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Fiscal decentralization and efficiency: empirical evidence from Italian municipalities

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Abstract

This paper investigates the association between fiscal decentralization and municipality efficiency by conducting an empirical analysis focused on the Italian context. We conduct a cost efficiency analysis based on a stochastic frontier approach with municipality and time fixed effects for 2010-2016 modelling the decentralization effect with a continuous variable, taxation autonomy, which allows for accounting for the degree and evolution of fiscal decentralization over time. The empirical analysis provides convincing evidence that fiscal decentralization is positively associated with municipalities' efficiency, robust to inclusion into the model of a large set of control variables. This evidence lends support for policies aimed at making more closely aligned expenditure and revenue decision making.

Keywords: Fiscal Decentralization; Local governance; Italian municipalities; Efficiency; Stochastic frontier analysis

JEL Classification: D61, H50, H77

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1. Introduction

Over the last decades, an increasing number of governments, both in developed and developing countries, have implemented fiscal decentralization policies by devolving to sub-national government decision-making powers concerning expenditure and revenue.

The rationale behind the decentralization policy dates back to Tiebout (1956) and Oates (1972), who support the idea that the transfer of powers and responsibilities to lower tiers of government allows for a better match between citizens' preferences and public policies, allowing welfare improvements. In particular, a decentralized structure of government improves service provision efficiency by reducing information asymmetries, enhancing the accountability of locally elected policy makers, promoting community participation, fostering competition among jurisdictions, and encouraging innovation in government policies and the diffusion of best practices (Weingast, 2009). In addition to these benefits, decentralization policy may not enhance or may even worsen the efficiency of public service provision (Prud'Homme, 1995). Diseconomies of scale, the manipulation of the decision-making process by local entities, or a lack of organization and administrative capacity among small local governments represent some potential limits of decentralization policy (Bardhan and Mookherjee, 2000, Smith, 1985).

The literature has long investigated the impact of fiscal decentralization on different economic and fiscal aspects. A wide share of these studies has focused on service delivery, analysing, in particular, education and health, the most important types of decentralized services worldwide. A shared consensus has emerged about the significant role of the decentralization process in improving both education and wealth outcomes (Faguet, 2004, Falch and Fischer, 2012, Faguet and Sanchez, 2014). Some optimistic findings have emerged from empirical studies on other forms of functional service delivery, such as infrastructures, though such analyses are still limited (Martinez-Vazquez, Lago-Penas, and Sacchi, 2017). Further, other issues receiving the attention of empirical literature concern the consequences of decentralization in helping or hurting economic growth (Gemmell, Kneller, and Sanz, 2013, Xie, Zou, and Davoodi, 1999), macroeconomic stability (Presbitero, Sacchi, and Zazzaro, 2014, De Mello, 2000), income inequality and poverty (Sepulveda and Martinez-Vazques, 2011, Neyapti, 2006, Sacchi and Salotti, 2014). The empirical findings in such fields remain mixed as reported by Martinez-Vazquez, Lago-Penas, and Sacchi (2017) in a comprehensive survey of such

studies.

The difficulties of empirical studies in reaching a shared consensus on the effect of decentralization policy can be ascribed to two main reasons. First, the presence of diverging findings could be due to an absence of standardization and the overall poor quality of decentralization data (Martinez-Vazquez, Lago-Penas, and Sacchi, 2017). One of the main issues of the empirical literature on fiscal decentralization concerns how such phenomena can be defined and measured and whether the required data are actually available (Martinez-Vazquez, Lago-Penas, and Sacchi, 2017). Furthermore, the presence of mixed empirical findings could be the result of inadequate estimation methods, usually not dealing with the problem of potential endogeneity (e.g., when omitted variables affect both decentralization and some control variables).

This paper provides a significant contribution to this literature by investigating whether fiscal decentralization could imply higher municipality efficiency through an empirical analysis focused on the Italian context.[1]

Italian municipalities provide an interesting case study since they have experienced a significant decentralization of public services in recent decades, whose progress may be fruitfully investigated through the evolution of municipal efficiency in different areas of the country. Furthermore, the Italian case is worthy of attention, as it shows a considerable spatial heterogeneity in the private sector, in revenues from taxation, and in public expenditures (Greco et al., 2018, Lagravinese, Liberati, and Resce, 2019, Patrizii and Resce, 2015).

We address the main issue of the empirical literature (i.e., the definition of a measure of fiscal decentralization) by using the degree of taxation autonomy, defined as the ratio of current municipal tax revenue to the sum of total current revenues at the municipal level. This indicator, which ranges from 0 (absence of taxation autonomy) to 1 (maximum taxation autonomy), shows how municipal taxes contribute to total municipal revenues (Degni, 2019). In other words, the measure captures the degree to which taxes collected by municipalities are in charge of municipal revenues, which is a natural

[1] In line with the empirical literature focused on the international context, studies on the impact of fiscal decentralization on the efficiency of Italian municipalities provide mixed results. However, some optimistic findings emerge from studies focused on the efficiency of health policy, finding some consensus on the role of fiscal decentralization in making local governments more accountable, thus improving the performance of their territories (Bordignon and Turati, 2009, Francese et al., 2014, Piacenza and Turati, 2014).

measure of fiscal decentralization (Balaguer-Coll, Prior, and Tortosa-Ausina, 2010, Cavalieri and Ferrante, 2016, Jia, Ding, and Liu, 2020).

