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Did the Single Market Cause Competition in Excise Taxes? Evidence from EU Countries

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Abstract

The introduction of the Single Market resulted in a switch from destination to origin-based taxation of cross-border transactions by individuals. The theory of commodity tax competition predicts that this change should give rise to excise tax competition and thus intensify strategic interaction in the setting of excise taxes. In this paper, we provide an empirical test of this prediction using a panel data set of 12 EU countries over the period 1987-2004. We find that for all excise duties that we consider (still and sparkling wine, beer, ethyl alcohol, and cigarettes), strategic interaction between countries significantly increased after 1993, consistently with the theoretical prediction. Indeed, for all these products except for cigarettes, there is no evidence of strategic interaction prior to 1993, so our findings are consistent with the hypothesis that the single market *caused* tax competition. For beer and ethyl alcohol, there is evidence that the minimum taxes, also introduced in 1993, have intensified strategic interaction.

JEL Classification: H70,H71,H77.

Keywords: tax competition, excise taxes, cross-border shopping.

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1 Introduction

The Single European Act, which came into force in July 1987, initiated a vast legislative programme involving the adoption of hundreds of directives and regulations, which gradually established the single market amongst EU member states over a period up to the end of 1992. Two of most important provisions of the single market were, first, to allow individuals to import relatively large quantities of goods purchased abroad, which had previously been subject to the importing country's rate of tax; and second, the abolition of physical border controls, which were replaced by random spot checks.

Before 1 January 1993, all imports to EU countries (either from EU countries or from outside EU) were subject to a duty-free regime. That is, a small quantity of the product could be bought at duty-free shops in airports, on boats, etc. without any tax payable, and then brought into the country of residence of the purchaser. Any excess imports were taxed by destination country (in practice, both duties and VAT are imposed). It is important to note that duty-free allowances are quite small[1].

On 1 January 1993, all imports to EU countries from other EU countries were subject to no restrictions, except (i) that tax must have been paid in the country of purchase of the good; and (ii) that good are not for resale. Condition (ii) is enforced by generous upper limits, plus random customs checks at borders. For example, according to the UK Customs and Excise,, "if you bring back large quantities of alcohol or tobacco, a Customs Officer is more likely to ask about the purposes for which you hold the goods. This will most likely be the case if you appear at the airport with more than: 3200 cigarettes, 400 cigarillos, 200 cigars, 3kg of smoking tobacco, 110 litres of beer, 10 litres of spirits, 90 litres of wine, 20 litres of fortified wine i.e.: port or sherry". The above allowance is more than enough for the annual consumption of the average two-adult household, and depending on the item, 15-40 times the UK duty-free allowance. Moreover, imports in excess of these levels do not automatically trigger fines or prosecution: the levels are indicative only, and the onus is on Customs officials to prove smuggling.

Obviously, these changes in the rules creates incentive both for legitimate tax-induced cross-border shopping and for smuggling. There is evidence that both these activities are occurring on a large scale at some borders. For example, the rates of excise duty on alcoholic drinks and tobacco products in the UK are significantly higher than those in most other EU Member States, especially France. In 1998, the loss of UK tax revenue lost from legal cross border shopping was estimated to be £375 million : £55m from beer, £180m from wine, £50m from spirits, and £85m from tobacco products[2]. In 2003/04 in the UK, 10.5 billion cigarettes were successfully smuggled and the further 6.5 billion cross-border shopped implying a loss of £3.1 billion of tax revenue. (CMO Annual Report (2004)).

What is less clear is whether these changes, and the subsequent excise revenue

[1] For example, in the UK, the allowances were: 200 cigarettes, or 100 cigarillos, or 50 cigars, or 250 grams of tobacco, 2 litres of still table wine, 1 litre of spirits or strong liqueurs over 22% of volume, or 2 litres of fortified wine, sparkling wine or other liqueurs.

[2] House of Commons Debate 26 November 1999 cc 254-5W.

losses in high-tax countries, have caused *tax competition* between EU member states to occur or intensify. Certainly, the theory (Kanbur and Keen 1993, Lockwood 1993, Ohsawa 1999, Nielsen 2001)) suggest that this should happen. Technically, the Single Market resulted in a switch from destination to origin-based taxation of cross-border transactions by individuals. These models predict that tax competition only occurs with origin-based taxation. So, the models predict, unambiguously and generally, that we should observe competition in excise taxes between EU countries only after 1993.

Of course, strategic interaction can occur for other reasons e.g. yardstick competition, or common intellectual trends. So, the observable implication of the theory is that strategic interaction between EU countries in the setting of excise taxes should intensify after 1993. How much it intensifies depends on the scale of cross-border shopping and potential revenue losses from high taxes: as the above discussion indicates, these might be quite large. The key idea of the paper is that completion of the single market can be interpreted as a kind of "natural experiment" that allows us to separate the effects of tax competition from other forms of strategic interaction.

This paper represents the first attempt, to our knowledge, to directly test this observable prediction. We employ a balanced panel data set of 12 EU countries over the period 1987-2004 and excise taxes on five commodities; still wine, sparking wine, beer, products made ethyl alcohol i.e. spirits, and cigarettes. The excise tax data were taken from the European Commission's Excise Duty Tables and Inventory of Taxes. Using this data set, we estimate an empirical model where the excise tax in a given country depends linearly on the weighted average of other countries' taxes, and a set of control variables. The equation is estimated separately on subsamples before and after 1993.

First, we find robust evidence that the coefficient estimates differ on the two subsamples. Specifically, looking across all five taxes, and a variety of different weighting matrices suggested by the theory, the null hypothesis of equality of coefficients can be rejected in every single case. Second, again looking across all five taxes, and a variety of different weighting matrices (i) coefficient measuring strategic interaction is *always* significantly positive post-1993; (ii) depending on the weighting matrix, this coefficient is often *not* significant before 1993, indicating an absence of strategic interaction; and (iii) whenever both are significant, the post-1993 coefficient is higher.

So, the evidence certainly supports the hypothesis that strategic interaction intensified after 1993. Moreover, if we focus on our "baseline" weighting matrix i.e. the maintained hypothesis that countries only interact with their geographical neighbors, which is what is suggested by the theory, then the strategic coefficient is significant before 1993 only for cigarettes. Thus one could go furthermore and say that for the other four products, there is evidence, consistently with the theory, that the single market *caused* tax competition.

We also investigate the impact of minimum tax rates, also introduced in 1993, on strategic interaction. Unfortunately, as explained in Section 5.1, the theory does not have any robust predictions about how a minimum tax will affect tax reaction functions. Also, because we split the sample in 1993, we can only consider minimum taxes that change - in real terms - after 1993. Only two such minima meet this criterion, the minimum taxes on beer and ethyl alcohol[3]. An increase in both of these minima have a significantly positive effect on the amount of strategic interaction.

Related literature is as follows. First, there is a small empirical literature on spatial interactions in excise taxes in the US (e.g. Nelson (2002), Rork (2003), Lockwood at al. (2005)). But in the US, there has been no "natural experiment" similar to the completion of the single market in the EU in recent times. Within the US, importation of commodities e.g. cigarettes subject to excises by individuals for private consumption is essentially unrestricted[4], meaning that the origin regime is firmly in place for these kinds of transactions.

There are also a couple of cross-country empirical studies of strategic interaction in commodity taxes (Egger et al. (2005), Evers et. al. (2004)). Egger et al. (2005) test some of the predictions of Ohsawa's theoretical model of commodity tax competition on commodity tax data for a panel of 22 OECD countries. But, unlike our study, they use an aggregate indicator of commodity taxation taken from national accounts data, which, relative to our paper, obviously has the disadvantage that it does not measure very precisely the setting of individual tax instruments by governments. The paper by Evers et. al. (2004), in contrast, studies strategic interaction in the setting of diesel excises in EU countries, plus Norway and Switzerland, and so is closest to our paper. But, almost by definition, the treatment of imports of fuel in the tank of a vehicle must be on an origin basis[5], and so completion of the single market has no predicted effect on the setting of this excise, except possibly through the introduction of a minimum EU excise; the latter effect is the focus of Evers et. al. (2004).

The rest of the paper is structured as follows. In Section 2, we explain our econometric method and estimation procedure. Section 3 describes the data, Section 4 the results and Section 5 some robustness checks. Section 6 provides concluding comments.

2 The Econometric Model

In the theoretical model first presented by Kanbur and Keen(1993), and developed by Ohsawa(1999), Nielsen (2001) amongst others, origin-based commodity taxation generates positively sloped reaction functions i.e. that in country i, the excise tax, t_i, is an increasing, piecewise linear, function of the tax rate in the other countries, $t_j,\ j \neq i$. Moreover, under realistic assumptions[6], the response of t_i to t_j will

[3]The minimum tax on wine (still or sparkling) is zero, and on cigarettes, the minimum is expressed as a percentage of the retail price, which has not changed since its introduction.

[4]The borderline of legality in the case of cigarettes is provided by the Contraband Cigarette Act of 1978, which prohibits single shipments, sale or purchase of more than 60,000 cigarettes not bearing the tax stamp of the state in which they are found.

[5]That is, even with border controls, customs officials have no way of knowing where the fuel in the tank of a vehicle has been bought.

[6]That is, that is, that prices are such that consumers do not wish to drive though a third country to buy in a low-tax country.

be non-zero only if i and j are contiguous i.e. share a common border. Finally, this response will depend on the length of the border between i and j and also on the population sizes in the two countries (Ohsawa 1999), Devereux, Lockwood and Redoano(2005)).

