UNIVERSITÀ DEGLI STUDI DI FERRARA
DIPARTIMENTO DI ECONOMIA ISTITUZIONI TERRITORIO
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US Excise Tax Horizontal Interdependence: Yardstick vs. Tax Competition

Alejandro Esteller-Moré – Leonzio Rizzo

US EXCISE TAX HORIZONTAL INTERDEPENDENCE: YARDSTICK *VS.* TAX COMPETITION*

Alejandro Esteller-Moré**

Leonzio Rizzo***

Abstract. US excise tax rates are state interdependent. For example, a one-cent increase in the cigarette tax rate implies a contemporaneous cigarette tax increase of 0.18 cents in the neighboring state, while in the case of gasoline taxation the reaction to the same rise is just 0.11 cents. However, identifying the source of this interaction is key to its normative assessment. Our empirical analysis – spanning the period 1992 to 2006 – finds that interdependence in the case of gasoline taxation is driven just by the (fear of) base mobility. By contrast, in the case of cigarette taxation, it is politically driven: only states with non-term limited governors react (providing evidence of yardstick competition), especially as the election year approaches. Additionally, cigarette taxes tend to be lower when the election year approaches, but again only under non-term limited governors, while the existence of smokers in the state tends to reduce the level of cigarette taxation independently of the electoral cycle and of the presence of a term limited governor.

Keywords: vertical tax competition, yardstick competition, termlimit, election year
JEL Codes: H71, H77

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aesteller@ub.edu, Universitat de Barcelona & IEB, * leonzio.rizzo@unife.it, Università di Ferrara & IEB.

1. Introduction

There can be little doubt that US excise tax rates are state interdependent (Hunter and Nelson, 1992; Nelson, 2002; Rork, 2003; Egger, Pfaffermayr and Winer, 2005; Devereux, Lockwood and Redoano, 2007; Jacobs, Ligthart and Vrijburg, 2010; Esteller and Rizzo, 2011). All previous studies, despite obvious differences in their empirical analyses, report a positive tax reaction to neighbors' tax rates and, implicitly or explicitly, argue that such a response is caused by strategic tax competition attributable to cross-border shopping, smuggling or both. In this paper we examine taxes on cigarettes and gasoline in the US and explicitly test for the source of horizontal interdependence.

Brueckner (2003) describes two sources of strategic interaction among governments, captured in the resource-flow and spillover models respectively. The former stresses the role of tax base mobility, while the latter points to the possibility of information spilling over among interested voters in different jurisdictions (Salmon, 1987). Unfortunately, it is difficult in practice to disentangle one source from the other, as both models make the same empirical prediction, namely that tax rates should be interdependent among sub-central governments. In the case of tax competition, tax base mobility (in our case, through cross-border shopping and/or smuggling) is required; in the case of yardstick competition, it is assumed that voters assess the relative performance of their respective governments and compare it with that of comparable governments when deciding who to cast their vote for. Thus, for this accountability mechanism to work, fiscal information must be readily available to voters. In any case, from a normative point of view, the cause of interdependence is not trivial. While yardstick tax competition improves political accountability; interdependence due to mobility of tax bases generates inefficiently low tax rates and hence the underprovision of public goods and services due to a race-to-the-bottom (Wilson, 1986; Zodrow and Mieszkowski,1986).[1]

As Wilson and Wildasin (2004) conclude, "More work is needed to incorporate reasonable political processes into tax competition models, leading to sharper empirical

[1] Obviously, this conclusion holds under a benevolent government. If not the size of the public sector tends to be excessive from a normative point of view – *i.e.*, Leviathan behavior (Brennan and Buchanan, 1980) – and this prescription is reversed, that is, tax competition would be welcomed.

distinctions between good and bad tax competition." (p. 1088). In our case, this is necessary for the very empirical identification strategy of the source of tax interdependence, since "…, the crucial point about testing yardstick competition theory is not about local tax setting behavior as such, but in tax setting as linked to the incentives and constraints that are generated by the local electoral system" (Bordignon, Cerniglia and Revelli, 2004, p. 332). Thus, our empirical approach is firmly rooted in the US political process at the state level.

In order to disentangle tax competition from that of yardstick, we proceed in line with the seminal papers by Case (1993) and Besley and Case (1995a). First, we distinguish those states run by a governor who is ineligible to run for reelection (because of a term limit) from all other states. We test their differential reaction for cigarette and gasoline taxes for a panel dataset running from 1992 to 2006. In the case of cigarette taxation, we find that only those states with governors who are not lame ducks set their tax rates by taking into account the rates levied by comparable jurisdictions - which, in keeping with the literature, we shall identify from this point on as the geographically contiguous states - while the other states do not react. Specifically, in the case of governors not approaching the end of their tenure, a one-cent increase in the real cigarette tax rate of their neighbors implies a contemporaneous cigarette tax increase of 0.18 cents. In contrast, the reaction in gasoline taxation is not politically driven, as long as it remains independent of the presence of a term limit. In this case the reaction is just 0.11 cents.

These results are confirmed when we expand our analysis of the political process to take into account the impact of the election year (see, for example, Solé-Ollé, 2003; Bartolini and Santolini, 2011). In particular, independently of their neighbors' tax policies, non-term limited governors tend to lower cigarette taxation as the election year approaches (Besley and Case, 1995b, 2003),[2] while their reaction to what their neighbors do is also greatest as election year approaches. These two additional results – which do not hold for gasoline taxation – reinforce the fact that cigarette tax interdependence is driven by a political process and – in contrast with what the literature has suggested – interdependence is due to yardstick competition.

[2] In fact, Besley and Case (1995b) initially reported this finding, though it was not confirmed by their 2003 paper. Alternatively, Johnson and Crain (2004) also found such a fiscal cycle reflecting term limits in an international sample.

A further interesting strand in the literature emphasizes the fact that "polluters" (in our case, drivers and smokers) are prone to excise "tax exploitation" by the majority. This is based on the more general concept proposed by Buchanan (1976) of "fiscal exploitation". As Hunter and Nelson (1990) argue: "Excise taxes by virtue of their narrow bases provide perhaps the best opportunity for shifting the cost of the public sector onto a select group of individuals" (p. 268).[3] The empirical hypothesis – which was confirmed by these authors for cigarette taxation – is that political support for an excise tax rises as the proportion of the population consuming the base falls. In our case, this hypothesis holds only for cigarettes, while in the case of gasoline we obtain weak evidence of just the opposite. This might be seen, therefore, as additional evidence of the fact that cigarette taxation is politically motivated.

The rest of the paper is organized as follows. In the section that follows, we provide a summary of the empirical literature on tax interdependence, focusing on yardstick competition and on the analyses carried out for US excise taxation. In section three, we present our empirical analysis and in section four we present and discuss our results. Finally, we conclude.

2. Previous literature

Salmon (1987) was the first author to recognize that comparative performance constituted a potential source of fiscal interdependence among sub-national governments. In his words, "each government has an incentive to do better than governments in other jurisdictions in terms of levels and qualities of services, of levels of taxes or of more general economic and social indicators" (p. 32). Subsequently, Besley and Case (1995a) developed a sophisticated information externality model among jurisdictions. The model implies that voters draw on relevant information from comparable jurisdictions in order to infer fiscal information that is fundamental in helping them make their next voting decision. Should this indeed be the case, then politicians need to be well aware of what their comparable jurisdictions are doing if they wish to ensure their own reelection for a further term.

[3] See also Alesina and Passarelli (2010) who, following this line of reasoning, attempt to justify within a political economy framework the instruments (including taxes) that might be chosen to fight against negative externalities.

