Tax Effort of Local Governments and its Determinants: The Spanish Case[*]

Jaime Vallés-Giménez

Department of Public Economics, Faculty of Economics and Business, University of Zaragoza, Spain
E-mail: jvalles@unizar.es

and

Anabel Zárate-Marco[†]

Department of Public Economics, Faculty of Economics and Business, University of Zaragoza, Spain
E-mail: azarate@unizar.es

We have implemented frontier techniques to analyse the local tax effort and its determinants. The results show that municipalities have been quite responsible on average (tax efforts between 72-85 percent), although most municipalities can increase their tax efforts both making a more intensive use of their tax authority and improving the efficiency of their tax collection. To respond to the financing problems of municipalities near the tax frontier, it would be desirable to reform the legal framework to allow a greater tax capacity while leaving the decision on how to use this potential in hands of each unit of government.

Key Words: Local taxes; Tax effort; Frontier techniques; Efficiency; Use of tax authority.

JEL Classification Numbers: H71, H21, H12, H77.

1. INTRODUCTION

Although there is a plethora of applied literature analysing the tax effort of federal governments, there are few empirical studies about this topic

at sub-central level. There are at least three reasons to analyse local tax behaviour, beyond the purely academic interest. First, studies about fiscal accountability analyse financial dependence on transfers from the central level, without directly tackling the real exercise of tax autonomy by sub-central governments via tax effort. Second, the literature associated with equalisation transfers has traditionally focused in the analysis and construction of indicators of fiscal needs, leaving aside the study of tax effort, even in countries like Spain where tax effort is used as a criterion for the distribution of state funds. And third, the difficult economic situation that many Eurozone countries are suffering makes it necessary to review their subcentral financing systems and adapt them to the new demands of solvency of the European institutions and to the needs of each country. For this, it will be necessary to know the tax reality of the different jurisdictions, their levels of efficiency and their possibilities as a source of revenue. This will also enable to test the accuracy of the claims of underfunding that sub-central governments, like the Spanish, traditionally use to position themselves as victims[1].

For all that, the aim of this paper is to quantify the use that Spanish municipalities are making of their tax capacity, i.e., their tax effort. Spanish local financing system presents a series of specific characteristics which make it an especially interesting case for these analyses. First, Spanish municipalities enjoy a high level of financial autonomy, permitting the appearance of heterogeneous tax behaviours within a shared national framework. Second, as we explained before, the design of the equalisation transfer model in Spain considers municipalities' tax effort as one of the factors determining the allocation of the state transfers. And finally, the aggregate budgetary balance shown by local level of government in Spain is the result of two measures which were unilaterally adopted by the central government: heavier local taxes (especially on residential property ownership) and spending cuts (Local Government Rationalisation and Sustainability Act). However, this overall budgetary situation conceals a widely differing reality, in which heavily indebted municipalities are found alongside others with balanced and robust financial accounts (Balaguer-Coll, et al, 2016). This also justifies the need to examine how the municipalities have used their tax discretion, in order to assess whether central government interven-

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[1]In fact, a recent paper of Cabaleiro and Buch (2014) confirms that the budgetary solvency dimension is associated with the tax collection effort. For that purpose they use the tax effort indicator calculated by the Spanish Ministry of Economy and Finance for the distribution of state funds, as the result of the difficulty in calculating the tax effort of the large set of existing municipalities, although they recognize that is not entirely satisfactory. The drawbacks of this indicator are detailed in Pedraja (2008) and Suárez-Pandiello and Fernández-Llera (2008).

tion was necessary, or on the contrary, whether the tax autonomy enjoyed by the municipalities gave them enough scope to increase their revenue.

Our empirical study takes a sample of 465 Spanish municipalities during the period 2002-2008, and presents four unique methodological features that distinguish it from the emerging corpus of existing international works about tax effort at sub-central level. First, we use various frontier techniques, which are only now beginning to be used in the field of fiscal federalism in order to calculate tax effort. We also suggest certain improvements to the estimates in the literature, given that we extend the hypotheses explaining tax capacity, combining general indicators with specific indicators of tax capacity, and consider new explanatory causes of the use of tax capacity. Another novelty is that despite the difficulty of obtaining information on the socio-economic situation of the smaller municipalities, we have included local governments of every size in the sample. This is particularly relevant in a country as Spain, where 60 percent of the municipalities have fewer than 1,000 inhabitants. And finally, we use a dynamic approach with panel data, rather than the cross-section estimates more often found in this type of study.

Our results show an average local tax effort between 72-85 percent, which suggests Spanish municipalities have usually exercised their regulatory capacity in the tax sphere with great responsibility, although they have a relevant average room to improve their collection. The Stochastic Frontier Analysis also suggests that for raising tax effort, municipalities can both make a more intensive use of their tax authority (e.g., raising their tax rates, eliminating or reducing tax allowances on these taxes, etc.) and improve the efficiency of the collection (e.g., combating corruption, tax evasion, etc). The result of tax efforts close to the frontier also highlights the need for undertaking reforms to raise the potential tax revenue (e.g., increasing the maximum tax rates; making compulsory the voluntary taxes; allowing local governments to access to new tax bases, etc.), leaving the decision on how to use this potential in the hands of each local government. We think that these results can be largely extended to other countries, can be helpful in designing of future tax reforms and can be used to analyse and solve problems of financial solvency.

The work is structured as follows. In the next section, we define the concept of tax effort and review the available literature on the subject and the different methodologies applied in its study. In the third section, we discuss the peculiarities of the local tax system in Spain, we present the sample of municipalities we are going to use, and we take two initial approaches to calculating tax effort: first, using a simple technique based on the range of tax rates which municipalities can set, and then using various non-parametric frontier approaches. In the fourth section, in order to extract practical conclusions that can improve tax collection (if this is

what the municipality wants), we analyse how intensively municipalities use their tax capacity and the factors explaining their tax effort, using a parametric stochastic frontier analysis. This alternative approach, which is rapidly becoming popular in the sphere of public economy research, enables us to see what aspects contribute to explaining the gap between potential and effective tax collection, includes variables reflecting the heterogeneity of our sample, and corroborates the robustness of the average results obtained with non-parametric approaches. The work ends with a section of concluding remarks.