Our empirical specification is therefore the following:

$$t_{is} = f_i + \sum_{j \neq i} \beta_{ij} t_{js} + \delta' \mathbf{Z}_{is} + \epsilon_{is} \tag{1}$$

where $i = 1, ..n$ denotes a country, and $s = 1, ...S$ a time-period, f_i a country fixed effect, $\mathbf{Z}_{is}$ a $k \times 1$ vector of relevant characteristics of country i at time s, and δ a $k \times 1$ vector of coefficients. However, this cannot be estimated as it stands, as there are too many parameters β_{ij} to be estimated. The usual approach is to modify (1) as:

$$t_{is} = f_i + \phi \sum_{j \neq i} \omega_{ij} t_{js} + \delta' \mathbf{Z}_{is} + \epsilon_{is} \tag{2}$$

where the ω_{ij} are exogenously chosen weights that aggregate the tax rates in other countries into a single variable, which has coefficient ϕ. The ω_{ij} are usually normalized so that $\sum_{j \neq i} \omega_{ij} = 1$. This is a widely used procedure and there is considerable discussion of the appropriate weights in the literature e.g. Brueckner(2003).

Our key theoretical hypothesis is that ϕ changes with the regime, being higher when the Single Market regime is in place. In fact, if only tax competition is present, and no other form of strategic interaction, we expect $\phi = 0$ before 1993. We test for this dependence by estimating (2) on two sub-samples. Initially, these subsamples are 1987-1992, and 1993-2004. Let the estimates of ϕ on the earlier and later subsample be ϕ_1, ϕ_2 respectively. So, our basic hypothesis is that $\phi_2 > \phi_1$. Note also that as the fixed effects are estimated separately on the two subsamples, we also effectively allow the intercept of the reaction functions (2) to shift after 1993.

The system (2) is known as a spatial autoregressive model (SAR). OLS estimation of a SAR model is inappropriate, because the right-hand side variables $t_{js},\ j \neq i$ are endogenous. We estimate this system by instrumental variables. At the first stage, the endogenous variable $\sum_{j \neq i} \omega_{ij} t_{js}$ is instrumented by the weighted averages of the controls i.e. $\sum_{j \neq i} \omega_{ij} z^c_{js}$, for control $c = 1, ..k$. So, our maintained hypothesis is that in country, the controls are exogenous to the setting of excise taxes on tobacco and alcohol products; given our list of controls in Table 2 below, this seems reasonable.

Finally, we turn to the specification of the weighting matrix. Following the theoretical literature, and several empirical studies, our baseline weighting matrix uses contiguity weights. These weights capture the idea that tax bases are mobile only between geographically neighbouring countries. Specifically, we define *contiguity weights* as:

$$\omega_{ij} = \begin{cases} \frac{1}{n_i} & \text{if } j \in N_i \\ 0 & \text{if } j \notin N_i \end{cases} \tag{3}$$

where N_i is the set of states that border state i, and $n_i = \# N_i$. This assigns equal weight to all countries on the border of country i, and weight zero to the other countries. The matrix is normalized to have rows summing to one.

One problem in implementing (3) is that it is difficult to define "neighbors" when a country is an island, or part of an island, or has no direct EU neighbors. These problems arise for three of the eight countries in our data-set; UK, Ireland, or Greece. A strict imposition of contiguity weights for the UK, for example, would give only Ireland as the neighbor for the UK, and vice versa. This is inaccurate, because it does not account for the considerable tax-induced cross-border shopping between the UK and France. Our solution was to say that if i is an island, a positive contiguity weight was given to country j when j could be directly reached from country i by crossing only over water i.e. without passing through a third country. But obviously, this is a rather arbitrary extension of the idea of contiguity.

A modification of contiguity weights often considered in the literature are distance weights. We use the longitude and latitude coordinates of the capitals of each country, and applying a method called Delauney triangulation, we generates two types of spatial weight matrix[7]. In practice, neighboring countries are given higher or lower weights according to the distance between their capitals.

Finally, following Case, Hines and Rosen (1992) we adopt a robustness check. Specifically, we want to test whether *any* weighting matrix will generate positive strategic interaction between countries; if not, i.e. only contiguity-type weighting matrices work, this is more evidence that the strategic interaction we observe is no due to something inherent in the econometric tax competition. Following Case, Hines and Rosen (1992), we construct a weighting matrix based on a "nonsense" procedure; $\omega_{ij} = 1$ only if the name of country j comes after country i in the alphabet.

3 Data

We construct a balanced panel of data from 12 EU countries over 17 years, 1987 and 1989-2004 inclusive[8]. We consider only the countries which were members of the EU in 1987, excluding those that joined the EU later on. The final sample size has 204 observations. Data on excises are based on the Excise Duty Table issued by the European Commission[9], cross-checked against the available issues of the Inventory of Taxes (only available for 1994, 1999, 2002). In the case of a discrepancy, which were not many, we took the data from the Inventory of Taxes as being authoritative, as this data is directly supplied by the member countries.

We study five kinds of products; still wine, sparkling wine, beer[10], cigarettes,

[7]In practice, the Delauney algorithm uses the longitude and latitude coordinates to generate in the plane a set of triangles. Two countries are contiguous if they have common vertex. Kelley Pace has written the code (FDELW2.m) to convert Delauney algorithm results into a contiguity matrix. The code is included in his Spatial Statistics toolbox 2.0 for Matlab, which can be downloaded from www.spatial-statistics.com.

[8]Data are not available for the year 1988, so there are 204 observations.

[9]In the Appendix we discuss all the problems we had in collecting the data.

[10]In the case of beer, there were two kinds of physical unit used in the Excise Duty Tables: degree Plato, and degree of alcohol by volume. According to Directive 92/84/EEC it has been

and ethyl alcohol, the last being effectively an excise tax on spirits, such as whiskey, brandy, etc. All of these products, except for cigarettes, are only subject to a specific or unit excise tax i.e. levied per unit of physical quantity. Where there are several rates of tax e.g. standard and reduced rates, we use only the standard rates.

In the case of cigarettes, all countries also levy an ad valorem excise tax. Moreover, depending on the country, either the specific or ad valorem component of the tax can be the more important one and so we cannot safely ignore either. On the other hand, we do not have data separately on the retail price of cigarettes, so we are constrained by data in the Excise Duty Tables. In the case of cigarettes the Excise Duty Tables also report the total tax (specific, ad valorem, and VAT) as a percentage of the retail price, and that is our baseline indicator of the tax on cigarettes.

In Figures 1-5, we report for each of the five goods the time series plot of the tax rates in nominal national currency. Detailed comments commodity-by-commodity are given in the section below on the regression results. But, some general features can be identified. First, as might be expected, countries generally adjust their nominal taxes upwards in nominal terms, in order to respond to general price inflation. Second, there are some exceptions, associated with the start of the single market in 1993. For example, both Denmark and Luxembourg cut their tax on wine (still and sparkling) in by large amounts in 1992, in the case of Luxembourg to zero. Again, Denmark cut its tax on beer, and Germany and Luxembourg raised their tax on beer, both by large amounts, in 1992.

When we run the regressions, we make two changes to the dependent variable First, we adjust for inflation by dividing through by the RPI for the relevant country, because rational governments will be concerned with the real, rather than nominal, value of the taxes they set. Perhaps for this reason, we did not find any evidence of strategic interaction when we used nominal taxes. Second, we find that our regressions work a little better when the dependent variable is converted to Euro[11], possibly because countries are comparing their own taxes to others in different national currencies, and can only do so in a common currency.

Finally, in estimating the determinants of the taxes, we need to control for other factors. We use a parsimonious set of controls that can be found in most of the existing empirical literature. These include: economic variables (GDP per capita in local currency unit and government final consumption expenditure as a percentage of GDP) and a demographic variable (total population in millions of inhabitants). All of these variables are taken from World Bank WDI (2004). We add two political dummy variables for the ideological orientation of governments. We used the Schmidt Index[12], included in the Comparative Political Data Set 1960-2004 (Armi-

accepted that a tax of 0.748 euro Plato is equal to a tax of 1.87 euro alcohol by volume, and we applied this conversion factor.

[11]Before 1999, we converted national currencies to ECU using the exchange rates provided in the Excise Duty Tables.

[12]This is an index created by Schmidt (1996) and which gives different weights according to the cabinet composition. Schmidt-Index: (1) hegemony of right-wing parties ($gov_{left} = 0$), (2) dominance of right-wing (and centre) parties ($gov_{left} < 33.3$), (3) stand-off between left and right

geon et al., 2006), to define a dummy for right-wing cabinets, a dummy for stand-off between left and right cabinets, and a dummy for left-wing cabinets. The second dummy is used as reference category in the estimation. The descriptive statistics for the controls are also given in Table 1.

Table 1: Summary Statistics - Control variables

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
$poptot^a$	292.13	268.52	3.72	825.41
$gdppc^b$	365.40	561.59	73.95	2484.32
$govcons^c$	19.86	3.30	13.74	26.76
$govright^d$	0.44	0.50	0.00	1.00
$govleft^e$	0.26	0.44	0.00	1.00

[a]total population (in millions)

[b]GDP per capita local currency unit

[c]government final cons. expend. (% of GDP)

[d e] proportion of cabinets.

4 Results

The results are given by commodity in Tables 4-6. All have the same format i.e. for each of the four weighting matrices, estimates of equation (2) over the period 1987-92, and 1993-2004 are given separately.