Besley and Case (1995a) tested this hypothesis by comparing the tax-setting decisions of those governors that could be reelected with the rates chosen by those who could not. They tested it both for state income-tax liability and for an amalgam of state taxes (sales, income and corporate income), and in both cases found that lame duck governors did not make tax changes that were dependent on their neighbors' rates, which was very much in contrast with the performance of the rest of the state governors. If tax competition were the cause of tax interdependence, then the reaction should have been independent of whether governors could be held accountable (no term limit) or not (binding term limit). For this reason, the authors conclude that the tax interdependence found was due solely to yardstick competition. In more recent studies, this source of tax interdependence has also been found by Bordignon, Cerniglia and Revelli (2003), Solé-Ollé (2003), Allers and Elhorst (2005) and more recently by Bartolini and Santolini (2011). All of which were undertaken with local governments in various countries with a primary focus on property taxation.

As we argued in the Introduction, in the case of excise taxation, there is considerable empirical evidence of tax interdependence for the US case. However, as a result no doubt of the extensive anecdotic evidence that cross-border shopping, and even smuggling, are very important in certain areas,[4] authors have tended not to devote much time in attempting to disentangle the most likely source of this interdependence.

Rork (2003) reported a horizontal reaction of 0.636 and 0.6 cents for cigarette and gasoline, respectively. He measured each tax in (real) cents, and attributed all the reaction to tax base mobility. Egger, Pfaffermayr and Winner (2005) obtained reactions as high as 0.9 and 0.898 cents for gasoline and cigarettes, respectively.[5] Devereux, Lockwood and Redoano (2007), Jacobs, Ligthart and Vrijburg (2010) and Esteller and

[4] For example, Fleenor (1998) finds that smuggling and cross-border sales account for 7.8% and 3.6% of final sales in the US; while Thursby and Thursby (2000) suggest that commercial smuggling accounted for about one-third of the revenue loss from inter-state transactions.

[5] It is difficult to reconcile the value of these reactions with the observed tax differentials among US states. For example, in our sample the coefficient of variation of real excise tax rates (for the pool of states for 1992-2006) is 75% and 25% for cigarettes and gasoline, respectively. In fact, Keen (2002) argues that this is a striking observation, as the presence and/or fear of cross-border shopping and/or smuggling would suggest much less variation. In any case, if reactions were closer to 1, tax rate differentials would tend to vanish over time, which does not seem to be the case (for cigarettes, the coefficient of variation in 1992 was 44%, while in 2006 it was 66%, and for gasoline the coefficient was 21% and 25%, respectively).

Rizzo (2011) included the lagged endogenous variable with the result that the estimate of the horizontal reaction was then considerably lower.[6] The former obtained a reaction of 0.277 and 0.191 (though, statistically insignificant) for cigarette and gasoline taxation, respectively, while the latter - deflating unit excise tax rates by means of a state price index - obtained a reaction of 0.22 and 0.12 (both statistically significant), respectively. Jacobs, Ligthart and Vrijburg (2010) define the tax rate variable as an "average effective tax rate", which is an average of the state sales tax and specific tax rates.[7] In their case, and although not fully comparable with the previous two results, the reaction they estimate is around 0.4.

While Jacobs, Ligthart and Vrijburg (2010) and Esteller and Rizzo (2011) are silent regarding the source of tax interdependence, Devereux, Lockwood and Redoano (2007) suggest that their results point to tax competition as being the most likely source, since in their spatial lag model the average of all other state taxes is not statistically significant while the tax average constructed using neighbor weights works better. However, note that their conclusions might be somewhat hastily drawn, as information externalities are usually thought to flow more easily between neighboring jurisdictions (Salmon, 1987; Besley and Case, 1995a).

In contrast with these previous studies, and now that the presence of tax interaction is well documented, we aim at identifying the source of this interdependence.

3. Empirical analysis

3.1. Empirical framework

In order to test for the source of horizontal tax interaction in the US, we estimate the tax reaction function by relating one state tax to the average tax in its neighboring states for the period 1992-2006. We repeat this procedure for gasoline and cigarette taxes transformed into real terms (using the federal Consumer Price Index). We proceed

[6] If state taxes are serially correlated, the estimates of horizontal interdependence obtained without controlling for the lagged endogenous variable are probably upwardly biased.

[7] Undoubtedly, this is an interesting approach. However, note that by adopting it we cannot identify how states react to the tax changes made by their neighbors, that is, by either varying the excise tax rate and/or by varying the general sales tax rate.

parsimoniously, and so first estimate a static tax reaction function (section 3.1.1). Next, we estimate a dynamic function, having first recognized the potential presence of inertia in excise taxation (section 3.1.2).

3.1.1. Static function

In order to estimate the potentially different reactions of states depending on whether their governor is or is not able to stand for reelection, we estimate the following equation:

$$t_{jst} = \alpha_s + \phi_t + \varphi_1 \sum_{i \neq s} w_{si} t_{jst} + \varphi_2 \left(\sum_{i \neq s} w_{si} t_{jst} \times Term\_limit_{st} \right) + \delta Term\_limit_{st} + X_{jst}\beta + \varepsilon_{jst} \quad [1]$$

where t_{jst} is the real tax rate on commodity *j* for state *s* in year *t*; α_s is a state fixed effect; ϕ_t is a year effect; $\sum_{i \neq s} w_{si} t_{jst}$ is the average real tax rate for commodity *j* of the neighboring states of state *s* in year *t*, where w_{si} are identical exogenous weights, normalized so that $\sum_{i \neq s} \omega_{si} = 1$, which accounts for the relative interdependence relation between *s* and the rest of the *i*-states; the variable $Term\_limit_{st}$ takes the value 1 for those states whose governor cannot stand for re-election (*i.e.*, lame duck governor); X_{jst} is a vector of state-specific time-varying regressors; while ε_{jst} is a mean zero, normally distributed random error. Thus, in the case of a state with a non-term limited governor its reaction to a one-cent increase in the average real tax rate of its neighbors is φ_1 cents, while if the governor is term limited, it is $\varphi_1 + \varphi_2$ cents.

Then, from the estimation of the above expression, we can reasonably expect to obtain one of the following cases for each tax:

(i) $\varphi_1 > 0$ and $\varphi_2 = 0$: there is horizontal interdependence, and this does not significantly differ according to whether the governor is term limited or not, so the source of interaction is (the fear of) cross-border shopping and/or smuggling, that is, tax competition due to base mobility.

(ii) $\varphi_1 > 0$ and $\varphi_2 < 0$: again, there is horizontal interdependence (*i.e.*, $\varphi_1 > 0$), but if $\varphi_1 + \varphi_2 = 0$, only yardstick competition plays a role, while if $\varphi_1 + \varphi_2 > 0$, tax and yardstick competition both play a role. Whatever the case, term limited governors tend to react less, that is, $\varphi_2 < 0$.

(iii) $\varphi_1 = 0$ and $\varphi_2 = 0$: there is no horizontal interdependence. According to section 2, this would be at odds with the previous literature.

Therefore, the estimate of φ_2 is basic for our identification strategy of the source of horizontal tax interdependence. Additionally, we would expect the level of taxation to be relatively higher if the state was governed by a term limited governor, that is, $\delta \geq 0$ (Besley and Case, 1995b)

As for econometric issues, note the mean neighboring tax rate, $\sum_{i \neq s} w_{si} t_{jst}$, is endogenous because it can be influenced simultaneously by the tax rate that we are estimating. Then, if this was a structural model, a simple OLS estimation of [1] would suffer from endogeneity bias: the error term ε_{jst} would be correlated with the error terms of the other simultaneous equations in the system. In order to overcome the simultaneity bias, we use the two-stage least-squares (2SLS) method: first, we estimate the reduced forms of the endogenous variables, and then we substitute their fitted values into [1]. The residuals of this last equation are corrected using the actual values of the endogenous variables. We instrument the mean neighboring tax rate with all the neighboring exogenous variables. In the case of the spatial lag that is interacted with the term limit, the instruments are the same albeit interacted with the neighbors' variable term limit.