Empirically, we implement a cost efficiency analysis based on a stochastic frontier approach with municipality and time fixed effects for 2010-2016, which models decentralization intensity as a continuous indicator, allowing us to account for the evolution of the degree of fiscal decentralization over time (Cavalieri and Ferrante, 2016, Bracco et al., 2015, Boetti, Piacenza, and Turati, 2012). The one-stage stochastic frontier model allows us to estimate both the efficiency and inefficiency explained by taxation autonomy. To this aim, the continuous indicator of fiscal decentralization, taxation autonomy, is included among the variables explaining efficiency levels in the estimation of the cost function. Furthermore, municipal and time fixed effects allow us to control for unobservable municipal-level variables and time common trends that could bias the coefficients.

The empirical analysis provides convincing evidence of a positive association between fiscal decentralization and municipalities' efficiency. Furthermore, the significant impact of fiscal decentralization is robust to inclusion into the model of additional control variables concerning demographic factors and institutional frameworks that could influence municipalities' inefficiency.

The remainder of the paper is organized as follows. Section 2 provides background information and defines how to measure decentralization in the Italian context. In Section 3, we develop and discuss the empirical model starting from the definition of a cost function, which is modified to allow the inefficiency term to depend on exogenous variables. Section 4 provides a detailed description of the dataset used to implement our empirical analysis. In Section 5, we present the findings of the empirical analysis, while in the final Section, we offer some concluding remarks.

2. Measuring decentralization in Italian municipalities

Italian municipalities obtain revenues from two main sources: own taxes and fees and transfers from upper levels of government, mainly the central government. Before the 2009 decentralization reform the main share of municipal revenues came from central grants and was composed of two components: one component with common elements for all municipalities following the historical expenditure criterion and an additional ad-hoc component not directly connected to efficiency and equity criteria (Bracco et al., 2015, Bracco, Porcelli, and Redoano, 2019). In 2009 the decentralization

reform (law n. 42) introduced a basic framework for the local finance system, defining the revenue structure of local authorities, identifying principles of the coordination of public finance and the tax system, and establishing mechanisms of equalization for the development of less economically developed areas (Corte dei Conti, 2019, De Simone and Liberati, 2020).

The new structure of financial relations between the central and local governments was aimed at overcoming the historical expenditure criterion, in favour of a resource allocation system based on standard needs for the financing of essential levels of civil and social rights benefits and the basic functions of institutions. With this aim, the fundamental revenue structure for each level of territorial government was explicitly defined.

To move from a system of derived finance to an autonomous municipal taxation system, in 2011, legislative decree n.23 (*Federalismo Municipale*) implemented a new revenue structure, establishing that traditional municipal revenues must be complemented by new sources of financing in the interest of autonomy.

Four main pillars support Italian municipalities' tax system: 1. 'own municipal tax' (IMU), whose tax base is the cadastral value of properties; 2. 'tribute for indivisible services' (TASI)[2] which applies to the possession, in any legal form, of buildings; 3. the municipal participation to personal income tax (*Addizionale IRPEF*), for which the tax base is the overall income determined for the computation of national personal income tax; and 4. the waste tax (TARI),[3] which is related to the cost of the waste management service, as it must ensure full cost coverage.

Italian municipalities have the faculty to modify, observing some limits, the rates of own taxes, consequently increasing or decreasing their tax revenues. Therefore, overall, the ongoing process of reforms is oriented towards the creation of a system based on the autonomous use of tax leverage by local authorities and on the elimination of traditional central transfers having a general and permanent nature.

Furthermore, the decentralization reform instituted a redistribution fund (*Fondo di Solidarieta' Comunale*-FSC) allocated on the basis of fiscal capacity and standard needs with the aim of guaranteeing the provision of fundamental services in all territories: municipalities with more tax capacity

[2]Law 147/2013 introduced TASI since 2014.

[3]Law 147/2013 introduced TARI since 2014.

than standard needs contribute to the FSC, and municipalities with more needs than tax capacity receive transfers from the FSC (Corte dei Conti, 2019).

From a policy perspective, in light of the process of decentralization in Italian municipalities, this paper aims to verify whether the autonomous use of tax leverage is associated with an improvement in the efficient provision of local services.

