

## PROGRESSIVITY AND TERRITORIAL INDICES OF RELATIVE FISCAL COMPLIANCE

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*This paper presents a framework to study territorial differences in fiscal compliance in the presence of a progressive income tax, and applies the resulting index to the Spanish system of Autonomous Communities. The results show that, in addition to the comparison between the relative tax base of a given area and its relative income, which may be an adequate procedure when the tax is proportional, the measurement of relative compliance when the tax is progressive needs also to take into account the relationship between relative real productivity and what might be termed relative fiscal productivity (relative tax base per taxpayer). (JEL H24, H26)*

### 1. Introduction

Policies to increase the degree of fiscal compliance may not always need information of an absolute nature. If, as it occurs in most federal countries, the administration of the tax system is territorially organized in areas about which we know aggregate data on taxes and economic conditions, then it is perfectly possible to evaluate indices of relative fiscal compliance on the basis of only this type of data, which, despite their simplicity, could be useful to allocate limited administrative resources among different areas. The purpose of this paper is to advance one such index for the case of a progressive income tax, and to evaluate it using Spanish data<sup>1</sup>.

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<sup>1</sup>Another use to which such indices can be put is as criteria to allocate funds in revenue sharing systems. See Akin (1973), Fisher (1979), King (1984), Manvel (1971) and Mathews (1977) for a general discussion of the issues involved and for examples in the US, Australia, Canada and Germany, and Zabalza (1987 and 1994) for applications to the finance system of the Spanish Autonomous Communities.

Generally, the aim of an index of fiscal compliance is to establish a relationship between actual and potential revenue from a given tax or set of taxes. The interesting questions arise with the definition of potential revenue, which in turn depends on the type of index sought. If the purpose is to obtain an absolute figure for the amount of tax fraud in a given area, then potential revenue should be equal to that obtainable, for a given set of legal rules, when the degree of compliance is at its maximum possible level. However, if the purpose is to obtain an index of relative fiscal performance, what matters is not so much the maximum degree of compliance possible, but the difference between the actual degree of compliance in an area and a given standard degree of compliance (for instance, the national mean degree of compliance<sup>2</sup>). For many uses, a relative index such as the one defined here may prove sufficient as an instrument to guide policies of tax administration, as usually the relevant question is not how many resources are needed to eliminate fiscal fraud overall, but how to allocate a given, limited amount of resources between different areas. Also, a relative index may be more readily available, to the extent that in many cases it may be easier to find robust information about relative differences than about absolute magnitudes.

The following section presents the model used to derive the proposed index of fiscal compliance and examines its main properties. Section 3 evaluates empirically this index using macroeconomic and income tax data for the year 1988 on the fifteen Autonomous Communities of common regime on which the Spanish State is organized<sup>3</sup>, looks at the temporal evolution of the index until 1992, and singles out the main factors behind this evolution. The paper ends with a section which summarizes the main conclusions obtained and suggests possibilities for further work on this issue.

<sup>2</sup>For the purposes of this paper, the term national is used as meaning the sum of all the geographical areas considered. Also, the term compliance is used in a generic sense, as differences in the index calculated below may capture not only differences in individual tax compliance, but also differences in tax administration.

<sup>3</sup>In fact there are seventeen Autonomous Communities, but two of them –País Vasco and Navarra– have their own income tax. Both these tax systems have some differences with respect to the income tax applicable to the rest of the country, and are under separate and independent tax administrations. These two areas are normally identified as Autonomous Communities “de régimen foral” as opposed to the other fifteen, which are known as Autonomous Communities “de régimen común”

## 2. A relative index of tax compliance

Let us assume that the income tax system faced by all individuals in all areas can be represented by the following expression:

$$T_{ij} = (B_{ij} - a)m, \quad \forall B_{ij} > 0, \quad [1]$$

where  $T_{ij}$  is the revenue raised by the income tax from individual  $j$  of Area  $i$ ,  $B_{ij}$  is the tax base of individual  $j$  of Area  $i$ ,  $a$  is a constant tax allowance and  $m$  is the (also constant) marginal tax rate.

Total income tax revenue in Area  $i$  can be obtained summing up expression [1] for all taxpayers in that area, as follows:

$$T_i = \sum_j T_{ij} = mB_i - amN_i, \quad [2]$$

where  $T_i$  is the revenue raised by the income tax in Area  $i$ ,  $B_i$  is the total tax base in Area  $i$  and  $N_i$  is the number of income taxpayers in Area  $i$ . Despite its simplicity and the unreality of the assumptions involved in the definition of the individual tax liability<sup>4</sup>, most progressive income taxes can in the aggregate be represented to a very good degree of approximation by expression [2].

Expression [2] can also be written as follows:

$$T_i = t_i B_i, \quad [3]$$

where  $t_i$  is the effective average income tax rate in Area  $i$ , and is defined as follows:

$$t_i = m \left[ 1 - \frac{a}{B_i/N_i} \right]. \quad [4]$$

As expression [4] shows, despite the constant marginal rate, the average tax rate increases with the tax base, as it should be with a progressive tax, and it approaches  $m$  asymptotically.

Next, the index of relative fiscal compliance for Area  $i$ ,  $IRFC_i$ , is defined as

$$IRFC_i = \frac{T_i}{T_i^*}, \quad [5]$$

where  $T_i^*$ , the potential income tax revenue in Area  $i$ , is

$$T_i^* = t_i^* B_i^*, \quad [6]$$

<sup>4</sup>In particular, the assumptions that the tax allowance is constant for all individuals and that expression [1] holds for all  $B_{ij} > 0$ . See footnote 7 below for the particular role played by the latter assumption

and

$$t_i^* = m \left[ 1 - \frac{a}{B_i^*/N_i^*} \right], \quad [7]$$

where  $t_i^*$  is the potential effective average tax rate in Area  $i$ ,  $B_i^*$  is the potential aggregate income tax base in Area  $i$ , and  $N_i^*$  is the potential number of income taxpayers in Area  $i$ .

Expressions [6] and [7] show that, apart from the income tax specification, potential revenue depends on the definition of the potential income tax base and of the potential number of income taxpayers. As pointed out above, the purpose of this exercise is to define an index of relative, rather than absolute, tax compliance. Consequently, rather than identifying what would be the tax base and the number of taxpayers in each area if the degree of compliance was the highest possible, the actual national income tax base (that is, the sum of the income tax base of all areas) and the actual national number of income taxpayers are taken as good, and the question considered is how these concepts should be distributed between areas if the degree of compliance was equal to the mean (national) degree of compliance. Naturally, to do that, criteria of distribution are needed, which, for each case, should be simple, susceptible of being defined for each of the areas considered, and as closely related to the concepts to be distributed as possible.

The proposal that this model incorporates is that personal income<sup>5</sup> and employed population for each area should be the criteria used for the distribution among areas of the income tax base and the number of taxpayers respectively. An alternative criteria to determine the potential tax base could be gross value added; but this concept does not include some sources of income such as family transfers, which are normally considered taxable in income tax laws, whereas it does include others, such as net benefits, which normally are taxable in income tax laws only if they have been generated by personal firms. Also, an alternative criterion to determine the potential number of taxpayers could be the total population in the area; but this would not take into account differences in the age structure that may exist between areas, nor the possible different territorial incidence of labour force participation and unemployment<sup>6</sup>.

<sup>5</sup>The exact definition of personal income used is for each Autonomous Community the aggregate of the "Renta Familiar Bruta Disponible" as given by the National Accounts, grossed up by the aggregate of the income tax revenue for that area.

