FISCAL INTERACTIONS AMONG EUROPEAN COUNTRIES

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Abstract

In this paper we investigate whether there is empical evidence that EU Countries set their public expenditure and their taxes interdependently. We use a panel of data across european countries, years and fiscal variables to estimated countries' reactions functions. We find evidence of intedependences consistent with the literature on tax and yardistick competition.

KEY WORDS: Spatial Correlation, Yardstick Competition, Tax Competition.

JEL CLASSIFICATION: H2**,** H7, D7.

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1 Introduction

In this paper we test whether or not EU countries' governments influence each others in determining their fiscal choices. There are two main theoretical explanations why countries should be affected by their "neighbors" when they determine their policy choices. The first one is based on the idea that there exists externalities among jurisdictions and therefore policy choices are not independent. An example of these type of externalities could be the amount of public investiments in infrastructures in a country (such as roads, airports, rail-tracks) whose benefits spill over in neighboring countries, and therefore affect the level of investments in the latter countries. Another type of interdependency is based on the idea that citizens can evaluate the performances of their policy makers by comparing the same policy choices taken by the neighboring countries. This idea of "yardstick" competition has been initially explored by Besley and Case (1993), who also confirm the theory by finding evidence for this using data from U.S.A. states.

The second type of explanation is based on the tax competition literature: countries compete with their neighbor in order to attract tax base. The theoretical literature on tax competition is now voluminous, an important branch of it develops the well-known Zodrow-Mieszkowski-Wilson (ZMW) model (Zodrow and Mieszkowski, (1986), Wilson, (1986)) of tax setting with mobile capital in various directions (see Wilson, (1999) for a survey).

This paper builds on a small but growing empirical literature on strategic interaction between fiscal authorities, initiated by a pioneering study by Case, Rosen and Hines (1993), who estimated an empirical model of strategic interaction in expenditures among state governments in the US. This literature essentially estimates "fiscal reaction functions", i.e. parameters which indicate whether any particular fiscal authority will change a tax rate or an expenditure level in response to changes in that variable by other authorities. However we think that this paper is distinctive in several

ways. First, to our knowledge, it is the only paper investigating both the tax and public expenditures side. Second, it is the first one using data on EU countries, with the exception of Altshuler and Goodsped (2002) who use a dataset on Western European countries to investigate the existence of fiscal interdependencies. However, they consider only a subset of EU Countries and study only capital and labour taxes. Moreover their paper also differs in the way taxes are calculated, they use a backward measure of taxes based on the ratio between tax revenue and GDP, while we use instead directly the tax rates set by governments and we consider also public expenditures. Specifically, on public expenditures side, existing studies are so far based on US States datasets; they are the already mentioned Case, Rosen and Hines (1993) and Baicker (2001) who basically replicates Case, Rosen and Hines's paper using different econometric techniques. On taxes side, most of existing empirical works on tax reaction functions has employed data on local (business) property tax rates (Brueckner, 1998, Brett and Pinkse, 2000, Heyndels and Vuchelen, 1998), or on local or state income taxes (Besley and Case, 1995, Heyndels and Vuchelen, 1998). The only exceptions are Besley, Griffith and Klemm (2001) and Devereux, Lockwood and Redoano (2002) who estimate reaction functions for OECD countries and Altshuler and Goodspead (2002) who studies reactions functions for a subset of European countries.

Our main goal is to estimate reaction functions for taxes, on income and capital, and public expenditures, both aggregated and disaggregated, using a dataset on EU countries for the period 1985-95. Corporate taxes mainly affect firms' location and investments[1] but only a minority of voters, therefore any strategic behavior by governments should be related to tax competition to attract tax base rather than to yardstick competition to attract voters. Income taxes, instead, hit income from labour, the less mobile factor, and are of interest for most of voters; therefore any kind of interdependence

[1] See Devereux, Lockwood and Redoano (2002) for a discussion about that.

should be linked to yardstick competition. If governments behave strategically toward their voters in order to be reelected, we should especially find positive sloped reaction functions for those expenditures which are most visible to voters such as education and health. Governments could also try to compete with other countries, in order to attract investments and therefore tax base, by undertaking investments in infrastructures (see on this topic Wooders and Zissimos (2003)). All these type of interdependencies imply that the reaction functions are positively sloped; but if, instead, they are related to positive fiscal externalities between countries we should expect a negatively sloped reaction function. This could be the case, for example, for expenditures in defence of friendly countries.

The results support the idea that states act interdependently when they take their policy choices both with respect expenditures and taxes. However the reasons seem different. We find evidence that tax competition mainly occurs with geographically close countries, since corporate taxes are more sensitive to those of closer countries; while yardstick competition is present either between countries having similar economic characteristics or with respect to "leader" countries. Finally we find evidence of positive externalities for public expenditures in defence and health.

The remainder of the paper is organized as follows. The next section discusses the theory on fiscal interdependencies and tax competition. Section 3 presents the empirical methodology, section 4 the data and section 5 the results. Discussion and conclusion are in the last part of the paper.

2 Empirical Specification

Both theoretical models of tax and yardstick competition have the same empirical predictions that state'i fiscal choices (either public expenditures or level of taxation) in year t, E_{it}, depend on $i's$ own characteristics, repre-

sented by the vectors X_{it}, and the correspondent variables of i's own neighbors.[2]

We follow Case, Hines and Rosen's (1993) specification to test the degree of these interdependencies, which can be written, in the case of a state with only one neighbor, as follows:

$$E_{it} = \alpha + \theta E_{jt} + X_{it}\beta + u_{it} \tag{1}$$

where α, β and θ are unknown parameters and u_{it} is a random error. Moreover, since we estimate using pooled cross-sectional time series data, we include a individual effect and we allow for time effect, which in our specification takes the form of an individual country time trend.

However, since a state usually has more than one neighbor, we have to deal with the issue of weighting the impact of one state's fiscal choices on other states' choices. As earlier studies suggest, there are many ways of considering a state a neighbour. All these ways rely on the introduction of a weighting matrix, based on the *a priori* definition of the type of similarity. In other words we allow for the possibility of multiple neighbors by replacing E_{jt} in equation (1) with

$$A_{it} = \sum_{j=1}^{n} w_{ijt} E_{jt}$$

where $\sum_{j=1}^{n} w_{ijt} = 1$, and $w_{ijt} = 0$ if state j is not a "neighbor" or if $j = i$.

