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ENVIRONMENTAL FEDERALISM: A PROPOSAL OF DECENTRALIZATION

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ABSTRACT: In a context in which environmental protection have become in an important issue, the paper analyses which would be the optimal division of environmental policymaking functions among the different government levels. From the point of view of the fiscal federalism theory, we will design the most appropriate level of decentralization in each situation. In this sense, a proposal of decentralization has been shown, analyzing the consequences that a lax environmental policy could generate on future generations.

Key words: Fiscal federalism, environmental policies, water management.

Clasificación JEL: H77, Q25, Q28

1.- Introduction

The relation between the intergovernmental structure of a country and various environment outcomes are currently the subject of research and debate (Oates, 2002). What is the degree of centralization more suited for environmental objectives? The topic about the degree of decentralization which is more convenient to achieve specific environmental objectives, such as improved water quality and service provision, is an important unresolved problem. In particular, the impact of the competition among governments on social welfare has been a controversial issue.

Some advantages of a decentralized environmental policies are based in technical characteristics that are unique to each jurisdiction or region, while others rely on heterogeneity of tastes among jurisdiction's citizenry. It is known, for example, that per-household cost of treating drinking water varies among communities depending on the size and other characteristics of water distribution and sewerage systems. Likewise, there are significant differences regarding preferences for environmental protection. Some populations are willing to sacrifice some economic growth for a cleaner environment, while others prefer the opposite. So, in that context, subcentral governments are more likely to choose efficient standards for drinking water.

On the other side, it is possible that some subcentral governments fail to choose efficient policies in the absence of central regulation. Centralization might be preferred if one jurisdiction's environmental policies generate externalities on other jurisdictions or maybe on future generations. Moreover, centralized environmental politics could be interpreted as a minimum protection for all population.

In this study, we have focused on analyzing different levels of centralization, in the context of water resources in Spain. The idea is that those resources are not shared out in an homogeneous way, and there are strong differences among regions and periods. Sometimes, some regions' deficit have to be covered with other regions' resources, so the overuse can lead to externalities in other jurisdictions.

The structure of the paper is the following. First of all, we have revised the main contributions in environmental federalism field. Next, a model to compare different levels of government centralization has been proposed. With the theoretical model, we capture the impact of several features (preferences, technology) on regions' welfare. The preliminary results of the empirical application have been shown, using a panel data of Spanish regions in the period 1996-2001, in order to notice water quality-consumption transformation function. Finally, we conclude with some ideas and suggestions about environmental policies and decentralization.

2.- Decentralization and environment: a brief review

From a general point of view, it is important to analyze the advantages and disadvantages associated to decentralization. In this sense, it has been argued that if there is heterogeneity among jurisdictions, centralization is suboptimal (Peltzman and Tideman, 1972; Oates and Schwab, 1996). This is because, strong differences among governments could lead to important losses for small jurisdictions (Burtraw and Porter, 1991; Dinan et al., 1999). In such cases, decentralization is a preferable alternative in

order to take into account local circumstances. On the other hand, decentralization could result in a severe reduction of environmental quality, as a consequence of ‘destructive interjurisdictional competition’ (Cumberland, 1979, 1981). The so-called ‘race to the bottom’ could lead to too much lax environmental regulations. This is a problem that decentralization could cause, and as we will see, there have been some studies that have analyzed that topic.

From a theoretical point of view there are mixed results in this field. Some studies stress the advantages of decentralization, because they argue that fiscal competition does not result in excessive pollution, and it can make possible efficiency improvements (Oates and Schwab, 1988; 1991; 1996). List and Mason (2001), develop a model based on games theory in a context of asymmetric information and strategic behaviors. They conclude that decentralization can dominate centralization when there are significant differences among jurisdictions and initial pollution conditions are not very high. Sometimes, we cannot find the ‘race to the bottom’ phenomenon (Fredriksson, 2000), but instead stringent regulations (Glazer, 1999).