<sup>6</sup>Another possibility would be to add the number of old-age pensioners to the

$B_i^*$  and  $N_i^*$  are thus defined as follows:

$$B_i^* = \gamma_i B, \tag{8}$$

$$N_i^* = \rho_i N, \tag{9}$$

where

$$\gamma_i = \frac{Y_i}{Y}, \tag{10}$$

$$\rho_i = \frac{P_i}{P}, \tag{11}$$

and  $B$  is the national income tax base,  $N$  the national number of taxpayers,  $Y_i$  and  $Y$  respectively Area  $i$  and national gross disposable income, and  $P_i$  and  $P$  respectively Area  $i$  and national occupied population. It follows that:

$$\sum_i B_i = \sum_i B_i^* = B; \sum_i N_i = \sum_i N_i^* = N;$$

$$\sum_i Y_i = Y; \text{ and } \sum_i P_i = P.$$

According to expressions [8] and [10], the potential income tax base per unit of income in Area  $i$  should be the same as the national income tax base per unit of income; and according to expressions [9] and [11], the potential number of income taxpayers per occupied person in Area  $i$  should be the same as the national number of income taxpayers per occupied person. Potential fiscal concepts of a given area are therefore defined as those that should be obtained if that area was as efficient as the nation as a whole in extracting fiscal magnitudes from the corresponding macroeconomic concepts.

Substituting [3] and [6] into [5], the index of relative fiscal compliance can be expressed as the product of two partial indices, one of relative rate compliance and the other of relative base compliance, as follows:

$$IRFC_i = \tau_i \beta_i, \tag{12}$$

where  $\tau_i$  is the partial index of relative rate compliance, which is defined as

$$\tau_i = \frac{t_i}{t_i^*}, \tag{13}$$

employed population, as pensions are also liable to income tax. Due to lack of adequate territorial data, this has not been attempted here. If the geographical distribution of pensioners is similar to that of the employed population, the use of one definition or another should not make much difference in practice

and  $\beta_i$  is the partial index of relative base compliance, which is defined as

$$\beta_i = \frac{B_i}{B_i^*}. \quad [14]$$

Then, substituting [4] and [7] in [13], [8] to [11] in [14], and the resulting expressions in [12], the index of relative fiscal compliance can be expressed as follows:

$$IRFC_i = \tau_i \beta_i = \frac{(B/N) - [a/(\alpha_i/\eta_i)]}{(B/N) - [a/(\gamma_i/\rho_i)]} \left( \frac{\alpha_i}{\gamma_i} \right), \quad [15]$$

where

$$\alpha_i = \frac{B_i}{B}, \quad [16]$$

and

$$\eta_i = \frac{N_i}{N}. \quad [17]$$

The first fraction in expression [15] denotes the partial index of relative rate compliance. If  $B_i/N_i$  and  $B_i^*/N_i^*$  are both greater than  $a$  for all  $i$ , a condition which is fulfilled by the data, this fraction will be a positive number.

$$\tau_i > 0, \quad \forall i. \quad [18]$$

The second fraction is the partial index of relative base compliance, which is also a positive number as both  $\alpha_i$  and  $\gamma_i$  are by definition greater than zero for all  $i$ . Relative base compliance, therefore, depends on the ratio  $(\alpha/\gamma)$ , and relative rate compliance depends on the two ratios,  $(\alpha/\eta)$  and  $(\gamma/\rho)$ , on the parameter  $a$  and on the national average tax base.

Suppose that the income tax law specifies that the individual's tax base is a fraction  $k$  of the individual's income and that income can only be obtained through employment. Then, if all people fully comply with the law,  $B_{i,j} = kY_{i,j}$  and  $B_i = kY_i$ , which in turn implies that  $\alpha_i = \gamma_i$ . Also, if according to [1] we define a taxpayer as the individual whose tax base is positive,  $B_{i,j} > 0$ , then full compliance implies that in all areas  $N_i = P_i$  or, what is the same, that  $\eta_i = \rho_i$ . Under these conditions of full compliance the value of  $IRFC$  equals 1 for all areas<sup>7</sup>.

<sup>7</sup>For this result to hold it is necessary that expression [1] is valid for all  $B_{i,j} > 0$ . Then it is possible to assert that all occupied people (that is, all people who obtain income) are taxpayers, and therefore that with full compliance  $N_i = P_i$ . As pointed out above, the assumption that [1] should be defined only for all  $B_{i,j} > 0$  is clearly

Suppose now that all taxpayers underdeclare by the same relative amount their tax base, so that  $B_{ij} = k'Y_{ij}$  where  $k' < k$ . Then the value of *IRFC* would continue to be 1 for all areas, a result which underlies the relative nature of the index considered here. *IRFC* will be different from unity and vary between areas only to the extent that the degree of compliance also differs between them.

As, by [18],  $\tau_i$  is positive for all  $i$ , other things equal, areas in which the ratio  $(\alpha/\gamma)$  is larger, will also have a higher degree of fiscal compliance. For any variable  $x$  denote the difference between  $x_j$  and  $x_i$ , where  $j$  and  $i$  are two different areas, by  $\Delta x$ . Then, holding the ratios  $(x/\eta)$  and  $(\gamma/\rho)$  the same for all areas, we have from [15] that

$$\frac{\Delta IRFC}{\Delta(\alpha/\gamma)} = \tau_j > 0. \quad [19]$$

Other things equal, the larger the area's share of the total tax base relative to its share of total income, the higher its index of fiscal compliance will be.

If the tax considered was proportional,  $a = 0$ , then  $\tau_i$ , the index of rate compliance, would equal 1 for all areas, and overall tax compliance would depend only on  $\beta_i$ , the index of base compliance. However, if the tax is progressive,  $a > 0$ , then, in addition to the ratio  $(\alpha/\gamma)$ , two other ratios,  $(\alpha/\eta)$  and  $(\gamma/\rho)$ , enter into the determination of overall tax compliance, as the term  $\tau_i$  no longer equals 1 for all areas. The first of these two ratios measures the extent to which the base per taxpayer in the area differs from the national base per taxpayer, and the second the extent to which the area income per worker differs from the national income per worker. The last ratio is a relative measure of real productivity and the first a relative measure of what could be termed "fiscal productivity". What the partial index  $\tau_i$  does, is to determine the degree of rate compliance as a function of the efficiency with which the area in question transforms real into fiscal productivity, relative to this efficiency at the national level.

unrealistic, as in fact no tax system gives away net handouts, but it is maintained to ensure that the value of the overall index is equal to one for all areas in the case of full compliance. This result, however, plays no role in the empirical analysis below, which is based on the area's aggregate representation of the tax system, expression [2], and which would follow under the same lines even if expression [1] was, more realistically, defined as valid for all  $B_{ij} > a$ . In this case, the only condition needed to ensure that the effective average tax rate is positive is that  $B_i/N_i > a$ , which, as has been noted above, in all cases is fulfilled by the data.

For a given area, the partial index of rate compliance  $\tau_i$  will be greater, equal or smaller than unity, as its relative fiscal productivity,  $(\alpha_i/\eta_i)$ , is greater, equal or smaller than its relative real productivity,  $(\gamma_i/\rho_i)$ .