The equations we finally want to estimate are in the form:

$$E_{it} = \alpha + \theta A_{it} + X_{it}\beta + u_{it} \tag{2}$$

Moreover, there are two econometric issues determined by the presence on the RHS of the equation (2) of the dependent variables. These are:

[2] In order to distinguish between the two forms we must rely on indirect tests, like for example in Besley and Case (199X), or make a priori analisys on the characteristics of the fiscal choices.

(i) endogeneity of the E'_{jt}s, and(ii) possible spatial error dependence. We analyze both in turn.

2.1 Endogeneity

Because of strategic interactions, the E values in different jurisdictions are jointly determined. As a result, the linear combination of the $E_{it}s$ appearing on the RHS of (2) is endogenous and correlated with the error term u_{it}.

If we rewrite (2) in matrix format, this yields

$$E_t = \theta W_t E_t + X_t \beta + u_t$$

E_t is the vector of E_{it}, W_t is the weighting matrix, X_t is the matrix of control variables. If we solve the equation for E and we drop the subscript from now on, we get

$$E = (I - \theta W)^{-1} X\beta + (I - \theta W)^{-1}(I - \lambda M)^{-1} v \tag{3}$$

If we do not take into account spatial error dependence in equation (2), this would not bias the estimation of β but it would reduce the efficiency of the estimation and produced biased standard errors.

Note that since each element of E depends on all the v's, it follows that each of the E_{jt} on the RHS of (2) depends on v_{it},the equation's error term. Therefore the resulting correlation means that OLS estimation of equation (3) is inconsistent.

There are three alternative methods to deal with this problem. The first one is to estimate the reduced form of equation (3) using ML methods. The second way of estimating equation (3) is to use instrumental variables approach to obtain predicted values of WE in the first stage of the estimation. The last way to deal with this problem is to avoid endogeneity issue by assuming that the interactions occur with one or more time lags, in this case E_{jt} in (2) is replaced with E_{jt-n}.

2.2 Spatial Error Dependance

If neighbors are subject to correlated random shocks, this determines a correlation between states' fiscal choices, which can be erroneously interpreted as causal influence. So if we omit in the regressions variables that are spatially dependent, these variables enter in the error term, and this complicates the estimation of (2), and the error should correctly take the form:

$$u = \lambda M u + v, \tag{4}$$

where M is a weighting matrix, often assumed to be the same as W in (2), v is a well behaved error vector, and λ is an unknown parameter.

There are three main ways to deal with this problem. One approach is to use maximum likelihood to estimate (2) taking into account of the error structure in (4). This methodology has been explored by Case et al. (1993).

Another way is to use IV estimation; Kelejian and Prucha (1998) have demonstrated that even in the presence of spatial error dependence IV method yields a consistent estimation of θ. There are many possible ways of instrumenting the endogenous variable. One common way to deal with the choice of instruments is to regress WE_{it} on WX_{it} and to use the predicted value to estimate E_{it}.

Finally, it is possible to estimate (2) by ML under the hypothesis of error independence and rely on hypothesis tests to verify the absence of spatial correlation. Examples of this approach can be found in Brueckner (1998), Saavedra (2000) and Brueckner and Saavedra (2001).

Anselin et al (1996) suggest a robust test that can be employed to detect the presence of spatial error dependance, which is based on the analysis of the residual generated by regressing the dependent variables on the exogenous variables using OLS.

2.3 The Choice of the Weights

Since in reality is very likely that a state has more than one neighbor, the next step before proceeding with the estimation is to solve this problem. The common way to deal with this issue is to generate a weighting matrix which measures the extent to which a state is neighbor to another state by assigning a value to each pair of states. The way this matrix is built depends on *a priori* interpretation of what a neighbor state is.

There are several ways in which a state can be neighbor to another state. The first one, is based on the geographical definition: the state located at a close distance and/or which whom sharing the borders. If we use this definition the weighted matrix will assign higher values to states geographically close. We use the geographical distance to build our first set of weights. More in detail:

$$w_{ij}^{d} = \frac{1}{d_{ij}} / \sum_{j} \frac{1}{d_{ij}}$$

Where w_{ij}^{d} is the ij element of the weighted matrix W^{d} and d_{ij} is the geographical distance between the capital of state i and state j. Another alternative way of considering weights based on geographical distance could have been based on a contiguity matrix, where the value 1 is assigned if two states share the same border and zero otherwise. We have preferred the first way because in presence of islands (like Britain and Ireland) and States not directly connected with other EU states (like Greece), these would have been excluded from the analysis.

The second way we consider two of more states being neighbors is if they have similar economic or demographic characteristics. For this purpose we construct our second and third weighting matrices based on the inverse of the distance between GDP and GDP per capita. Note that contrary to most of

the previous studies we allow the matrices to be time variant.[3] Each element of these two matrices are constructed as follow:

$$w_{ijt}^{g} = \frac{1}{|GDP_{it} - GDP_{jt}|} / \sum_{jt} \frac{1}{|GDP_{it} - GDP_{jt}|}$$

$$w_{ijt}^{gp} = \frac{1}{|GDP_{it}/POP_{it} - GDP_{jt}/POP_{jt}|} / \sum_{jt} \frac{1}{|GDP_{it}/POP_{it} - GDP_{jt}/POP_{jt}|}$$

A third way could be to test whether or not countries follows a "leader" or a group of them, defined as for example the state's with higher GDP, in this case a higher weight is assigned to countries with higher values of the variables used as weights.

$$w_{ijt}^{l} = \frac{GDP_{jt}}{\sum_{jt} GDP_{jt}},\ j \neq i$$

There are several other ways of dealing with weights, for instance we can construct weights based on measures of openness such as (FDI, or trade).

The *a priori* choice of the weights is totally arbitrary, however after the estimations are carried out it is possible to assess their goodness by selecting the regressions that produces higher and more significant coefficients and, in this way, understand better the nature of these interdependencies.

3 The Data

We estimate model (2) using annual data on the European Union States over the period 1980 -1995. We consider several specifications of the model, where the variable E_{it} takes is in turn the aggregated and disaggregated level of per capita public expenditures, and income and capital tax rates.

[3] Previous studies like Case, Hines and Rosen used matrices based on the average of a variables over time.

With respect to the public expenditure specification we consider, beside the overall level of public expenditures per capita of the central government ($GPEX_{it}$), public expenditures in Education ($PEDU_{it}$), Health ($PHEA_{it}$), Social Security and Welfare ($PSSW_{it}$) and Defence ($PDEF_{it}$). We use per capita public expenditures in $ at constant prices 1995, the main source is Eurostat.

