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Fiscal Autonomy and Tax Compliance: insights from Italy's Municipal Waste Tax

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Abstract

This paper investigates the determinants of local tax compliance focusing on Italy's municipal waste tax (TARI). Despite the 2012 fiscal federalism reform that expanded local autonomy, fiscal evasion rates remain high and not homogeneous across territories. Using a balanced panel of 6,846 municipalities over 2017-2023, we apply a dynamic panel approach to account for endogeneity, persistence, and unobserved heterogeneity in tax collection behaviour. The results show that civic engagement significantly enhances compliance, while generalized trust exerts a negative effect, suggesting that exclusive social ties may undermine fiscal responsibility. These findings highlight the behavioural foundations of local tax performance and indicate that fiscal autonomy alone is insufficient to foster compliance without supportive social capital. To assess whether these relationships are spatially homogeneous, we extend the analysis by implementing a local System GMM estimation, which reveals substantial regional heterogeneity and underscores the spatially contingent nature of fiscal behaviour. These results call for spatially tailored fiscal policies that integrate institutional capacity with the social foundations of compliance.

Keywords: Tax compliance, Fiscal federalism, Local taxation, Social capital, Municipal finance, System GMM

JEL Codes: C23; H26; H71; H77; Z13

Preliminary version, do not quote without permission

1. Introduction

With annual revenue losses estimated at around €90 billion ([Ministero dell'Economia e delle Finanze, 2025](#)), tax evasion poses a critical threat to Italy's public finances at both national and local levels. This substantial revenue shortfall severely undermines the capacity to guarantee adequate public services amid widening economic and social inequalities. These challenges are particularly relevant considering that Italy exhibits one of the highest level of debt-to-GDP ratio among the OECD countries ([OECD, 2023](#); [European Commission, 2024](#)).

In such context, understanding what drives tax compliance acquires crucial importance. Despite extensive research on tax evasion and compliance in major national taxes (among others, [Carfora et al., 2018](#)), relatively few studies have examined local taxation in Italy ([Bordignon et al., 2024](#)). Closing this gap is particularly relevant for two reasons. First, local taxes play a crucial role in sustaining municipal budgets, especially since 2012, when Italy underwent a fundamental transformation of its fiscal framework from a centralized system of grants toward greater fiscal autonomy for local governments. Second, understanding local tax compliance can shed light on compliance patterns with national taxes and inform the ongoing debate on the viability of fiscal federalism reforms. A key rationale behind this reform was that coupling decentralized expenditure with decentralized revenue would enhance accountability, improve the quality of public spending, and consequently increase citizens' willingness to comply ([Oates, 1972](#); [Tiebout, 1956](#); [Brosio et al., 2002](#)). Nevertheless, estimated evasion rates for local taxes remain comparable to those observed for national taxes ([Ministero dell'Economia e delle Finanze, 2025](#)), suggesting that the roots of non-compliance extend beyond institutional design.

Recent research suggests that fundamental dimensions of social capital - civic engagement, interpersonal trust, and community norms - play a decisive role in shaping tax compliance, potentially outweighing the effects of accountability or enforcement capacity at the local level. While traditional economic models of tax evasion, pioneered by [Becker \(1968\)](#) and adapted by [Allingham and Sandmo \(1972\)](#), characterize compliance as a rational response to audit probabilities and expected sanctions, more recent behavioural and sociological approaches emphasize the influence of social norms, trust, and moral values on individuals' willingness to pay taxes ([Frey, 1997](#); [Frey and Torgler, 2007](#); [Alm and Torgler, 2006](#)). In this perspective, tax morale, the intrinsic

motivation to comply, derives from broader dimensions of social capital encompassing institutions, networks, and shared norms that foster cooperation and adherence to collective rules (Bourdieu, 1977; Coleman, 1988; Dasgupta, 2000; Putnam et al., 1993).

The aim of this paper is to explore the dynamics that determine tax compliance rates at the municipal level by focusing on Italy’s Municipal Waste Tax (TARI). TARI represents a particularly suitable case for analysing local tax compliance since it represents the second-largest source of municipal tax revenue, totalizing approximately €11.2 billion in 2024. Unlike many other local taxes, it is directly collected by municipalities, finances a tangible and universally consumed service, and allows for precise measurement of compliance, as voluntary payments can be clearly distinguished from total assessed liabilities. Average compliance stands at roughly 70%, with substantial geographical variation across regions. Hence, TARI represents an ideal setting to study how contextual and social factors shape taxpayer behaviour. Moreover, it allows analysing possible spatial patterns that may arise in studying local tax compliance rates.