To understand the effect on the partial index of rate compliance of differences in these two ratios between areas, denote the numerator and denominator of [15] by respectively  $X_i$  and  $Z_i$ . That is,

$$\tau_i = \frac{X_i}{Z_i} = \frac{(B/N) - [a/(\alpha_i/\eta_i)]}{(B/N) - [a/(\gamma_i/\rho_i)]}, \quad [20]$$

where, under the conditions for which [19] holds,

$$X_i > 0 \text{ and } Z_i > 0 \quad \forall i. \quad [21]$$

Comparing the values of  $\tau$  in areas  $j$  and  $i$ , where both  $(\alpha/\eta)$  and  $(\gamma/\rho)$  differ, we obtain

$$\Delta\tau = \frac{a}{Z_i} \left( \frac{\gamma_i}{\rho_i} \right) \left( \frac{\gamma_j}{\rho_j} \right) \Delta(\alpha/\eta) - \frac{aX_j}{Z_i Z_j} \left( \frac{\alpha_i}{\eta_i} \right) \left( \frac{\alpha_j}{\eta_j} \right) \Delta(\gamma/\rho). \quad [22]$$

Then, holding real productivity  $(\gamma/\rho)$  equal for both areas, we have

$$\frac{\Delta\tau}{\Delta(\alpha/\eta)} = \frac{a}{Z_i} \left( \frac{\gamma_i}{\rho_i} \right) \left( \frac{\gamma_j}{\rho_j} \right) > 0, \quad [23]$$

and holding fiscal productivity  $(\alpha/\eta)$  equal for both areas,

$$\frac{\Delta\tau}{\Delta(\gamma/\rho)} = -\frac{aX_j}{Z_i Z_j} \left( \frac{\alpha_i}{\eta_i} \right) \left( \frac{\alpha_j}{\eta_j} \right) < 0. \quad [24]$$

Given that  $a$ ,  $X_j$ ,  $Z_i$  and  $Z_j$  are positive numbers, according to expression [23] other things equal, if area's  $j$  fiscal productivity is higher than area's  $i$ , area's  $j$  index of rate compliance will also be higher. That is, higher fiscal productivity when real productivity is the same, gives rise to a higher degree of rate compliance. Also, according to expression [24], if areas  $j$  and  $i$  do not differ in fiscal productivity, area  $j$  will have a lower index of rate compliance if its real productivity is higher than that of area  $i$ .

All the results so far refer to the value of *IRFC* at a given moment in time, or to the comparison between the *IRFC* of different areas, also at a given moment of time. It would also be interesting to know how this index evolves over time and what are the factors that determine

this evolution. Here, contrary to what has been done above, the characteristics of the tax system ( $B/N$  and  $a$ ) cannot be held constant, as normally they will change over time<sup>8</sup>. From expression [15] we have that

$$IR\dot{F}C_i = \dot{\tau}_i + \dot{\beta}_i \tag{25}$$

where, for any variable  $x$ ,  $\dot{x} = dx/x$ .

By definition,

$$\dot{\beta}_i = (\alpha_i/\gamma_i).$$

And, from [20],

$$\begin{aligned} \dot{\tau}_i = & \frac{a}{X_i(\alpha_i/\eta_i)} \left( \frac{\dot{\alpha}_i}{\eta_i} \right) - \frac{a}{Z_i(\gamma_i/\rho_i)} \left( \frac{\dot{\gamma}_i}{\rho_i} \right) \\ & - \frac{a(B/N)}{X_i Z_i} \left[ \frac{1}{(\alpha_i/\eta_i)} - \frac{1}{(\gamma_i/\rho_i)} \right] \left[ \dot{a} - \left( \frac{B}{N} \right) \right] \end{aligned} \tag{26}$$

Then, holding constant  $(\gamma_i/\rho_i)$ ,  $a$  and  $(B/N)$ , we have,

$$\frac{\dot{\tau}_i}{(\alpha_i/\eta_i)} = \frac{a}{X_i(\alpha_i/\eta_i)} > 0,$$

and holding constant  $(\alpha_i/\eta_i)$ ,  $a$  and  $(B/N)$ ,

$$\frac{\dot{\tau}_i}{(\gamma_i/\rho_i)} = -\frac{a}{Z_i(\gamma_i/\rho_i)} < 0.$$

That is, as was the case in the cross-section comparison, for an unchanged tax system, if fiscal productivity grows while real productivity remains constant, the index of rate compliance goes up; contrariwise, if real productivity grows while fiscal productivity remains constant, the index of rate compliance goes down.

Finally, holding  $(\alpha_i/\eta_i)$  and  $(\gamma_i/\rho_i)$  constant, we have

$$\begin{aligned} \frac{\dot{\tau}_i}{\left[ \dot{a} - (B/N) \right]} &= -\frac{a(B/N)}{X_i Z_i} \left[ \frac{1}{(\alpha_i/\eta_i)} - \frac{1}{(\gamma_i/\rho_i)} \right] \\ &> 0 \text{ if } \frac{(\alpha_i/\eta_i)}{(\gamma_i/\rho_i)} > 1 \\ &< 0 \text{ if } \frac{(\alpha_i/\eta_i)}{(\gamma_i/\rho_i)} < 1 \end{aligned}$$

<sup>8</sup>The index of relative fiscal compliance does not depend on the marginal rate  $m$  (see expression [15]), and therefore changes in this parameter do not affect the way in which the value of the index varies over time.

The term  $\left[\dot{a} - (B/\dot{N})\right]$  measures the effect on the index of rate compliance of changes in the overall degree of progressivity of the tax system; although these changes are the same for all areas, their effect on a particular area's index will vary depending on the relative position of this area. Given that both  $X_i$  and  $Z_i$  are positive, increments in the overall degree of progressivity,  $\left[\dot{a} - (B/\dot{N})\right] > 0$  will increase the index of rate compliance of those areas in which fiscal productivity is above real productivity, and viceversa for those areas in which fiscal productivity is below real productivity.

### 3. An application to Spain

The previous section has developed a theoretical model to measure relative territorial differences in fiscal compliance. Even taking as adequate the distribution criteria that define the potential tax base and effective rate, the empirical usefulness of the model depends on the extent to which [2] is a good representation of the actual income tax system whose compliance wants to be investigated. This is considered below for the case of the fifteen Spanish Autonomous Communities of common regime for the "Impuesto sobre la Renta de las Personas Físicas" (IRPF), but first it is interesting, only on the basis of the tax and macroeconomic elements singled out in the previous analysis, to see if there is *prima facie* evidence of territorial differences in the degree of fiscal compliance.

#### 3.1 A territorial comparison of fiscal and macroeconomic concepts

The analysis of Section 2 suggests that the ratios  $(\alpha/\gamma)$ ,  $(\alpha/\eta)$  and  $(\gamma/\rho)$  play an important role in the measurement of relative differences in fiscal compliance. It is therefore instructive, before incorporating them into the index defined by expression [15], to look at the value of these ratios for the fifteen Spanish Autonomous Communities of common regime.

Figure 1 shows for 1988 the pairs of values  $\alpha$  and  $\gamma$  for these fifteen areas, and Figure 2 gives the same information in an enlarged form for the smallest nine of them<sup>9</sup>. If the differences in the two distributions

<sup>9</sup>The year 1988 is chosen for reasons of data availability. In Section 3.3 we analyse the evolution of the index until 1992, which is the last year on which the complete set of data needed is available for all Autonomous Communities. Going back to 1988 gives a span of five years, which is the time length for which the system of

were not very significant, the observations in both figures should be closely aligned along the 45° line. That is, the relative distribution of the tax base should be similar to the distribution of income. This, however, is not the case. Out of the fifteen Autonomous Communities considered, only three –Aragón (ARA), Cantabria (CTB) and Rioja (RIO)– have a relative tax base that differs less than 5 percentage points (pp) from their relative income; in five of them –Andalucía (AND), Asturias (AST), Castilla-León (CTL), Catalunya (CAT) and Valencia (VAL)– this difference is between 5 and 10 pp; in another five –Murcia (MUR), Baleares (BAL), Canarias (CAN), Castilla-Mancha (CTM) and Galicia (GAL)– between 10 and 20 pp, and finally, in the remaining two –Madrid (MAD) and Extremadura (EXT)– above 20 pp. The empirical evidence then seems to suggest that there are substantial differences among Autonomous Communities in the efficacy with which the tax administration and the compliance of taxpayers transform income into tax base<sup>10</sup>. For example, while in Madrid the relative base is 25,3 pp above relative income, in Extremadura it is 24,6 pp below.