Table 1 and 2 present summary statistics for these variables. In particular, if we disaggregate the figures by countries (Table 2), we observe that despite there is a lot of variation among countries on the level of public expenditure, which depends mainly on country specific characteristics, they all seem to follow a quite similar pattern as shown in graphs 1 and 2.

About the nature of possible interactions of states' public expenditures, we expect that their existence is mainly due to a form of yardstick competition, rather than a form of tax competition; since interstate mobility of residents in Europe is quite low and it mainly based on the labour market. Another possible explanation of public expenditures interdependencies among states could be also related not to strategic interactions but to a common "intellectual" trend, as suggested by Manski (1993), that drives countries fiscal choices in the same directions. However, if this is the case, we should not observe that the level of interactions increases with the level of "observability" by voters of different categories of public expenditures, like Health and Education, compare for example to Defence or general public expenditures.

On the side of the tax variables, we consider two types of taxes: corporate taxes ($STAT_{it}$) and income taxes ($TOPINC_{it}$). In both case we use the top rate of statutory tax rate and income tax rate. These two taxes are both important, they overall account for more than 40% of the tax revenue. The tax base, in the first case, is represented by the income of the company and is highly mobile across countries, in the second case, by the income of residents and is less mobile but hits the majority of citizens. Therefore

interdependencies is corporate taxes should be mainly due to competitive behavior by governments in order to attract tax base, while, in income taxes, should mainly be related to governments trying to persuade their voters about the goodness of their performances.

If governments are concern about tax competition we should expect a higher interaction of the factor more mobile, the capital, compared to the less mobile, labour, as pointed out by Besley, Griffith and Klemm (2001). If government are, instead, more concerned about possible yardstick competition, we would expect higher interactions with respect to the taxation of the factor owned by the majority of voters. In this case income taxes should be more interdependent than corporate taxes.

The main source for statutory tax rates is the Price Waterhouse -Corporate Taxes - A Worldwide Summary, and, for income taxes, we use the top income rate, from Price Waterhouse - Individual Taxes- A Worldwide Summary.

Table 1 and 2 reports summary statistics on these variables, and their trend is illustrated by Graph 3. We can observe that for most of the countries there has been a decrease in both statutory and income tax rates.[4]

Moreover we use a set of time varying variables X_{it} which are conventionally assumed to affect the determination of the above fiscal choices. These variables include:

1. Socio-demographic characteristics: proportion of population less than 14 years old and over 65 (PYOU_{it} and POLD_{it} respectively), population density (PDENS_{it}), proportion of population living in urban areas (PURB_{it}).

2. Economic variables: level of Public Expenditures as a proportion of GDP (PCONS_{it}), Tax Revenue as a proportion of GDP (TREV_{it}), GDP per capita (GDPPRO_{it}), the sum of FDI in flows and outflow

[4] For a possible explanation see Devereux, Lockwood and Redoano (2002).

as a proportion of GDP[5] ($OPEN_{it-1}$),.and the ratio between each state in the sample GDP and SIZE of US GDP ($SIZE_{it}$),

3. Political variables: Left- right government dummy ($POLITIC_{it}$), 1 for left, 1/2 for center and 0 for right, and election year dummy ($ELECTION_{it}$).

For descriptive statistics refer to Table 1 to Table 3 in the Appendix. Table 1 reports summary statistics for these variables and Tables 2 and 3 break down the figures by country. The second column of table 3 shows the mean of variable OPEN, which measures the level of investment funded by foreign capital. We observe a quite lot of variation across countries, from 5.6% in Netherland to less than 1% in Italy. The third column shows the level of GDP per capita: the highest level is reported for Denmark (26.000 $) and the lowest for Portugal (16.000 $). Columns 4 and 5 report respectively the ratio between tax revenue and public consumption and GDP: Scandinavian countries have the highest rates among EU countries while Greece and Portugal the lowest. The final columns show the means of our demographic variables.

4 Results

We estimate several versions of the following equation, which represents the reaction function of one country's fiscal choices to other countries decisions.

$$E_{it} = \alpha + \theta E_{it-1} + \beta A_{it} + \gamma X_{it} + D_i + \eta_{it} + \varepsilon_{it} \tag{5}$$

The fiscal choices taken into account (E_{it}) are the aggregated and disaggregated level of public expenditures per capita and two different type of

[5] Note we use the variable OPEN lagged of one year in order to avoid endogeneity problems.

taxes, corporate taxes and income taxes, A_{it} is the weighted average of the other countries fiscal choices (i.e. $A_{it} = \sum_{j=1}^{n} w_{ijt} E_{jt}$), X_{it} and ε_{it} is the error term. In all specifications we condition on year dummies (D_i) ,and individual linear time trend (η_{it}). In the first case we want to control for unchanging characteristics of a state that may have an impact on policy choices, in the second case we want to control for macroeconomic shocks.

Since in every regression the LM test on the residuals suggests that the regression suffer from serial correlation, due to a lot of persistence of the dependent variable, we include in our regression the dependent variable lagged of one year (E_{it-1}), which solves the serial correlation problem.

Because of strategic interactions, the E values in different jurisdictions are jointly determined. As a result $A'_{it}s$ appearing on the RHS of (5) is endogenous and correlated with the error term ε_{it}.

To correct for this problem, we need some source of variation correlated with neighbors' fiscal choices but uncorrelated with the error term. One potential source of variation is neighbor Xs. So we create neighbor values for these variables multiplying them by the same weights used for weighting the fiscal variables. The first stage of our IV estimation thus is:

$$\widehat{A}_{it} = \alpha + \sum_{k=1}^{m} \beta_k \sum_{j \neq i} w_{ijt} X_{kjt} + X_{it} + \varepsilon_{it}$$

Where $\widehat{A}_{it}$ is the predicted value of A_{it}, $\sum_{j \neq i} w_{ijt} X_{kjt}$ is the weighted average of each of the control variables of the neighboring states.

Tables 4 to 7 report the regression results of the second stage with respect to the four types of weights. Table 4 presents the results using a weighted matrix based on geographical distance, table 5 on GDP, table 6 and 7 on GDP distance and GDP per capita distance between states.

Column 2 in each of the above mentioned tables reports the results for the statutory corporate tax rate. For each of the weights we find that the coefficient of the average tax rate of the neighboring countries is positive,

the expected sign, but is significant only with respect to the geographical distance weight and GDP distance weight, in the first case the coefficient pass the 1% test with a value of 0.89 and in the second case it is significant only at 10% with a much lower coefficient. This result seems to suggests the idea that countries mainly look at their geographical neighbors when they set their corporate taxes. One possible explanation is that countries try to attract capital from close countries. Moreover, these results seem to reject the hypothesis of an European leader (possibly Germany or France) able to drive other countries tax choices. If this hypothesis were true, we would expect significant values of the coefficient on A_{it} when the weighted matrix is based on countries GDP.