2. REVIEW OF THE LITERATURE ON TAX EFFORT

Several approaches to the concept of tax effort have been suggested in the literature, but none has been universally accepted as satisfactory. The most widely recognised tendency considers tax effort to be the degree to which a jurisdiction effectively uses its tax capacity. The tax capacity of a jurisdiction can be defined as the tax resources which a government can obtain when making full use of its regulatory power over the taxes within its reach (legal tax capacity) or the maximum tax revenue that could be collected in a jurisdiction given its economic, social, institutional and demographic characteristics (economic tax capacity). In this way, the numerator of the tax effort (the exercised tax capacity or real collection) depends on the action of the government, but not the denominator (tax capacity) which is unobservable and difficult to quantify.

In practice, this tax capacity (denominator) has sometimes been measured through real present or past tax collections, or via macroeconomic indicators such as the income or wealth of the territory. A pioneering example of this school of thought is Frank's index (1959), which defines tax effort as the quotient between the fiscal pressure of the jurisdiction and its per capita income. Suarez and Fernández (2008) and Cordero et al. (2010) used this technique in Spain, although their results were excessively high in low income territories.

An alternative way to approach tax capacity is the representative tax system (ACIR, 1988), which calculates the potential tax revenues that governments would obtain using the current tax system and applying an average fiscal pressure to the different tax bases available to them. This method requires a great deal of information and subjective decisions in the evaluation process. We could include Poveda and Sánchez (2002) and Delgado (2008) in this group of work, because they identify the tax capacity of local governments in Spain with the highest rates they can set for local taxes. They calculate the tax effort of municipalities by comparing actual tax rates versus the maximum permitted rates, although without considering the other possibilities the law grants for modulating tax collection.

Given the limitations of the above approaches, the econometric method is the one used by most empirical studies of tax capacity. The first econometric applications used the least squares analysis (OLS) to estimate the average tax capacity a jurisdiction should achieve given its characteristics, and the tax effort was obtained by comparing real tax revenue with the average revenue estimated using the regression. There are many works using this methodology at the national level (from the pioneering Lotz and Morss, 1967, to the recent work of Le et al, 2012), although as far as we know, at the local level only the papers of Wang et al (2009) for China, and Cordero et al. (2010) for Spain use it.

Recently a novel methodology has come into use for quantifying tax capacity, based on the stochastic frontier production possibilities suggested by Aigner et al. (1977) and Meeusen and van den Broeck (1977). Pessino and Fenochietto (2010 and 2013), Cyan et al. (2014), Ndiaye and Korsu (2014) or Zakova and Slabosh (2015) for central governments; Ramírez and Erquizio (2011) and Garg et al. (2017), for regions, as well as the preliminary approach of Medina (2012) for the Spanish regions; and the research of Alfirman (2003) and Aguilar (2007) on local governments, have used this alternative to conventional econometric estimation by least squares. This methodology uses maximum likelihood techniques to estimate a stochastic tax frontier. In this way, the tax capacity of a jurisdiction will be considered the maximum collection level it could obtain with an efficient exploitation of its tax bases and effective management of its taxes. Statistically, this idea means a regression model has to be specified for the tax frontier with two error terms, v and u, where v represents the usual statistical noise, and u represents the error in obtaining the maximum amount of revenue for given inputs. Furthermore, u is a function of a series of explanatory variables or exogenous factors which are associated with the municipality's tax margin and may vary over time. The tax effort index is constructed by comparing real revenue with the estimated frontier or potential tax revenue, so it cannot exceed 100 percent. No economic agent can be located beyond the frontier, so that any deviation from it will represent each jurisdiction's margin to raise its revenue to the "potential" maximum.

To a much more limited extent, other techniques have been tried in tax effort studies, which although not parametric, share the frontier approach and are frequently found in evaluations of the efficiency of units of production. Data Envelopment Analysis (DEA), designed in its current form by Charnes et al. (1978), constructs an enveloping surface where the local governments that obtained the maximum level of tax collection based on the inputs would be, so that the tax collecting margin of the municipalities could be measured by their distance from the frontier. DEA has been used to measure the tax effort of municipalities in Colombia (Departamento Nacional de Planeación, 2005) and in several states in India (Thirtle et al,

2000 and Rajaraman and Goyal, 2012). Its non-convex version, the Free Disposal Hull (FDH) model proposed by Deprins et al. (1984), has been less used. As far as we know, only Mattos et al. (2011) have used it to measure efficiency in the collection of municipal taxes in Brazil. With FDH, a municipality which does not exploit its maximum tax-gathering potential will be compared with a real municipality which obtains more tax income, and not a virtual one constructed from linear combinations (as in the DEA model).

There are two more recent developments, the so-called order-m (Cazals et al, 2002) and order-α (Aragon et al, 2005) partial frontier approaches, which are generalisations of the FDH and do not envelop all the data. Although they are beginning to be used in business efficiency studies, they have not yet found a place in the field of fiscal federalism. These non-parametric partial frontier methods allow atypical or super-efficient efficiency observations, i.e., beyond the estimated tax collection frontier, making it possible to greatly reduce sensitivity to errors of measurement and outliers.

To summarise, the review of the literature leads us to conclude that there is ample international empirical evidence for calculating tax effort at the national level, although there are still few empirical studies about this topic at sub-central level. The problem of the availability of applied research becomes more acute in the case both of municipalities, especially the smallest ones, due to the problems of information they present, and of the works that consider several years at the same time (panel data). Alongside this, the existence of various analytical techniques, each with its pros and cons, requires us to be aware of the limitations of the approach used at any time, and as far as possible, allows us to apply alternative methodologies in order to take advantage of the merits of each method and overcome its weaknesses, while checking the robustness of the results obtained.

3. QUANTIFICATION OF THE USE OF TAX CAPACITY IN SPANISH MUNICIPALITIES

In Spain, the law (Real Decreto Legislativo 2/2004, de 5 de marzo, Texto Refundido de la Ley Reguladora de las Haciendas Locales, onwards TRLRHL) establishes a standard framework for local government taxation throughout the territory, and rules that municipalities can use the revenue collected through five taxes: Property Tax (Impuesto sobre Bienes Inmuebles, IBI), levied on the value of each real estate property in the municipality; Economic Activity Tax (Impuesto sobre Actividades Económicas, IAE), levied on the income presumably obtained from economic activity in the municipality; the Motor Vehicle Tax (Impuesto sobre Vehículos de

Tracción Mecánica, IVTM), on the ownership of any vehicle which can legally be driven; the Building Work and Installations Tax (Impuesto sobre Construcciones, Instalaciones y Obras, ICIO), on any building work or civil engineering; and the Tax on Increase in Urban Land Value (Impuesto sobre el Incremento del Valor de los Terrenos de Naturaleza Urbana, IIVTNU), levied on the capital gains obtained on transfers of urban land.