One of the main issues of the empirical literature studying the consequences of fiscal decentralization concerns how to define and obtain an accurate measure for fiscal decentralization. Ideally, fiscal decentralization should be measured as a multidimensional indicator by combining political and administrative aspects with the degree of sub-national governments' autonomy in tax and spending decisions making (Ebel and Yilmaz, 2003). Furthermore, this measure should take the endogeneity into account, since decentralization is often contemporaneous to other policies and institutional changes, making it difficult to isolate its effect (Martinez-Vazquez, Lago-Penas, and Sacchi, 2017). The empirical literature typically captures fiscal decentralization by means of sub-national governments' expenditure and revenue data provided by the OECD (i.e., studies focused on advanced economies) and IMF (i.e., studies analysing both developed and developing countries).

With the aim of capturing the fiscal decentralization of Italian municipalities, we use the degree of taxation autonomy, defined as the ratio between tax revenue and total current revenue (Corte dei Conti, 2019, Degni, 2019). This indicator, annually computed by ISTAT (2019), is defined as the ratio of revenue from the municipal taxes (i.e., IMU, TASI, Addizionale IRPEF, TARI, and other municipal taxes such as tourist tax, tax on the occupation of public spaces and areas, and municipal tax on advertising and publicity) after FSC transfers to the total current revenues of the municipality.

The degree of taxation autonomy is generally used by central institutions to measure the taxation effort of the local government, and it is considered a good proxy for the accountability of the local policy maker since it captures how a municipality is independent from contributions and transfers from the central government (Corte dei Conti, 2019, Degni, 2019).

3. Model

With the aim of investigating whether fiscal decentralization is linked to municipalities' efficiency in the provision of local services, we develop an

econometric framework estimating a cost function for Italian municipalities based on a stochastic frontier analysis (Kumbhakar and Lovell, 2000). In particular, following Aigner et al. (1977) and Meeusen and van Den Broeck (1977), we adopt the parametric stochastic frontier approach, which, in the case of the cost function, can be written as:

$$y = f(\boldsymbol{x}; \boldsymbol{\beta}) + v + u, \tag{1}$$

where for each unit of analysis, y is the total expenditure, $\boldsymbol{x}$ is a vector of output variables and input prices and $f(\cdot)$ defines a cost (frontier) relationship between the total cost and outputs depending on the corresponding parameter vector $\boldsymbol{\beta}$, which represents technology to be estimated. Therefore, $f(\cdot)$ defines the minimum feasible cost for a given level of outputs and prices (the input-oriented analysis). The error term has two components: v is a symmetric two-sided error representing random disturbance due to measurement errors (i.e., the classical noise) while u is a one-sided error term which represents technical inefficiency ($u > 0$). In particular, v is assumed to follow a two-sided normal distribution (i.e., $v \sim iid\ N(0, \sigma_v^2)$), while u follows a half-normal distribution on the non-negative part of the real number line (i.e., $u \sim iid\ N^+(0, \sigma_u^2)$).

To take into account the presence of contextual variables that can affect municipalities' efficiency, following Battese and Coelli (1995) we modify equation (1), allowing inefficiency term u to linearly depend on exogenous variables $\boldsymbol{z}$:

$$u = \boldsymbol{z}\boldsymbol{\delta} + w, \tag{2}$$

where $\boldsymbol{\delta}$ is a vector of parameters for the determinants of technical inefficiency, w is the truncation of the $N(0, \sigma_u^2)$ distribution such that $w > -\boldsymbol{z}\boldsymbol{\delta}$ and, consequently, u is a non-negative truncation of the $N(\boldsymbol{z}\boldsymbol{\delta}, \sigma_u^2)$ distribution.

Our model specification takes into account the heterogeneity of each individual unit by modelling the mean of the inefficiency term as a function of taxation autonomy and several contextual variables.[4] Equations (1) and (2)

[4]The specification adopts a stochastic frontier panel data model with municipal and time fixed effects allowed only if the specified model exhibits the scaling property, see for instance Wang and Ho (2010). However the model of Battese and Coelli (1995) does not exhibit the scaling property Wang and Schmidt (2002). For this reason the results are to be considered as a preliminary analysis for further investigations.

are estimated in one-step by maximum likelihood.

To allow production units to have rather heterogeneous technologies, in this paper we specify $f(\cdot)$ by considering the translog cost function.[5] It represents a class of flexible functional forms for the cost functions since it provides a second order approximation to any arbitrarily twice differentiable function. More specifically, the cost function can be written as:

$$ln\ y = ln\ f(\boldsymbol{x}, \boldsymbol{\beta}) = \beta_0 + \sum_i \beta_i\ x_j + \frac{1}{2} \sum_j \sum_k \beta_{jk}\ ln\ x_j\ ln\ x_k, \qquad (3)$$

with $\beta_{jk} = \beta_{kj}$ and input elasticities given by

$$\epsilon_j = \beta_j + \sum_k \beta_{jk}\ ln\ x_k. \qquad (4)$$

Most of the applied literature based on stochastic frontier analysis imposes the functional form without checking if the monotonicity condition is fulfilled, despite its importance. Considered that neglecting the monotonicity requirement may lead to potential bias in the estimation of inefficiency effects (Belotti and Ferrara, 2019), we use the translog specification under a monotonic constraint adopting the three-step approach developed by Henningsen and Henning (2009). More specifically, the three steps involve estimating *i*) the unconstrained SF model; *ii*) the constrained parameters by minimum distance estimation; and *iii*) inefficiency effects and relative scores.