As the analysis of the previous section suggests, given the progressive nature of the income tax, the relative base per taxpayer ( $\alpha/\eta$ ) –the relative fiscal productivity of the area– and the relative real productivity ( $\gamma/\rho$ ) are also relevant factors to measure compliance. Figure 3 plots for each Community the pairs of values of these two types of productivity. Again, if the distribution of these two ratios was similar, the observations would be closely lined up along the 45° line. Out of the fifteen Communities considered, only six –Catalunya, Madrid, Canarias, Murcia, Extremadura and Castilla-León– have a relative fiscal productivity that is within 5 pp of their relative real productivity; in five Communities –Andalucía, Valencia, Castilla-La Mancha, Asturias and Baleares– the difference is between 5 and 10 pp, and in the remaining four –Galicia, Cantabria, Rioja and Aragón– it is above 10 pp.

regional finance is agreed. Thus, the complete exercise can also give an idea as to how an index such as this would influence regional finance, should it be used as part of the Spanish regional revenue sharing system. The data on income tax come from the Agencia Estatal de Administración Tributaria as compiled in Zabalza (1994) and the macroeconomic data come from the Spanish National Accounts and the Active Population Survey of the Instituto Nacional de Estadística. All the data used in this article are available upon request from the author.

<sup>10</sup>It should be noted that the administration of the income tax in all regions is the responsibility of the Agencia Estatal de Administración Tributaria, an agency dependent on the central government.

FIGURE 1  
Relative tax base and income, 1988

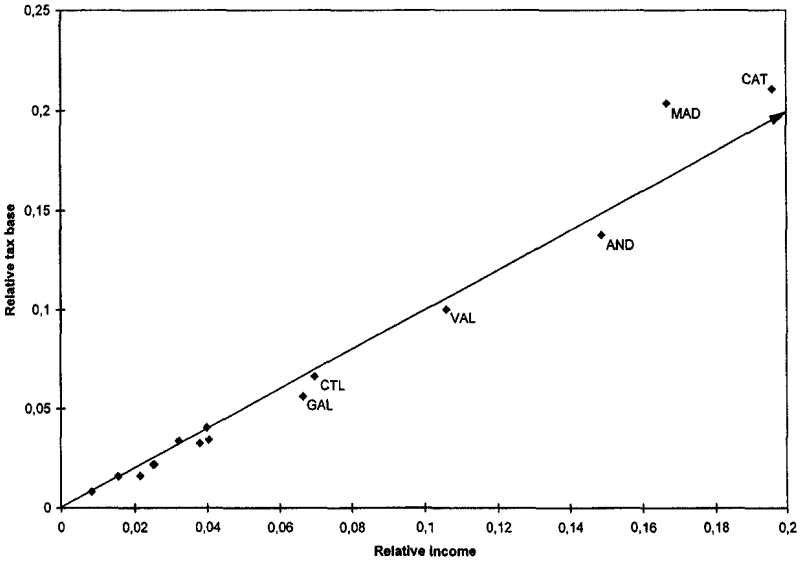
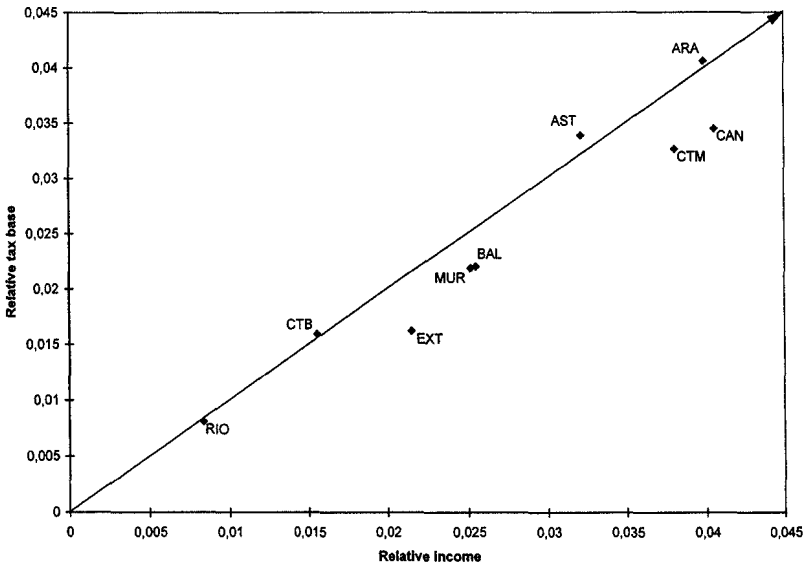


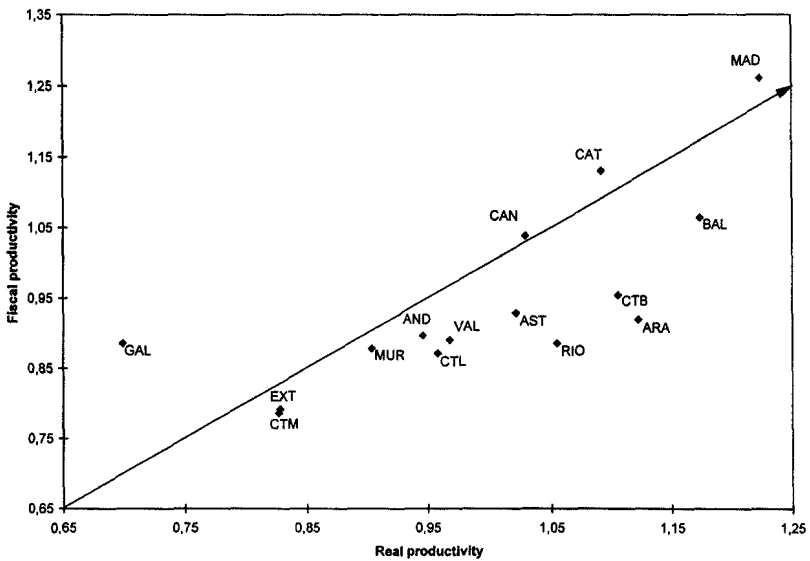
FIGURE 2  
Relative tax base and income for selectd Communities, 1988



Perhaps the most remarkable case is that of Galicia, whose relative fiscal productivity in 1988 was 24,6 pp above its relative real productivity. As seen in Figure 1 above, Galicia has a relative tax base which is low relative to its disposable income. The results of Figure 3 suggest that the cause of this could be the significant number of cases

in which the minimum level of income that determines the obligation to declare is binding, due to the low real productivity of the region. This is in principle a possibility; however, given its large size, the result could also be due to specific data errors affecting this region. As fiscal information is based on actual records, the main source of these errors has to be placed on either personal income or employment. To investigate this question would take us beyond the scope of this paper, but it is surprising that this region should have such a low level of real productivity. In 1988 it was only 69,9% of the mean national level, while that of Extremadura, the poorest Spanish region, was 82,8 % of this mean level. That is, taken at face value, these figures mean that Extremadura was in that year 18,5% more productive than Galicia<sup>11</sup>.