The following diagnostic statistics are reported. First, Pagan and Hall's (1983) test is a test of heteroskedasticity for instrumental variables (IV) estimation. This statistic is distributed as chi-squared under the null of no heteroskedasticity, and under the maintained hypothesis that the error of the regression is normally distributed. When we find heteroskedasticity we report the corrected standard errors using a robust variance estimator. Second, the F test in the first stage of the estimation tests the null hypothesis of whether the instruments are not correlated with the endogenous variable. A rejection means that there is such a correlation. Third, the Anderson canonical correlations likelihood-ratio tests whether the equation is identified[13]. The statistic provides a measure of instrument relevance, and rejection of the null indicates that the model is identified. Fourth, the Hansen-Sargan test is a test of overidentifying restrictions. The joint null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Under the

($33.3 < gov_{left} < 66.6$), (4) dominance of social-democratic and other left parties ($gov_{left} > 66.6$), (5) hegemony of socialdemocratic and other left parties ($gov_{left} = 100$).

[13]The null hypothesis of the test is that the matrix of reduced form coefficients has rank=K-1, where K=number of regressors, i.e, that the equation is underidentified. Under the null of underidentification, the statistic is distributed as chi-squared with degrees of freedom=(L-K+1), where L=number of instruments (included+excluded).

null, the test statistic is distributed as chi-squared in the number of overidentifying restrictions. A rejection casts doubt on the validity of the instruments.

4.1 Still Wine

Looking at Figure 1, six countries out of twelve have zero tax rates on wine still, LU reduced the excise to zero in 1993. Therefore, it is not easy to analyze a situation of tax competition. The UK only increased slowly the rate over the 17 year-period, some of the others (BE, IE, NL, FR) increased it just once or twice after 1992 and some countries (DK, LU) decreased the rate in 1993 and keeping it constant after.

The first two columns of Table 2 show the equation using a contiguity weight matrix. The equation after 1993 performs much better, note first the Chow test is rejected and there is a structural break after 1993. The controls are joint significant and the standard errors correct for heteroskedasticity according to the Pagan test. We reject the F test of no correlation between instrument and endogenous variables. The equation passes both tests on IV validity, i.e. Anderson and Hansen tests. Turning on the spatial lagged coefficient: WTAX is increasing, positive and significant after 1993, before it is negative and insignificant. Also, note that as the taxes are in levels, the interpretation of the coefficients is that after 1993, for example, a 1 Euro increase in the specific tax on wine still in all other countries causes a given country to raise its tax by about 0.4 Euros.

Looking across the other matrix specifications the same picture is confirmed. The WTAX coefficient is always positive, highly significant and increasing after 1993. A further confirmation is given by the estimation with Wrand, since the WTAX coefficients are negative and insignificant. The difference between the results based on distance weights on the one hand, and random weights on the other, gives us some confidence that we are picking up some real effect.

4.2 Sparkling Wine

The tax rates of the excise on wine sparkling reproduce a similar pattern as for wine still, that is there are some countries with a zero rate and others increasing or reducing the rates after 1993 (see Figure 2). Looking at the second column of Table 3 note that estimation of the equation after 1993 gives better results than the equation before 1993. Again, the Chow test provides evidence of a structural break after 1993. The controls are jointly significant. All the diagnostic tests pass, this means validity of the instruments and identification of the model.

Using a contiguity matrix, the coefficient of WTAX after 1993 is positive and significant, while before 1993 it is negative and insignificant. Across the other matrix specifications we get the same results, further confirmed using Wrand where the coefficient after 1993 is negative and not significant. In our baseline specification, a 1 Euro increase in duty by all other countries causes the home country to riase its tax by about 1.2 Euros.

4.3 Beer

Looking at Figure 3 we first notice that all countries have positive excise duties on beer, and only PT and UK have a clear constant increasing trend. Some countries (such as ES, DE, FR and LU) react to the market unification with strong increase of the tax rates in 1993. Other countries (DK, IT, NL) have the opposite behavior decreasing their tax rates.

The first two columns in Table 4 give estimates of equation (2) over the period 1987-92, and 1993-2004, for our baseline case of contiguity weights. First, note that we can reject the null hypothesis that the two regressions are the same. Generally speaking, the second regression performs better than the first; the controls are jointly significant. The F-test in the first stage shows absence of correlation between the endogenous variable and the instruments. The rejection of the Anderson test indicates that the model is identified, and finally the model passes the Hansen test of over-identifying restrictions that means that the instruments used are valid.

Turning on the key coefficient of the variable WTAX, it is insignificant before 1993, and larger and significant after 1993, consistent with the main hypothesis of this paper. In our baseline specification, a 1 Euro increase by all other countries leads the home country to increase its tax by abour 0.3 Euros. Looking across the different weighting matrices, we see that this picture is similar for Wdis1, Wdis2. But now, the slope of the reaction function is much larger; indeed, implausibly large. Finally, in the case of Wrand, we see that the spatial lag coefficient is only positive before 1993, and negative, very small in absolute value, and insignificant afterwards.

4.4 Ethyl alcohol

In Figure 4 we notice an increasing tax rate trend in any country. After 1993, the main reaction is to put up the rate, some countries (e.g. LU, FR, IT) show big jumps. DK and DE reduce their rate after 2000, IE and NL instead increase it in the same period.

Looking at the first two columns of Table 5 we notice first from the Chow test that there is a structural break after 1993. Focusing on the second equation, the controls are jointly significant and the standard errors are robust to heteroskedasticity. The F-test in the first stage says that the instruments are correlated with the WTAX variable, and the Anderson test indicates that the model is identified. The Hansen test is not rejected therefore the excluded instruments are correctly excluded from the estimated equation.

The coefficient of WTAX after 1993 is significant at 10% and almost the double of the coefficient before 1993, although the latter is not significant. Specifically, after 1993, our finding is that a 1 Euro increase by all other countries leads the home country to increase its tax by about 0.68 Euros. A similar pattern is confirmed with a uniform matrix, with Wdis1 and Wdis2 instead the coefficient of WTAX is decreasing after 1993, however with Wdis2 the spatial lag coefficient before 1993 is not significant. Again, when we use Wrand, we get a completely different picture, in this case enormously high positive coefficients, with significance only before 1993.

This again is evidence that real spatial interactions are being measured in the first three regressions.

4.5 Cigarettes

Looking at Figure 5, we notice a generally across countries, increasing trends in the tax rates from 1987 to 2004. In general, the increase is small but for Ireland and the UK the excises have been more than doubled. The first two columns of Table 6 give the estimates using a contiguity matrix and we observe how the second equation performs better. We notice first that there is a structural break after 1993. Moreover the controls are jointly significant. Looking at the diagnostic tests, we reject the F-test in the first stage at 5%, there is correlation between the instruments and WTAX. We reject also the Anderson test, the model is identified. The equation passes the Hansen test of OID restrictions that means that the instruments used are valid.

Turning to the coefficients of the spatial lagged dependent variable WTAX, we see that it is always positive, significant and in all specifications, it is increasing in value after 1993. In our baseline specification, a 1 Euro increase in the specific tax rate on cigarettes in all other countries causes a given country to raise its tax by about 1.3 Euros. Looking across the other matrix specifications, the same picture is confirmed. When using Wrand we have positive and significant coefficients, but the model after 1993 is not valid since it does not pass the Hansen test on OID restrictions.

4.5.1 Total Tax on Cigarettes

Looking at Figure 6 we notice that the total tax on cigarettes show the same trend as the specific excise. For all countries there is increase in the tax after 1993, however we observe a small decrease in the early years of 2000s. e.g DK, IE, PT and UK. Other countries follow the opposite pattern instead, they further increase their tax rate, e.g. DE, FR and IT. In Table 7 we report our estimations, and we first note that there is always a structural break with all the weight matrices used. The diagnostic tests confirm the validity of the instruments and the absence of heteroskedasticity. The coefficient of WTAX is not increasing when we consider a contiguity matrix, but it slightly decreases after 1993. When we use distance matrices we get results consistent with the theory, in fact WTAX is always positive, highly significant and increasing after 1993. With WRAND the coefficients of WTAX are negative and not significant.

5 Robustness Checks

5.1 Minimum Tax Rates

So far in the analysis, we have ignored any possible effects of minimum tax rates. Evers et. al.(2005), based on the theoretical literature, argue that such rates, if they affect the Nash equilibrium at all, will generally cause rates to rise. For example, in Nielsen's (2001) model, it is easily verified in the two-country case that if the minimum tax is binding on the lower-tax country, it will not only raise the tax in that country, but also in the other country, as the latter country is moved along its upward-sloping tax reaction function. So, we should expect, other things equal, the minimum tax to increase the intercepts of the reaction functions.

It is less clear how the minimum tax will affect the amount of strategic interaction. Again, in the same simple two-country model of Nielsen, a minimum tax that binds on the low-tax country (say country B) will make the country B's tax locally unresponsive to A's tax. Evers et. al.(2005) allow for such effects by interacting the minimum tax with the weighted average of other countries' taxes. So, given that minimum taxes did not come in force until 1993, one might estimate, over the period 1993-2004, an augmented version of (4) i.e.

$$t_{is} = f_i + \phi \sum_{j \neq i} \omega_{ij} t_{js} + \delta' \mathbf{Z}_{is} + \theta m_t + \gamma \left(m_t \times \sum_{j \neq i} \omega_{ij} t_{js} \right) + \epsilon_{is} \tag{4}$$

where m_t is the minimum tax at time t. We expect $\theta > 0$ and possibly $\gamma \neq 0$. But there are some complications.

First, for wine (still and sparkling) the minimum tax rate is zero, so (4) cannot be estimated for these products. Second, for cigarettes, the minimum tax rate (measured as a percentage of the retail price) has been unchanged since 1993, at 57%. So, as the minimum tax rate m_t is not time-varying in this case, θ, γ cannot be identified from regression (4) just over the period 1993-2004.