In order to isolate the independent impact of the average tax rate of the neighboring states, we include other variables that might affect the state tax rate and which must be taken into account in order to avoid biased estimates. These variables are included in the vector X_{jst}. Specifically, state taxation may be influenced by the economic, demographic and political environment. Details of these variables are given in section

3.2.3, but note we also include a variable that captures the importance of polluters as a minority group in the state (in line with the arguments advanced in the Introduction based on the “tax exploitation” hypothesis). This variable will be lagged one period to avoid reverse causality: while we seek to estimate the impact of polluters on taxes, taxes will also have an impact on the number of polluters.

Certain invariable state characteristics are likely to affect its tax system, such as climate or geography, among others. We take these characteristics into account by including a dichotomous variable for each state. Changes in the macroeconomic situation may also affect a state’s fiscal policies, and so we include a set of time effects.[8]

3.1.2. Dynamic function

Recent empirical papers dealing with horizontal fiscal interdependence recognize the possibility that reactions are not immediate. In order to account for this sluggishness, we amend expression [1] and include the lagged endogenous variable as an additional explanatory variable. This is what Anselin *et al.* (2007) call a “time-space simultaneous” model. Thus, the dynamic model we wish to estimate is as follows:

$$t_{jst} = \alpha_s + \phi_t + \rho t_{jst-1} + \varphi_1 \sum_{i \neq s} w_{si} t_{jst} + \varphi_2 \left(\sum_{i \neq s} w_{si} t_{jst} \times Term\_limit_{st} \right) + \delta Term\_limit_{st} + X_{jst}\beta + \varepsilon_{jst} \quad [2]$$

As long as $\rho > 0$, we can conclude that when faced by a shock, taxes will show a certain degree of inertia (the higher the estimate of ρ, the greater the degree of inertia) and so the new optimal level of the excise tax rate will be achieved in the long run.[9] Most importantly, the interpretation of the estimates of φ_1 and φ_2 is the same as that provided for the static version of the model. Likewise, the justification and the list of controls

[8] In the dynamic version of the model (see next section), the inclusion of time effects also serves a useful technical purpose. In that version, we need to estimate the covariance matrix of the transformed errors, which is built on the assumption that errors are only correlated within but not across individuals. As such, the time effects serve to remove universal time-related shocks from the errors.

[9] Additionally, in order to avoid an explosive specification, and for the tax rate to be compatible with the concept of Nash equilibrium (see, for example, Lockwood and Migalli, 2008), which we implicitly employ, we also expect ρ<1.

included in [2] are no different from those in expression [1].

However, the estimation procedure is, since this specification is known to cause a bias due to the correlation of the lagged dependent variable with the individual specific effects. This bias is especially serious for short panels like ours (Nickell, 1981). For this reason we employ the so-called system GMM dynamic panel estimator (Arellano and Bover, 1995; Blundell and Bond, 1998). In fact, this estimator is an augmented version of the difference GMM (Arellano and Bond, 1991), and is considered more efficient (Blundell and Bond, 1998). Basically, these estimators mean, first, transforming the original model to a system that takes a first difference equation[10] and, second, instrumenting the lagged endogenous variable using lags that are two or more of the endogenous variable in levels (i.e., $\Delta t_{jst} \equiv t_{jst} - t_{jst-1}$ is instrumented using $t_{jst-2}, t_{jst-3}, t_{jst-4}, \ldots$). Unlike the difference GMM, which just employs the differences equation, the system GMM builds a stacked data set, one in levels and one in differences. Then, the differences equation is instrumented with levels, while the levels equation is instrumented with differences.

Using all the available lags as instruments is efficient, but can cause severe downward bias in the GMM estimators because of the overfitting of instrumental variables if the sample is finite (Ziliak, 1997). For this reason, in line with Roodman (2009), we seek to keep the number of instruments below the number of groups or, in our case, states. In order to check instrument validity, we employ the standard Hansen test (whose null hypothesis states that the corresponding group of instruments is exogenous) but the power of which is seriously weakened if the number of instruments is especially high.

In any case, the consistency of the GMM estimator crucially depends on the assumption that the error term, ε_{jst}, is serially uncorrelated. Otherwise some of our instruments will be invalidated. If there is no serial correlation in the ε_{jst}, first-differenced residuals should display first-order serial correlation, but not second-order serial correlation (*i.e.*, $E[\Delta\varepsilon_{jst}, \Delta\varepsilon_{jst-2}] = 0$). That is why we test for first (AR(1)) and second-order (AR(2))

[10] Our dynamic approach, which implies removing the fixed effects taking first differences, is also useful for overcoming the inconsistency of the estimates due to the "incidental parameters problem" for a fixed T as in our case (Neyman and Scott, 1948).

serial correlation, where the null hypothesis is the absence of serial correlation (Arellano and Bond, 1991).

To implement GMM we need to estimate the covariance matrix of the transformed errors. In a two-step system GMM, the standard covariance matrix is robust to panel-specific autocorrelation and heteroskedasticity, and so the estimator is more efficient. The standard errors, though, are downward biased. In order to correct this bias we employ the correction procedure proposed by Windmeijer (2005). For comparative purposes, though, we also show the estimation results under a one-step system GMM.

As discussed in section 3.1.1, the dynamic model we propose estimating includes a further endogenous variable, namely, the spatial lag. This can be instrumented as in the static version. We label these instruments “external”, in contrast with the “internal” instruments, which are the lags of the spatial lag. We make this differentiation because when T rises the instrument count can easily grow relative to the sample size, thereby causing the asymptotic properties of the estimators to be misleading (Roodman, 2008). Then, we need to check the extent to which our results are dependent on the use of both sets of instruments or just the “internal” one, which in fact forms the basis of the GMM estimator.

Having accounted for the most important technical questions regarding the GMM estimation, we next need to estimate the following dynamic model:

$$
\begin{aligned}
t_{jst} = {} & \alpha_s + \phi_t + \rho t_{jst-1} + \varphi_1 \sum_{i \neq s} w_{si} t_{jst} + \varphi_2 \left(\sum_{i \neq s} w_{si} t_{jst} \times Term\_lim\,it_{st} \right) + \delta_1 Term\_limit_{st} + \\
& + \varphi_3 \left(\sum_{i \neq s} w_{si} t_{jst} \times Election\_year_{st-1} \right) + \varphi_4 \left(\sum_{i \neq s} w_{si} t_{jst} \times Term\_lim\,it_{st} \times Election\_year_{st-1} \right) + \\
& + \delta_2 Election\_year_{st-1} + \delta_3 \left(Term\_limit_{st} \times Election\_year_{st-1} \right) + \\
& + X_{jst} \beta + \varepsilon_{jst}
\end{aligned}
\quad [3]
$$

This should serve as additional evidence of the source of tax interdependence. That is, we estimate it as an additional step in our identification strategy. *Ceteris paribus*, we expect a greater reaction from the non-term limited incumbents as elections approach, so $\varphi_3 > 0$, and also a lower level of taxation when the election year approaches for non-term limited governors, that is, $\delta_2 < 0$. If these two hypotheses hold, we obtain evidence in favor of yardstick competition. In order to measure the impact of the election year, we include the pre-election year, given that for tax policy to have an impact on voting decisions it has to be set some time in advance.[11]

3. 2. Data

3.2.1 Nominal tax rates

Taxes on gasoline and cigarettes vary considerably across states. In 1992, for example, the tax on a pack of cigarettes ranged from 2 cents in North Carolina to 40 cents in Connecticut. In the same year, the tax on a gallon of gasoline ranged from 7.5 cents in Georgia to 22 cents in Connecticut and Washington. Thus, there is significant cross-sectional variation.