However, the conclusions of some of those studies are excessively dependent upon severe assumptions, such as some technological characteristics (i.e. returns to scale), the size of jurisdictions, the objectives of local governments¹ or the existence of strategic behavior among jurisdictions. If the initial assumptions are relaxed, it is possible to find some researches which have concluded that competition among jurisdictions can lead to welfare losses. See, for example, models which assume that local governments cannot use all kind of fiscal instruments to implement environmental

¹ Oates and Schwab (1988) showed that, under the hypothesis of a revenue-maximizing government, there is a trend to lax environmental standards in order to increase the tax base.

policies (Zodrow and Mieszkowski, 1986; Wilson, 1986; Wildasin, 1989). Those studies show that public goods will be provided under the optimum level and they result in excessively lax environmental standards.

More recently, Markusen *et al.* (1993, 1995) developed a model under the assumption of increasing returns to scale and shipping costs between regions. They concluded that pollution taxes affect firm's decisions. Moreover, they presented some numerical examples of how tax competition results in more plants and pollution. As Levinson (1997) pointed out, an example can help us to clarify the distinction between Oates and Schwab's framework and Markusen's model.

Oates and Schwab develop a model applicable to many small jurisdictions that are competing for attracting investments to examine the effects of decentralization level on welfare. Markusen *et al.* show that regional governments establish their taxes in order to attract foreign plants. In such context, the regions are looking for getting economics rents that would otherwise be earned elsewhere, and by competing, the regions decrease their ability to do that and to regulate efficiently the pollution. Levinson conciliates both kind of models in a theoretical framework. The consequences of decentralization on efficiency depend on monopoly profits and tax exporting, not the nature of the pollution externality or environmental federalism. Finally, Fredriksson and Gaston (2000) found that centralized and decentralized governments could have similar effects. They showed, for example, that sometimes environmental standards are independent of institutional design. They found that the decentralized policy is efficient as long as either or neither lobby groups are organized.

The presence of externalities is another reason that leads to central government intervention. It is said that if the environmental policy of one jurisdiction affects to others jurisdictions, it is convenient to adopt a mix solution, allowing central government to fix (not necessarily uniform) standards (Oates, 2002). Shapiro and Petchey (1997) show a bundle of conditions which characterize interjurisdictional cooperation as an efficient solution, without the need for centralized policies². In this way, other studies have analyzed the impact that different decentralization levels have on jurisdiction's welfare (Shapiro, 1996; Mueller and Oates, 1996)

From an empirical point of view, some studies have focused on analyzing the consequences of decentralization in an environmental context (Dinan *et al.*, 1999; List and Gerking, 2000; Fredriksson and Millimet, 2002; Millimet, 2003; Millimet and List, 2003; Fomby and Lin, 2003). Most of these studies fail to find empirical evidence of the 'race to the bottom' effect. Hence these studies defend decentralization process, because centralization policies impose large welfare losses to some jurisdictions³. Sometimes, as it has been forecasted by some theoretical models, the opposite effect has been observed, the so-called 'race to the top'. Moreover, Fredriksson and Millimet (2002) find that governments fix higher levels of abatement spending when neighboring

² Those conditions are the following: a) States have sufficient trust in one another's morality, b) States are fully informed about the policy choices of their treaty partners, c) The benefits of cooperation are sufficiently high relative to the rewards of defection. As Braden *et al.* (1997) pointed out, these conditions are hard to find in real situations, but it is possible to conclude that the existence of interjurisdictional externalities is not sufficient condition for central government intervention in an environmental context.

³ Dinan *et al.* (1999) analyzed the effects of centralized standards of water quality on households' welfare. They found that decentralizing standards settings process could allow governments to establish standards that better reflect their individual costs and benefits.

jurisdictions establish more stringent rules, but there appears to be no effect on a government's spending when the regulation is lax.

3.- The theoretical model: comparing alternatives

In this section, we develop a two-jurisdiction model, with some basic assumptions, following Shapiro (1996). We show that, in order to decide the optimal level of decentralization, it is important to find out how intense is the relationship between consumption and environmental quality.

Jurisdiction (region) is denoted by the sub-index s , so $i = 1, 2$. In each state there are two kinds of citizens, capital owners (k) and greens (g). The type of individual is denoted by j , where $j = k, g$. So the population of each group in each state is denoted by n_{ij} . We supposed that the majority of population in state 1's are capital owners, while in state 2 citizens preferred to preserve environmental quality. The utility function of a representative citizen is the following:

$$U_{ij} = Qc_{ij}^{\gamma_j} \quad (1)$$

The previous function is showing the preferences that citizens have about environmental preservation, where Q is an index of the natural resource's quality and availability, and c_{ij} denotes the private consumption of the j -th individual in the i -th jurisdiction. We only consider one parameter on which preferences can vary, γ . Moreover, we know that $\gamma_k > \gamma_g$. By other side, we can model the presence of externalities:

$$Q = \sum_{i=1,2} Q_i \quad (2)$$

If we think about water resources in several regions of a country, we can find that some regions consume more intensively than other and higher levels of economic activity can lead to an overuse and quality deterioration of water resources. In some cases, that fact generate water transfers from some regions to others. This kind of transfers can be costly from an economic point of view ⁴.

