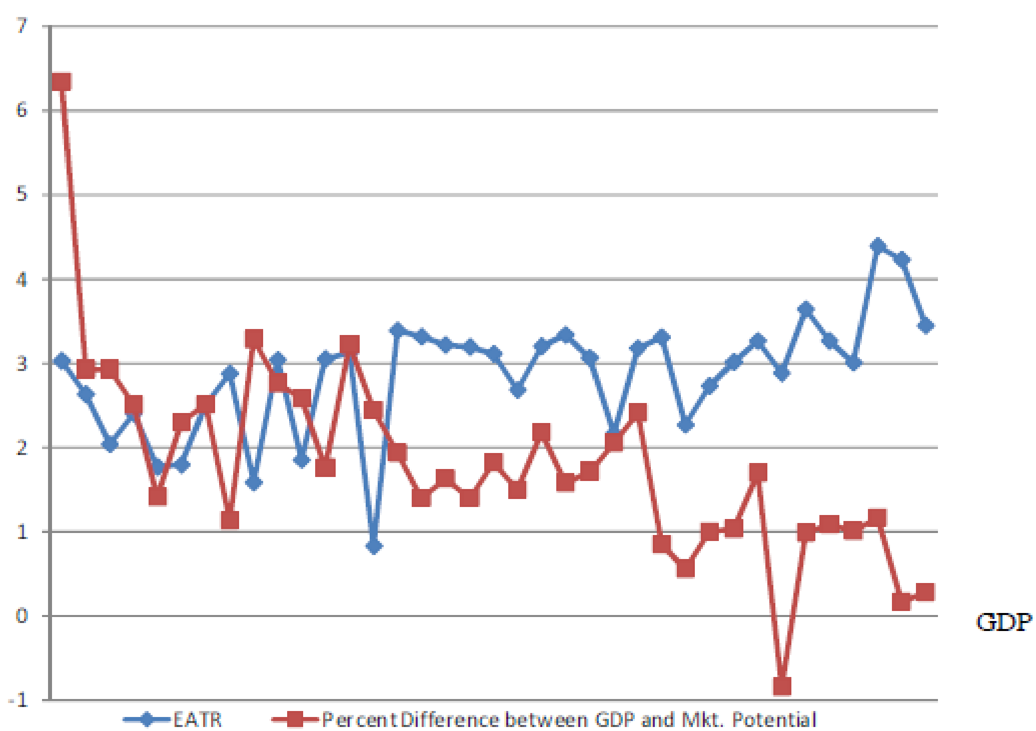


Figure 2: Difference between GDP and Market Potential



Appendix

A.1 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:

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

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. $R^* = (\rho - r)/(1+r)$. Abstracting from personal income taxes, the project's net present value in the presence of corporate tax is given by:

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

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.

A.2 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	0.994

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

A.3 Predicting Exports

	(1)	(2)
	Our Method	GDP 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***	0.296***
	(0.017)	(0.016)
$Trend_t$	0.070***	-0.005***
	(0.001)	(0.002)
Exporter $GDP_{l,t}$		1.317***
		(0.034)
Importer $GDP_{j,t}$		0.950***
		(0.041)
Constant	9.016***	-21.728***
	(0.515)	(0.628)
Observations	25942	25411
R-squared	0.954	0.960

*** p<0.01, ** p<0.05, * p<0.1. Includes directional, pair-specific fixed effects. Column 2 utilizes GDP rather than population, a more standard formulation of the gravity specification of trade flows. As can be seen, we find similar results using our population method with the added benefit of exogeneity of the control variable.

A.4 Replicating Other Papers

In Table 4, our estimates differ from those of other papers in two key ways. First, we have a different sample of countries. Devereux, Lockwood, and Redoano (2008) use only OECD countries. Overesche and Rincke (2008) use only European countries (which, like us, includes central and eastern European countries as well as the western ones). Second, they estimate a single spatial lag. In order to reassure the reader that the differences in Table 4 are not due to different underlying data, here we present results using our data but restricting our sample to those in each of these papers and using a single spatial lag. These results, reported below, show that when doing so we find a significantly positive spatial lag in the Devereux, Lockwood, Redoano-type regression (column 1) and a positive but insignificant spatial lag in the Overesche and Rincke-type regression (column 3). Thus, these results indicate that when using their approach we find results similar to what they did. Finally, columns 2 and 4 repeat these regressions using the limited samples, but using our two spatial lags (one for the EU and one without the EU). These results demonstrate that the negative lags in Table 4 result from changing the lag structure, not from the different set of countries in the samples.

	(1)	(2)	(3)	(4)
	Devereux, Lockwood, and Redoano		*Overesche and Rincke*	
Spatial Lag$_{l,t}$	0.618*		0.070	
	(0.365)		(0.320)	
Non-EU Spatial Lag$_{l,t}$		0.954***		-0.053
		(0.228)		(0.115)
EU Spatial Lag$_{l,t}$		-0.393***		-0.487***
		(0.140)		(0.082)
Market Potential$_{l,t}$	-0.045*	-0.050***	-0.082***	-0.083***
	(0.024)	(0.018)	(0.015)	(0.012)
Gov. Expenditures$_{l,t-1}$	0.400***	0.374***	0.386***	0.402***
	(0.070)	(0.070)	(0.062)	(0.065)
Urban$_{l,t}$	0.250**	0.223**	0.473***	0.369***
	(0.112)	(0.095)	(0.136)	(0.110)
Dependency$_{l,t}$	-2.228***	-2.280***	-1.748***	-1.792***
	(0.232)	(0.207)	(0.271)	(0.239)
EU$_{l,t}$	-0.104***	-0.539***	-0.096***	-0.616***
	(0.021)	(0.156)	(0.033)	(0.107)
Openness$_{l,t}$	-0.067***	-0.069***	-0.033***	-0.032***
	(0.010)	(0.010)	(0.004)	(0.004)
Trend$_t$	-0.001	0.007	-0.020	-0.044***
	(0.010)	(0.007)	(0.017)	(0.010)
Constant	-3.835***	-3.402***	-4.265***	-3.681***
	(0.760)	(0.651)	(0.909)	(0.630)
Observations	516	516	522	522
R-squared	0.479	0.497	0.437	0.482

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