The laws applying to these five taxes are State-wide, although local governments have some regulatory capacity which they can exercise within certain limits, as established in the TRLRHL. Thus, the amount of Spanish local tax revenue can be influenced by at least six optional factors. First, municipalities have a certain amount of discretion when setting the rates of these taxes. Second, they can affect the amount of the tax bases insofar as, for example, they may decide to revise the cadastral values of properties[2], to modify the IAE tax liability within certain limits (depending on the category of street on which economic activity takes place), etc. Third, they can use techniques that combine the two mechanisms above, so that, for example, if the amount of the tax base is increased, the tax rate applied can be reduced. Fourth, they have the power within the municipal area to decide whether to impose two taxes: the ICIO and the IIVTNU, which are optional. Fifth, they have the regulatory capacity to establish certain exemptions and rebates. For example, a local government can decide to exempt properties used in healthcare, etc., from the IBI; the IAE can be rebated for activities that have created jobs; etc. And finally, there are significant differences between municipalities in terms of management, control and inspection capacity, which can have an impact on tax collection. For example, collecting the ICIO largely depends on both the local government monitoring building work in the municipality and how far building work is accurately reflected in its budget, insofar as the taxable basis of the ICIO is the cost of the work to be carried out, which must be provided to the local Administration by the taxpayer.

All of these elements can give local government considerable capacity to act in the sphere of taxes, and therefore we believe it is important to quantify the available or unexploited tax margin still within reach for the units of this level of government. This is precisely the task we will be dealing with in the next sections. Given the wide range of techniques to calculate tax effort used in the literature, we will be using different approaches in this work. First, we will start calculating the quotient between the tax rates set by municipalities and the maximums permitted by the TRLRHL,

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[2]The cadastral value of the property constitutes the tax basis of the IBI and is revised at the same time for all the properties in the municipality, by a central agency, at the request of the local government. The cadastral value is also used for calculating the tax basis of the IIVTNU, which the local government can also decide on by applying percentages and reductions, within certain limits.

due to the simplicity of this method. Second, we will test the tax revenue margin obtained with this approach by applying various non-parametric frontier techniques. We will estimate the explanatory factors behind the different usage levels of tax capacity in section four, at the same time as the municipal tax capacity, using the parametric Stochastic Frontier Approach (SFA). This will also let us check the robustness of the previous methods and complete and modulate their results adding new elements to the analysis.

3.1. The database

The sample in our empirical exercise consists of 465 municipalities in four regions of Spain (Aragón, Cantabria, Galicia and Madrid) for which we were able to find all the socio-economic information we needed. The data cover information from 2002 to 2008, both inclusive, and municipalities of every size, as can be seen in the left side of Table 1, which provides the composition of the sample by region and population size. The right side of this table also shows the distribution of municipalities in each of the four Spanish regions considered in the paper, by population size, which lets us contextualise the sample in the real municipal situation. These data show that the weight of municipalities with under 5,000 inhabitants is lower in the sample than in reality, due to the impossibility of obtaining part of the data needed for our analysis from the smallest municipalities. Despite this, the smaller municipalities are in the majority in our sample (59 percent), and most (90 percent) do not exceed 20,000 inhabitants, in line with the real municipal situation in Spain, where 95 percent of municipalities are under this population level.

TABLE 1.

Distribution of municipalities by population segment

POPULATION SEGMENT	Composition of the sample (in percent)					Spanish municipal structure (in percent)				
	Aragon	Cantabria	Galicia	Madrid	Total sample	Aragon	Cantabria	Galicia	Madrid	Total sample
$POP < 5,001$	75.95	73.13	54.88	42.47	59.14	97.26	82.35	60.95	66.48	83.79
$5,001 \leq POP < 20,000$	20.25	20.90	37.40	26.03	30.32	2.33	13.73	33.02	18.44	11.31
$20,001 \leq POP < 50,000$	2.53	2.99	4.88	12.33	5.38	0.27	1.96	3.81	6.70	3.11
$50,001 \leq POP < 100,000$	0.00	1.49	1.63	8.22	2.37	0.00	0.98	1.27	3.91	1.02
$POP \geq 100,000$	1.27	1.49	1.22	10.96	2.80	0.14	0.98	0.95	4.47	0.76
Total number of municipalities	79	67	246	73	465	730	102	315	179	8,114

Source: By the authors, based on INE data

3.2. Calculating the local tax effort using the tax rates quotient (TRQ)

As a first approach to municipal tax effort, based somehow in the representative fiscal system, we calculate for each of five Spanish local taxes the quotient between the tax rate set by the local government (calculated based on data provided by the Ministry of the Economy and Finance) and the legal maximum permitted by the TRLRHL. From this, we can make an aggregated calculation of the tax effort of each municipality for the five taxes, as the average of the quotients of each tax weighted with the real tax collection from each one.

To do this, we took a set of particularities into account. For the IBI, we weighted the quotient of tax rates (set/maximum) of rural and urban real estate property, with the weight in the municipality of the aggregate value of these goods, rural and urban, respectively. For the IAE we have calculated the ratio between the highest situational coefficient set by the local government and the maximum permitted by TRLRHL. For the IVTM, as municipalities can increase the rate applicable to each type of vehicle in a different way, we have calculated the ratio using the rate applicable to cars, as these vehicles provide most of the tax revenue, and more specifically, cars with 8 to 15.99 tax horsepower, as these are the majority. For the IIVTNU, as local governments can set a different tax rate according to the period of time when the capital gains were generated, we used the ratio between the simple average of the tax rates established in the municipality and the maximum rate they can set according to TRLRHL. For the ICIO, we used the ratio between the tax rate set and the maximum allowed by TRLRHL.

The results, which we present in Table 2, are slightly lower than those obtained by Poveda and Sánchez (2002), although it must be borne in mind that almost all our work corresponds to the period after the reform of the local financial system, which came into force in 2003 and raised the maximum tax rates which could be set by most local governments in local taxes, i.e., the denominator of the ratios. In fact, the tax effort ratios we have calculated for 2002, the first year in the period we are studying, are fairly close to those in the study by Poveda and Sánchez for 1999.

Our calculations show that the average tax effort (2002-2008) of the five taxes was 56.24-69.07 percent, depending on whether all the municipalities are considered (scenario a) or only those that apply any of the two optional taxes (scenario b). Significant differences are also seen in the degree of effort made with each tax. With the compulsory taxes the average tax effort was 52.34 percent. The greatest tax effort was made for IVTM (61.22 percent), followed by IBI (50.60 percent) and, a distant third, IAE (37.53 percent). It is possible that the lower visibility of IVTM and the processes of tax competition in IAE to attract economic activity, explain these results.