FIGURE 3  
Fiscal and real productivity, 1988

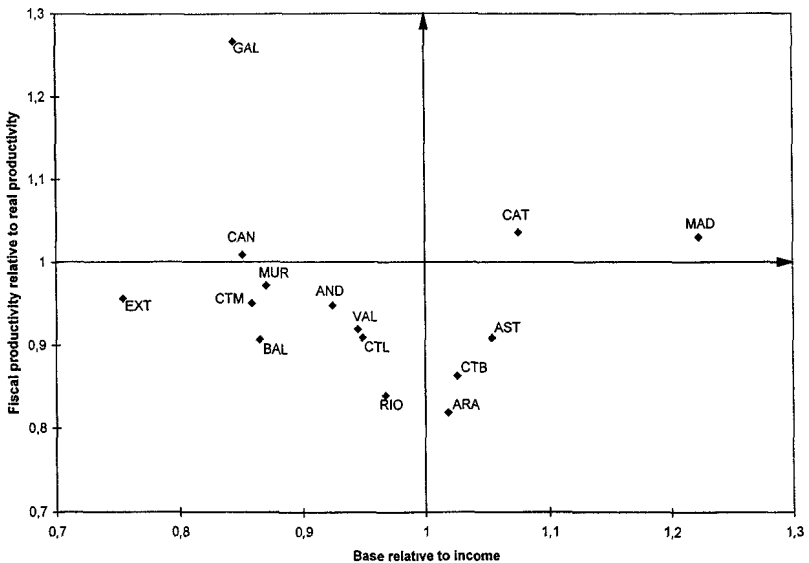


The index of relative fiscal compliance is in fact a combination of, on the one hand, the information given by Figure 1 and, on the other, a

<sup>11</sup>The results are similar if value added is used instead of personal income. Also, it makes no difference whether the data for regional occupation is obtained from the National Accounts or from the Employment Survey. As stated in the text, this is a problem the investigation of which goes beyond the scope of this paper, but which clearly deserves some attention if Spanish regional data are to be fruitfully used. It may be interesting to note that the problem may have subsided to the extent that in 1992 relative real productivity in Galicia (76,5% of the national mean level) was much closer to that of Extremadura (83,3%) than it was the case in 1988, although according to these data Galicia was still the least productive region in Spain.

transformation of the information given by Figure 3. Thus, a fairly complete idea of compliance should be obtained by putting together these two types of information. This is done in Figure 4, the axes of which measure the relative difference with respect the 45° line of respectively Figure 1 and Figure 3. At one end we have Madrid and Catalunya, both of them in the northeast quadrant of the figure, as they show not only a high base relative to their income, but also a high level of efficacy in transforming their real productivity into fiscal productivity. At the other end we have Castilla-León, Rioja, Valencia, Andalucía, Murcia, Canarias, Baleares, Castilla-La Mancha and Extremadura, all in the southwest quadrant as they show both a low relative base and a low level of efficacy in transforming real into fiscal productivity. Asturias, Cantabria and Aragón, which fall in the southeast quadrant, have a high relative base but their fiscal productivity is low relative to their real productivity. Canarias, in the northwest quadrant, has a low relative base but a fiscal productivity slightly above its real productivity. And finally, Galicia, which is also in the northwest quadrant, stands out as a clear outlier, with the second lowest relative base but with a level of fiscal productivity which is very large in relation to its low real productivity.

FIGURE 4  
The elements of relative fiscal, compliance, 1988



3.2 *The relative index of fiscal compliance for 1988*

What the relative index of fiscal compliance developed in Section 2 does, is to collapse into a number all the information so far reviewed. For this to be possible, however, we need to show that [4] is a good representation of the income tax system and to have an estimate of the parameters  $a$  and  $m$ . Equation [4] defines the tax system used in the development of the index. How good a representation of the Spanish IRPF is this equation?

For estimation purposes, [4] can be rewritten as follows:

$$\frac{T_i}{B_i} = m - ma \left[ \frac{1}{(B_i/N_i)} \right], \tag{27}$$

where all symbols have already been defined. According to [27], the parameters  $m$  and  $a$  can be retrieved from the estimation of a linear equation that relates the effective average tax rate in each Autonomous Community with the inverse of its tax base per taxpayer. Figure 5 represents graphically the form that this equation takes when we plot the effective average tax rate against the tax base per taxpayer. The average rate is zero when the base per taxpayer equals the tax allowance, increases as the base per taxpayer increases, and converges asymptotically to the marginal rate as the base per taxpayer tends to infinity.

FIGURE 5  
The representation of the income tax system

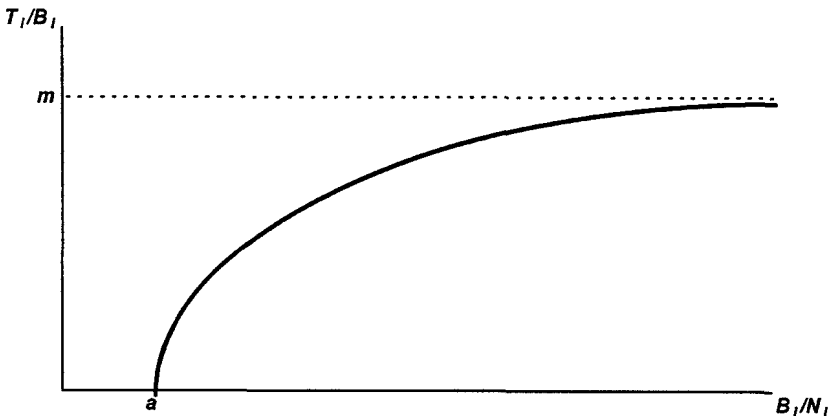


Table 1, using data on the fifteen Autonomous Communities, presents the weighted least square estimates of equation [27] for 1988 and, for

use in the next section, for the other four years of the period considered in this exercise<sup>12</sup>. Centering our attention for the time being on the year 1988, we see that the estimates obtained have the expected sign and dimension and are statistically very significant. The tax allowance is estimated at 827.585 Pesetas of 1988 and the marginal tax rate at 27,55%. No Community had in that year an average tax base below the estimated tax allowance; the observed values range from Ptas. 1.329.613 for Extremadura to Ptas. 2.118.502 for Madrid.

TABLE 1  
Weighted ls estimates of equation [27]

Year	Constant	$N_i/B_i$	$R^2$	Implied		Mean of	
				m	a	$B_i/N_i$	$T_i/B_i$
	(1)	(2)	(3)	%	Ptas.	Ptas	%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1988	0,2755 (43,15)	-0,2280 (20,95)	0,9988	27,55	827.585	1.679.476	14,05
1989	0,2958 (47,03)	-0,2627 (22,91)	0,9989	29,58	888.168	1.797.717	15,02
1990	0,3025 (49,14)	-0,2831 (23,40)	0,9990	30,25	935.934	1.936.956	15,70
1991	0,3017 (52,17)	-0,2938 (24,48)	0,9991	30,17	973.813	2.045.624	15,87
1992	0,3145 (49,94)	-0,3195 (24,53)	0,9991	31,45	1.015.763	2 036.515	15,82

Note Numbers in parentheses are absolute values of the t-statistics Number of observations 15

Using these estimates, Table 2 presents in column (1) the level of what has been termed above relative fiscal productivity, in column (2) relative real productivity, and in column (3) the value of the partial index of relative rate compliance given by expression [20]. The values of fiscal and real productivity have already been discussed in the previous section. The value of  $\tau_i$ , on the other hand, shows that the correction introduced by progressivity is empirically important, with values that range from +50,2% for Galicia to -6,7% for Extremadura. Column (4)