Finally, the lagged dependent variable is in every specification very significant and the value of its coefficient is always above 0.31. Regarding the control variables, TOPINC (used here as explanatory variable) is always positive an significant. We include it as explanatory variable because it has frequently been argued that corporation tax is a necessary "backstop" for income tax: that is, in the absence of corporation tax, individuals could potentially escape tax on their earnings by incorporating themselves. So, we should expect a positive coefficient on this variable, and that is the case. Among the economic variables, GDPPRO is significant in two regressions and it is always negative; a possible explanation is that richer countries do not need to set high tax rates to raise fiscal revenue. The two political dummies apparently do not play any role in affecting tax behavior, they are never significant and their value is always very close to zero. This broadly supports the idea that any interaction in STAT is mainly due to competitive behavior among states in order to attract tax base rather than to yardstick competition.

Columns 3 of Tables 4 to 7 show the results when the dependent variable is TOPINC, the top income tax rate. This variable performs rather well when we weight the neighbors by GDP and GDP distance, in both

cases the coefficient of the interactions is 0.95, and significant at 1%. If we use the geographical distance weight the coefficient is significant but much lower (0.62). As for the statutory tax rate the lagged depend variable is always significant in all specifications and always above 0.37. The control variables that perform better are the proportion of old people (POLD) and the political dummy (1 for left, 1/2 for center and 0 for right), POLITIC. They are both always significant and of the expected sign. POLD is expected positive because the greater this proportion, the greater the demand for spending on health, pensions etc., that has to be publicly funded, and POLITIC positive because left wing government are supposed to be more progressive in their income taxes. The election dummy (ELECTION) has always the expected negative sign but it is not significant.

Columns 4 of Tables 4 to 7 report the regressions coefficients for aggregated public expenditures (GPEX). The interaction coefficient is always positive in all four specifications but it is significant only when the average of neighbors' expenditures is calculated with respect to GDP and GDP distance, in both cases the coefficient is similar, about 0.41. This confirms the results obtained for TOPINC, where the same weights have the better performances. In this specification the election dummy has the expected positive sign and it is significant in all four specifications. The other control variables that perform well are: SIZE which is always positive and significant at 10% in all our four specifications, suggesting that larger countries have bigger governments; the proportion of urban population (PURB) which is positive and significant at 10% in three of our four specifications, implying that more urbanized countries incur extra "congestion" costs; and, finally, GDP per capita which as expected is positive in all our cases.

Considering together the results for TOPINC and GPEX we can clearly see the symptoms of yardstick competition. First, contrary to the regressions with STAT, the weights that perform better are in both cases the one based on GDP distance and GDP, the first one suggests that governments

are more concerned with the policy choice taken by countries with similar characteristics and the second one by "leader" countries, which is consistent with the fact that voters compare the performances of countries to whom they feel more similar, and about what they have more information. Second, the election dummy has in both cases the expected opposite sign, suggesting that governments, during elections, behave strategically by lowering their income taxes and raising their public expenditures, consistently with the business cycle literature.

These results seem to be strenghtened and confirmed if we look at the disaggregated public expenditures. Expenditures in Education (PEDU) in the neighboring countries have always the expected positive sign, and are significant at 5% in two specifications, the same as general public expenditures. According to the figures an increase of 1 dollar spent in education by the neighbor increases the same expenditure in a country by over 0.40 dollars. The same strong correlation is never registered for the other categories of public expenditures. Moreover, election dummies are always positive and significant in all specifications, confirming that governments change their policy decisions during elections. It would be interesting to combine the interaction variable with the election dummies, to test directly whether governments become more sensitive to neighbors' policies during elections; however in this sample this is not possible because we do not have enough observations on elections. The other variables that matter for determining public expenditures in education are per capita GDP, which is always positive and significant and the proportion of young population, which surprisingly enters with the "wrong" negative sign.

Public expenditures on Health (PHEA) do not seem to be affected by neighbors but mainly by the previous year expenditures, the "wealth" of a nation (GDPPRO), and the party in power.

Finally, the results for public expenditures in Social Security (PSSW) and Defence (PDEF) show that there exists some positive externality be-

tween geographically close countries since the interaction terms are in both cases negative and significant, which suggests the idea of a free riding behavior in these type of expenditures.

5 Summary and Conclusion

In this paper we have estimated EU states reaction functions for a set of fiscal variables, both on the expenditure and tax side. The aim of the paper was two-fold; first to determine whether or not these reaction functions have a non-zero slope, and, second to investigate their nature (in case they exist).

The theory mainly distinguishes between two theoretical models of competitive behavior which generate identical empirical specifications. In order to asses whether these interactions exist because governments try to attract tax bases (tax competition) or to please voters (yardstick competition) we have relied on *a priori* hypothesis based on the characteristics of the above mentioned fiscal choices.

First, with respect to corporate taxes, consistently with the previous empirical studies on tax competition (Devereux, Lockwood and Redoano (2001), Besley, Griffith and Klemm, (2001) and Altshuer and Goodspeed (2002)), we have found that the slope of the reaction function is generally positive and significant. In particular, the regression results suggest that tax competition occurs in Europe mainly between geographically close countries.

Second, we have found evidence of a similar governments' behavior in income taxes' setting and public expenditures' decisions. In both cases the reaction functions are always positively sloped and the weights that perform better are those based on GDP and GDP distance; in addition to this, the election dummy has always the expected sign (i.e. positive for public expenditures and negative for taxes). This seems to confirm our *a priori* hypothesis about a possible existence of yardstick competition among EU countries,

with respect to countries with similar characteristics and "leader" countries. Moreover, consistently with our expectations, the results for disaggregated public expenditures suggest that governments behave strategically mainly with respect to those expenditures which are more directly comparable such as expenditures in education.