The inefficiency score of each unit is estimated by the conditional distribution of the u component with respect to compound error $\varepsilon = v + u$ (Jondrow et al., 1982). Denoting $\lambda = \sigma_u/\sigma_v$ and $\sigma^2 = \sigma_u^2 + \sigma_v^2$, the estimates of individual efficiency score are:

$$u = \frac{\sigma\lambda^2}{1+\lambda^2}\Big[\frac{\phi(\omega)}{1-\Phi(\omega)} - \omega\Big] \qquad (5)$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the standard normal density and cumulative distribution functions, respectively, and

$$\omega = \lambda\frac{y - f(\boldsymbol{x};\boldsymbol{\beta})}{\sigma} \qquad (6)$$

[5]Among the different parametric functional forms, the translog function is the most commonly used in empirical applications and is a generalization of the Cobb-Douglas function, which assumes homogeneity, unitary elasticity of substitution between inputs, and separability.

Finally, individual cost efficiency can be obtained from $CE = \exp\{-\hat{u}\}$.[6]

4. Data

Our empirical analysis is based on a dataset providing information concerning economic, socio-demographic and institutional aspects of a sample of Italian municipalities. The dataset was obtained by merging data from different sources: ISTAT, SOSE, ACI and OMI.[7] The data cover a sample of more than 5,000 Italian municipalities belonging to Ordinary Statute Regions[8] observed in 2010, 2013, 2015 and 2016.

In our model specification (equation 1) we define total costs as the sum of current expenditures for services included in the essential functions as defined by legislation: education, waste management, general administration, local policing, urbanization and road conditions, and social care services.

Following Agasisti and Porcelli (2019), we consider six output variables: equivalent students, waste disposed, population, equivalent sanctions, equivalent light points and equivalent assisted people. Equivalent students are the result of a standard cost estimation, combining the number of students in primary and middle school eligible for meals, those eligible for transportation, and those engaged in extracurricular activities managed out of school hours. Equivalent sanctions are the result of the aggregation of 15 different typologies of fines. Equivalent light points and equivalent assisted people were estimated with a two step procedure: 18 micro outputs reflecting activities connected to the function were aggregated into macro outputs (2 for light

[6] All of the analyses were carried out in the `R` Environment (R Core Team, 2020), using the `frontier`, `quadprog`, `micEcon`, `semsfa` packages. For a review of stochastic frontier models using `R` see Ferrara (2020).

[7] ISTAT is the Italian national institute of statistics; SOSE (Solution for the Economic System) is an agency of the Italian Ministry of Economy and Finance specialized in econometric analysis; ACI is the Italian automobile association; OMI is the real estate market observatory of the Italian tax office.

[8] Italy is divided into 20 regions: 15 are defined as ordinary statute regions (OSRs) and 5 are defined as special statute regions (SSRs). OSRs and SSRs mainly differ in how they are financed. As SSRs regions (Trentino Alto Adige, Friuli Venezia Giulia, Valle d'Aosta, Sicilia, and Sardegna) were not considered during data collection for estimating municipalities' standard needs (Law 42/2009) (COPAFF, 2012, IFEL, 2016), the unavailability of expenditure data for such regions led us to focus the analysis exclusively on OSRs, limiting the potential bias related to the different organization that such regions can self-regulate independently (Braga and Scervini, 2017).

points and 6 for assisted people) and then aggregated using the correlation between macro outputs and current expenditures as weights.[9]

Finally, we include in the cost function two price variables: the average local cost for renting offices/apartments and average revenues declared for fiscal reasons. Such variables represent the cost of the two classical production factors (capital and labour) and are exogenous enough to be included in the cost function for the public sector given that endogenous public spending cannot affect their levels (Agasisti and Porcelli, 2019).

Table 1 reports descriptive statistics of costs, outputs and prices used in our model specification in 2010, 2013, 2015 and 2016.

When analysing costs, it emerged that the average value of current expenditures per capita for general administration decreased from 334 to 258 euros. A slightly decreasing trend is observed for education (from 80 to 69 euros) and social services (from 74 to 65 euros). In contrast, the average expenditure for waste disposed increased from 123 to 134 euros. Quite stationary are the expenditures for both local policing (33 euros) and urbanization and road conditions (a decrease from 101 to 99 euros).

On the output side, a decreasing trend characterized most of the variables: waste disposed per capita (a decrease from 463 to 445 tons); the number of equivalent students (from 0.93 to 0.83); the number of equivalent light points (from 0.59 to 0.27); and the number of equivalent sanctions (from 3.7 to 2.06). The number of equivalent assisted people increased from 0.88 to 0.91, and the population value reached 5306 from 4746 thousand.