Individual state taxes on cigarettes also vary over time. For example, in North Carolina the tax rate varied between 2 and 5 cents in 1992, but reached 30 cents in 2005 and 35 cents in 2006. Connecticut shows even greater variation, having increased its rate from 40 to 45 cents in 1992, it subsequently raised it again to 47 cents in 1994, 50 in 1995, 111 in 2002 and finally to 151 cents in 2003. Likewise, individual state taxes on gasoline show considerable variation over time. While Georgia maintained the same tax (7.5 cents) throughout the period studied here, the rate varied markedly in Connecticut and Washington. Connecticut increased its tax rate from 14 to 38 cents in 1997. This was followed by a reduction to 36 cents in 1998, 32 in 1999 and, finally, to 25 cents in 2002. Washington set a tax rate of 22 cents in 1990 and 23 in 1991. The tax was then increased to 28 cents in 2004, 31 in 2005 and, finally, 34 cents in 2006.

3.2.2 Description of the term limit variable

The term limit is a dichotomous variable which is equal to 1 for all years corresponding to a lame duck governor's last term. In our sample, it varies considerably across states and even over time. In fact, in our sample (see Table 1) there are states in which there is

[11] We also employed the election year, but the estimate was not statistically significant.

no term limit on the governor's election and states where the governor can be re-elected for a second term (two-term limit). In this latter case, if re-elected he/she is term limited. There is also the case of Utah (corresponding to two years in our sample) where the governor can be elected for three consecutive terms (three-term limit) and the case of Virginia where the governor can only stand for one term (one-term limit) and so he/she is always term limited.

Additionally, some states in our sample have changed their legislation from a no-term limit to a two-term (RI) limit or from a one-term limit to a two-term limit (KY, MS). We exploit this variation (Besley and Case,1995b; List and Sturm, 2006) across states and over time in order to assess the potentially different performances of governors with electoral concerns and voter behavior when they are lame duck or not.

[TABLE 1]

3.2.3 The other variables

The rest of the right-hand side variables in [1] and in [2], together with their definitions, means and standard deviations are reported in Table 2.

[TABLE 2]

We include a set of time-varying variables that characterize the states' economic and demographic situation: the state population (*POP*), per capita state income (*INC*), the state unemployment rate (*UNEMP*), the proportion of individuals in the state who are aged between 5 and 17 (*CHILD*), and the proportion who are over 65 years of age (*AGED*). The states' political environment can also affect fiscal outcomes. Therefore, we use a dummy variable that equals one if the governor is a Democrat (*DEMGOV*). We also account for the proportion of Democrats in the state Senate and in the House of Representatives (*DEMSEN* and *DEMHOU*, respectively). The cigarette and gasoline industries might affect the state tax rate by lobbying for the rates of their respective commodities (Dixit, 1996). Therefore, in order to control for the influence of lobbies, we include *TOBINC* (tobacco production per dollar of state income) and *GASINC* (gasoline production per dollar of state income). In line with the "tax exploitation" hypothesis (Hunter and Nelson, 1990), we also include the percentage of "polluters", which is proxied by the percentage of adult smokers (*PREVALENCE*) and by the ratio of licensed drivers to the total population (*PCDRIVERS*) for cigarette and gasoline taxation, respectively. Both variables are lagged one year to avoid reverse causality as discussed in section 3.1.1. The federal fiscal policy, other than commodity tax rates, may also affect state commodity tax rates. Thus, we control for per capita federal grants to the states (*GRANTS*).

4. Empirical results

4.1. Source of identification: Term Limits

Table 3 shows our results for the estimation of the tax reaction functions both on cigarettes and on gasoline. We take a static approach, that is, in response to any shock the tax levels immediately reach the new optimum. According to columns (1) and (5), there is a positive, statistically significant horizontal interdependence in cigarettes and gasoline, respectively. This is in line with results published elsewhere in the literature. However, the degree of interdependence is quite high, with the estimated reaction being much higher for gasoline (0.949 *vs.* 0.535).[12] This probably reflects the fact that we have not taken into account the inertia in the tax setting. This is especially relevant in unit excise taxes. Thus, the role of inertia is being picked up by the spatial lag. Whatever the case, our empirical aim is to infer the origin of tax interdependence, which is what we turn to next.

According to column (3), we find strong evidence of yardstick competition in cigarettes, while column (7) suggests that this source of interdependence is not an issue for gasoline taxation. In the case of cigarettes, a state with a non-term limited governor would increase its tax by 0.556 in response to a one-cent tax increase in its neighboring states, while a state with a lame duck governor would increase the tax rate by just 0.295 cents (*i.e.*, 0.556-0.261, an estimate that is statistically significant at the 95% level). In

[12] The most readily comparable results are those obtained by Rork (2003). As mentioned in Section 2, we obtained a reaction for cigarettes that is relatively similar to that reported in his paper - 0.636 (see Table 2, column 1 of his paper), while we obtained a much higher reaction for gasoline - 0.6 (see Table 2, column 2 of his paper). Nevertheless, note the poor performance of the over-identifying test for all our regressions in the case of gasoline.

the case of gasoline, a state with a non-term limited governor would increase its tax by 0.728 cents, while a state with a term limited governor would do so by 0.654 cents (also statistically significant at the 99% level). Hence, states with term limited governors tend to react less,[13] which perhaps reflects the fact that their governors do not need to build a reputation by means of setting taxes at the same level as those of their neighbors since they are unable to stand for reelection. However, the estimated reaction is only statistically different in the case of cigarette taxation. In this latter case, note that – where cross-border shopping is the alternative to comparative performance – taxes are interdependent as a result of both yardstick competition (47%, *i.e.*, 0.261/0.556) and tax competition (53%, *i.e.*, 0.295/0.556).

In addition, we find that cigarette taxes are higher in states with a lame duck governor (see the *Term_limit* estimate in column (3)), which is in line with accepted theory, while there is no difference in the case of gasoline. In general, we can conclude that the political environment has a much greater impact on cigarette tax rates than it does on those of gasoline. The higher the percentage of Democrats in the lower (*Demhou*) and upper (*Demsen*) state houses, the higher the level of cigarette taxation, while Republican governors (*Governor*) tend to counterbalance this effect by lowering excise taxation. Only this latter variable is (weakly) significant – presenting a negative sign, but with a very modest impact – in the case of gasoline taxation. The signs of the variables designed to capture the impact of lobbies (*Tobinc* and *Gasinc*) are positive, which is at odds with our expectations. Finally, all these results do not depend on whether or not we take into account the role of "polluters" (*Prevalence* (-1) and *Pcdrivers* (-1); see columns (2), (4), (6) and (8)), while the estimates of this variable are not statistically significant for gasoline or for cigarette taxation and tend to show a positive sign, which contradicts the "tax exploitation" hypothesis.

[TABLE 3]

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[13] The exogeneity of the variable *Term limit* might be disputed on the grounds that term limited governors could be more competent than non-term limited governors, assuming the latter are in their first term (see, for example, Alt, Bueno de Mesquita and Rose, 2011). Hence, reelection (and thus the presence of a term limited governor) might be a function of taxes. Were this to be an issue, then the estimates of the particular performance of term limited governors would be biased. However, as Bordignon, Cerniglia and Revelli (2003) argue this would mean that our estimates can be safely interpretable as being at the lower boundary.

Tables 4a and 4b show the results for cigarettes when we explicitly acknowledge the possibility of inertia in tax setting[14]. For this reason, in these regressions we include the lagged dependent variable. The results in the two tables are qualitatively identical, although the values of the estimates vary slightly. From this point onwards, we focus our comments on the two-step procedure (Table 4b). In column (1), the presence of tax interdependence is confirmed, although the estimate is now just 0.216. This value is even lower when we control for the role of minority groups (*Prevalence* (-1)), 0.183 (column (2)). In fact, once we control for inertia, the role of minority groups presents the expected negative sign, in contrast with the sign in the static model. In the other models, the statistical significance and the sign of this variable remain unchanged. The political variables, though, become statistically insignificant, while the impact of lobbies (*Tobinc*) now shows the expected negative sign, although we cannot reject the possibility that its impact might be null. Thus, we can confirm the presence of horizontal interdependence, while today's taxes are almost 90% of yesterday's taxes, since the variation in real unit tax rates can lag far behind.