<sup>12</sup> Ordinary Least Square give very similar results and are very highly significant, but not as precisely estimated as those obtained by Weighted Least Squares. Although there was no evidence of heterocedasticity problems, we weighted the data to take into account the large differences in size among Autonomous Communities. The weight used is the number of taxpayers in each Community. The highly significant results obtained are as expected, as what is being estimated is not a behavioural relationship but an approximation to a definitional relationship between effective mean tax rates and individual taxable basis determined by the income tax law.

shows the partial index of relative base compliance, and column (5) the overall index of relative tax compliance. Clearly, as both Table 2 and Figure 6 show, the most striking result is the one that corresponds to Galicia, for which the progressivity correction means a shift upwards in the order of compliance from the second position from the bottom to the first position. As has been commented above, this is probably due to the abnormally low real productivity that according to the official statistics this Community has and, although it does not affect excessively the results for the other Communities, it gives a distorted image of the distribution of relative compliance.

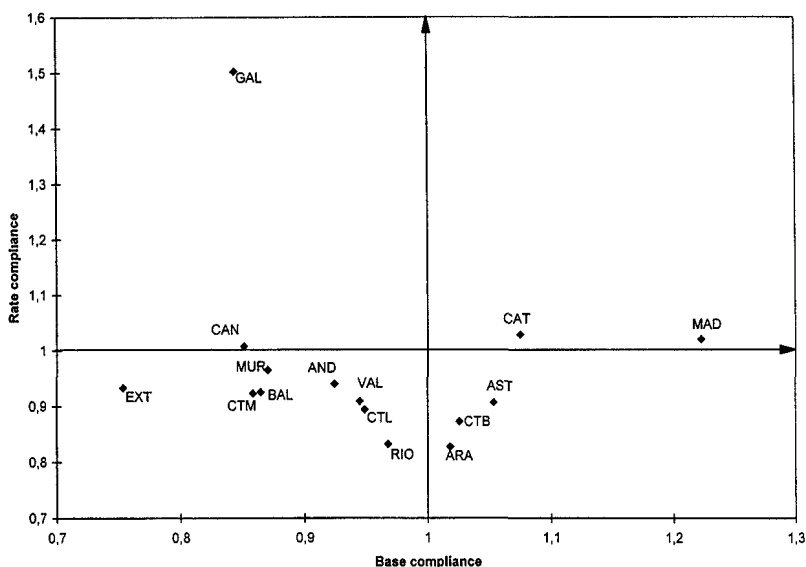
TABLE 2  
The index of tax compliance and its components. 1988

Autonomous Community	$\alpha_i/\eta_i$ (1)	$\gamma_i/\rho_i$ (2)	$\tau_i$ (3)	$\alpha_i/\gamma_i$ (4)	IRFC <sub>i</sub> (5)=(3)*(4)
Galicia	0,8853	0,6991	1,5023	0,8439	1,2678
Madrid	1,2614	1,2237	1,0201	1,2225	1,2471
Cataluña	1,1311	1,0914	1,0289	1,0756	1,1066
Asturias	0,9291	1,0219	0,9070	1,0543	0,9562
Cantabria	0,9547	1,1054	0,8730	1,0261	0,8957
Andalucía	0,8969	0,9458	0,9407	0,9241	0,8693
Valencia	0,8905	0,9682	0,9095	0,9447	0,8592
Canarias	1,0389	1,0297	1,0082	0,8513	0,8582
Castilla y León	0,8714	0,9583	0,8944	0,9486	0,8484
Aragón	0,9195	1,1221	0,8275	1,0186	0,8429
Murcia	0,8784	0,9036	0,9656	0,8704	0,8404
Rioja	0,8859	1,0548	0,8328	0,9673	0,8056
Baleares	1,0645	1,1737	0,9258	0,8651	0,8009
Castilla-La Mancha	0,7861	0,8269	0,9234	0,8586	0,7928
Extremadura	0,7917	0,8278	0,9330	0,7542	0,7036

To mitigate this problem, Table 3 and Figure 7 repeat the exercise excluding Galicia from the set of Communities considered<sup>13</sup>. Although the relative distribution among the remaining Communities remains practically the same, the progressivity correction is now smaller, ranging from a +3,7% for Madrid to a -3,4% for Extremadura. According to these results, in relative terms, the highest degree of overall compliance is found in Madrid, followed at a certain distance by Catalunya.

<sup>13</sup>For statistical efficiency reasons, however, Galicia is not excluded from the estimation of equation [27]. Although this region is an outlier insofar as the relationship between fiscal and real productivity is concerned, it is clearly not an outlier concerning the relationship between the taxable base and the effective mean tax rate. Because of this, dropping this observation in the estimation of equation [27] leaves the estimated coefficients practically unchanged.

FIGURE 6  
The index of relative fiscal compliance 1998

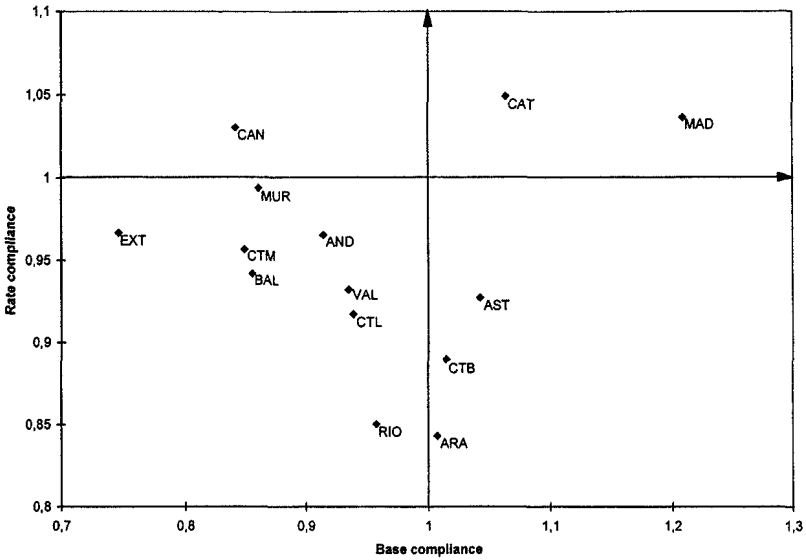


A group of two Communities –Asturias and Cantabria– follow, whose index of overall compliance is between 0,9 and 1,0. Then there is the largest group –Andalucía, Valencia, Canarias, Castilla-León, Murcia, Aragón, Rioja, Castilla-La Mancha and Baleares–, whose index of overall compliance goes between 0,8 and 0,9, the most singular case being that of Aragón, whose relatively high index of base compliance

TABLE 3  
The index of tax compliance and its components in 1988. (Excluding Galicia)

Autonomous Community	$\alpha/\eta_1$ (1)	$\gamma/\rho_1$ (2)	$\tau_1$ (3)	$\alpha/\gamma_1$ (4)	IRFC <sub>1</sub> (5)=(3) <sup>4</sup> (4)
Madrid	1,2517	1,1863	1,0367	1,2091	1,2534
Cataluña	1,1224	1,0580	1,0493	1,0638	1,1162
Asturias	0,9219	0,9906	0,9274	1,0427	0,9670
Cantabria	0,9473	1,0716	0,8899	1,0148	0,9031
Andalucía	0,8900	0,9168	0,9655	0,9140	0,8825
Valencia	0,8836	0,9385	0,9324	0,9343	0,8712
Canarias	1,0309	0,9982	1,0305	0,8419	0,8676
Castilla y León	0,8647	0,9290	0,9174	0,9381	0,8607
Murcia	0,8717	0,8759	0,9938	0,8608	0,8555
Aragón	0,9125	1,0877	0,8432	1,0074	0,8494
Rioja	0,8791	1,0225	0,8505	0,9567	0,8136
Castilla-La Mancha	0,7800	0,8016	0,9568	0,8492	0,8124
Baleares	1,0563	1,1377	0,9419	0,8555	0,8059
Extremadura	0,7856	0,8024	0,9666	0,7459	0,7210

FIGURE 7  
The index of relative fiscal compliance, excluding Galicia, 1988



is significantly corrected downwards by a low index of rate compliance. Finally we have Extremadura, whose overall index is below 0,8. Extremadura has a very low index of base compliance that is partially compensated by a relatively high index of rate compliance.