For beer the minimum tax rate has been unchanged since 1993, and it is equal to 0.7448 Euros per hl/degree Plato or 1.87 EUR per hl/degree of alcohol of finished product. So, in *real* terms, m_t is declining, and this allows us to estimate (4) in this case. The first column of Table 8 reports the estimation of equation (4) for beer, using a contiguity weight matrix and IV method. We notice that the coefficient ϕ of WTAX is negative as expected but insignificant. The coefficient θ of the minimum tax rate is negative and insignificant as well. However, the coefficient γ of the interactive variable, obtained by multiplying the minimum tax time the spatial lagged dependent variable, is positive and significant.

For Ethyl alcohol, the Article 3(1) of Council Directive 92/84/EEC explains that the basic minimum rate is fixed at 500 EUR per hl of pure alcohol. However, it also notes that those Member States which at the time the Directive was adopted already had rates of duty greater than 1000 ECU per hl were not permitted to reduce their rates below 1000 ECU. Similarly, Member States with rates between 550 ECU and 1000 ECU were not permitted to make any reduction to their rates. In Table 8, second column, we show the estimate of equation (4) for ethyl alcohol. The results are more consistent with the theory. We find a negative although insignificant value of ϕ, and the coefficient of the minimum tax, θ, is positive and significant. The coefficient of the interactive variable, γ, is not zero as expected: positive and significant.

5.2 Dependent Variable in National Currency

The regressions we reported were all performed using the dependent variables in euro, adjusted for inflation. We tried the same regressions using the tax variables in real national currency. The results are broadly similar and in Table 9 we show the estimates using a distance weighting matrix. In particular, we notice (i) in every case, the ϕ coefficient is higher after 1993 than before (and always positive and significant); (ii) in every case, we can reject the null of no structural break after 1993. In this case, the reaction function coefficients are somewhat higher than in the case where the taxes are measured in Euros.

6 Conclusion

In this work we analyzed the effects of the tax competition after the introduction of the Single Market in EU in 1993. We built a panel data set using 12 EU countries over a period of 17 years from 1987 to 2004. We tested for the presence of strategic interaction among neighboring countries using spatial econometrics framework. Our work differs most other empirical studies in the same area, since we use as dependent variable the statutory tax rate and not some derived tax ratio. We consider the excise duty on several goods, as provided by the Excise Duty Tables issued by the EU Commission.

Our main finding is a structural break after 1993, indicating that the introduction of the Single Market has modified tax setting among the EU countries. Specifically, for all five taxes and different weighting matrices we reject the null hypothesis of equality of coefficients. Moreover, the coefficient measuring strategic interaction is *always* significantly positive post-1993, whereas before 1993, sometimes it is not; and whenever both are significant, the post-1993 coefficient is higher.

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Figure 1: Wine still - Specific Excise in National Currency