The results shown in columns (1) and (2) have been obtained using both internal (lagged values of endogenous variables) and external (exogenous variables of neighboring jurisdictions) instruments. However, the results remain almost unchanged if we just employ the internal instruments (see columns (5) and (6)). In column (3), we test for the source of tax interdependence. Given we are using both internal and external instruments, there is the danger of overfitting (as the high value of the Hansen test tends to indicate).[15] Whatever the case, the estimates tend to confirm the hypothesis of yardstick competition obtained previously under a static tax setting. In order to overcome any potential overfitting (*i.e.*, number of instruments greater than number of groups) and to check the robustness of our result, in column (7) we carry out the same regression, but now using the internal instruments only. The yardstick competition hypothesis clearly holds. In fact, in contrast with the static analysis, there seems to be room solely for this source of horizontal interdependence. This result is independent of the inclusion of the variable *Prevalence* (-1) (columns (4) and (8), respectively). There

[14] In all regressions both for cigarettes and gasoline, note that according to AR(1) and AR(2) tests first-differenced residuals display a first-order serial correlation, but not a second-order serial correlation.

[15] In this case, the Hansen test is not robust, while the apparent bias of the interaction toward zero may indicate weak instrumentation.

is also weak evidence that taxes are higher if the state is ruled by a lame duck governor (see column (7)).

[TABLE 4a]

[TABLE 4b]

In the case of gasoline, state tax setting is not affected by the fact that the governor is a lame duck or not. This is demonstrated by means of Table 5a (one-step system GMM) and Table 5b (two-step system GMM). Here again we focus our analysis on Table 5b[16]. We find evidence of horizontal interdependence, but at a much lower degree than when we did not control for inertia, and in all circumstances much lower than that recorded in the case of cigarette taxation (specifically, 0.106 *vs.* 0.183 according to column (2) of Table 5b and Table 4b, respectively). The degree of inertia is even higher in the case of gasoline taxation, which might explain the marked decrease in the value of the estimate of the spatial lag when we include the lagged endogenous variable (0.975 *vs.* 0.106, the first value being that shown in column (6) of Table 3). In general, political variables do not seem to play a role, especially when we control for "polluters". In fact, this latter variable (*Pcdrivers* (-1)) shows a positive sign, which does not fit within a political economy framework. Whatever the case, as regards the source of interdependence, the dynamic analysis tends to confirm what we found previously when taking a static approach: there is no difference in the reaction of gasoline taxation depending on whether the state is ruled by a lame duck governor or not (see columns (3), (4), (7) and (8)).

[TABLE 5a]

[TABLE 5b]

4.2. Source of identification: Term Limit and Electoral Year

Testing whether the response to changes in the taxes of neighboring jurisdictions is

[16] Although the empirical framework reported here is quite different and the panel is shorter, these results are almost identical to the dynamic estimation provided by Esteller and Rizzo (2011). In this previous paper the authors reported a reaction in the case of cigarette taxation of 0.219 (Table 5, column 5) and of 0.117 for gasoline (Table 4, column 5), while – if we leave to one side the regressions that include the role of "polluters", as this variable is not considered in Esteller and Rizzo (2011) – we now obtain reactions of 0.216 (Table 4b, column 1) and 0.118 (Table 5b, column 1), respectively.

greatest during the electoral year in the case of non-term limited governors could help us to further identify the political determinants of tax interdependence. This is shown in Table 6. Here, again we present our results following both the one-step and two-step system GMM estimation strategies and we find that the previous results are confirmed.

If we focus on the two-step estimation for cigarettes (column (2)), the reaction of a non-term limited governor during an electoral year is 0.559 (*i.e.*, 0.0948+0.4639, which is statistically significant at the 99% level). Additionally, independently of the horizontal reaction, taxes tend to be lower when the electoral year approaches if the governor is non-term limited (-108.83 cents), and certain political variables tend to become statistically significant again. Specifically, lower houses dominated by Democrats tend to raise taxes, while the negative impact of a Republican governor is only statistically significant under the one-step estimation strategy. The impact of polluters (*i.e.*, smokers) is again statistically significant, and with the expected negative sign within a political economy framework. All in all, this source of identification tends to enrich the previous results regarding cigarettes, but adds little or nothing to those regarding gasoline (see columns (3) and (4)).

The setting of cigarette tax rates only becomes dependent on the policies carried out by neighboring states if the governor can stand for reelection. Hence, the accountability mechanism through comparative performance does hold in this case. In addition to the political economy motive affecting the setting of taxes, there is a further factor; specifically, states with non-term limited governors tend to decrease taxes when the electoral year approaches. Finally, independently of the presence of a term limit, smokers – either as a lobby group or as voters – tend to have a negative impact on the level of cigarette taxation.

5. Conclusions

We estimate and characterize horizontal excise tax interdependence for the US case, specifically for gasoline and cigarette taxation. In carrying out the estimation, we employ both static and dynamic frameworks so as to allow for a sluggish reaction. Although both empirical frameworks offer the same qualitative results, the point estimates make greater sense under the dynamic framework. Thus, within this latter framework, we find that the reaction in both taxes is relatively modest: in response to a one-cent tax increase in its neighboring states, a state increases its cigarette tax rate by 0.18 cents and its gasoline tax rate by 0.11 cents. However, the origins of these two reactions – compatible with a very high degree of inertia in tax setting – are quite distinct. In cigarette taxation, horizontal tax interdependence is politically motivated, while in the case of gasoline taxation, politics plays no role. Therefore, here, we are able to shed light on the origin of horizontal tax interaction. On the basis of our analysis, we find the following contrast: yardstick competition operates in cigarette taxation[17] while tax competition operates in gasoline taxation.

This result is robust to different specifications. The basic identification strategy has been to distinguish between the reactions of states with lame duck governors and those made by the rest. In the case of gasoline, all states react; in the case of cigarettes, only those with non-term limited governors do. The result for cigarettes should be welcome as long as the presence of yardstick competition can be considered to hold the executive accountable. This main result is enhanced when we test for a differential behavior according to the electoral cycle. Then, we find the political motivation is reinforced in the case of cigarette taxation: only non-term limited governors react, but only when state elections are on the horizon. In fact, not only do they tend to mimic their neighbors, but they also seem to cut taxes. All in all, from a normative point of view, it seems that the accountability mechanism through comparative performance is closely associated with the electoral cycle.

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[17] Fredriksson (2009) argues that tobacco taxation is a clear example of a "secondary policy" (according to List and Sturm's, 2006, terminology) so that the level of taxation is potentially influenced both by lobbying groups and by electoral concerns, since it is a priority for some groups, producers and consumers/voters, respectively. In this sense, our empirical results corroborate this presumption.

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Table 1: *Term Limits for Governors by State (1992-2006)*

States with no term limits:
CT, ID (1), IL, IA, MA (2), MN, NH, NY, ND, TX, UT(3), VT, WA (4), WI

States limiting governors to one term of office:
VA

States limiting governors to two terms of office:
AL, AZ, AR, CA, CO, DE, FL, GA, IN, LA, KS, MD, ME, MI, MO, MT, NC, NE, NJ, NM, NV, OH, OK, OR, PA, SC, SD, TN, WV, WY

State law changed from no term limit to a two-term limit:
RI (1994)

State law changed from one-term limit to a two-term limit:
KY (1994), MS (1994)

Notes: The year in brackets is the year in which the term limit legislation changed. (1) a two-term limit was passed in 1994, but repealed in 2002; (2) Term limits were enacted in 1994, but declared unconstitutional by the Idaho Supreme Court in 1997; (3) a three-term limit was passed in 1994, but repealed in 2003; (4) two-term limit in 1992, but declared unconstitutional by the Washington Supreme Court in 1998
Source: List and Sturm (2006) and
http://ballotpedia.org/wiki/index.php/States_with_gubernatorial_term_limits