TABLE 2.

Local tax effort (in percentage). Tax rate quotient approach (TRQ).

	Compulsory taxes				Discretionary taxes				Total taxes	
					Scenario a		Scenario b		Scenario a	Scenario b
	IBI	IVTM	IAE	TOTAL	ICIO	IIVTNU	ICIO	IIVTNU		
2002	59.77	68.83	54.02	61.02	83.33	38.09	89.08	82.00	66.19	85.32
2003	48.21	57.67	31.04	49.14	56.35	34.20	59.72	73.35	51.28	67.08
2004	48.91	58.51	33.49	49.87	59.49	36.05	62.74	75.00	53.36	65.86
2005	49.27	59.82	35.04	50.92	62.01	39.31	64.84	75.33	55.29	67.18
2006	49.22	60.55	35.82	51.45	63.10	40.82	66.10	75.90	56.08	66.82
2007	49.16	61.10	36.20	51.69	64.06	41.76	66.95	76.26	56.07	66.85
2008	49.57	62.02	36.98	52.23	65.74	42.28	68.41	77.22	55.33	67.03
AVERAGE	50.60	61.22	37.53	52.34	64.89	38.93	68.25	76.42	56.24	69.07

Scenario a: The calculations were made considering all the municipalities in the sample.
Scenario b: The calculations were made considering only the municipalities that apply optional taxes.
Source: By the authors.

In the discretionary taxes, there is a greater tax effort with CIO (64.89 percent) than with IIVTNU (38.93 percent). Moreover, these ratios rise considerably (68.25 percent and 76.42 percent, respectively) in scenario b, coming closer to the calculations of Poveda and Sánchez (2002) and IIVTNU becoming the local tax where the greatest use is made of tax power. This scenario b shows that when a municipality decides to impose either of the two optional taxes, it does so at levels closer to the legal maximum. The great difference seen in IIVTNU between scenarios a and b (in Table 2) is because many local governments have decided not to implement this tax.

The results also show a large drop in the level of tax effort in 2003 with all local taxes, due to the reform of the local financing system that came into force that year. That reform enabled all municipalities, whatever their population, to set the same maximum tax rates permitted for the largest municipalities[3].

This simple way of calculating municipal tax effort uses very precise but limited information, as it only takes into account the rates set for local taxes compared to the legally permitted maximums. It could be a simple way of measuring the legal tax capacity of a jurisdiction, defined above, although it ignores many of the factors we saw in the previous section in which local governments also have some freedom to act and which enable them to differentiate themselves in terms of tax revenue (decisions on rebates

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[3]Before the reform, the larger the size of the municipality the greater the maximum tax rate that could be set.

and exemptions, modulation of taxable bases, effective management of tax collection, etc.), but which are not easy to get information about. This, together with the fact that to calculate these ratios we had to adopt a series of subjective and therefore questionable assumptions, is the fundamental weakness of this approach. Therefore, we are going to use other techniques which let us calculate in a better way the tax power used by municipalities while minimising the required information. With these other techniques we will approach the economic tax capacity of a jurisdiction, as opposed to the legal one, measuring the amount of revenue that an economy can collect, given its economic, social, institutional and demographic characteristics.

3.3. Calculating the local tax effort using non-parametric frontier techniques

Frontier techniques, particularly non-parametric ones, enjoy only an incipient popularity for estimating tax capacity, when they are methods that should work well in the field of taxation studies given that tax revenue can be considered the output of governments' tax policy and can be obtained based on a set of inputs such as income, tax bases, etc. There are also similarities between the problems of governments in generating tax revenue and the problems of firms in producing their output, since both agents are concerned about potential tax revenues or production which is not obtained by a poor management or inefficiency.

Regarding the non-parametric frontier methodology, we have applied two variants. On one hand, the FDH, by adopting an output approach given that any local government can maximise its tax collection under its particular socioeconomics conditions and characteristics. On the other, the partial frontier approaches, Order-m and Order-α, which permit extreme efficiency observations, beyond the frontier.

To apply these techniques we took as output the revenue obtained with the five local taxes, TAX. These taxes provided two-thirds of the tax revenues of the municipalities, so we amply covered the sources of income which could be distributed in a highly uneven manner among the municipalities. Table 3 shows the definition of each variable used, the source the data were obtained from and the main descriptive statistics of the variables[4].

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[4]All monetary variables were deflated with the CPI.

TABLE 3.

Definition, source and statistics describing the variables

Variables	Source of the information	Average	Std. Dev.	Min	Max
TAX	Ministry of the Economy and Finance	6,100,089	54,700,000	27,919.86	1,450,000,000
PROPVpc	Directorate General for Cadastre	21,829.66	19,321.65	3,434.35	236,332.80
T0		0.04	0.20	0.00	1.00
T5		0.74	0.44	0.00	1.00
T10		0.49	0.50	0.00	1.00
VEHICpc	Economic Yearbook of Spain. La Caixa	610.67	106.41	295.79	1,308.84
dREFORM					
POP	National Institute of Statistics	20,549.70	150,660.90	139.00	3,213,271.00
OLDPOP		23.76	9.75	3.42	53.43
INCOMEpc	Regional Institutes of Statistics	10,777.84	2,537.51	4,971.18	26,548.46
dCRISIS					
dTR		0.46	0.50	0.00	1.00
TRQ-IBI	By the authors, based on data from the Ministry of the Economy and Finance	0.51	0.13	0.21	0.99
TRQ-IAE		0.38	0.19	0.13	1.00
TRQ-IVTM		0.61	0.11	0.50	1.00
TWOVOLT	Based on data from the Ministry of the Economy and Finance	0.49	0.50	0.00	1.00
COLLECTpc		19.43	48.17	0.00	964.04
PROPINCpc	Ministry of the Economy and Finance	20.61	89.22	0.00	3,015.54
ILLUSIONpc		414.96	261.67	105.61	5,145.27
TEXPENSpc		768.92	512.37	0.00	7,598.06
DEBTEXPENSpc		32.00	89.74	0.00	4,341.70
dPRE	Ministry of the Interior				
POLITCOMP		4.04	5.83	0.00	28.98
POLITCOLOUR		1.27	0.94	0.00	2.00
dPOP1	National Institute of Statistics	0.03	0.18	0.00	1.00

Source: By the authors.