In that point, one thing which is important to model accurately is the relationship between water quality and private consumption, recognizing the emissions and natural resource pressure as an inevitable byproduct of the productive process. In this case, the so-called transformation function shows that relationship:

$$Q_i = \alpha - \beta C_i + \delta Z_i \quad (3)$$

So water resources quality and availability depends on regional total consumption, $C_i = n_{ik}c_{ik} + n_{ig}c_{ig}$, and on a bundle of exogenous factors, denoted by Z_i . As we will see, some parameter of that transformation function will be significant in order to decide which level of decentralization is preferred from a welfare point of view. In the empirical section, we test that relationship, because we understand that it is a key feature in this context. From (3), we can find a concrete expression for Q :

⁴ In Spain, for example, the contrasts between regions in terms of the natural availability of water has led to a policy of diverting water between basins. The National Water Planning, which aims to improve the water supply in regions in the south of Spain on the Mediterranean coast, has an estimated cost of around 3.78 billion euro.

$$Q = 2\alpha - \beta n_1 c_1 - \beta n_2 c_2 + \delta n_1 z_1 + \delta n_2 z_2 \quad (4)$$

Under the assumptions of majority rules and anonymity, we can obtain the optimal solution for several scenarios⁵. Firstly, we consider a decentralized context, A, in which each region maximize its utility subject to the externality revealed in (4). Next, we proposed two centralized scenarios, with a central government which maximize total welfare, B1, or majority's welfare, B2. The optimal levels of private per capita consumption in each scenario and each region are presented in Table 1:

TABLE 1
Optimal per capita consumption under several scenarios

	DECENTRALIZATION	CENTRALIZATION	
	A	B1 (efficient)	B1 (majority)
c_1^*	$\frac{2\alpha\gamma_k}{\beta n_1(1 + \gamma_k + \gamma_g)}$	$\frac{2\alpha\gamma_k\gamma_g}{\gamma_k(n_{1k} + n_{2k}) + \gamma_g(n_{1g} + n_{2g})}$	$\frac{2\alpha\gamma_m}{\beta n(\gamma_k + \gamma_g)}$
c_2^*	$\frac{2\alpha\gamma_g}{\beta n_2(1 + \gamma_k + \gamma_g)}$	$\frac{2\alpha\gamma_k\gamma_g}{\gamma_k(n_{1k} + n_{2k}) + \gamma_g(n_{1g} + n_{2g})}$	$\frac{2\alpha\gamma_m}{\beta n(\gamma_k + \gamma_g)}$

Total country population is denoted by $n = n_1 + n_2$.

National majority's preferences parameter is denoted by γ_m

Substituting in (4) and (1), it is possible to obtain the optimal values of Q and U_i . We can observe that in all cases, the parameters of transformation function have an influence on consumption and environmental quality levels. In the next section, we have estimated a transformation function for Spanish regions.

⁵ For more details, see Shapiro (1996).

4.- Empirical application: the Spanish case

To estimate the equation proposed in (4), we have at our disposal a panel data of Spanish Autonomous Regions during the period 1996-2001. The information source has been the Spanish Institute of Statistics (INE). We have analyzed the relationship between water quality/availability and consumption, trying to control with another exogenous variable that have influence in water resources quality/quantity. Standard static panel data models, *between-groups*, *within-groups* and *random-effects*, have been compared.

Regarding dependent variable, it is difficult to find some disaggregated index of water quality. In this study, the inverse of *per capita* sewage water has been considered (Q). With this indicator, we are showing two features. By one side, it be a proxy of the level of pressure which is doing on water resources, because there is a direct relationship between water consumption and sewage water. By the other side, sewage water is quality deteriorated water by consumptive uses, so it could be interpreted as a proxy of water quality resources.