Regarding prices used in our cost function, the average local cost for renting decreased from 4.34 to 4.177 euros (m2 per month), and average revenues per capita increased from 28.27 to 30.58 thousand euros.

Table 2 summarizes the descriptive statistics for financial information provided by ISTAT (2019). Taxation autonomy, measured as the ratio of tax revenue after FSC transfers to total current revenue, increased from 0.43 to 0.68. This trend may be partially due to an ongoing process of reform oriented towards the autonomous use of tax leverage by municipalities and toward the elimination of traditional central transfers, as described in Section 2. Surplus on current revenues, measured by excess current revenues over expenditures, also increased from 0.15 to 0.38. Expenditure rigidity,

[9]For further details on the methodology adopted to compute the output variables see Agasisti and Porcelli (2019).

Table 1: Descriptive statistics: costs, outputs and prices (mean and *standard deviation*)

Year	**2010**	**2013**	**2015**	**2016**
Expenditure for General Administration	0.334	0.248	0.245	0.258
	(0.264)	*(0.157)*	*(0.169)*	*(0.216)*
Expenditure for Education	0.080	0.073	0.072	0.069
	(0.037)	*(0.041)*	*(0.039)*	*(0.039)*
Expenditure for Local Police	0.033	0.033	0.033	0.033
	(0.035)	*(0.027)*	*(0.026)*	*(0.029)*
Expenditure for Waste Management	0.123	0.133	0.135	0.134
	(0.064)	*(0.129)*	*(0.071)*	*(0.073)*
Expenditure for Social Services	0.074	0.061	0.069	0.065
	(0.112)	*(0.065)*	*(0.081)*	*(0.078)*
Expenditure for Urbanization and Road Conditions	0.101	0.104	0.104	0.098
	(0.114)	*(0.084)*	*(0.082)*	*(0.103)*
Waste Disposal	0.463	0.424	0.432	0.445
	(0.154)	*(0.14)*	*(0.142)*	*(0.148)*
Equivalent Students	0.935	0.795	0.800	0.838
	(2.086)	(0.808)	(1.096)	(1.16)
Equivalent Light Points	0.587	0.405	0.446	0.275
	(0.544)	(0.397)	(0.476)	(0.348)
Equivalent Assisted People	0.884	0.874	0.992	0.910
	(0.728)	(0.339)	(0.905)	(0.902)
Equivalent Sanctions	3.700	2.220	1.944	2.056
	(8.472)	(3.828)	(5.022)	(4.016)
Population	4.746	5.156	5.331	5.306
	(5.980)	*(6.479)*	*(6.450)*	*(6.754)*
Average Local Cost of Renting	4.434	4.307	4.241	4.177
	(1.485)	*(1.488)*	*(1.414)*	*(1.379)*
Average Revenues	28.269	30.122	30.757	30.584
	(2.077)	*(2.29)*	*(2.341)*	*(2.177)*
Observations	**5433**	**5185**	**4779**	**5163**

Note: All expenditure and output variables are per capita measures; expenditure variables are expressed in thousands of euros; waste disposal is expressed in tons; population is expressed in thousands; the average local cost of renting is measured in monthly euros per sq. meter; average revenues are expressed in thousands of euros.

Table 2: Descriptive statistics: financial data (mean and *standard deviation*)

Year	**2010**	**2013**	**2015**	**2016**
Taxation autonomy	0.427	0.642	0.690	0.683
	(0.134)	*(0.124)*	*(0.130)*	*(0.140)*
Surplus on current revenues	0.149	0.170	0.348	0.382
	(0.259)	*(0.258)*	*(0.486)*	*(0.368)*
Expenditure rigidity	0.404	0.428	0.456	0.300
	(0.218)	*(0.294)*	*(0.357)*	*(0.104)*
Loan reimbursement on current revenues	0.125	0.180	0.216	0.062
	(0.200)	*(0.273)*	*(0.334)*	*(0.064)*
Collection capacity	0.675	0.711	0.766	0.793
	(0.144)	*(0.135)*	*(0.122)*	*(0.111)*
Spending capacity	0.629	0.648	0.762	0.769
	(0.134)	*(0.145)*	*(0.119)*	*(0.109)*
Transfers on current expenditure	0.122	0.134	0.135	0.135
	(0.09)	*(0.106)*	*(0.118)*	*(0.125)*
Transfers on capital expenditure	0.059	0.073	0.072	0.065
	(0.139)	*(0.172)*	*(0.164)*	*(0.171)*
Accumulation of passive residues	0.535	0.531	0.525	0.836
	(0.442)	*(0.404)*	*(0.769)*	*(0.94)*
Average income	20.129	20.930	21.415	21.669
	(3.092)	*(3.179)*	*(3.276)*	*(3.313)*
Observations	**5433**	**5185**	**4779**	**5163**