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APPENDIX

Table 1 . Summary Statistics

Variables	Data Source	Obs	Mean	Std.Dev.	Min	Max
STAT	Price Waterhouse.	195	0.415	0.135	0.1	0.627
TOPINC	Price Waterhouse.	195	0.588	0.1019	0.4	0.92
GPEX	Eurostat and IMF-Government Finance Statistics Yearbook	195	7.144	2.333	1.405	12.725
PDEF	Eurostat and IMF-Government Finance Statistics Yearbook	195	0.378	0.166	0.149	0.824
PEDU	Eurostat and IMF-Government Finance Statistics Yearbook	195	0.766	0.271	0.165	1.502
PHEA	Eurostat and IMF-Government Finance Statistics Yearbook	195	0.795	0.407	0.015	2.057
PSSW	Eurostat and IMF-Government Finance Statistics Yearbook	195	2.546	1.339	0.234	5.960
OPEN	OECD- International Investment Yearbook	195	0.022	0.020	-0.001	0.107
GDPPRO	Datastream	195	0.021	0.004	0.012	0.030
TREV	OECD- Revenue Statistics	195	0.392	0.070	0.244	0.555
PCONS	OECD National Accounts	195	0.195	0.041	0.131	0.297
POPYOU	World Bank Development Indicators	195	0.198	0.031	0.149	0.304
POPOLD	World Bank Development Indicators	195	0.140	0.017	0.105	0.178
POPURB	World Bank Development Indicators	195	0.715	0.139	0.309	0.892

Table 2. Public Expenditures and Tax Variables: Mean by Country

COUNTRY	GPEX	PEDU	PHEA	PSSW	PDEF	STAT	TOPINC
United Kingdom	6.989	0.838	0.866	2.507	0.739	0.39	0.51
Germany	7.226	0.691	1.033	3.279	0.383	0.61	0.55
France	9.191	0.995	1.505	3.778	0.612	0.42	0.61
Ireland	5.493	0.675	0.755	1.449	0.173	0.10	0.56
Italy	8.430	0.870	1.016	2.957	0.344	0.46	0.57
Spain	4.175	0.440	0.498	1.547	0.225	0.35	0.56
Austria	7.320	0.696	0.933	3.325	0.194	0.51	0.56
Denmark	10.672	1.283	0.990	4.463	0.405	0.34	0.69
Finland	7.729	0.917	0.789	0.536	0.271	0.47	0.64
Greece	3.847	0.323	0.319	0.757	0.339	0.42	0.53
Netherland	9.580	1.034	1.162	3.535	0.469	0.40	0.66
Sweden	8.196	0.692	0.084	3.882	0.518	0.47	0.61
Portugal	4.029	0.514	0.393	1.084	0.244	0.47	0.60

Table 3. Control Variables: Mean by Country

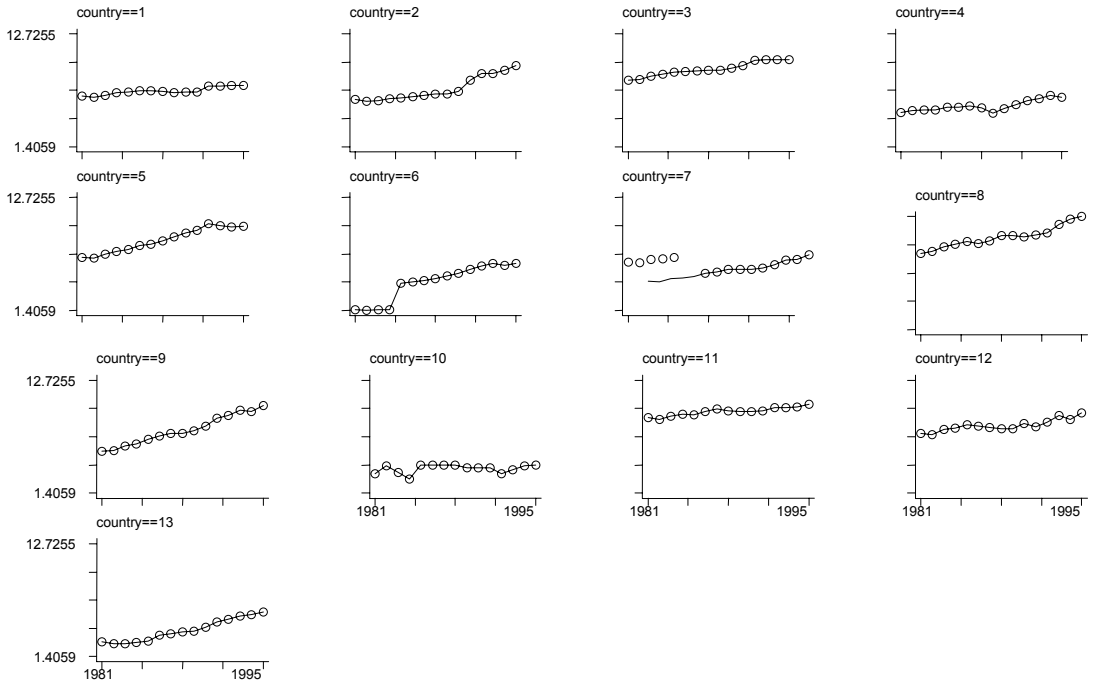
COUNTRY	OPENESS	GDPPRO	TREVGDP	PCONSGDP	POPYOU	POPOLD	POPURB
United Kingdom	0.044	0.020	0.364	0.206	0.194	0.154	0.890
Germany	0.013	0.022	0.377	0.197	0.163	0.149	0.847
France	0.021	0.024	0.434	0.214	0.206	0.138	0.739
Ireland	0.009	0.016	0.355	0.167	0.279	0.109	0.566
Italy	0.008	0.022	0.375	0.184	0.177	0.143	0.667
Spain	0.018	0.016	0.315	0.153	0.209	0.131	0.748
Austria	0.008	0.024	0.418	0.193	0.181	0.147	0.645
Denmark	0.017	0.026	0.482	0.267	0.180	0.151	0.845
Finland	0.017	0.023	0.423	0.213	0.194	0.130	0.612
Greece	0.014	0.015	0.293	0.151	0.199	0.139	0.586
Netherland	0.056	0.023	0.454	0.154	0.192	0.124	0.886
Sweden	0.039	0.024	0.514	0.274	0.182	0.175	0.831
Portugal	0.017	0.014	0.296	0.157	0.214	0.131	0.431