The paper provides three main contributions to the literature. First, it contributes to the growing body of work on the behavioural and institutional foundations of tax compliance by explicitly linking fiscal decentralization to the social capital framework. Building on the theoretical relationship between social capital and tax morale, it extends existing research by exploring how civic engagement and interpersonal trust shape compliance at the local level. Previous studies have identified these dimensions as key determinants of individuals’ willingness to comply with taxation (Alm and Torgler, 2006; Torgler, 2007; Cummings et al., 2009). Consistent with this perspective, bridging social capital, characterized by inclusive and cooperative networks, tends to foster collective responsibility and higher compliance (Putnam et al., 1993; Knack and Keefer, 1997), whereas bonding social capital, associated with closed, exclusive groups, may reinforce in-group loyalty at the expense of compliance with public obligations (Guiso et al., 2011; Bjørnskov, 2006). Italy provides an ideal setting to test these hypotheses, combining substantial regional heterogeneity in social capital with relatively homogeneous enforcement, largely carried out by the National Tax Agency to which municipalities typically delegate this function.

Second, it addresses spatial heterogeneity in the determinants of tax compliance. Recent advances in spatial econometrics demonstrate that behavioural and institutional mechanisms are rarely spatially uniform (Bruns-

don et al., 1996; Páez et al., 2011; Oshan et al., 2019). In Italy, where civicness, trust, and institutional quality display marked regional contrasts, spatial non-stationarity is particularly relevant for understanding tax compliance. To capture such heterogeneity, we complement a global System GMM model with a spatially weighted specification that allows coefficients to vary across municipalities according to their geographic proximity. This framework enables us to test whether the effects of civic engagement and trust are spatially stable or exhibit region-specific patterns, offering new insights into the geography of fiscal behaviour.

Third, from a methodological perspective, it applies a local dynamic panel approach to a comprehensive dataset of Italian municipalities, allowing for the treatment of endogeneity, persistence, and unobserved heterogeneity in the spatial analysis of tax compliance. This empirical design provides more robust identification of the relationship between social capital and local tax performance compared to cross-sectional or static panel analyses employed in previous studies. Our findings reveal that civic engagement is positively associated with higher rates of voluntary compliance. By contrast, generalized trust displays a negative correlation with tax compliance. These results reflect the ambivalent nature of social ties on tax evading behaviour. Our findings reveal also a pronounced spatial asymmetry in the effects of social capital. This spatial heterogeneity shows that the behavioural foundations of fiscal compliance are context-dependent, reflecting deep-rooted social capital and institutional differences.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature, while Section 3 describes TARI and its institutional context. Section 4 presents the data and variable construction, and Section 5 outlines the empirical strategy and discusses the main results. Section 6 concludes.

2. Literature review

Tax compliance encompasses a wide spectrum of taxpayer behaviours, ranging from voluntary compliance motivated by tax morale (Frey and Torgler, 2007; Luttmer and Singhal, 2014), to enforced compliance driven by fear of detection (Kirchler et al., 2008), as well as compliance based on the perceived benefits derived from government services and institutional setting and its quality (Levi, 1988; Myles and Naylor, 1996; Barone and Mocetti, 2011). The multifaceted nature of the phenomenon renders a comprehensive

analysis inherently challenging. Moreover, as with other social phenomena, tax compliance is shaped by social interactions among economic agents and thus displays considerable variation across geographic units, even when underlying determinants remain relatively similar (Galbiati and Zanella, 2012; Davis et al., 2003; Abramovitz, 1956; Guerra and Harrington, 2022).

Focusing on the research that emphasizes the role of tax morale in shaping tax compliance, two distinct strands of literature can be identified. The first examines contextual and socio-demographic factors associated with individual tax morale, such as age, gender, culture, religiosity, and education (Alm and Torgler, 2006; Lago-Peñas and Lago-Peñas, 2010; D’Attoma, 2018; Zhang et al., 2016).

The second investigates the relationship between social capital and tax morale Putnam et al. (1993); Alm and Gomez (2008); Cascavilla et al. (2024); Calamunci and Frattini (2023). Social network interactions are regarded as determinant (Putnam, 1995). Depending on whether social interactions are inclusive or exclusive, they can lead to different social outcomes. Depending on whether such interactions are inclusive or exclusive, they may lead to markedly different social outcomes. To capture this heterogeneity, Putnam (2000) introduces the distinction between bridging and bonding forms of social capital.