Note: Average income is measured in thousands of euros.

measured as the ratio of personnel costs plus loan reimbursement over current revenues, decreased, recording, on average, a non monotonic trend for the period considered. A similar trend is observed for the share of loan reimbursement on current revenues, decreasing from 12.5% to 6.2%. Both the collection capacity, measured as the ratio of actual collected revenues to assessed revenues, and the spending capacity, the ratio of actual payments to assessed payments, increased monotonically. Transfers as a share of expenditure for both current and capital components increased. The accumulation of passive residues, measured as the ratio of passive residues on initial passive residues, increased in the period considered, particularly from 2015 to 2016, when it increased from 0.52 to 0.83. Finally, the average income in municipalities increased from 20,129 to 21,669 euros.

Finally, Table 3 provides information about additional contextual variables that could influence municipalities' efficiency. Such information concerns demographic factors and institutional frameworks. As predictable, most of these variables are rather stable from 2010 to 2016. An exception is

Table 3: Descriptive statistics: additional contextual factors (mean and *standard deviation*)

Year	**2010**	**2013**	**2015**	**2016**
Population density	331.265	332.345	332.010	331.810
	(684.532)	*(688.355)*	*(688.598)*	*(688.827)*
Buildings	1.378	1.517	1.558	1.577
	(1.049)	*(1.161)*	*(1.214)*	*(1.242)*
Roads	0.042	0.043	0.044	0.045
	(0.050)	*(0.053)*	*(0.055)*	*(0.056)*
Commuters	0.022	0.022	0.022	0.022
	(0.095)	*(0.094)*	*(0.093)*	*(0.092)*
Differentiated waste	38.031	45.200	50.593	56.085
	(22.562)	*(22.799)*	*(21.584)*	*(22.049)*
Tourists	0.016	0.017	0.017	0.016
	(0.069)	*(0.078)*	*(0.071)*	*(0.071)*
Car accidents	0.002	0.002	0.002	0.002
	(0.002)	*(0.001)*	*(0.001)*	*(0.001)*
Population 0-2 years	2.594	2.392	2.224	2.168
	(0.758)	*(0.706)*	*(0.67)*	*(0.652)*
School meals provided directly	0.220	0.241	0.227	0.201
	(0.378)	*(0.421)*	*(0.411)*	*(0.393)*
Local units (companies)	0.069	0.068	0.068	0.067
	(0.022)	*(0.023)*	*(0.022)*	*(0.022)*
Observations	**5433**	**5185**	**4779**	**5163**

Note: Population density is the value of people per sq. km of land area; buildings is the per capita value of total buildings; roads is the per capita value of the length of communal roads in km; commuters is the per capita number of incoming commuters minus the number of outgoing commuters; differentiated waste is the share in terms of the total quantity of waste; tourists is the per capita value; car accidents are measured as per capita value; population 0-2 is the share in terms of the total population; school meals provided directly is the share of total meals provided; local units is the per capita value of all local companies.

found for the share of differentiated waste, which recorded an increase of approximately 50% (from approximately 38% to 56%). Furthermore, also the per capita number of total buildings also increased, from 1.4 to 1.6. Finally, we observe a reduction in the share of the population of 0-2 years of age, demonstrating a progressive ageing of the population due to its low natality.

5. Results

This section presents the findings concerning the association between fiscal decentralization and the efficiency of Italian municipalities in 2010-2016. To compare our results with the previous literature, we start our empirical

analysis by modelling municipalities' efficiency as a function of fiscal decentralization and adding additional controls over two steps. In particular, we estimate three nested specifications of the model with equations (1) and (2):

- Model 1: municipalities' inefficiency is considered exclusively a function of taxation autonomy;
- Model 2: the whole set of financial variables is included in the cost function;
- Model 3: additional control variables that can affect municipalities' inefficiency - demographic factors and institutional framework - are included.

All model specifications include municipal and time fixed effects in the cost function to account for individual (i.e., municipal) heterogeneity and for time trends.