	TABLE 4 GEOGRAPHICAL DISTANCE WEIGHTED						
Explanatory Variables	Statutory Tax Rate	Top Rate Income Tax	General Public Expenditures	Public Expenditures in Education	Public Expenditures in Health	Public Expenditures in Social Security and Welfare	Public Expenditures in Defence
$T_{i,t-1}$	0.31*** (0.10)	0.435*** (0.12)	0.336** (0.16)	0.403*** (0.08)	0.539*** (0.16)	0.490*** (0.16)	0.352*** (0.08)
A_{it}	0.893*** (0.22)	0.625*** (0.18)	0.166 (0.18)	0.267 (0.22)	0.359 (0.34)	-0.569* (0.29)	-0.594*** (0.02)
$SIZE_{it}$	0.815 (0.50)	0.498 (0.55)	10.42* (0.49)	0.452 (0.87)	1.032 (2.12)	2.663 (3.20)	-0.195 (0.39)
$TOPINC_{it}$	0.095* (0.05)		0.427 (0.49)	-0.053 (0.04)	-0.049 (0.07)	0.068 (0.18)	-0.031 (0.02)
$TAUR_{it}$		0.046 (0.12)	-0.402 (0.69)	-0.066 (0.10)	0.196 (0.12)	-0.310 (0.29)	0.014 (0.03)
$POLITIC_{it-1}$	-0.003 (0.005)	0.021** (0.008)	0.098 (0.07)	0.025** (0.01)	0.050** (0.02)	0.029 (0.04)	0.002 (0.003)
$ELECTION_{it-1}$	-0.003 (0.004)	-0.001 (0.005)	0.111** (0.04)	0.012** (0.005)	0.005 (0.01)	0.034 (0.02)	0.007*** (0.002)
$POPDENS_{it-1}$	0.002 (0.005)	-0.006 (0.006)	0.062 (0.04)	0.005 (0.004)	-0.002 (0.01)	0.042* (0.02)	-0.005** (0.002)
$PYOU_{it}$	0.340 (0.78)	1.660 (1.23)	-7.037 (8.04)	-2.816** (1.25)	-0.845 (1.74)	6.349* (3.61)	-1.114* (0.54)
$POLD_{it}$	0.546 (0.76)	5.053*** (1.64)	-12.323 (8.66)	0.817 (1.09)	1.912 (2.88)	1.387 (4.88)	-0.905 (0.67)
$PURB_{it}$	-0.650 (1.35)	2.141 (1.91)	26.76* (13.47)	1.495 (1.495)	1.293 (1.99)	2.772 (3.77)	-0.044 (0.78)
$PCON_{it}$	-0.276 (0.25)	-0.387 (0.36)					
$TREV_{it}$			0.128 (1.71)	0.152 (0.24)	0.064 (0.29)	0.725 (0.71)	-0.019 (0.08)
$OPEN_{it-1}$	-0.116 (0.18)	-0.313 (0.24)	-1.153 (2.03)	-0.464 (0.39)	-0.503 (0.37)	0.669 (0.85)	0.114 (0.12)
$GDPPRO_{it}$	-0.000016** (0.000)	0.00007 (0.000)	45.635 (31.37)	16.936*** (3.72)	12.307* (6.27)	27.099* (15.13)	0.956 (2.01)
country fixed effects	yes	yes	yes	yes	yes	yes	yes
individual time trend	yes	yes	yes	yes	yes	yes	yes
R^2	0.95	0.88	0.98	0.98	0.97	0.99	0.99
LM serial							
LM spatial							
Observations	195	195	195	195	195	195	195

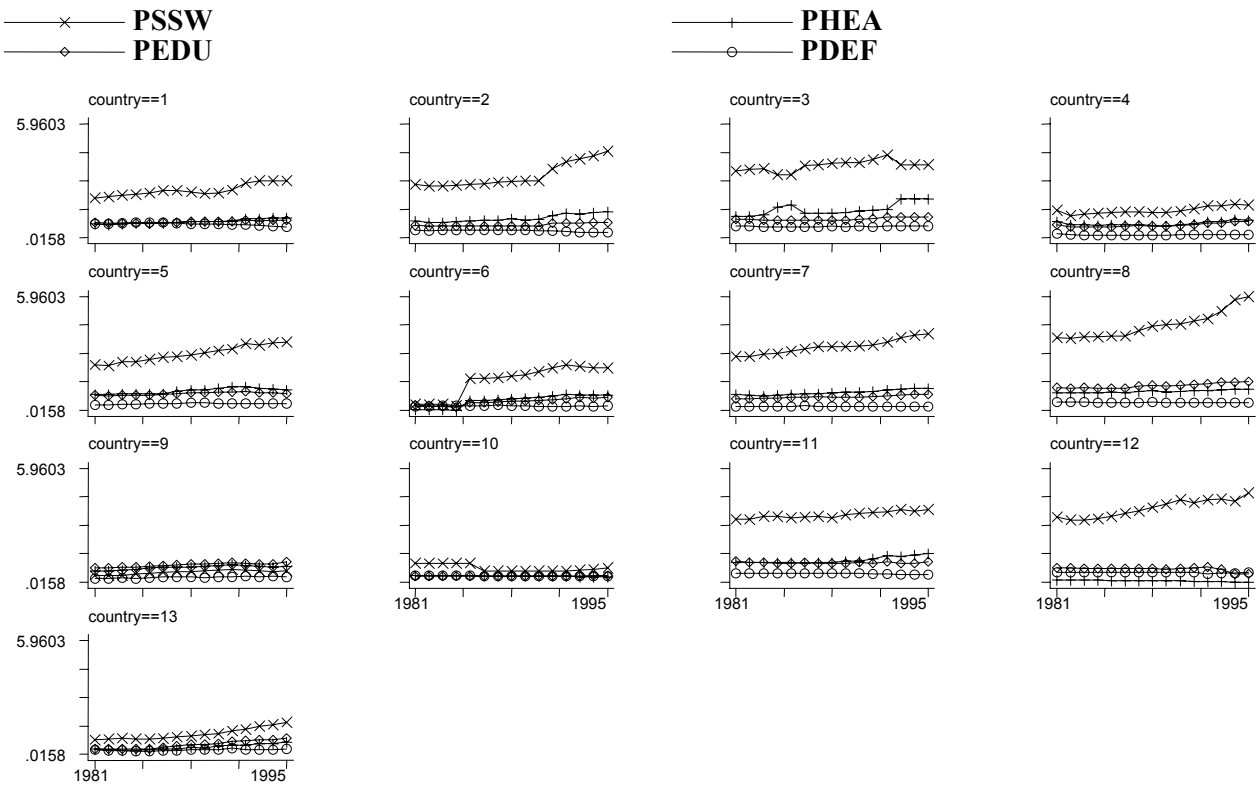
	TABLE 5 GDP WEIGHTED						
Explanatory Variables	Statutory Tax Rate	Top Rate Income Tax	General Public Expenditures	Public Expenditures in Education	Public Expenditures in Health	Public Expenditures in Social Security and Welfare	Public Expenditures in Defence
$T_{i,t-1}$	0.326*** (0.12)	0.376*** (0.12)	0.355** (0.16)	0.395*** (0.08)	0.532*** (0.16)	0.481*** (0.17)	0.398*** (0.08)
A_{it}	0.426 (0.34)	0.951*** (0.21)	0.409** (0.18)	0.404** (0.19)	0.343 (0.21)	0.115 (0.15)	-0.022 (0.11)
$SIZE_{it}$	-0.257 (0.58)	0.294 (0.54)	10.852* (5.52)	0.477 (0.86)	0.835 (0.21)	3.227 (3.16)	-0.291 (0.39)
$TOPINC_{it}$	0.114* (0.06)		0.285 (0.52)	-0.046 (0.04)	-0.096 (0.08)	0.177 (0.17)	-0.030 (0.02)
$TAUR_{it}$		0.049 (0.11)	-0.300 (0.72)	-0.041 (0.10)	0.190* (0.10)	-0.154 (0.26)	-0.002 (0.04)
$POLITIC_{it-1}$	0.003 (0.005)	0.024*** (0.008)	0.109 (0.07)	0.027*** (0.01)	0.051** (0.02)	0.032 (0.04)	0.002 (0.003)
$ELECTION_{it-1}$	0.003 (0.004)	-0.00013 (0.005)	0.113 (0.04)	0.012** (0.005)	0.005 (0.10)	0.030 (0.02)	0.007*** (0.002)
$POPDENS_{it-1}$	-0.0001 (0.0005)	-0.009 (0.006)	0.051 (0.04)	0.005 (0.004)	-0.003 (0.01)	0.038 (0.02)	-0.004* (0.002)
$PYOU_{it}$	-0.390 (0.81)	1.279 (1.15)	-8.820 (8.11)	-2.931*** (1.09)	-0.879 (1.75)	1.825 (3.33)	-0.597 (0.51)
$POLD_{it}$	0.017 (0.84)	5.156*** (1.61)	-12.720 (8.24)	0.625 (1.09)	2.374 (3.10)	-4.119 (4.70)	-0.262 (0.68)
$PURB_{it}$	-1.469 (1.41)	0.882 (1.77)	22.459* (13.05)	0.868 (1.31)	1.348 (1.78)	0.042 (3.50)	0.401 (0.84)
$PCON_{it}$	-0.466* (0.27)	-0.540 (0.36)					
$TREV_{it}$			0.179 (1.71)	0.161 (0.23)	0.060 (0.29)	1.065 (0.69)	-0.098 (0.09)
$OPEN_{it-1}$	-0.274* (0.16)	-0.235 (0.20)	-0.216 (1.97)	-0.453 (0.39)	-0.486 (0.35)	0.727 (0.86)	0.160 (0.12)
$GDPPRO_{it}$	-0.000016** (0.000)	0.00005 (0.000)	52.623* (30.97)	17.099*** (3.62)	15.027** (6.07)	34.657** (15.12)	1.976 (2.02)
country fixed effects	yes	yes	yes	yes	yes	yes	yes
individual time trend	yes	yes	yes	yes	yes	yes	yes
R^2	0.96	0.89	0.98	0.98	0.97	0.99	0.99
LM serial							
LM spatial							
Observations	195	195	195	195	195	195	195