Table 2: *Descriptive Statistics (1992-2006)**

Variable	Obs	Mean	Stand. Dev.	Min	Max
tg (state unit gasoline tax, cents*10 in real terms with CPI)	720	120.5	28.6	37.20	236.8
tc (state unit cigarette tax, cents*10 in real terms with CPI)	720	269.6	215.3	13.59	1,302
POP(state population*10^{-6})	720	5.708	6.101	0.463	36.250
INC (state income per capita*10^{-2} in real terms with CPI)	720	158.3	25.4	104.3	251.8
UNEMP (state unemployment rate)	720	5	1.331	2.3	11.3
CHILD (proportion of population between 5 and 17)	720	0.186	0.014	0.157	0.259
AGED (proportion of population over 65)	720	0.128	0.017	0.085	0.185
TOBINC (tobacco production, thousand pounds per dollar of state income*10^{-1} in real terms with CPI)	720	17.567	62.192	0	483.9
GASINC (daily gasoline production, thousand barrels per day, per dollar of state income in real terms with CPI)	720	0.493	1.467	0	13.106
GRANTS (federal grants per capita *10^{-2} in dollars in real terms with CPI)	720	6.82	2.51	3.10	27.40
DEMGOV (=1 if the governor is a Democrat)	720	0.537	0.499	0	1
TERMLIMIT (=1 when the governor is a lame duck)	720	0.268	0.443	0	1
ELECTION YEAR (=1 when the election occurs)	720	0.275	0.447	0	1
PREVALENCE (percentage of total population who reported having smoked at least 100 cigarettes and who currently smoke every day or on some days)	720	22.927	3.055	10.5	32.6
PCDRIVERS (ratio of licensed drivers to the total population)	720	0.697	0.051	0.569	0.909
DEMSEN (proportion of state Senate that is Democratic)	705	0.577	0.186	0.086	1
DEMHOU (proportion of state House that is Democratic)	705	0.574	0.179	0.129	1

*Figures are based on annual data for continental US states for the year 1992 to 2006, inclusive. All the monetary variables are expressed in real terms, divided by the Consumer Price Index (CPI) 1982-84 taken from the Statistical Abstract of the United States. We do not include non continental states (Hawaii, District of Columbia and Alaska) and, for DEMSEN and DEMHOU, Nebraska, whose Legislature is unicameral and non-partisan.

Table 3: *Cigarette and Gasoline Tax interdependence (1992-2006): Static Version (2SLS) & Identified through Term Limit*

VARIABLES	(1) Stcigtax	(2) Stcigtax	(3) Stcigtax	(4) Stcigtax	(5) Stgastax	(6) Stgastax	(7) Stgastax	(8) Stgastax
Wstcigtax	0.5348***	0.5899***	0.5564***	0.5834***				
	(0.1234)	(0.1238)	(0.1185)	(0.1185)				
Wstcigtax×Term_limit			-0.2612***	-0.2732***				
			(0.0839)	(0.0842)				
Wstgastax					0.9492***	0.9752***	0.7279***	0.6220**
					(0.2647)	(0.3215)	(0.2251)	(0.2497)
Wstgastax×Term_limit							-0.0739	-0.0541
							(0.0628)	(0.0627)
Term_limit			41.0463**	43.0300**			11.1292	9.0874
			(16.3854)	(16.7188)			(7.2510)	(7.1790)
Demsen	348.8147***	323.0290***	339.9818***	308.2920***	-4.5510	-4.3933	-7.1617	-9.2022
	(88.2321)	(97.2893)	(86.1142)	(95.5745)	(7.1428)	(7.9833)	(6.6711)	(7.1069)
Demhou	234.4019**	278.4660***	230.3912**	280.1435***	9.4958	8.4144	10.8345	10.2956
	(99.0836)	(107.7632)	(99.0119)	(107.6053)	(6.8992)	(7.4174)	(6.7507)	(7.0629)
Governor	-55.5057***	-61.2715***	-52.9047***	-58.3365***	-1.0773	-0.9557	-1.2601*	-1.1646*
	(10.7941)	(11.3251)	(10.5853)	(11.0703)	(0.7412)	(0.7357)	(0.7239)	(0.7049)
Prevalence (-1)		0.4832		-1.1606				
		(3.1130)		(3.1004)				
Tobinc	0.0215**	0.0173	0.0231**	0.0214*				
	(0.0109)	(0.0119)	(0.0105)	(0.0115)				
Pcdrivers (-1)						16.8284		19.7453
						(19.1992)		(18.3958)
Gasinc					2.2317**	1.9662*	2.7567***	3.0756***
					(0.9955)	(1.1482)	(0.9091)	(1.0053)
Observations	705	658	705	658	705	658	705	658
R-squared	0.795	0.800	0.799	0.806	0.908	0.908	0.915	0.918
F-test (exc.inst.-spatial lag)	19.73	18.25	11.31	10.93	15.75	9.91	10.93	7.54
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
F-test (exc.inst.-interacted spatial lag)	-.-	-.-	23.44	29.66	-.-	-.-	22.28	16.61
			[0.000]	[0.000]			[0.000]	[0.000]
Hansen-test	16.01	18.47	28.78	27.12	58.81	54.43	77.56	72.83
Hansen-test (*p*-value)	0.0666	0.0475	0.0922	0.207	0.000	0.000	0.000	0.000

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Table 4a: *Cigarette Tax interdependence (1992-2006): Dynamic Version (System-GMM//1-Step) & Identified through Term Limit*

VARIABLES	(1) Stcigtax	(2) Stcigtax	(3) Stcigtax	(4) Stcigtax	(5) Stcigtax	(6) Stcigtax	(7) Stcigtax	(8) Stcigtax
Stcigtax (-1)	0.8934***	0.8661***	0.8954***	0.8715***	0.8651***	0.8513***	0.8346***	0.8254***
	(0.0479)	(0.0459)	(0.0499)	(0.0472)	(0.0499)	(0.0503)	(0.0550)	(0.0544)
Wstcigtax	0.1468**	0.1477**	0.1457**	0.1442**	0.1243	0.1161	0.1597*	0.1481*
	(0.0720)	(0.0686)	(0.0706)	(0.0683)	(0.0775)	(0.0775)	(0.0880)	(0.0877)
Wstcigtax×Term_limit			-0.0452	-0.0393			-0.1800*	-0.1652*
			(0.0473)	(0.0474)			(0.0982)	(0.0997)
Term_limit			3.7427	2.1664			32.6344	29.2924
			(10.5208)	(10.6107)			(22.4551)	(22.7663)
Demsen	-23.6658	-45.8031	-23.3198	-45.5729	-22.1072	-41.8206	-16.6164	-35.8036
	(44.8321)	(43.2338)	(42.2960)	(40.8893)	(45.5800)	(42.4156)	(43.9926)	(41.9888)
Demhou	42.7273	76.9164*	41.5517	75.3123*	50.8513	80.1218*	49.8619	77.5494*
	(45.6308)	(43.0791)	(43.6825)	(41.3487)	(45.7228)	(41.7031)	(44.7525)	(41.9254)
Governor	-14.7940*	-17.4648**	-14.5947*	-17.1366**	-16.2768**	-18.3400**	-16.6424**	-18.5301**
	(7.9282)	(8.2723)	(7.7073)	(8.0211)	(8.1766)	(8.4664)	(8.4060)	(8.6513)
Prevalence (-1)		-4.2531***		-4.2078***		-4.2490***		-4.2188***
		(1.3776)		(1.3547)		(1.3719)		(1.4769)
Tobinc	-0.0050	-0.0023	-0.0050	-0.0021	-0.0068	-0.0036	-0.0093**	-0.0059
	(0.0035)	(0.0030)	(0.0036)	(0.0031)	(0.0042)	(0.0036)	(0.0045)	(0.0040)
Observations	658	658	658	658	658	658	658	658
Internal Instruments	YES	YES	YES	YES	YES	YES	YES	YES
External Instruments	YES	YES	YES	YES	NO	NO	NO	NO
# Instruments	46	48	59	62	46	47	46	47
AR(1) (*p*-value)	3.39e-05	3.41e-05	3.83e-05	3.83e-05	3.06e-05	3.60e-05	4.51e-05	5.14e-05
AR(2) (*p*-value)	0.272	0.278	0.299	0.305	0.264	0.272	0.354	0.358
Hansen-test	29.23	28.49	19.14	17.26	22.08	21.96	17.90	17.61
Hansen-test (*p*-value)	0.109	0.160	0.965	0.992	0.395	0.402	0.529	0.549