With respect to independent variables, we have included an index of the economic activity of the region and another which approximate the effort of firms to improve water quality and availability. For the first one, two alternatives have been compared, the gross domestic product (GDP) and the households' domestic expenditure (HDE). For the second one, we have considered the one-period lagged firm capital expenditures on technologies which allow to improve water quality, such as low-water-

consumption or low-water-waste technologies (KEXP-1). The descriptive statistics of those variables appear in Table 2:

TABLE 2
Descriptive statistics

VARIABLE		MEAN	STD. DEV.	MIN	MAX
Q	overall	0.0209357	0.0097724	0.0088952	0.0498132
	between		0.0082827	0.0098243	0.0366965
	within		0.0055188	0.0000757	0.0362643
GDP	overall	34494.26	32225.62	4103.721	119784.5
	between		32860.54	4522.92	110832.4
	within		3483.115	21884.83	46258.68
HDE	overall	21664.48	18795.21	2140.458	68659.97
	between		19152.15	2314.523	63553.31
	within		21480.16	14677.12	27883.44
KEXP-1	overall	28.15429	30.69755	1.360753	144.9467
	between		26.15781	3.46393	95.61519
	within		17.43709	-41.90667	99.8703

Monetary variables are expressed in millions of euros

The estimates are presented in Tables 3 and 4. In Table 3, we have estimated including GPD as a proxy of regional consumption. The Table 4 shows the results using household expenditure, HDE. Such as can be deduced of Hausman's test results, in both cases *within-effect* model is preferred. Under that modeling, all the variables are significant. This fact indicates that an individual effect is significant, so it would be possible to capture a different constant for each region. As a consequence, optimal consumption level registered in Table 1 could change, because we test the existence of an α_i .

TABLE 3
Estimates (I): GPD

	VARIABLE	COEF.	STD. ERR.
BETWEEN-GROUPS	GDP	-0.14652	0.14983
	KEXP-1	57.79983	184.13090
	Constant	0.02397***	0.00293
WITHIN-GROUPS	GDP	-0.60950***	0.18337
	KEXP-1	84.85987**	37.25472
	Constant	0.04061***	0.00638
RAMDOM-EFFECTS	GDP	-0.20328***	0.06634
	KEXP-1	67.32256*	36.52470
	Constant	0.02578***	0.00286
Hausman test	Prob> $\chi^2(2)$ = 0.0575 (5.71)		

Dependent variable: *Q*. For the estimations, monetary variables are expressed in euros/1,000,000

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level

TABLE 4
Estimates (II): HDE

	VARIABLE	COEF.	STD. ERR.
BETWEEN-GROUPS	HDE	-0.20560	0.27274
	KEXP-1	29.61053	196.06010
	Constant	0.02417***	0.00305
WITHIN-GROUPS	HDE	-1.04465***	0.30423
	KEXP-1	85.02748**	36.98429
	Constant	0.04226***	0.00666
RAMDOM-EFFECTS	HDE	-0.34724***	0.11473
	KEXP-1	67.29705*	36.53663
	Constant	0.02630***	0.00301
Hausman test	Prob> $\chi^2(2)$ = 0.0084 (9.55)		

Dependent variable: *Q*. For the estimations, monetary variables are expressed in euros/1,000,000

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level

In general, it is noticed the negative relationship between economic activity, expressed in GPD or HDE form, and the index of water quality/pressure. Moreover, it is possible to see the positive and significant impact that firms' efforts have on water resources conservation. Firms' capital expenditures in green technologies has been a

control variable which has allowed to isolated the net effect of productive process on water quality.

5.- Conclusions

Fiscal decentralization in an environmental context is a controversial topic which has to be analyzed carefully. We have reviewed the main contributions in this field, showing the advantages and disadvantages of decentralization processes. Sometimes, jurisdictions' heterogeneity leads to implement more centralized policies, to avoid high welfare losses for some jurisdictions.

In this paper we have focused on some features that have an important influence in order to choose the better option in the context of water resource policies. Firstly, from a theoretical point of view, by means of a two-region model. Next, we have developed an empirical application in Spanish regions using a panel data base. We have estimated a water quality-consumption transformation function, finding the expected signs. Consumption has an important impact in water quality and availability, and, at the same time, the efforts that firms have done to conserve environmental quality are significant.

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