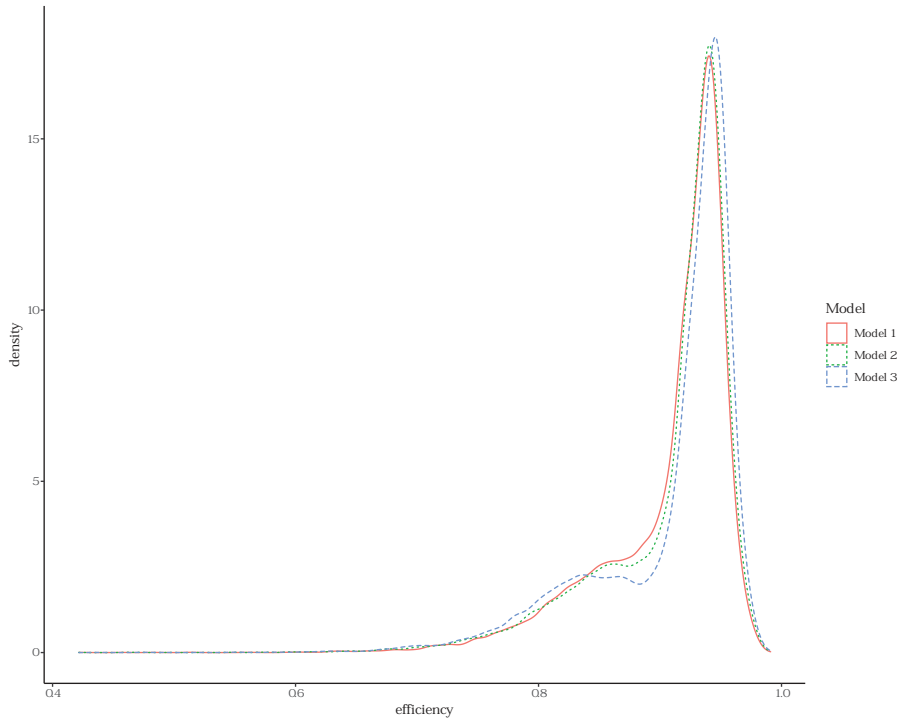
With the aim of providing brief considerations about municipalities' inefficiency in Figure 1 we report the density of efficiency scores estimated by adopting the three different model specifications. We obtain a narrow distribution of efficiency scores of close to 0.9 for the three different models as also highlighted in Table 4 where we show the estimated mean efficiency.

Furthermore, Table 4 provides considerations in terms of monotonicity, showing the average elasticity of outputs[10] in the cost function estimated by equations (1) and (2). Following Henningsen and Henning (2009), the elasticity related to no output falls below zero, and monotonicity is maintained.

Table 5 summarizes the findings of the empirical estimations of the three model specifications. We provide convincing evidence for the association between fiscal decentralization and municipalities' inefficiency: when we consider municipalities' inefficiency exclusively as a function of taxation autonomy (Model 1) we document a negative and highly significant association between these variables. Furthermore, the significant negative effect for taxation autonomy on inefficiency is confirmed after the inclusion of fiscal variables (Model 2) and additional controls (Model 3). Overall, these findings are in line with previous international literature providing convincing

[10]In the estimation, following Kumbhakar and Lovell (2000), to ensure that the cost frontier is linearly homogeneous in input prices, the dependent variable and prices are normalized by a price component (in our case, the labour factor price).

Figure 1: Density scores of efficiency for the different model specifications.



evidence that fiscal decentralization may influence government size through different channels such as the reduction of excessive spending (De Mello, 2006, Rodden, 2004, Jin and Zou, 2002, Cassette and Paty, 2010, Ashworth, Galli, and Padovano, 2013) and of excessive borrowing (Goodspeed, 2002, Koppl-Turyna and Pitlik, 2018).

When we investigate the effect of financial data (Model 2), a significantly negative effect emerges for the surplus on current revenues. Although achieving a surplus is not the main goal of a virtuous municipality (Goodspeed, 2002, Koppl-Turyna and Pitlik, 2018), the negative association between surplus and inefficiency could be explained by the expenditure value, as it is more likely that higher surplus is associated with lower expenditures and, consequently, lower municipality inefficiency. Furthermore, municipality inefficiency is negatively affected by expenditure rigidity, although this is considered a not-virtuous financial indicator (Degni, 2019): the higher the share of personnel costs over current revenues is, the lower the level of inefficiency

Table 4: Elasticity of outputs (mean and *standard deviation*)

	Model 1	**Model 2**	**Model 3**
Waste disposed	0.041	0.024	0.013
	(0.008)	*(0.005)*	*(0.003)*
Equivalent students	0.037	0.034	0.034
	(0.007)	*(0.007)*	*(0.006)*
Equivalent light points	0.025	0.024	0.022
	(0.005)	*(0.005)*	*(0.005)*
Equivalent assisted people	0.001	0.001	0.001
	(0.000)	*(0.000)*	*(0.000)*
Equivalent sanctions	0.007	0.007	0.007
	(0.001)	*(0.001)*	*(0.001)*
Mean efficiency	**0.907**	**0.908**	**0.908**
Observations	**20545**	**20545**	**20545**

is. On the other hand, municipality inefficiency is positively linked to the repayment of loans on current revenues, confirming that the more resources are assigned to repayments, the less resources can be dedicated to the provision of public services. Furthermore, we find that the greater resources available for municipalities with more collection capacity are not able to contribute to local service provision, at least for the essential services considered in this paper, thus increasing inefficiency but with weak significance. The positive association between inefficiency and transfers on current expenditure can be explained by the fact that the more municipalities transfer money directly to citizens, the less municipalities can spend on the provision of such outcomes used to estimate inefficiency. A positive association emerges between the accumulation of passive residues and inefficiency, showing that municipalities with a slow disbursement system can be less efficient even in the provision of public services. Furthermore, a significantly positive association emerges between inefficiency and average income, demonstrating that more complex and expensive local services are requested when municipalities' economic development increases (Geys et al., 2010, Boetti, Piacenza, and Turati, 2012, Moreno-Monroy, Schiavina, and Veneri, 2020).