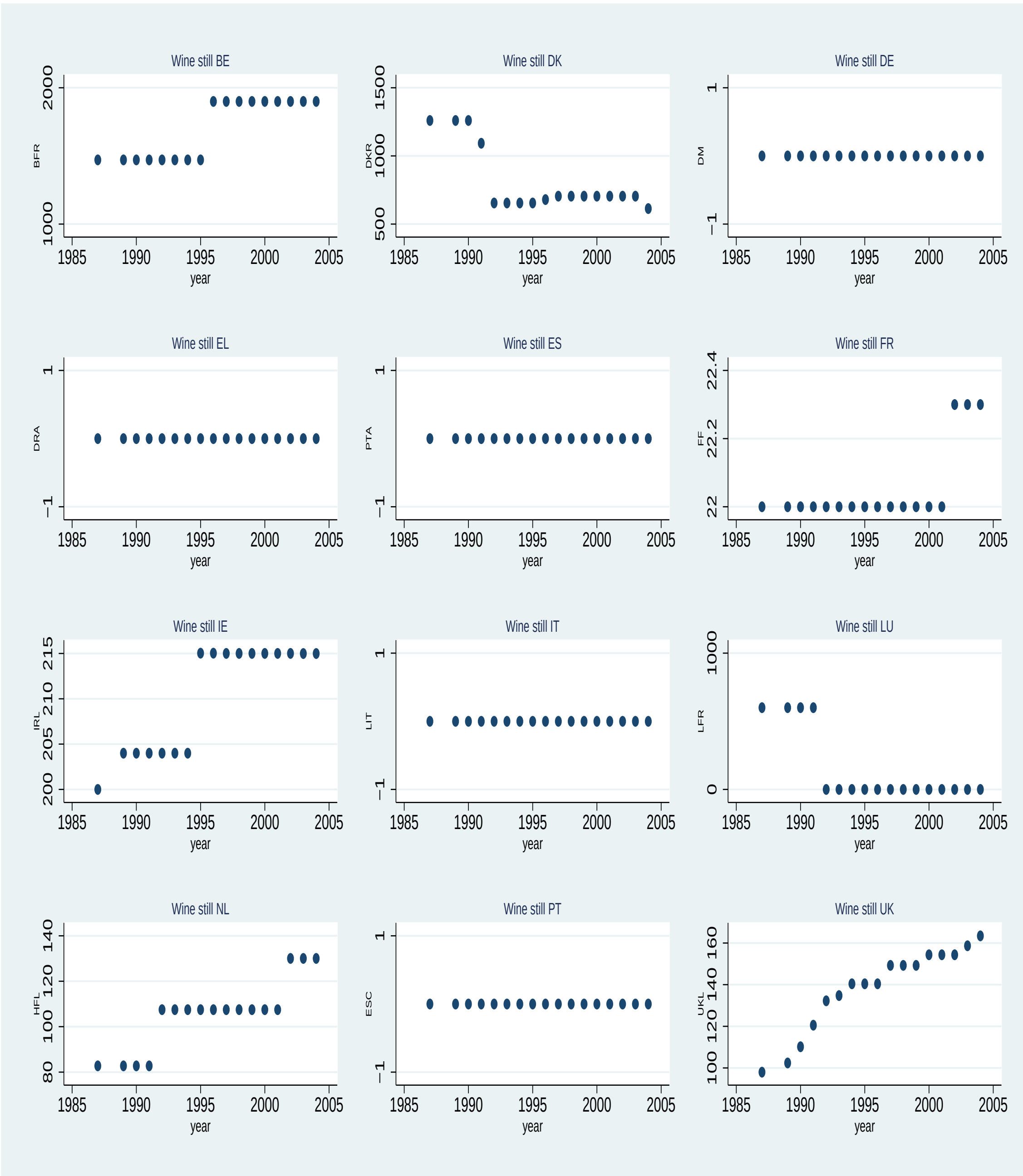

Figure 2: Wine sparkling - Specific Excise in National Currency

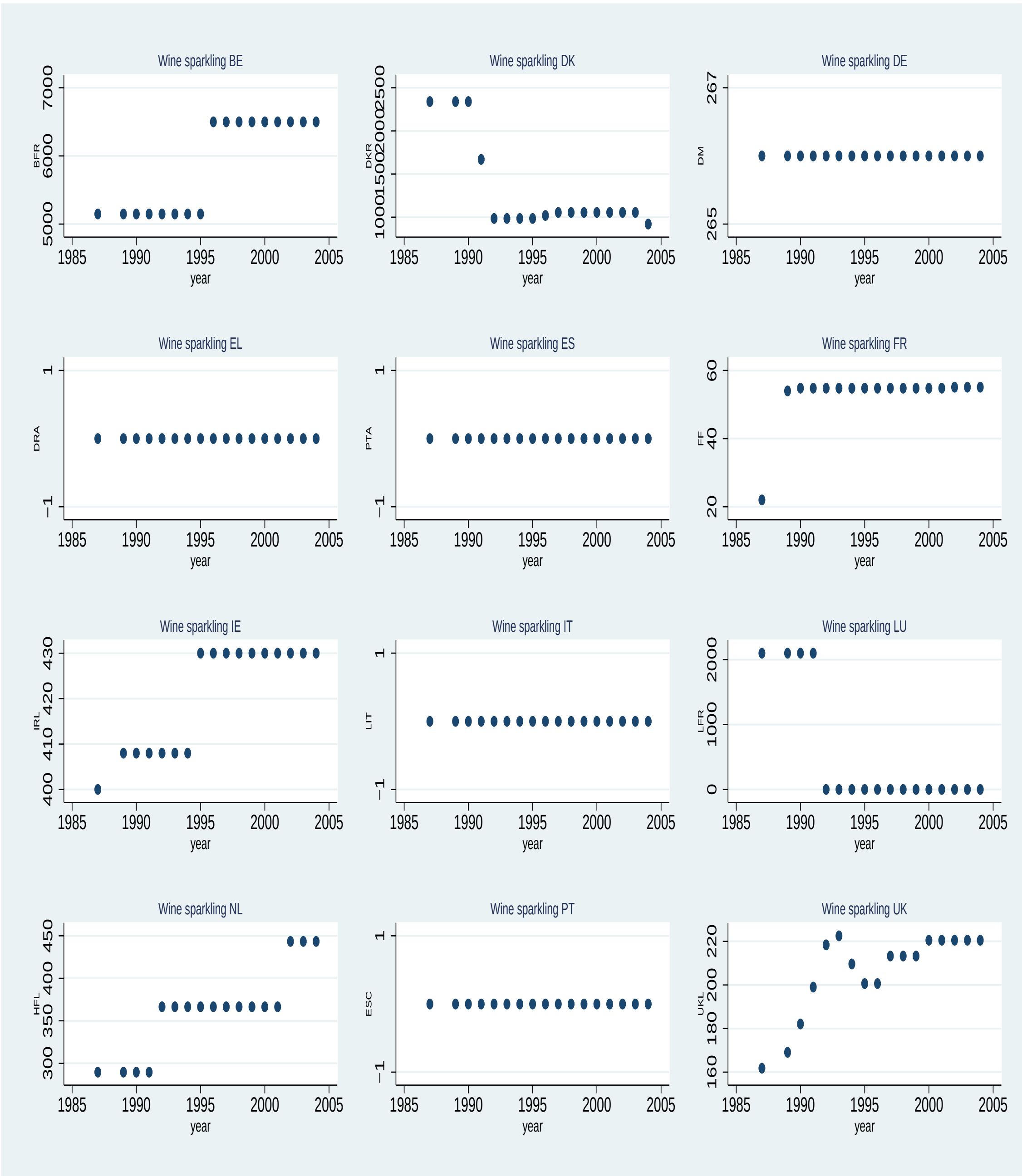

Figure 3: Beer - Specific Excise in National Currency

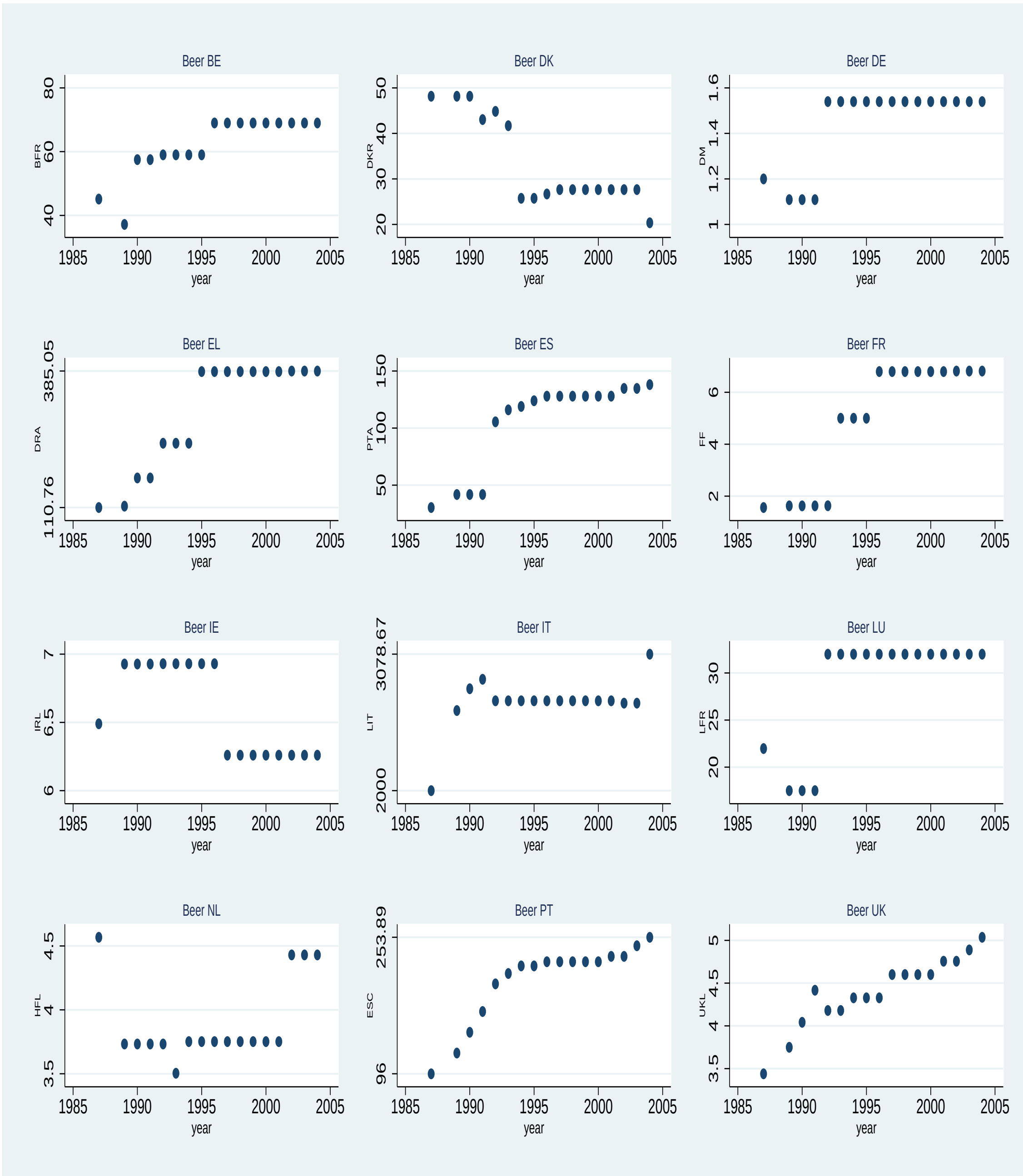

Figure 4: Ethyl alcohol - Specific Excise in National Currency

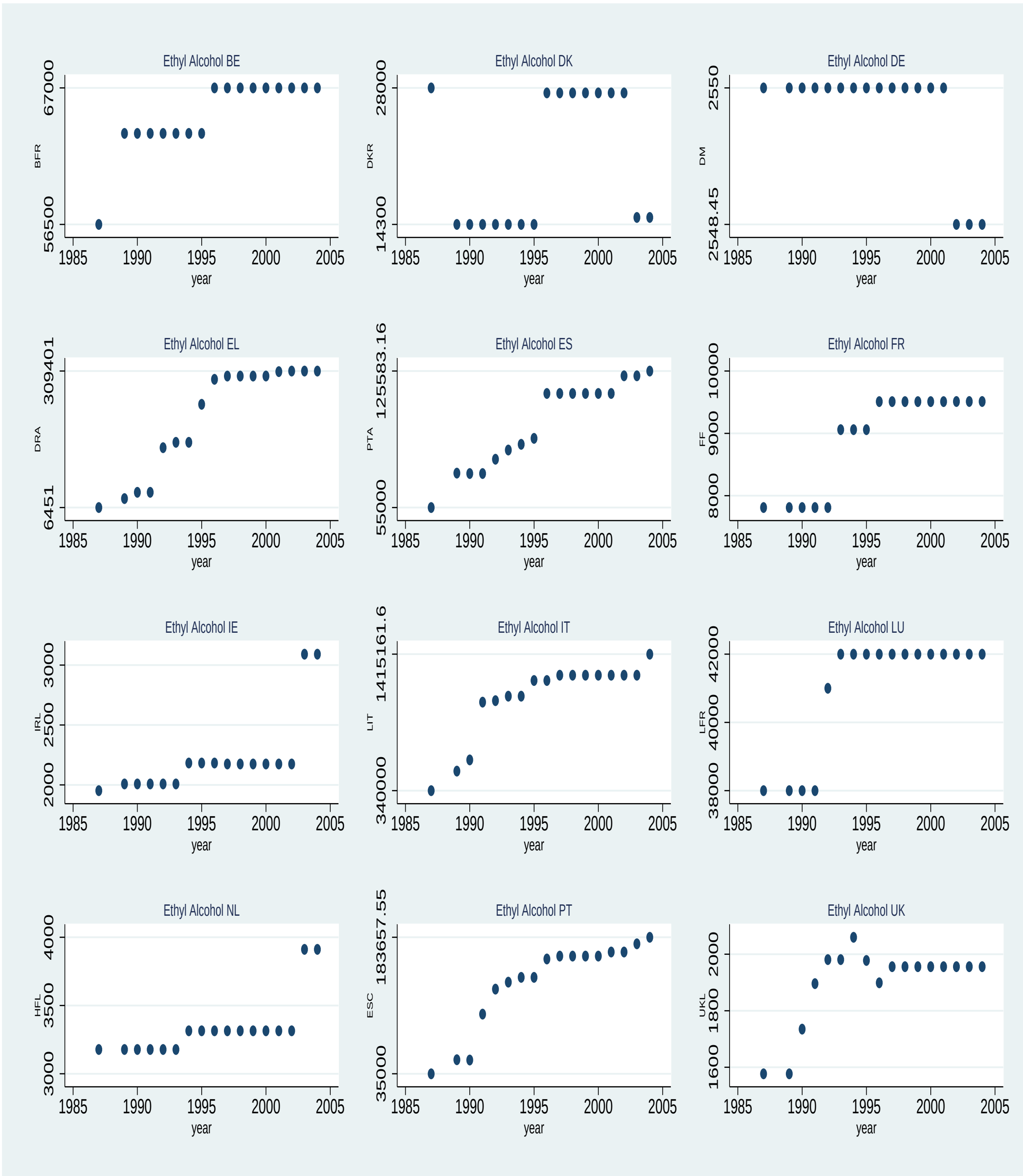

Figure 5: Cigarettes - Specific Excise in National Currency

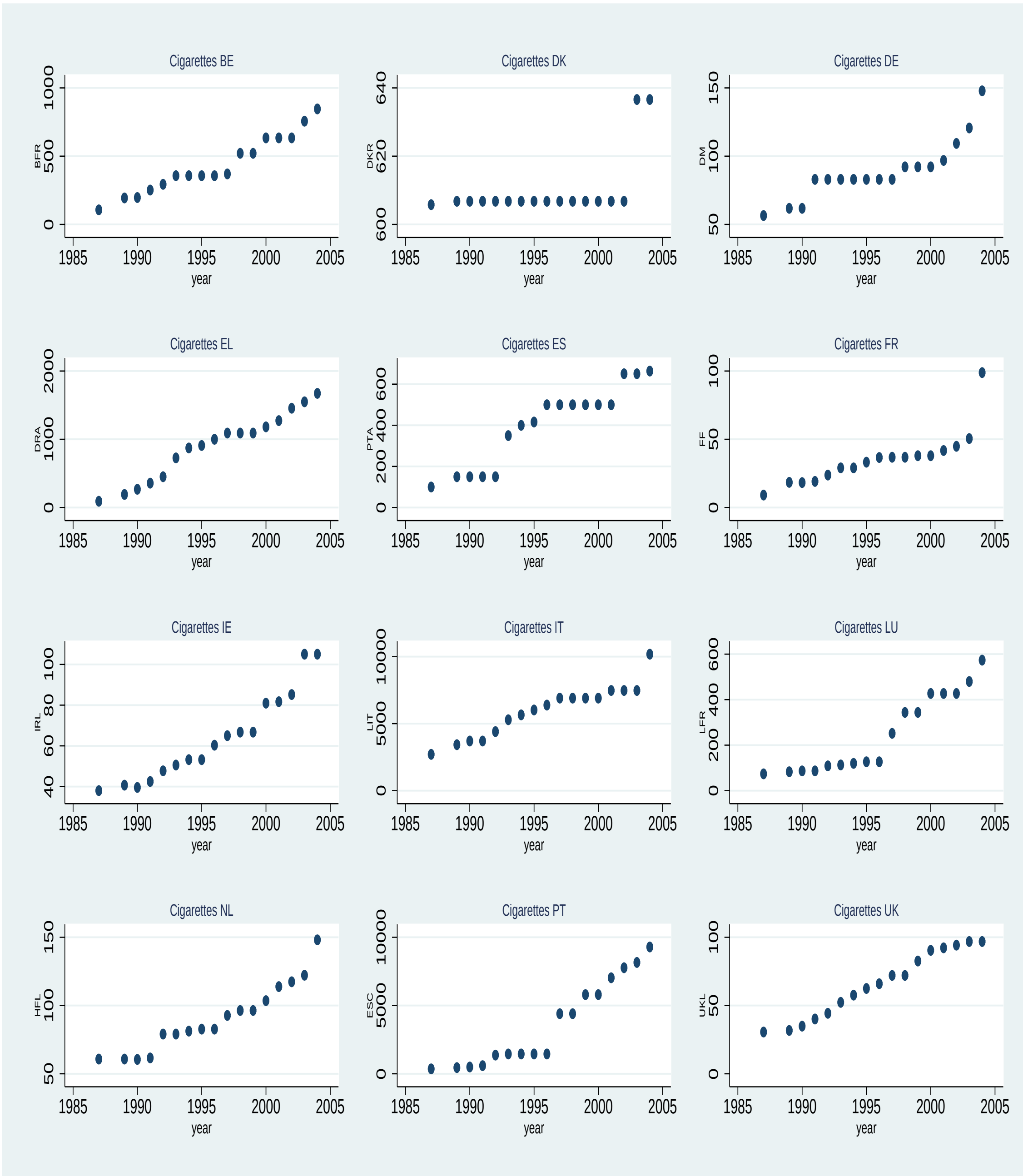

Figure 6: Cigarettes - Total Tax-% retail price

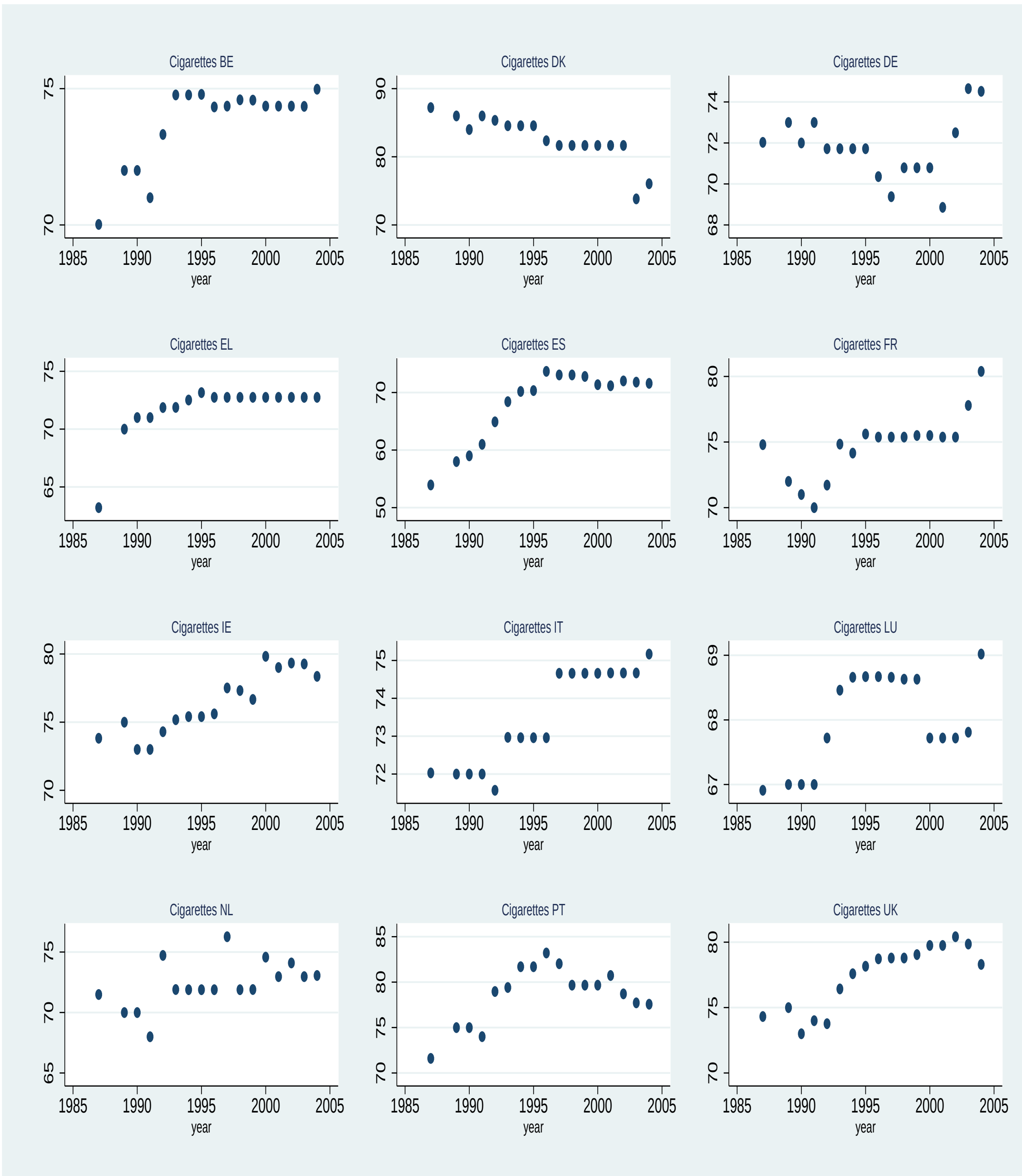

Table 2: Pooled model with spatially lagged dependent variable and time period fixed effects

Dependent Variable: Wine still specific tax rates - (2000 prices) Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	-0.550	0.428*	1.088	1.705***	1.784*	1.935***	-0.099	-0.176
	(1.131)	(0.156)	(1.088)	(0.537)	(1.040)	(0.665)	(0.224)	(0.137)
total population	0.672	0.437*	0.847*	-0.532*	0.882*	-0.611	0.772	0.795*
	(0.597)	(0.255)	(0.462)	(0.314)	(0.466)	(0.423)	(0.513)	(0.408)
gdppc[a]	-0.044	0.005	-0.290	-0.028	-0.413	-0.042*	-0.102	0.045**
	(0.248)	(0.015)	(0.267)	(0.021)	(0.285)	(0.025)	(0.155)	(0.018)
govcons[b]	0.502	-0.454	-0.922	1.122	-2.250	1.197	1.075	-2.505
	(2.501)	(1.166)	(2.398)	(1.677)	(2.788)	(2.024)	(2.521)	(1.581)