Description of the variable

TAX Tax collected by the municipality

PROPVpc Cadastral value per capita of urban and rural properties

T0 =1 the year when the municipal cadastre was revised, =0 in other years

T5 =1 when more than 5 years have passed since the last revision of the cadastre, =0 otherwise

T10 =1 when more than 10 years have passed since the last revision of the cadastre, =0 otherwise

VEHICpc Number of vehicles per 1000 inhabitants

dREFORM = 0 in 2002, when the reform of the local financing system was not in force, =1 in other years

POP Population of the municipality

OLDPOP Percent of the population over 65

INCOMEpc Per capita income

dCRISIS =1 the year 2008 in which the crisis began in Spain, = 0 otherwise

dTR = 1 when the ratio between the average tax rate applied in the municipality and the maximum rate permitted by law (i.e., the tax rates quotient calculated in section 3.2) is above the average, = 0 otherwise

TRQ-IBI Ratio of rates set in the IBI for rural property assets and for urban property assets in relation to the maximum rates permitted for these properties in the TRLRHL, weighted with the weight the aggregate value of these rural and urban assets have in the municipality, respectively.

TRQ-IAE The highest situational coefficient set by the local government / maximum coefficient permitted by the TRLRHL

TRQ-IVTM Ratio between the rates set for cars, 8 - 15.99 fiscal horse-power, and the maximum possible rates that the TRLRHL permits for these vehicles, according to the population of the municipality.

TWOVOLT = 1 when the municipality requires the two optional taxes, =0 otherwise

COLLECTpc Difference between budgeted and actually received income from local taxes, per capita

PROPINCpc Per capita income from assets

ILLUSIONpc Income from current and capital borrowing and transfers, in per capita terms

TEXPENSpc Per capita spending

DEBTEXPENSpc Per capita spending on interest payments and amortisation of the principal

dPRE =1 in an election year and the year before; =0 otherwise

POLITCOMP percent of votes obtained −50 percent

POLITCOLOUR Dummy = 1 if a regionalist party is in government, 2 if a right-wing party is, and 0 otherwise

dPOP1 =1 if the municipality $< 1,000$ inhabitants, =0 in otherwise

To choose the input, we considered the available empirical evidence about sub-central tax behaviour and the fact that tax capacity is independent of the government's actions. Owing to these considerations we included as input the tax bases of both IBI and IVTM, which are the two taxes providing more revenue to the municipalities (51 percent and 15 percent

of municipal tax revenue, respectively[5]). As tax basis for IBI we used the per capita cadastral value of the real estate property in the municipality (PROPVpc), which coincides exactly with the real tax base. And as tax basis for IVTM, we used the number of vehicles per 1000 inhabitants of each municipality (VEHIC). Alongside this, given that we were unable to find proxies for the tax bases of the other local taxes, we used three general indicators of tax capacity often used in the literature: population, the percentage of the population aged over 65, and income.

The results in Figure 1 show that the average local tax effort is between 72.15 and 85.22 percent, depending on the non-parametric technique used[6]. The tax margin is smaller than that obtained via the TRQ, which we have also included (only scenario a) in this Figure for comparison. This divergence in the results could indicate that, although municipalities have a high margin in terms of both tax rates and the implementation of optional taxes, if the analysis is refined considering different indicators of tax capacity (such as the bases of certain taxes and other more general indicators like population or income), the range within which municipalities can increase their tax collection revenues is much more restricted. The legal tax capacity is greater than the economic one (Khwaja and Iyer, 2014), so the legal tax effort is reasonably lower than the economic one.

The distribution of municipalities by tax effort deciles, in Figure 2, shows a high degree of asymmetry in municipal behaviour when using the non-parametric frontier approaches. These approaches are represented with bars. Thus, many units of observation (around 43-46 percent) that are making full use of their tax potential coexist with a considerable group (rough 30-37 percent) with tax efforts below 70 percent, which therefore still has a wide margin for increase. Surprisingly, these techniques also place many municipalities in the first deciles[7], when the TRQ (represented with a dotted line) shows that the municipalities making the least effort locate at best in the fourth decile. At the same time, we can see that with the partial frontier techniques there are few observations (3-6 percent) outside the estimated frontier. This shows the nature of this approach, which allows for super-efficient observations. These are usually large municipalities, including provincial capitals, so it makes sense for them to present

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[5]Based on data supplied by the D.G. of Financial Coordination with the Autonomous Regions and Local Governments (Ministry of the Economy and Finance), corresponding to the settlement of the budgets of local governments, 2002-2008.

[6]Although it does not appear in this document, we have carried out a sensitivity analysis of the efficiency indicators, calculating the metafrontiers for $m = 12, 22, 50, \ldots, 200$ and $\alpha = 90, 95, \ldots, 97$, whose estimations give robustness to the results presented, and can be provided to readers upon request.

[7]We have not seen any particularly notable feature in this group of municipalities, except that they are usually municipalities of under 10,000 inhabitants where property values are not very high.
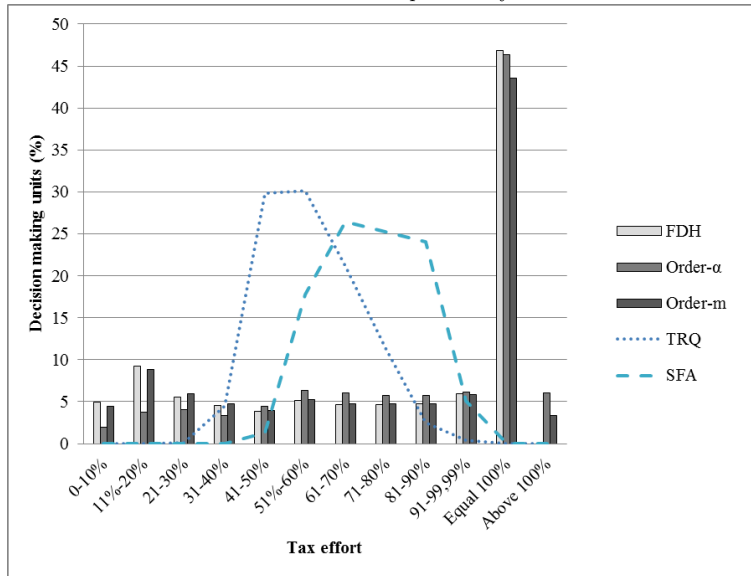
FIG. 1. Tax effort of the Spanish local governments (in percent)
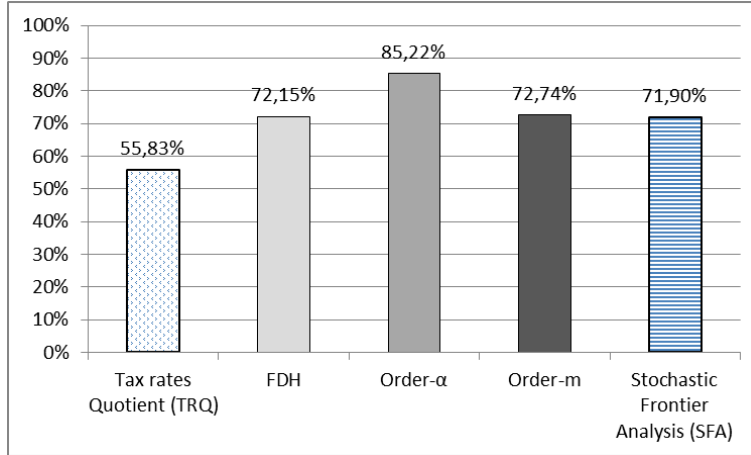
Source: By the authors