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Table 4b: *Cigarette Tax interdependence (1992-2006): Dynamic Version (System-GMM//2-Step) & Identified through Term Limit*

VARIABLES	(1) Stcigtax	(2) Stcigtax	(3) Stcigtax	(4) Stcigtax	(5) Stcigtax	(6) Stcigtax	(7) Stcigtax	(8) Stcigtax
Stcigtax (-1)	0.8893***	0.8561***	0.8835***	0.8823***	0.8689***	0.8547***	0.7927***	0.7893***
	(0.0830)	(0.0759)	(0.0617)	(0.0648)	(0.0587)	(0.0588)	(0.0657)	(0.0643)
Wstcigtax	0.2160*	0.1828*	0.1676**	0.1263*	0.2106**	0.2016**	0.1915**	0.1772**
	(0.1271)	(0.1105)	(0.0724)	(0.0705)	(0.0918)	(0.0916)	(0.0889)	(0.0882)
Wstcigtax×Term_limit			-0.0385	-0.0491			-0.1958**	-0.1851**
			(0.0473)	(0.0423)			(0.0866)	(0.0857)
Term_limit			2.4432	5.6786			28.8235*	27.0191
			(7.7914)	(7.5756)			(16.4789)	(16.4267)
Demsen	17.9483	-1.9241	-10.7307	-22.3238	-0.7314	-9.9345	-30.3197	-42.2263
	(68.5034)	(57.1089)	(36.2301)	(36.4481)	(52.9670)	(46.6572)	(45.9242)	(42.9133)
Demhou	-5.4823	13.1599	5.4638	43.4622	15.3228	40.9624	43.5992	67.7609
	(73.9103)	(62.2580)	(38.6279)	(34.6742)	(52.3566)	(46.6329)	(43.1163)	(43.2964)
Governor	-5.9271	-14.4927	-4.3144	-5.7659	-4.6399	-6.5613	-11.3672	-12.1644
	(11.0922)	(13.1987)	(7.9316)	(8.0997)	(10.9248)	(11.3915)	(9.6250)	(9.6815)
Prevalence (-1)		-3.8529***		-3.6045**		-3.4233***		-3.1049**
		(1.4469)		(1.5852)		(1.3048)		(1.5107)
Tobinc	-0.0010	-0.0006	-0.0054	-0.0003	-0.0026	-0.0000	-0.0068	-0.0040
	(0.0050)	(0.0042)	(0.0037)	(0.0038)	(0.0041)	(0.0037)	(0.0045)	(0.0038)
Observations	658	658	658	658	658	658	658	658
Internal Instruments	YES	YES	YES	YES	YES	YES	YES	YES
External Instruments	YES	YES	YES	YES	NO	NO	NO	NO
# Instruments	46	48	59	62	46	47	46	47
AR(1) (*p*-value)	6.28e-05	5.06e-05	4.49e-05	4.07e-05	1.84e-05	2.29e-05	4.87e-05	5.14e-05
AR(2) (*p*-value)	0.340	0.294	0.261	0.343	0.320	0.332	0.397	0.407
Hansen-test	29.23	28.49	19.14	17.23	22.08	21.96	17.90	17.61
Hansen-test (*p*-value)	0.109	0.160	0.965	0.992	0.395	0.402	0.529	0.549

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

Table 5a: *Gasoline Tax interdependence (1992-2006): Dynamic Version (System-GMM//1-Step) & Identified through Term Limit*

VARIABLES	(1) Stgastax	(2) Stgastax	(3) Stgastax	(4) Stgastax	(5) Stgastax	(6) Stgastax	(7) Stgastax	(8) Stgastax
Stgastax (-1)	0.9497***	0.9540***	0.9440***	0.9476***	0.8923***	0.8970***	0.8982***	0.9026***
	(0.0265)	(0.0241)	(0.0258)	(0.0244)	(0.0563)	(0.0626)	(0.0676)	(0.0729)
Wstgastax	0.1240**	0.1242**	0.1293**	0.1369**	0.2138	0.2038	0.1948	0.1792
	(0.0538)	(0.0549)	(0.0537)	(0.0562)	(0.1706)	(0.1706)	(0.1781)	(0.1730)
Wstgastax×Term_limit			0.0152	0.0099			0.1864	0.1771
			(0.0513)	(0.0509)			(0.1604)	(0.1580)
Term_limit			-1.0785	-0.4150			-21.1933	-20.0574
			(5.7654)	(5.7029)			(18.9688)	(18.6923)
Demsen	2.0283	1.9696	1.8268	1.8722	2.4665	2.1748	1.8576	1.4934
	(2.5580)	(2.6065)	(2.8090)	(2.9184)	(4.3855)	(4.1991)	(4.9983)	(4.7396)
Demhou	-3.8164	-3.4077	-3.4656	-3.0438	-2.8828	-2.1367	-2.3957	-1.5860
	(2.8735)	(2.9358)	(3.1358)	(3.2390)	(4.7990)	(4.6349)	(5.2102)	(4.9270)
Governor	-0.5237	-0.4979	-0.5414	-0.5103	-0.3757	-0.3278	-0.4363	-0.3794
	(0.4008)	(0.3863)	(0.4247)	(0.4110)	(0.4498)	(0.4190)	(0.5019)	(0.4604)
Pcdrivers (-1)		9.0851		9.7040		12.4323		12.8705
		(5.8246)		(5.9324)		(11.7522)		(13.0032)
Gasinc	-0.2699	-0.3200*	-0.2447	-0.3011	-0.2296	-0.2857	-0.2734	-0.3185
	(0.1880)	(0.1903)	(0.2035)	(0.2112)	(0.4117)	(0.4553)	(0.4422)	(0.4772)
Observations	658	658	658	658	658	658	658	658
Internal Instruments	YES	YES	YES	YES	YES	YES	YES	YES
External Instruments	YES	YES	YES	YES	NO	NO	NO	NO
# Instruments	46	48	59	62	46	47	46	47
AR(1) (*p*-value)	0.000655	0.000664	0.000631	0.000635	0.00133	0.00157	0.00194	0.00218
AR(2) (*p*-value)	0.943	0.948	0.940	0.943	0.950	0.958	0.976	0.983
Hansen-test	23.50	22.29	16.93	18.05	22.02	22.28	22.55	22.75
Hansen-test (*p*-value)	0.318	0.443	0.987	0.989	0.398	0.384	0.258	0.249

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses

Table 5b: *Gasoline Tax interdependence (1992-2006): Dynamic Version (System-GMM//2-Step) & Identified through Term Limit*