govright	5.653	-0.961	6.247	-1.778	6.737	-1.438	6.198	-4.204
	(5.945)	(2.992)	(5.783)	(3.432)	(6.458)	(3.481)	(5.239)	(2.793)
govleft	6.822	-1.926	10.162	-0.848	11.842	-0.733	7.398	-4.414
	(7.127)	(4.537)	(8.042)	(5.227)	(8.509)	(5.354)	(6.297)	(4.591)
Intercept	149.506	-365.351*	-386.615	380.532**	831.052	436.829	-81.251	-1.168
	(484.233)	(208.341)	(279.784)	(162.335)	(530.112)	(319.065)	(68.407)	(36.593)
N	60	144	60	144	60	144	60	144
R^2	0.966	0.981	0.978	0.974	0.974	0.972	0.978	0.979
F-test	62.83	536.39	112.09	637.53	89.09	561.08	133.48	554.73
Pagan-H	7.603	73.245	25.025	73.711	19.901	70.815	32.130	65.549
	(0.990)	(0.000)	(0.200)	(0.000)	(0.400)	(0.000)	(0.0568)	(0.000)
F_{IV}	1.12	3.52	1.47	10.30	1.23	6.29	7.79	11.84
	(0.3511)	(0.017)	(0.229)	(0.000)	(0.312)	(0.000)	(0.000)	(0.000)
Anderson	3.875	22.721	11.199	53.329	7.801	27.158	51.91	86.72
	(0.275)	(0.000)	(0.024)	(0.000)	(0.050)	(0.050)	(0.000)	(0.000)
Hansen	0.046	0.280	7.089	1.640	7.801	0.179	7.261	7.938
	(0.9880)	(0.869)	(0.069)	(0.650)	(0.124)	(0.914)	(0.122)	(0.093)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : $*$: 10% $**$: 5% $***$: 1% std. err. in brackets, p-values for the tests.
F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)
[b] General government final consumption expenditure (% of GDP)