special tax behaviours (large constructions and buildings, industrial poly-
gons, big commercial areas). In contrast, the TRQ locates practically all
the observations in the central ranges of tax effort.

FIG. 2. Distribution of municipalities by tax effort deciles

Source: By the authors

4. FACTORS EXPLAINING MUNICIPAL TAX EFFORT
AND THE STOCHASTIC TAX FRONTIER

Our study is completed by implementing the SFA, an alternative methodology, to check and adjust the results obtained with the previous approaches and to determine the explanatory factors behind the different levels of tax effort, estimating them simultaneously with the frontier tax revenue. This can also be done with procedures associated with non-parametric techniques (Daraio and Simar, 2007), but a parametric approach, such as SFA, will enrich the analysis of tax effort we are implementing, furthermore allowing us to take the advantages and minimize the limitations of each method (nonparametric and stochastic), and to check the robustness of our obtained results. SFA is a parametric technique, increasingly popular internationally in empirical studies of tax effort, which allows us to see if the hypotheses on the relationship between input (tax bases and general indicators of tax capacity) and output (potential tax collection) are significant, something which is particularly interesting in a study like ours. It also allows us to add dummies which identify possible causes of sample heterogeneity on the frontier, as we have very different municipalities.

4.1.   Hypotheses

To estimate the stochastic tax frontier, we used as explanatory variables on one hand, the inputs included in the non-parametric applications, i.e., the tax basis of IBI and IVTM (PROPVpc and VEHIC) and the three general indicators of tax capacity (POP, OLDPOP and INCOMEpc); and on the other hand, via dummies, different aspects of the socioeconomic context which we think can be highly relevant. First, in order to be able to compare the cadastral values of the municipalities despite having been revised in different years, we have included three fictitious variables ($T0$, $T5$ and $T10$) which capture the years passed since the latest revision, so that they interact with PROPVpc. Secondly, we wanted to test, with the dummy dREFORM, the possible implications for tax capacity of the reform of the local finance system. This reform came into force in January 2003 and significantly affected local taxes (e.g., the maximum tax rates of the local taxes were all raised as was the maximum situational coefficient for the IAE, all individuals plus companies with a turnover of under a million euros were exempted from IAE, etc.). And, finally, we capture with dCRISIS the possible effect of the onset of the crisis on local tax capacity[8].

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[8]We tried to include other variables (the unemployment rate, the weight of the agricultural sector,...) but none were significant or improved the model. Although some papers include transfers received from other levels of government as an explanatory variable (among others, Dahlberg et al., 2008), we believe this aspect does not affect the tax capacity estimated, although it could be included as a factor explaining the level of tax collecting, as we have done later.

To estimate the determinants of the unused potential tax revenue, we considered that in the tax sphere the difference between real and frontier output can only be interpreted as the not obtained part of the potential tax revenue, but it cannot be seen as a measurement associated exclusively with inefficiency. It can be really caused by at least two groups of factors: on one hand, by political decisions regarding the own revenues the local government wants to obtain, i.e., the tax effort may be intentionally low; on the other, by inefficiency in the municipality's tax management and collection process which may be due to corruption, tax evasion, poor management, the use of obsolete tax administration technology, a lack of suitable human resources, etc. Despite this, it can be a useful indicator to identify the municipalities that would be able to increase their tax revenues. More concretely, we have suggested five groups of causes explaining heterogeneous behaviour in the use of potential tax revenues.

A first set of factors, associated with the tax provisions deliberately adopted by municipalities to get a specific tax collection, includes two dummies which take the value 1 when the municipality sets high local tax rates (dHTR) and when the municipality requires the two optional taxes (TWO-VOLT). A second group, related to the existence of alternative local income sources other than taxes, includes the income from the assets management (PROPINCpc) and the income which generates a financial or fiscal illusion (ILLUSIONpc). We include in a third group the total volume of local spending (TSPENSpc) and, attempting to gather certain aspects linked to the quality of credit management, the spending on interest payments and repayment of debts (DEBTEXPENSpc). This variable measures the pressure of postponing part of the tax effort through debt, the cost of which increases with the volume of accumulated debt given that the financial markets penalise the most indebted. This discipline introduced by the market enables us to connect to the fourth group of hypotheses, related to the management quality of local governments. This group includes, on one hand, a variable covering the difference between budgeted and actually collected local tax revenue (COLLECTpc), which would capture the inefficiency in the collection; and on the other hand, a dummy to capture the poorer management capacity of small municipalities (POP1), although it would also capture the greatest difficulty for its residents to avoid taxes.

In the fifth group are the political variables which, as shown in the review by Benito et al. (2010) can influence the tax collection of a jurisdiction. We have included a variable which measures the level of competition the government faces (POLITCOMP), a qualitative variable (POLITCOLOUR) intended to show whether the degree of discretionary tax collection depends on the ideology of the party in power in the local government, and a fictitious variable (PRE) to test the electoral cycle thesis, which postulates

that in pre-election periods the governments tend to take popular measures (e.g. reduce tax effort) postponing their cost until the next years.