	TABLE 6 GDP DISTANCE WEIGHTED						
Explanatory Variables	Statutory Tax Rate	Top Rate Income Tax	General Public Expenditures	Public Expenditures in Education	Public Expenditures in Health	Public Expenditures in Social Security and Welfare	Public Expenditures in Defence
$T_{i,t-1}$	0.315*** (0.12)	0.375*** (0.12)	0.356** (0.17)	0.394*** (0.08)	0.530*** (0.17)	0.481*** (0.17)	0.398*** (0.08)
A_{it}	0.545* (0.31)	0.949*** (0.21)	0.418** (0.18)	0.411** (0.19)	0.341 (0.21)	0.114 (0.15)	-0.022 (0.11)
$SIZE_{it}$	0.215 (0.62)	0.294 (0.54)	10.744* (5.45)	0.479 (0.86)	0.830 (1.94)	3.227 (3.16)	-0.291 (0.39)
$TOPINC_{it}$	0.115* (0.05)		0.251 (0.51)	-0.046 (0.04)	-0.097 (0.08)	0.177 (0.17)	-0.030 (0.02)
$TAUR_{it}$		0.051 (0.11)	-0.233 (0.67)	-0.039 (0.10)	0.195* (0.10)	-0.154 (0.26)	-0.002 (0.04)
$POLITIC_{it-1}$	0.001 (0.005)	0.024*** (0.008)	0.112 (0.07)	0.027*** (0.01)	0.051** (0.02)	0.032 (0.04)	0.002 (0.003)
$ELECTION_{it-1}$	-0.003 (0.004)	-0.001 (0.005)	0.113** (0.04)	0.012** (0.005)	0.005 (0.01)	0.030 (0.02)	0.007*** (0.002)
$POPDENS_{it-1}$	0.0005 (0.005)	-0.009 (0.006)	0.050 (0.04)	0.005 (0.004)	-0.003 (0.01)	0.038 (0.02)	-0.004* (0.002)
$PYOU_{it}$	0.043 (0.88)	1.278 (1.15)	-8.031 (8.10)	-2.931 (1.09)	-0.830 (1.75)	1.826 (3.33)	-0.598 (0.51)
$POLD_{it}$	0.573 (0.89)	5.175*** (1.61ù)	-12.458 (8.34)	0.613 (1.09)	2.395 (3.11)	-4.115 (4.70)	-0.263 (0.68)
$PURB_{it}$	-1.269 (1.40)	0.873 (1.77)	22.377* (13.23)	0.880 (1.31)	1.417 (1.76)	0.044 (3.50)	0.400 (0.85)
$PCON_{it}$	-0.359 (0.26)	-0.538 (0.36)					
$TREV_{it}$			0.134 (1.69)	0.165 (0.23)	0.068 (0.28)	1.065 (0.69)	-0.098 (0.09)
$OPEN_{it-1}$	-0.193 (0.16)	-0.236 (0.20)	-0.235 (1.96)	-0.451 (0.39)	-0.482 (0.35)	0.726 (0.86)	0.160 (0.12)
$GDPPRO_{it}$	-0.000008 (0.000)	-0.00008 (0.000)	52.071* (30.49)	17.093*** (0.036)	14.958** (6.04)	34.657** (15.13)	1.977 (2.02)
country fixed effects	yes	yes	yes	yes	yes	yes	yes
individual time trend	yes	yes	yes	yes	yes	yes	yes
R^2	0.96	0.89	0.98	0.98	0.97	0.99	0.99
LM serial							
LM spatial							
Observations		195	195	195	195	195	195