Table 3: Pooled model with spatially lagged dependent variable and time period fixed effects

Dependent Variable: Wine sparkling specific tax rates - (2000 prices) Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	-0.763	1.208***	1.248	1.565***	-0.349	1.452***	0.053	-0.019
	(2.513)	(0.339)	(0.823)	(0.437)	(1.625)	(0.337)	(1.491)	(0.169)
total population	1.831	-0.012	2.714**	-0.637	1.965	-0.428	1.235	0.916
	(1.392)	(0.234)	(1.007)	(0.574)	(1.368)	(0.382)	(1.404)	(0.533)
gdppc[a]	-0.086	-0.061	-0.859	-0.061**	-0.307	-0.063**	-0.631	0.058**
	(1.043)	(0.049)	(0.571)	(0.026)	(0.737)	(0.029)	(0.391)	(0.027)
govcons[b]	-0.479	4.325	-4.090	0.992	0.850	-0.098	-0.736	-4.892
	(5.748)	(3.143)	(5.439)	(2.276)	(5.412)	(2.397)	(4.747)	(2.496)
govright	12.373	5.309	15.586	-3.312	14.205	-3.505	14.747	-6.597
	(10.725)	(6.791)	(13.534)	(4.973)	(10.637)	(4.839)	(9.449)	(4.615)
govleft	10.386	2.353	19.741	-3.056	11.780	-3.893	13.684	-6.244
	(14.515)	(7.103)	(17.083)	(6.849)	(15.305)	(6.684)	(16.206)	(11.379)
Intercept	362.944	1.377	-1358.000**	400.457	730.387	413.905	-177.544	9.884
	(1774.486)	(89.921)	(579.341)	(289.677)	(1252.846)	(307.862)	(122.735)	(50.763)
N	60	144	60	144	60	144	60	144
R^2	0.955	0.972	0.968	0.985	0.973	0.985	0.974	0.984
F-test	68.85	843.78	136.10	1247.68	158.33	1279.50	183.44	927.93
Pagan-H	6.233	39.733	17.926	52.699	26.354	49.833	24.536	58.582
	(0.997)	(0.003)	(0.592)	(0.000)	(0.091)	(0.000)	(0.267)	(0.000)
F_{IV}	0.32	4.75	1.41	7.53	2.42	24.86	9.99	13.06
	(0.814)	(0.003)	(0.249)	(0.000)	(0.101)	(0.000)	(0.577)	(0.000)
Anderson	1.642	14.402	12.14	43.942	9.039	58.185	50.35	66.77
	(0.649)	(0.002)	(0.016)	(0.000)	(0.010)	(0.010)	(0.000)	(0.000)
Hansen	0.108	0.284	7.788	1.727	2.994	1.405	7.459	10.115
	(0.947)	0.867)	(0.050)	(0.630)	(0.083)	(0.235)	(0.113)	(0.038)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : * : 10% ** : 5% *** : 1% std. err. in brackets, p-values for the tests.

F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)

[b] General government final consumption expenditure (% of GDP)

Table 4: Pooled model with spatially lagged dependent variable and time period fixed effects

Dependent Variable: Beer specific tax rates (2000 prices) Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	0.265	0.309*	1.610***	1.685***	1.415***	1.465***	0.743**	-0.062
	(0.384)	(0.175)	(0.554)	(0.467)	(0.524)	(0.391)	(0.302)	(0.119)
total population	0.015	0.020**	-0.014	-0.009	-0.005	-0.003	0.002	0.028**
	(0.010)	(0.009)	(0.016)	(0.008)	(0.015)	(0.007)	(0.010)	(0.012)
gdppc[a]	0.003	0.000	-0.006	-0.001*	-0.006	-0.001	-0.007	0.001
	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)	(0.001)	(0.005)	(0.001)
govcons[b]	0.080*	0.036	-0.042	0.142**	-0.047	0.110**	-0.038	-0.008
	(0.042)	(0.037)	(0.077)	(0.055)	(0.087)	(0.047)	(0.079)	(0.038)
govright	0.039	0.046	0.040	0.085	0.053	0.058	0.015	-0.024
	(0.051)	(0.095)	(0.137)	(0.107)	(0.110)	(0.101)	(0.070)	(0.079)
govleft	0.072	0.016	0.081	0.105	0.082	0.045	0.116	-0.035
	(0.117)	(0.144)	(0.174)	(0.162)	(0.155)	(0.156)	(0.128)	(0.138)
Intercept	-4.228	1.861	0.465	4.168	15.465	-1.004	-1.678	-1.315
	(6.421)	(2.025)	(2.052)	(5.771)	(9.293)	(1.963)	(1.821)	(1.007)
N	60	144	60	144	60	144	60	144
R^2	0.987	0.985	0.983	0.964	0.984	0.967	0.981	0.987
F-test	213.45	281.51	244.70	219.27	179.60	214.74	153.32	483.48
Pagan-H	17.735	66.717	28.265	2.123	27.124	73.006	27.947	67.039
	(0.604)	(0.000)	(0.132)	(0.000)	(0.166)	(0.000)	0.1417	(0.000)
F_{IV}	1.35	3.94	11.30	11.74	13.41	13.88	11.60	11.52
	(0.270)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Anderson	5.508	27.154	45.378	69.692	45.571	69.848	49.582	83.204
	(0.239)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen	4.779	7.768	5.574	7.193	2.683	9.320	6.618	4.794
	(0.188)	(0.051)	(0.233)	(0.126)	(0.612)	(0.053)	(0.157)	(0.3091)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : ∗ : 10% ∗∗ : 5% ∗ ∗ ∗ : 1% std. err. in brackets, p-values for the tests.
F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)
[b] General government final consumption expenditure (% of GDP)

Table 5: Pooled model with spatially lagged dependent variable and time period fixed effects

Dependent Variable: Ethyl Alcohol specific tax rates (2000 prices) Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	0.357	0.678*	1.496***	1.149***	1.260	1.171***	468.042***	25.795
	(0.313)	(0.366)	(0.470)	(0.270)	(0.752)	(0.281)	(170.743)	(72.316)
total population	20.349**	1.421	-2.550	-9.311**	1.678	-8.593*	12.153	8.560*
	(9.269)	(6.952)	(5.814)	(4.035)	(10.735)	(4.705)	(8.208)	(4.538)
gdppc[a]	-3.655	2.304***	-2.981	1.024	-2.742	0.799	-4.116	2.190*
	(5.341)	(0.568)	(4.754)	(1.222)	(4.828)	(1.201)	(5.627)	(1.304)
govcons[b]	48.082	10.101	-8.804	21.846	-1.872	12.921	-10.665	29.982
	(30.938)	(37.158)	(31.958)	(21.983)	(44.541)	(24.591)	(36.827)	(26.137)
govright	22.697	-20.973	86.778	-78.569	83.953	-77.961	21.921	-83.333
	(49.042)	(82.089)	(86.248)	(75.338)	(80.581)	(74.522)	(55.786)	(69.742)
govleft	152.522	-182.880*	200.393*	-180.119*	196.353*	-178.296*	126.596	-227.056**
	(105.022)	(99.795)	(116.895)	(101.844)	(116.29)	(99.766)	(108.519)	(113.950)
Intercept	6296.901	-3627.501**	1239.071	7147.908**	5479.077	-1326.798**	-1818.842**	121.114
	(10365.494)	(1443.639)	(852.079)	(3251.876)	(9759.017)	(668.68)	(787.610)	(508.953)
N	60	144	60	144	60	144	60	144
R^2	0.922	0.897	0.933	0.905	0.939	0.908	0.917	0.904
F-test	127.56	163.84	129.67	88.49	172.80	87.45	70.65	174.53
Pagan-H	36.086	78.192	18.580	47.865	15.531	43.211	28.247	66.821
	(0.010)	(0.000)	(0.549)	(0.000)	(0.688)	(0.001)	(0.1333)	(0.000)
F_{IV}	13.10	14.70	9.10	35.00	3.01	33.44	11.60	11.52
	(0.000)	(0.000)	(0.000)	(0.000)	(0.041)	(0.000)	(0.000)	(0.000)
Anderson	31.196	43.810	36.991	95.697	14.073	79.809	49.582	83.204
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Hansen	5.220	0.422	8.491	1.621	6.741	1.517	10.683	6.921
	(0.073)	(0.809)	(0.036)	(0.654)	(0.034)	(0.468)	(0.0304)	(0.140)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : * : 10% ** : 5% *** : 1% std. err. in brackets, p-values for the tests.