The role of additional contextual factors in explaining municipalities' inefficiency (Model 3) is in line with findings of previous literature. The efficiency of more compact urban areas has yet to be shown in terms of costs (Camagni, Gibelli, and Rigamonti, 2002). More urban density, determined from higher population density and incoming mobility, lead economies of scale in the pro-

Table 5: Estimation results

	Model 1		**Model 2**		**Model 3**	
Taxation autonomy	-0.856	***	-0.698	***	-0.616	***
	(0.018)		(0.026)		(0.026)	
Surplus on current revenues			-0.053	***	-0.049	***
			(0.012)		(0.012)	
Expenditure rigidity			-0.478	***	-0.53	***
			(0.066)		(0.066)	
Loan reimbursement on current revenues			0.459	***	0.502	***
			(0.069)		(0.069)	
Collection capacity			0.065	.	0.057	
			(0.038)		(0.038)	
Spending capacity			-0.016		0.032	
			(0.037)		(0.037)	
Transfers on current expenditure			0.318	***	0.343	***
			(0.05)		(0.051)	
Transfers on capital expenditure			-0.028		-0.036	
			(0.023)		(0.023)	
Accumulation of passive residues			0.012	*	0.017	***
			(0.005)		(0.005)	
Average income			0.000	***	0.000	***
			(0.000)		(0.000)	
Population density					-0.001	*
					(0.000)	
Buildings					-0.245	***
					(0.033)	
Roads					4.902	**
					(1.698)	
Commuters					-2.207	.
					(1.338)	
Differentiated waste					-0.003	
					(0.000)	
Tourists					0.067	
					(0.13)	
Car accidents					5.547	*
					(2.71)	
Population 0-2 years					0.033	***
					(0.007)	
School meals provided directly					0.018	*
					(0.009)	
Local units (companies)					2.991	***
					(0.517)	

Note: Signif. codes: 0.001 '***' 0.001 '**' 0.05 '*' 0.1 '.'.

vision costs of local public services, thus reducing municipalities' inefficiency (Geys, 2006, Hortas-Rico and Sole-Olle, 2010, Sung, 2007). In line with these considerations, our estimation results (Table 5) provide convincing evidence that municipalities' inefficiency decreases as population density increases. We show that two additional variables proxying for municipalities' density, based on land use, are significant in affecting municipalities' inefficiency. The first is the number of buildings: when the number of buildings increases, municipalities become more compact, and consequently cost inefficiency decreases. The second variable is the length of roads measured in km: municipalities characterized by a major road network are characterized by low population density, increasing cost inefficiency (Balaguer-Coll and Prior, 2009). Further, in investigating the role of incoming population mobility, we find convincing evidence that the number of incoming commuters minus outgoing commuters, which implies more compact areas, significantly reduces municipalities' inefficiency. Two variables proxying for municipalities' urban development, i.e., the share of differentiated waste and the number of tourists are not significant in explaining municipalities' inefficiency. A positive association is found between inefficiency and the number of car accidents, highlighting that the presence of congested roads implies diseconomies in providing services (Agasisti and Porcelli, 2019). Regarding the population structure, the higher the share the young population represents, the higher the level of inefficiency is, showing that children's families express more qualified demand for costly services connected to schooling. The share of school meals provided directly is positively associated with inefficiency, demonstrating that costs are higher when meal provision is not assigned to external entities that can take advantage of economies of scale. The number of companies is positively associated with inefficiency, confirming, in line with the finding related to income, that higher levels of economic development also increase the demand for high-cost or high-quality public services: a 'preference effect' (see, among others, Geys et al. (2010)).

6. Concluding remarks

This paper investigates the association between fiscal decentralization and efficiency in analysing a sample of Italian municipalities for 2010-2016. In particular, we implement a cost efficiency analysis based on a stochastic frontier approach and model the decentralization effect through taxation autonomy. This decentralization variable is measured by means of the share

of revenues from taxation over the total revenues for each municipality. Efficiency is estimated by means of a cost function for six essential services provided by municipalities: education, waste management, general administration, local policing, urbanization and road conditions, and social care services.

The econometric analysis, based on a one-stage stochastic frontier with municipal and year fixed effects, provides convincing evidence of a positive association between fiscal decentralization and municipalities' efficiency. This evidence is in line with a large stream of existing literature showing that inefficiency increases when expenditure and revenue are not assigned to the same tier of government.

From a policy perspective, this evidence lends support for policies aimed at making the expenditure and revenue decision making more closely aligned to avoid fiscal illusions, facilitate the discovery of inefficient behaviours and foster accountability among policy makers.

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