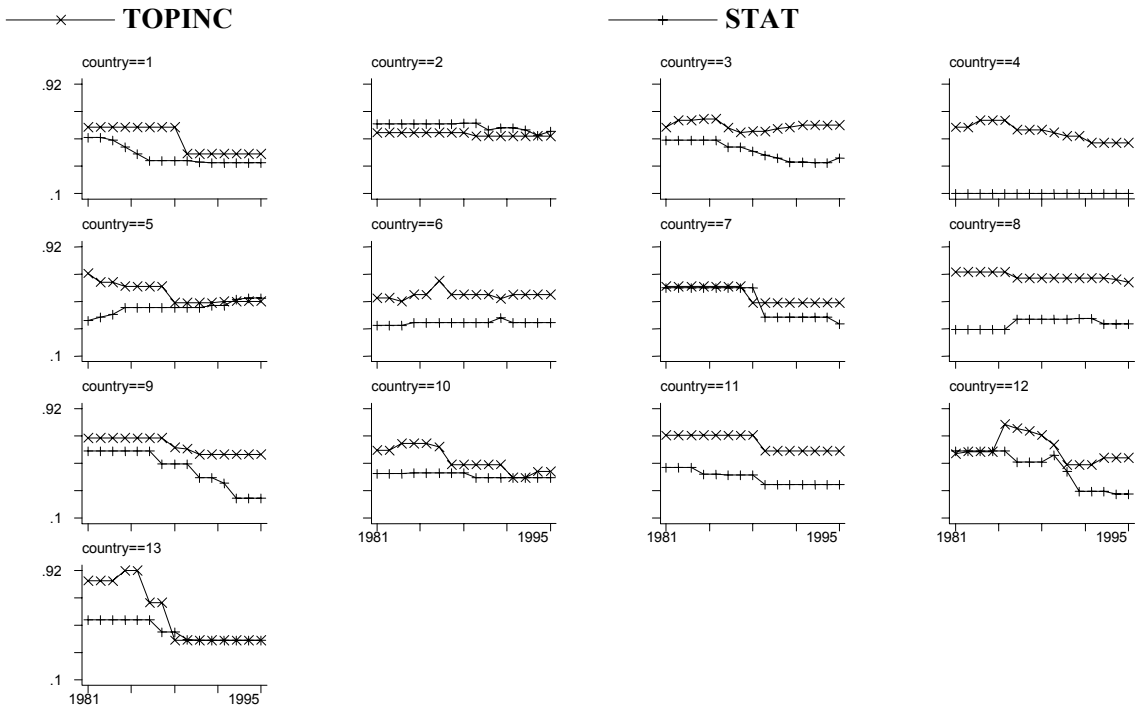
	TABLE 7 GDP PER CAPITA WEIGHTED						
Explanatory Variables	Statutory Tax Rate	Top Rate Income Tax	General Public Expenditures	Public Expenditures in Education	Public Expenditures in Health	Public Expenditures in Social Security and Welfare	Public Expenditures in Defence
$T_{i,t-1}$	0.313*** (0.12)	0.486*** (0.12)	0.410*** (0.13)	0.423*** (0.08)	0.555*** (0.16)	0.478*** (0.17)	0.399*** (0.08)
A_{it}	0.292 (0.25)	0.232 (0.15)	0.175 (0.10)	0.024 (0.07)	-0.050 (0.05)	-0.075 (0.03)	0.014 (0.03)
$SIZE_{it}$	-0.001 (0.58)	-0.152 (0.61)	10.591* (5.66)	0.445 (0.92)	0.981 (1.87)	4.609 (2.89)	-0.230 (0.43)
$TOPINC_{it}$	0.128** (0.05)		0.430 (0.46)	-0.076 (0.04)	-0.012 (0.07)	0.245 (0.16)	-0.031 (0.02)
$TAUR_{it}$		0.062 (0.12)	-0.294 (0.74)	0.079 (0.11)	0.182 (0.12)	-0.349 (0.26)	-0.001 (0.04)
$POLITIC_{it-1}$	0.003 (0.005)	0.022*** (0.008)	0.104 (0.07)	0.024** (0.01)	0.047** (0.02)	0.036 (0.04)	0.002 (0.004)
$ELECTION_{it-1}$	-0.003 (0.004)	-0.001 (0.006)	0.115** (0.04)	0.012** (0.005)	0.004 (0.01)	0.027 (0.02)	0.008*** (0.002)
$POPDENS_{it-1}$	0.0004 (0.005)	-0.005 (0.006)	0.052 (0.04)	0.005 (0.004)	-0.0002 (0.01)	0.031 (0.02)	-0.004* (0.002)
$PYOU_{it}$	-0.376 (0.80)	1.580 (1.31)	-7.583 (8.32)	-2.074* (1.08)	-0.397 (2.05)	4.828 (3.49)	-0.544 (0.50)
$POLD_{it}$	-0.080 (0.81)	3.785** (1.51)	-7.521 (8.22)	1.561 (0.96)	2.152 (3.35)	-1.586 (4.71)	-0.259 (0.64)
$PURB_{it}$	-1.471 (1.43)	2.330 (2.06)	14.448 (12.46)	1.444 (1.24)	2.828 (1.86)	-2.145 (3.48)	0.474 (0.81)
$PCON_{it}$	-0.446 (0.27)	-0.385 (0.381)					
$TREV_{it}$			-0.333 (1.71)	0.122 (0.24)	-0.089 (0.30)	0.743 (0.71)	-0.100 (0.08)
$OPEN_{it-1}$	-0.233 (0.174)	-0.458 (0.30)	-2.426 (2.33)	-0.470 (0.40)	-0.681 (0.42)	0.402 (0.88)	0.160 (0.12)
$GDPPRO_{it}$	-0.000008 (0.000)	-0.00008 (0.000)	34.444 (32.48)	17.058*** (3.73)	11.527* (6.41)	36.03*** (13.51)	3.034 (2.03)
country fixed effects	yes	yes	yes	yes	yes	yes	yes
individual time trend	yes	yes	yes	yes	yes	yes	yes
R^2	0.96	0.87	0.98	0.98	0.99	0.99	0.99
LM serial							
LM spatial							
Observations	195	195	195	195	195	195	195



Graph 1.GPEX



Graph 2. Disaggregated public expenditures



Graph 3. Tax variables