VARIABLES	(1) Stgastax	(2) Stgastax	(3) Stgastax	(4) Stgastax	(5) Stgastax	(6) Stgastax	(7) Stgastax	(8) Stgastax
Stgastax (-1)	0.9416***	0.9572***	0.9539***	0.9325***	0.9051***	0.9007***	0.9025***	0.8949***
	(0.0373)	(0.0292)	(0.0350)	(0.0295)	(0.0552)	(0.0561)	(0.0850)	(0.0878)
Wstgastax	0.1184*	0.1059*	0.0797	0.1136**	0.1200	0.1055	0.1934	0.1813
	(0.0650)	(0.0568)	(0.0522)	(0.0562)	(0.1622)	(0.1586)	(0.1934)	(0.2032)
Wstgastax×Term_limit			0.0023	0.0177			0.1304	0.1364
			(0.0497)	(0.0604)			(0.1604)	(0.1508)
Term_limit			-0.0871	-1.8250			-15.2039	-15.8039
			(5.5709)	(6.9944)			(19.1097)	(17.9893)
Demsen	0.7931	0.9339	9.5132*	2.1422	0.4163	0.1934	1.6702	0.9744
	(2.1459)	(2.2588)	(5.3324)	(3.1075)	(3.3309)	(3.2620)	(4.5037)	(4.2493)
Demhou	-3.3108	-2.9647	-13.8865***	-3.9108	-1.9495	-1.2231	-1.2777	0.0098
	(2.5754)	(2.4971)	(5.1905)	(2.8135)	(3.8947)	(3.8381)	(5.3606)	(4.8667)
Governor	-0.4796*	-0.3668	-0.2728	-0.1065	-0.4024	-0.3149	-0.1563	-0.0512
	(0.2849)	(0.2685)	(0.3266)	(0.3094)	(0.3754)	(0.3175)	(0.5004)	(0.4327)
Pcdrivers (-1)		11.9500*		13.2554		10.8536		14.2497
		(6.5660)		(8.3258)		(10.0970)		(15.1099)
Gasinc	-0.0811	-0.1577	-0.1597	-0.3013	0.0594	0.0914	-0.0907	-0.1109
	(0.2259)	(0.2173)	(0.2681)	(0.2917)	(0.4473)	(0.4628)	(0.4709)	(0.4869)
Observations	658	658	658	658	658	658	658	658
Internal Instruments	YES	YES	YES	YES	YES	YES	YES	YES
External Instruments	YES	YES	YES	YES	NO	NO	NO	NO
# Instruments	46	48	59	62	46	47	46	47
AR(1) (*p*-value)	0.000781	0.000634	0.000813	0.000942	0.000929	0.000994	0.00129	0.00146
AR(2) (*p*-value)	0.945	0.938	0.977	0.996	0.964	0.971	0.949	0.961
Hansen-test	23.50	22.29	16.93	18.05	22.02	22.28	22.55	22.75
Hansen-test (*p*-value)	0.318	0.443	0.987	0.989	0.398	0.384	0.258	0.249

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

Table 6: *Cigarette and Gasoline Tax interdependence (1992-2006): Dynamic Version (System-GMM) & Identified through Term Limit and Election Year*

VARIABLES	Stcigtax (*1-Step*)	Stcigtax (*2-Steps*)	Stgastax (*1-Step*)	Stgastax (*2-Steps*)
Stcigtax (-1)	0.8466***	0.8015***		
	(0.0557)	(0.0671)		
Stgastax (-1)			0.8618***	0.8826***
			(0.0691)	(0.0802)
Wstcigtax	0.0583	0.0948		
	(0.0735)	(0.0743)		
Wstcitax×Term_limit	-0.0728	-0.1307		
	(0.1071)	(0.1081)		
Wstcigtax×Election_year (-1)	0.4604***	0.4639***		
	(0.1207)	(0.1594)		
Wstcigtax×Term_limit×Election_year (-1)	-0.7039*	-0.4789		
	(0.4201)	(0.4868)		
Wstgastax			0.1447	0.0584
			(0.1529)	(0.2189)
Wstgastax×Term_limit			0.0627	0.1462
			(0.1313)	(0.1380)
Wstgastax×Election_year (-1)			0.1247	0.1189
			(0.1569)	(0.2174)
Wstcigtax×Term_limit×Election_year (-1)			-0.2057	-0.4773
			(0.2981)	(0.4533)
Election_year (-1)	-113.2105***	-108.8296**	-14.6473	-13.8766
	(34.3999)	(44.1678)	(18.9437)	(26.1377)
Term_limit	6.7436	13.9891	-6.6834	-17.1554
	(22.4970)	(20.5795)	(15.4687)	(16.5447)
Term_limit×Election_year (-1)	173.4207*	122.3343	24.6945	57.2881
	(98.9781)	(113.8869)	(35.6874)	(54.9305)
Demsen	-16.6516	-25.0830	1.7183	-0.4845
	(37.1430)	(34.1306)	(4.6794)	(5.3951)
Demhou	60.8605*	73.7368*	-1.6592	-0.0267
	(35.2575)	(37.9353)	(4.9876)	(6.2726)
Governor	-18.6483**	-10.9763	-0.1612	0.0595
	(8.4680)	(8.7039)	(0.4165)	(0.4439)
Prevalence (-1)	-3.9998***	-3.5111*		
	(1.5192)	(1.8521)		
Tobinc	-0.0058	-0.0058		
	(0.0043)	(0.0041)		
Pcdrivers (-1)			9.0303	7.3420
			(10.1441)	(15.0642)
Gasinc			-0.0881	0.2366
			(0.4556)	(0.7017)
Observations	658	658	658	658
Internal Instruments	YES	YES	YES	YES
External Instruments	NO	NO	NO	NO
# Instruments	48	48	48	48
AR(1) (*p*-value)	0.000	0.000	0.001	0.001
AR(2) (*p*-value)	0.583	0.528	0.862	0.958
Hansen-test	14.01	14.01	17.33	17.33
Hansen-test (*p*-value)	0.598	0.598	0.364	0.364

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

Data Appendix

- t_{st} US cigarette tax rate for state s in year t, divided by the CPI. These rates are taken from www.OTPR.org: cigarette tax rates are expressed in US dollars per pack of 20 cigarettes and gasoline tax rates are expressed in US dollars per gallon of gasoline.

Endogenous variables

- $\sum_{i \neq s} w_{si} t_{st}$ is the mean tax rates, divided by the CPI, of the states bordering state s in year t.

Demographic and socio-economic variables

- POP_{st} is the number of persons in state s in year t. This figure is taken from www.census.gov.
- $CHILD_{st}$ is the ratio of individuals aged 5-17 years to the total population of state s in year t, taken from www.census.gov for the USA.
- $AGED_{st}$ is the ratio of individuals over 65 years of age to the total population of state s in year t, taken from www.census.gov for the USA.
- $UNEMP_{st}$ is the unemployment rate for state s in year t, taken from www.stats.bls.gov.
- INC_{st} is the per-capita income for state s in year t divided by the CPI or HPI. Income data were taken from http://www.bea.doc.gov.
- $GRANT_{st}$ is the per-capita federal grant-in-aid for state s in year t. It is obtained from "Federal Expenditures by State" which is part of the Consolidated Federal Funds Reports program from US Census Bureau.
- $DEMGOV_{st}$ dummy=1 if the governor of the state is a Republican, taken from the Statistical Abstracts of the United States.
- $TERMLIMIT_{st}$ dummy=1 if the governor cannot run for reelection, taken from the Statistical Abstracts of the United States.
- $DEMSEN_{st}$ proportion of state Senate that is Democratic, taken from the Statistical Abstracts of the United States.
- $DEMHOU_{st}$ proportion of state House that is Democratic, taken from the Statistical Abstracts of the United States.
- CPI_t Consumer Price Index was taken from the Statistical Abstracts of the United States (2000).
- $TOBINC_{st}$ annual tobacco production (thousand of pounds); from http://www.nass.usda.gov, the website of the National Agricultural Statistics Service in the USA.
- $GASINC_{st}$ is the daily gasoline production (thousand barrels per day) per dollar of state income in real terms with CPI or HPI; from http://www.eia.doe.gov, the website of the Energy Information Administration in the USA.
- $PREVALENCE_{st}$ is the percentage of persons who reported having smoked at least 100 cigarettes and who currently smoke every day or on some days; from http://apps.nccd.cdc.gov/statesystem/TrendReport/TrendReports.aspx, the Behavioral Risk Factor Surveillance System (BRFSS)
- $PCDRIVERS_{st}$ is the ratio of licensed drivers to the total population; from

http://www.fhwa.dot.gov/policy/, The US Department of Transportation, Federal Highway Administration.