4.2. Results for local tax effort using the SFA

In light of the hypotheses discussed above, we have estimated with panel data (2002-2008) and in a single stage, the following equations (1) and (2) of the stochastic tax frontier model, with random effects proposed by Greene (2005) and Belotti et al. (2012)[9].

$$
\begin{aligned}
\text{TAX} \;=\; & f(\text{PROPVpc}, \text{PROPVpc} * T0, \text{PROPVpc} * T5, \text{PROPVpc} * T10, \\
& \text{VEHICpc}, \text{POP}, \text{OLDPOP}, \text{INCOMEpc}, \text{dREFORM}, \text{dCRISIS}) \quad\quad (1) \\
u \;=\; & g(\text{dHTR}, \text{TWOVOLT}, \text{PROPINCpc}, \text{ILLUSIONpc}, \text{TEXPENSpc}, \\
& \text{DEBTEXPENSpc}, \text{COLLECTpc}, \text{POP1}, \text{POLITCOMP}, \quad\quad (2) \\
& \text{POLITCOLOUR}, \text{DPRE})
\end{aligned}
$$

The results of this estimation, which we carried out using the STATA^{TM} statistical package and taking the variables in logarithms, are shown in Table 4. We corroborate the suitability of the SFA as method of estimation of the tax effort, from the null hypothesis test that quantifies whether the contribution of the variance of u to the total variance of the error is significant (H0: $\gamma = 0$). As λ estimator is significant in the model, the null hypothesis that γ equals 0 is rejected, which confirms the suitability of the SFA as method of study in this case, i.e. the need to include the unrealized tax effort, u, in the tax capacity function, which should not be approximated using an estimated average behaviour function (OLS). Additionally, the significant value of θ suggests that unobserved heterogeneity of municipalities must be separated from the inefficiency effects, which validates the Greene (2005) approaches we use[10]. Meanwhile, the significance of the variables explaining the exercise of tax power validates the suggested equation.

The results are consistent with the theoretical expectations and the available empirical evidence (Lotz and Mors, 1967; Allers et al., 2001; Pessino and Fenochietto, 2010, or Delgado et al., 2015, among others). All the variables in the tax frontier equation (1) are relevant. The tax basis of the taxes, especially the value of real estate property, has a positive influence on potential tax collection, according to the relative importance of the IBI in municipal tax revenues. Moreover, the effect of PROPVpc is greater, in

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[9]In the true random effects model (TRE), the municipalities share the constant term of the specification. Although Farsi et al (2006 and 2007) point out that TRE models yield the most plausible estimations of efficiency, we have also tested the fixed effects approach of Greene (2005), in which the constant term is different for each municipality, with the model giving similar results.

[10]See Farsi, Filippini and Greene (2006).

TABLE 4.

Results of the stochastic tax frontier model

	Model 1	Model 2
Tax frontier		
PROPVpc	0.4239**	0.4320**
	(16.49)	(16.40)
PROPVpc * T0	−0.0129**	−0.0131**
	(−3.81)	(−3.87)
PROPVpc * T5	0.0109**	0.0101**
	(4.86)	(4.46)
PROPVpc * T10	0.0029	0.0034
	(1.30)	(1.50)
VEHICpc	0.1871**	0.1774**
	(2.54)	(2.43)
POP	0.9724**	0.9662**
	(74.76)	(72.23)
OLDPOP	−0.0084**	−0.0105**
	(−4.25)	(−5.54)
INCOMEpc	0.2851**	0.2472**
	(3.56)	(3.11)
dREFORM	0.1903**	0.2615**
	(8.15)	(10.08)
dCRISIS	−0.0937**	−0.1051**
	(−3.69)	(−4.23)
CONS	−2.3119**	−1.9834**
	(−3.34)	(−2.95)

general, the longer it has been since the last cadastral revision. A €100 increase in the cadastral value increases potential tax revenue, in model 1, by €42.39 if the assessment delay is less than 5 years, and by €43.48 if it is 5 to 10 years (coefficient of PROPVpc + coefficient of $PROPVpc * T5$), with an impact of €41.1 in the year of the revision (coefficient of PROPVpc + coefficient of $PROPVpc * T0$). The model also reveals that the reform of the local finance system (dREFORM) substantially raised the local tax capacity, as could be expected from the increase in the maximum tax rates of all local taxes, and despite the IAE exemption for many business owners. Regarding the general indices of ability to pay, while the retirement-age population (OLDPOP) negatively influences the local tax capacity, population (POP) and income (INCOMEpc) are a clear and direct positive influence, this last one confirmed by the sign and significance of dCRISIS. This flexibility shown in our estimation (and in Poveda and Sánchez, 2002) by the local tax capacity when faced with changes in the economic cycle,

TABLE 4—*Continued*

Unused tax capacity or unrealized tax effort

dTR	−0.1910**	
	(−6.60)	
TRQ-IBI		−0.7919**
		(−5.45)
TRQ-IAE		−0.3377**
		(−4.35)
TRQ-IVTM		−0.4622**
		(−2.38)
TWOVOLT	−0.1060**	−0.0755**
	(−3.70)	(−2.62)
ILLUSIONpc	−0.0034	−0.0340
	(−0.14)	(−1.34)
PROPINCpc	−0.0269**	−0.0243**
	(−4.07)	(−3.65)
dPRE	−0.0004	−0.0009
	(−0.02)	(−0.05)
POLITCOMP	0.0021	0.0023
	(0.23)	(0.23)
POLITCOLOUR	−0.0097	−0.0237*
	(−0.79)	(−1.79)
TEXPENSpc	−0.0053	−0.0040
	(−0.91)	(−0.64)
DEBTEXPENSpc	−0.0263**	−0.0236**
	(−3.64)	(−3.31)
COLLECTpc	0.0420**	0.0477**
	(7.18)	(8.31)
dPOB1	−0.2824**	−0.2032**
	(−3.46)	(−2.71)
CONS	0.5984**	1.4047**
	(3.69)	(6.88)
θ	0.2316**	0.2299**
	(20.22)	(19.95)
$\lambda(H0 : \gamma = \sigma_\nu^2/\sigma_\Sigma^2 = 0)$	0.3514**	0.2998**
	(15.53)	(13.07)

(**) Significance at 1 percent and (*) at 5 percent.
Standard errors are in parentheses
Source: By the authors

calls into question one of the main disadvantages historically attributed to the Spanish local tax system: its rigidity in reacting to changes in the economic cycle.

Regarding the hypotheses explaining the intensity of use of tax capacity, or rather the unrealized tax effort [equation 2], the results are quite in line with what is theoretically expected and with the available empirical evidence (Pessino and Fenochieto, 2010). The variables capturing the willingness of municipalities to obtain tax revenue making use of the regulatory capacity granted by the TRLRHL (TWOVOLT and dHTR), have a strong and positive influence on the tax effort made[11]. As an alternative to dHTR, we have included in model 2 of Table 4, the TRQ separately for each on the compulsory taxes. The coefficients of these ratios suggest that IBI is the local tax in which the decision to raise tax rates has a greater influence on the available tax revenue margin, followed by IVTM and IAE. These results are in line with the weight of these taxes in tax revenue, and corroborates that local taxation basically depends on real estate property.