3.3 *The evolution of the index from 1988 to 1992*

How has the index of relative fiscal compliance evolved over time? Table 4 shows in panel A the evolution between 1988 and 1992 of the index in numerical terms, while panel B presents for each of the five years the position of the Communities ordered according to the value of their index. In both panels, and for the reasons given above, Galicia has been excluded.

As can be seen in panel A, the dispersion of fiscal compliance between Communities has gone up slightly during this period. Panel B, on the other hand, indicates that there has been a lot of stability in the extremes of the distribution, with Madrid and Catalunya always showing the highest indices of tax compliance, and Baleares and Extremadura the lowest. However, there has also been some mobility in the middle of the distribution, Castilla-León and Andalucía being the Communities that have advanced most in the ranking of compliance, and Valencia and Murcia those that have worsen most.

TABLE 4  
Evolution of the index of compliance excluding Galicia  
and ordered positions by compliance from 1988 to 1992

Panel A					
Evolution of the index					
Autonomous Community	1988	1989	1990	1991	1992
Andalucía	0,8825	0,8546	0,8975	0,9012	0,8893
Aragón	0,8494	0,8679	0,9025	0,8882	0,8731
Asturias	0,9670	0,9210	0,9039	0,8823	0,8830
Baleares	0,8059	0,7753	0,7815	0,7368	0,6689
Canarias	0,8676	0,8775	0,8785	0,8442	0,8693
Cantabria	0,9031	0,9151	0,9109	0,8925	0,8783
Castilla-La Mancha	0,8124	0,7800	0,7832	0,8243	0,8678
Castilla y León	0,8607	0,8198	0,8506	0,8729	0,9218
Cataluña	1,1162	1,1810	1,0927	1,1073	1,0740
Extremadura	0,7210	0,6577	0,6962	0,7508	0,7896
Madrid	1,2534	1,2388	1,2569	1,2684	1,3020
Murcia	0,8555	0,8473	0,8820	0,8329	0,8146
Rioja	0,8136	0,7755	0,8217	0,8084	0,8203
Valencia	0,8712	0,8775	0,8898	0,8520	0,8556
Standard deviation	0,1360	0,1541	0,1368	0,1391	0,1459

Panel B					
Ordered positions					
	1988	1989	1990	1991	1992
	Madrid	Madrid	Madrid	Madrid	Madrid
	Cataluña	Cataluña	Cataluña	Cataluña	Cataluña
	Asturias	Asturias	Cantabria	Andalucía	Cast.-León
	Cantabria	Cantabria	Asturias	Cantabria	Andalucía
	Andalucía	Canarias	Aragón	Aragón	Asturias
	Valencia	Valencia	Andalucía	Asturias	Cantabria
	Canarias	Aragón	Valencia	Cast.-León	Aragón
	Cast -León	Andalucía	Murcia	Valencia	Canarias
	Murcia	Murcia	Canarias	Canarias	Castilla-M
	Aragón	Cast.-León	Cast.-León	Murcia	Valencia
	Rioja	Castilla-M.	Rioja	Castilla-M.	Rioja
	Castilla-M.	Rioja	Castilla-M.	Rioja	Murcia
	Baleares	Baleares	Baleares	Extremad.	Extremad.
	Extremad	Extremad	Extremad	Baleares	Baleares

Using expression [25], Table 5 and Figure 8 present the contribution of the change in rate and base compliance to the evolution of the overall index between 1988 and 1992. Over this period, the Communities whose overall index of fiscal compliance has increased most are Extremadura, Castilla-León and Castilla-Mancha, while those whose compliance has decreased most are Baleares and Asturias. Normally, in

those Communities where the overall index has increased, the improvement has come from an increase in both rate and base compliance, and in those Communities where it has decreased, the deterioration has also come from a fall in both rate and base compliance. Still, most of the improvement of overall compliance in Extremadura comes from a higher level of base compliance, while most of the deterioration of overall compliance in Baleares comes from a lower level of rate compliance.

TABLE 5  
The evolution of the index of tax compliance and its components between 1988 and 1992, excluding Galicia

Autonomous Community	IRFC <sub>i</sub> (1)	Percentage increase of		
		$\tau_i$ (2)	$\beta_i$ (3)	Remainder (4)=(1)-(2)-(3)
Extremadura	9,51	0,51	8,96	0,05
Castilla y León	7,11	3,60	3,39	0,12
Castilla-La Mancha	6,81	0,48	6,30	0,03
Madrid	3,88	3,79	0,09	0,00
Aragón	2,79	2,84	-0,04	0,00
Rioja	0,82	-0,54	1,37	-0,01
Andalucía	0,77	0,24	0,53	0,00
Canarias	0,19	-0,65	0,84	-0,01
Valencia	-1,79	-2,58	0,81	-0,02
Cantabria	-2,74	1,10	-3,80	-0,04
Cataluña	-3,78	-1,18	-2,63	0,03
Murcia	-4,78	-4,77	-0,01	0,00
Asturias	-8,69	-3,23	-5,64	0,18
Baleares	-17,00	-13,32	-4,25	0,57

FIGURE 8  
The evolution of the index of compliance and components between 1988 and 1992, excluding Galicia