F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)

[b] General government final consumption expenditure (% of GDP)

Table 6: Pooled model with spatially lagged dependent variable and country fixed effects

Dependent Variable: Cigarettes specific tax rates (2000 prices) - Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	0.500***	1.316***	0.902***	1.946***	0.679**	1.718***	0.423**	0.366***
	(0.181)	(0.287)	(0.312)	(0.353)	(0.308)	(0.288)	(0.184)	(0.102)
total population	0.559***	-0.273	0.365**	-1.353***	0.502***	-0.852***	0.498***	0.364
	(0.126)	(0.327)	(0.150)	(0.383)	(0.138)	(0.321)	(0.144)	(0.354)
gdppc[a]	-0.036	-0.079**	-0.032	-0.074***	-0.032	-0.082***	-0.016	0.017
	(0.033)	(0.039)	(0.028)	(0.025)	(0.036)	(0.026)	(0.039)	(0.016)
govcons[b]	0.723*	3.382**	0.250	-0.667	0.279	-1.832	0.018	-1.369
	(0.428)	(1.597)	(0.525)	(1.300)	(0.609)	(1.284)	(0.745)	(1.505)
govright	-0.071	3.909	-0.444	-0.511	-0.430	-2.305	-0.691	-3.870
	(0.810)	(3.478)	(0.954)	(2.648)	(0.875)	(2.661)	(0.844)	(2.856)
govleft	1.352	5.250	0.776	3.121	0.871	0.599	0.971	-3.384
	(1.238)	(4.356)	(1.341)	(4.349)	(1.285)	(4.234)	(1.341)	(4.163)
Intercept	72.936	119.609	13.676	1145.768***	78.598	78.165***	30.238	-24.635
	(61.855)	(81.460)	(10.916)	(313.818)	(72.961)	(21.221)	(0.0873)	(44.816)
N	60	144	60	144	60	144	60	144
R^2	0.988	0.902	0.987	0.904	0.986	0.911	0.983	0.926
F-test	303.25	86.72	1053.50	288.79	487.81	174.76	360.78	238.70
Pagan-H	21.060	55.911	30.077	74.39	23.243	73.408	29.021	67.369
	(0.393)	(0.000)	(0.068)	(0.000)	(0.331)	(0.000)	(0.113)	(0.000)
F_{IV}	36.307	2.69	59.16	13.59	20.06	18.15	48.64	7.70
	(0.000)	(0.0341)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Anderson	8.11	20.59	85.068	68.590	68.584	96.354	92.641	99.296
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen	0.51	5.07	1.26	3.46	4.32	5.14	6.437	16.485
	(0.916)	(0.166)	(0.738)	(0.325)	(0.363)	(0.272)	(0.168)	(0.002)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : * : 10% ** : 5% *** : 1% std. err. in brackets, p-values for the tests.
F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)
[b] General government final consumption expenditure (% of GDP)

Table 7: Pooled model with spatially lagged dependent variable and country fixed effects

Dependent Variable: Cigarettes total tax rates (2000 prices) - Spatial Autoregressive Model - IV

Explanatory Variables	Coefficient Estimates							
	Wcont		Wdis1		Wdis2		Wrand	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	1.166***	1.036***	0.885***	1.726***	1.036***	1.537***	-0.027	-0.022
	(0.296)	(0.153)	(0.184)	(0.211)	(0.196)	(0.188)	(0.192)	(0.044)
total population	0.179	0.175***	0.111	-0.060	0.036	-0.011	-0.033	0.118***
	(0.189)	(0.065)	(0.148)	(0.096)	(0.149)	(0.067)	(0.114)	(0.042)
gdppc[a]	-0.041	-0.018***	0.002	-0.039***	-0.026	-0.035***	0.033	-0.013***
	(0.065)	(0.006)	(0.051)	(0.006)	(0.055)	(0.005)	(0.052)	(0.004)
govcons[b]	0.289	0.095	1.608*	1.438***	1.174	0.951*	1.139	-0.465*
	(0.878)	(0.444)	(0.858)	(1.300)	(0.725)	(0.494)	(0.853)	(0.263)
govright	0.240	1.061	0.472	1.113*	0.604	1.015*	-0.691	0.189
	(0.810)	(0.685)	(0.770)	(0.600)	(0.755)	(0.556)	(0.844)	(0.413)
govleft	0.489	1.209	1.293	0.776	1.374	.365	0.419	0.281
	(1.259)	(1.000)	(1.212)	(1.013)	(1.162)	(0.965)	(1.098)	(0.587)
Intercept	68.149	-6.674	-58.814***	-9.641	-43.974	31.383*	57.854***	80.086***
	(131.032)	(15.783)	(18.490)	(67.962)	(118.850)	(16.859)	(0.0873)	(7.170)
N	60	144	60	144	60	144	60	144
R^2	0.819	0.902	0.956	0.758	0.961	0.773	0.856	0.874
F-test	123.87	47.04	85.72	36.89	98.54	40.73	65.52	92.05
Pagan-H	15.647	27.378	16.493	18.181	19.118	21.080	37.679	30.831
	(0.680)	(0.096)	(0.685)	(0.575)	(0.514)	(0.392)	(0.014)	(0.076)
F_{IV}	2.60	12.3	32.97	5.82	29.41	7.35	110.13	41.65
	(0.065)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Anderson	18.29	57.362	111.70	27.333	107.54	30.870	139.85	146.87
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen	5.79	0.29	7.56	0.35	7.14	1.43	5.976	8.076
	(0.055)	(0.863)	(0.056)	(0.950)	(0.067)	(0.697)	(0.200)	(0.088)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : $*$: 10% $**$: 5% $***$: 1% std. err. in brackets, p-values for the tests.

F-test: F(17,42) for 87-92 and F(17,126) for 93-04.

[a] GDP per capita (constant LCU)

[b] General government final consumption expenditure (% of GDP)

Table 8: Estimation with Minimum Tax Rate

Spatial Autoregressive Model - IV

Dependent variable: excise duty in 2000 prices

Control Variables	Beer (Std. Err.)	Alcohol (Std. Err.)
WTAX	-0.327	-0.374
	(0.262)	(0.462)
mintax × WTAX	0.479**	0.220*
	(0.196)	(0.117)
mintax	-0.037	0.423**
	(0.218)	(0.189)
total population	0.023***	6.934*
	(0.007)	(3.664)
gdppc	-0.002**	2.321**
	(0.001)	(1.056)
govcons	0.040	14.165
	(0.032)	(17.724)
govright	-0.048	34.173
	(0.085)	(57.777)
govleft	-0.059	-83.202
	(0.126)	(91.058)
N	204	204
R^2	0.959	0.887
$F_{(19,184)}$	314.036	142.671

Significance levels : $*$: 10% $**$: 5% $***$: 1%

Table 9: Pooled model with spatially lagged dependent variable and country fixed effects

Dependent Variable: specific tax rates national currency (2000 prices) - Spatial Autoregressive Model - IV

Coefficient Estimates

Explanatory Variables	Wine still		Wine spark		Beer		Ethyl Alcohol		Cigarettes	
	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04	87-92	93-04
WTAX	0.227	1.275**	0.121	1.447**	0.903	1.212***	0.650*	1.345***	0.075	2.041**
	(0.409)	(0.598)	(0.386)	(0.707)	(0.586)	(0.366)	(0.354)	(0.334)	(0.347)	(0.884)
total population	4.548	-2.470	13.392	-7.967	-0.009	-0.731	477.927	-836.261	3.689	-80.745*
	(2.792)	(1.612)	(8.606)	(5.475)	(2.344)	(1.011)	(1151.235)	(690.570)	(4.048)	(43.748)
gdppc[a]	-2.470*	0.096	-7.658	0.062	-0.696	-0.289**	-113.840	-253.119***	3.391	-4.730*
	(1.392)	(0.104)	(4.666)	(0.236)	(1.205)	(0.111)	(631.182)	(82.857)	(2.960)	(2.570)
govcons[b]	-11.011	18.149*	-41.248	61.800*	29.906	4.434	17936.178	4122.954	90.143*	384.659**
	(9.694)	(9.951)	(31.846)	(33.405)	(18.976)	(6.937)	(10716.275)	(4651.274)	(45.497)	(160.289)
govright	74.206*	11.665	205.992*	42.960	28.991	7.414	21635.954	5219.824	-8.364	279.130
	(39.522)	(16.463)	(110.339)	(53.270)	(66.952)	(23.066)	(50870.817)	(15562.001)	(107.219)	(237.860)
govleft	62.231	-5.688	135.237	-5.817	51.715	1.233	39745.669	-339.858	79.216	468.366
	(40.015)	(16.375)	(93.635)	(52.212)	(67.093)	(21.824)	(44678.678)	(15108.077)	(103.094)	(298.273)
Intercept	-1938.394	1375.428	-5319.229	4994.327	266.371	-350.972*	-757617.485	584716.611	-8773.199	58896.784*
	(1464.029)	(1105.371)	(4393.763)	(3874.648)	(2378.671)	(183.514)	(765175.427)	(575301.389)	(6681.727)	(34715.104)
N	60	144	60	144	60	144	60	144	60	144
R^2	0.973	0.979	0.972	0.979	0.958	0.995	0.782	0.987	21.324	0.804
F-test	154.01	256.43	119.77	193.26	18.55	479.10	7.58	299.98	21.32	25.01
Pagan-H	33.428	92.275	43.574	89.037	35.700	58.616	39.924	60.495	24.483	47.574
	(0.041)	(0.000)	(0.002)	(0.000)	(0.016)	(0.000)	(0.007)	(0.000)	(0.221)	(0.000)
F_{IV}	3.51	10.65	3.48	8.48	4.65	9.82	4.14	9.22	4.64	6.92
	(0.010)	(0.000)	(0.010)	(0.000)	(0.003)	(0.000)	(0.004)	(0.000)	(0.003)	(0.000)
Anderson	22.784	52.142	22.638	42.973	23.380	39.905	26.093	46.141	23.360	29.216
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hansen	6.515	5.689	7.340	3.765	3.054	7.753	4.540	9.029	4.093	6.905
	(0.163)	(0.223)	(0.119)	(0.438)	(0.383)	(0.051)	(0.337)	(0.060)	(0.251)	(0.075)
Chow	Rej Ho		Rej Ho		Rej Ho		Rej Ho		Rej Ho	

Significance levels : * : 10% ** : 5% *** : 1% std. err. in brackets, p-values for the tests.

F-test: F(17,42) for 87-92 and F(17,126) for 93-04. Distance weighting matrix used.

[a] GDP per capita (constant LCU)

[b] General government final consumption expenditure (% of GDP)