The existence of alternative local income sources other than tax revenue does not create the substitution effect or financial illusion expected (ILLUSIONpc), according to both theory and empirical evidence (Garg et al., 2017). Further, the asset income variable (PROPINCpc) is shown to be complementary to tax revenue, so that when there are budget tensions the municipality seeks tax revenue and income from assets, showing a consistent and responsible behaviour, not misled by money illusion phenomena. Although total spending does not appear to condition the local tax effort, financial spending (DEBTEXPENSpc) has a positive influence, which reflects the pressure arising from postponing part of the tax effort by acquiring debt. Regarding the variables associated with management quality, the greater the difference between budgeted and actually collected local tax revenue, i.e., inefficiency in tax collection (COLLECTpc), the further the municipality remains from its potential revenue. The results also show that very small municipalities (POP1) make high tax efforts, which may be due to the supporting work of the Provincial Councils, but is surely also because the small size of a jurisdiction facilitates control and inspection, making it more difficult to hide taxable bases.

However, political variables are not shown to be relevant to explaining the local tax effort. Only the political colour (POLITCOLOUR) has any influence. Particularly, tax effort is greater when the governing party is right-wing.

Figure 1 shows that with the SFA the municipalities collect on average 71.9 percent of their potential tax revenue. This indicator is in line with the results obtained with the non-parametric techniques, for which we obtained tax effort levels of 72-85 percent. The percentage distribution of municipalities by tax effort deciles resulting from the SFA (shown in Figure 2

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[11]The results are similar when the dummy is constructed taking into account tax effort with only the compulsory taxes.

with a broken line) places all the municipalities below the tax frontier, by technique definition. The municipalities which make the least tax effort are in the fifth decile. Around 93 percent of the observation units are located in the 50-90 percent tax effort bands and only the 5 percent have a maximum margin of 10 percentage points. The SFA generates an inverted-U distribution of municipalities similar to that of the TRQ (dotted line), but shifted to the right, which corresponds to the greater average level of tax effort obtained with the SFA. This gap can be attributed to the different methodology and to the factors which are not considered with the TRQ[12].

According to Badunenko et al. (2012), the not very high value of ? might suggest that nonparametric frontiers approaches are preferable to SFA. In this sense, we must point out that the former are more flexible methods (especially since they do not require specifying a functional form) than the latter, and that the nonparametric partial frontier approaches specifically allow to identify those super-efficient municipalities collecting more revenues probably because of their atypical tax bases (large constructions and buildings, industrial polygons, nuclear power plants, big commercial areas, toll roads, wetlands). However, the location of municipalities in the first deciles of tax effort with non-parametric techniques, contradicts the reality which, on the contrary, TRQ and SFA do capture. According to these, there are not municipalities with null tax effort and most municipalities are concentrated in the upper central deciles. In addition, SFA offers decisive advantages such as being able to identify the significance of the variables considered, establishing explanatory hypotheses of the unused tax capacity, and estimating simultaneously the tax frontier and the unused tax potential, in order to avoid bias in the estimations. And finally, it must be taking into account that in a scenario such as the tax one, where the difference between real and frontier output cannot be seen as a measurement associated exclusively with inefficiency, the non-parametric approaches may not be working correctly. All this leads us to combine in our analysis simultaneously the results achieved by both methods.

5. CONCLUDING REMARKS

The continuous growth in demand for local public services together with the depth and persistence of the current economic recession, have led to substantial budget imbalances. This scenario makes it necessary to quantify the use that local governments have made of their tax capacity because

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[12]These are variables influencing the tax potential of the municipality and thus indirectly also influencing the tax effort (e.g., the tax bases of local taxes, other indicators of tax capacity and the impact of the crisis) as well as variables not affecting the potential tax revenue but directly influencing the municipality's tax effort (e.g., the pressure of financial spending, inefficiency in tax collection and the municipality size).

it can be useful for different purposes: e.g. identify the municipalities that would be able to increase their tax revenues; help to determine whether their tax behaviour may be behind the financial solvency problems faced by municipalities; guide the reform of the local financing system, etc. To that end, we have calculated the tax effort of Spanish municipalities using different techniques: the quotient between the tax rates set by local governments for their taxes and the maximum legally permitted rates; FDH; other nonparametric partial frontier approaches and the SFA.

With our paper, we contribute to the implementation of new methodologies (i.e., partial frontier approaches) in the empirical field of fiscal federalism, and improve the specification of the SFA in the sphere of tax effort, in two ways. First, we extend the hypotheses explaining tax capacity including both general indicators of ability to pay alongside the tax bases (in order to capture the uneven distribution of taxable bases and avoid tax management strategies for these bases), and different issues of the socioeconomic context (which identify causes of sample heterogeneity on the frontier). Second, we add new variables explaining the tax effort, which help us to understand the heterogeneity of the results. Thus, SFA takes into account a greater number of factors in the calculation of the tax effort.

All frontier approaches show high average levels of tax effort, which would suggest the municipalities have exercised their regulatory capacity in the tax sphere with great responsibility, calling into question the need of the recent intervention of the central government, which adopted several measures on local finances (heavier local property tax and spending cuts). However, a more detailed analysis shows a relevant asymmetry in the behaviour of the municipalities. On the one hand, most local governments have some room to raise their tax collection. Our SFA suggest that for that purpose municipalities can make a more intensive use of their tax authority, e.g., raising their tax rates to the maximum legally permitted levels, eliminating or reducing tax allowances on these taxes, and implementing the optional taxes if they have not already done so. The model also reveals that an important part of the unrealized tax effort is due to an inefficient collection, which prevents collected tax revenues from being as close as possible to budget. Taking measures to combat corruption, tax evasion and other inadequate forms of local tax management, can improve the tax effort level of many municipalities. Other significant variables, which also influence the local tax effort, are the need to obtain income (pressure of financial spending), the population, and the political colour of the party in the local government.

And, on the other hand, there are municipalities whose tax revenues can hardly increase due to being very close to tax frontier (depending on the used technique there are municipalities located beyond the frontier). In order to attend to the possible financing problems of these municipalities,

it might be desirable to reform the legal framework to allow increase the maximum tax rates, make the voluntary taxes obligatory, or enable local governments to access to new tax bases (their own or from other levels of government). This would make it possible to raise the potential tax revenue of all municipalities, i.e., to shift the tax frontier, helping to correct the endemic financial problems that have historically afflicted part of the Spanish local government level, while leaving the decision on how to use this potential in hands of each unit of government. All of these would be consistent with a scenario as heterogeneous as the displayed by the local tax effort in many countries such as Spain.

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