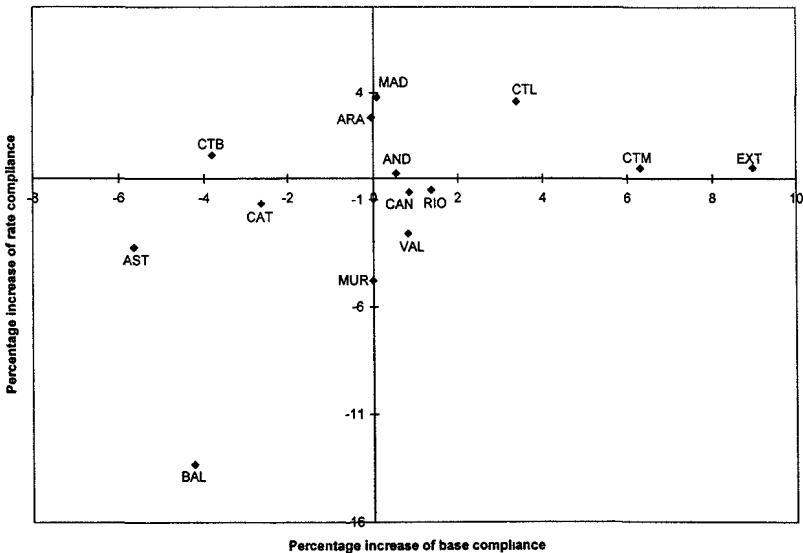


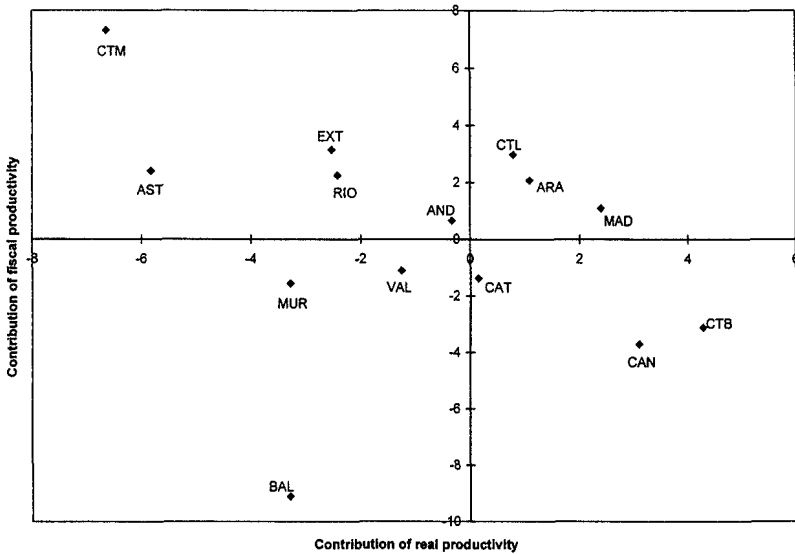
TABLE 6  
Contributing factors to the evolution of the index of rate compliance between  
1988 and 1992, excluding Galicia (percentages)

Autonomous Community	Increment of the index of rate compliance (1)	Contribution of				Remcinder (5)=(1)- [(2)+(3)+(4)]
		Fiscal productivity (2)	Real productivity (3)	Tax progressivity (4)		
Madrid	3,79	1,09	2,39	0,09	0,22	
Castilla y León	3,60	2,98	0,78	-0,28	0,11	
Aragón	2,84	2,08	1,09	-0,49	0,16	
Cantabria	1,10	-3,11	4,27	-0,33	0,27	
Extremadura	0,51	3,16	-2,53	-0,13	0,01	
Castilla-La Mancha	0,48	7,31	-6,64	-0,17	-0,02	
Andalucía	0,24	0,66	-0,33	-0,11	0,02	
Rioja	-0,54	2,26	-2,42	-0,49	0,11	
Canarias	-0,65	-3,72	3,09	0,08	-0,11	
Cataluña	-1,18	-1,37	0,14	0,13	-0,08	
Valencia	-2,58	-1,11	-1,26	-0,22	0,01	
Asturias	-3,23	2,40	-5,83	-0,22	0,42	
Murcia	-4,77	-1,56	-3,28	-0,02	0,09	
Baleares	-13,32	-9,10	-3,29	-0,16	-0,76	

Finally, using expression [26], Table 6 and Figure 9 show to what extent the evolution of fiscal productivity, real productivity and the progressivity of the tax system have contributed to the change in the index of rate compliance in each Community over the period considered. The contribution of progressivity is, in absolute terms, smaller than that of the other two elements. Between 1988 and 1992 the value of the term  $[\dot{a} - (B/N)]$  has been positive (an increase in progressivity), thus the sign of this effect in each Community reflects whether its fiscal productivity is higher (positive sign) or lower (negative sign) than its real productivity. The highest increase in the index of rate compliance is that of Madrid (3,8%), and is explained by the fact that in this Community, despite a fall in relative real productivity of 3,4%, relative fiscal productivity has increased by 1,7%. This relationship between real and fiscal productivity also occurs in the next two Communities -Castilla-León and Aragón- where fiscal productivity has improved despite a fall in real productivity. The opposite happens in the two Communities where the index of rate compliance has fallen most - Baleares and Murcia. In both cases, the increase in real productivity experienced has not been transformed in a corresponding increase in fiscal productivity. Baleares, in particular, despite having experienced

an increase of 4,4% in relative real productivity, shows a 10,6% fall in its relative fiscal productivity.

FIGURE 9  
 Contribution of fiscal and real productivity to the increase of rate compliance between 1988 and 1992, excluding Galicia



#### 4. Concluding remarks

This paper has advanced a framework to study relative fiscal compliance (or relative fiscal effort, if seen from the point of view of a revenue sharing system) in the presence of progressive taxation, and has applied this framework to the Spanish system of Autonomous Communities. The results show that, in addition to the comparison between the relative tax base of a given area and its relative income, which may be an adequate procedure when the tax system is proportional, the measure of relative compliance when taxes are progressive needs also to take into account the relationship between relative real productivity and what here has been termed “relative fiscal productivity”

The application to Spanish data illustrates how this framework can be used empirically. The results obtained conform to expectations as to the differences in compliance between the Spanish Autonomous Communities, and suggest that there is some relation between fiscal compliance and: (a) the extent of dependent work (which would explain the high index levels obtained for Madrid and Catalunya, where

the number of civil servants and dependent workers is relatively much larger than in other Communities); and (b) the extent of dependent work *in the manufacturing sector* (which would explain in addition the low values obtained for Baleares, where the number of workers in the tourist sector is relatively much larger than in other Communities, and for the eminently agrarian Communities of Murcia and Extremadura).

The detailed analysis of the relationship between fiscal compliance and industrial structure that this exercise suggests is beyond the scope of this paper, but it is interesting to note that intuitively the existence of this connection has for a long time been widely held by public opinion. This poses the question as to the need for an analysis as elaborate as the present one to obtain a result which is in effect already known. The answer goes in three parts. First, if it was the case that this relationship is a robust one, which is by no means an obvious conclusion, it would be reassuring to find out that the results obtained using independent data agree with general opinion as to the relationship between fiscal compliance and industrial structure. Second, industrial structure may be related to compliance, but the two are different things and a given industrial structure need not inevitably lead to a given level of compliance. In fact, the value of the index across Communities suggests that there may be something more than industrial structure to fiscal compliance. Third, even if industrial structure was the sole determinant of compliance, the procedure developed here offers a simple and fairly accessible way to compute a quantitative measure of the extent to which differences in industrial structure are reflected in differences in compliance, and thus an operative instrument to guide the allocation of administrative resources<sup>14</sup>.

<sup>14</sup>Perhaps another way of putting this point is that this paper has been concerned with measuring as opposed to explaining relative compliance. One of the referees suggests possible venues for future work, by way of regressing the index here obtained with those elements (such as the industrial structure between areas) that one may think are behind these differences in compliance. This is an interesting exercise that should help us to understand the relative importance of these factors in explaining compliance. Another interesting issue, also suggested by the referee, is the interpretation of the residuals of such an exercise. I venture that they would reflect differences in what may be termed "pure compliance attitudes" and/or efficacy in regional tax administration.

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## Abstract

*Este trabajo presenta un marco analítico para estudiar diferencias territoriales en el grado de cumplimiento fiscal en presencia de un impuesto progresivo sobre la renta, y aplica el índice resultante al sistema español de financiación autonómica. Los resultados muestran que, además de la comparación entre la base fiscal relativa de una determinada área y su renta relativa, que puede ser un procedimiento adecuado cuando el impuesto es proporcional, la medición del grado de cumplimiento relativo cuando el impuesto es progresivo debe tomar en cuenta también la relación entre la productividad real relativa y lo que podría denominarse la productividad fiscal relativa (base fiscal relativa por contribuyente).*

*Recepción del original, abril de 1998*

*Versión final, agosto de 1998*