Bridging social capital derives from inter-group relationships characterized by weak social ties (Granovetter, 1973, 1985), which connect individuals who are dissimilar to one another (Putnam and Goss, 2002). Such ties tend to foster tolerance and acceptance of diversity in terms of people, values, and beliefs (Paxton, 2002). Bridging social capital, thus, tends to improve economic performance by generating positive externalities, including the reduction of transaction costs and the promotion of solidarity and cooperation.

Bonding social capital, by contrast, arises from strong social ties among individuals who share similar social identities (Putnam and Goss, 2002). Unlike bridging ties, bonding forms are more likely to generate negative externalities owing to their exclusive nature. They may create barriers to extending trust beyond the group and to individuals who do not share the same identity or values, thereby constraining broader cooperation (Beugelsdijk and Smulders, 2009; Pervaiz and Chaudhary, 2015; Muringani et al., 2021).

Beyond the Italian context, a growing body of empirical research has explored the determinants of tax compliance in local and property-related taxation across different institutional settings. Bordignon et al. (2003) and

Brühlhart and Jametti (2006) analyse fiscal behaviour among Italian and Swiss municipalities, respectively, highlighting how inter-jurisdictional competition and local accountability influence both tax rates and collection efficiency. Similarly, Torgler and Schneider (2009) provide cross-country evidence that institutional quality and tax morale jointly shape tax evasion levels, suggesting that compliance depends not only on enforcement mechanisms but also on the broader trust in government. Studies on Spain and Germany further confirm the relevance of regional and cultural heterogeneity: in these contexts, civic norms and perceived fairness of local taxation systems are found to significantly affect willingness to pay (Lago-Peñas and Lago-Peñas, 2010; Frey and Torgler, 2007). Compared to this literature, the present paper adds to the debate by focusing on a single, homogeneous institutional setting as TARI where compliance can be measured with high precision and institutional variation is minimal, allowing for a cleaner identification of the behavioural mechanisms linking trust in family, in the others and civiness respect to local tax performance.

3. The TARI as an empirical setting for studying Local Tax compliance

3.1. Institutional framework of the TARI

TARI is the municipal tax earmarked to cover the full cost of waste management. It is assessed on the basis of proxies for taxpayers' potential waste production. For households, these proxies include the cadastral surface of the dwelling and the number of residents, while for institutions and businesses they consist of a combination of floor space and sector-specific indicators of waste-generating capacity.

As an alternative, municipalities may adopt tariff-based schemes in which charges are linked to the actual quantity of waste produced. The implementation of such schemes may be very costly. In addition to the substantial infrastructural and enforcement requirements needed to measure waste production with accuracy, these systems also presuppose the existence of strong social norms that discourage opportunistic practices such as illegal waste dumping, which may generate spillovers across municipal borders. In contexts where such norms are weak, tariff schemes may therefore create incentives for non-compliant behaviour, ultimately resulting in higher waste collection costs. In Italy, different tariff regimes, ranging from less precise systems to more accurate ones based on actual waste generation, have been adopted primarily by

smaller local governments concentrated in the North-Eastern regions. This geographical clustering may partly reflect the spillovers associated with the adoption of tariff schemes¹.

3.2. Fiscal and economic relevance

From a fiscal perspective, the TARI represents the second most important source of municipal tax revenue, amounting to €11.2 billion in 2024, after the property tax on real estate (IMU), which yielded €14.6 billion. Other municipal revenue sources generate substantially lower amounts. Unlike the IMU, which is not levied on primary residences of individuals, the TARI applies universally to all owners and occupants of residential dwellings.

The TARI tax rates are set to fully cover the costs of the waste management service. These costs are not determined entirely endogenously by municipal decisions, but depend to a large extent on the availability of waste-processing facilities at the regional level. Where such facilities are insufficient, municipalities must bear higher transportation costs to transfer waste beyond regional borders, and in some cases even abroad. As a result, TARI tax rates are also shaped by exogenous factors, which nonetheless tend to be regionally clustered².

The TARI is governed by specific assessment rules which, when combined with the structure of municipal balance sheets³ make it possible to precisely distinguish the share of revenue collected during the year through voluntary compliance of taxpayers from that arising from overdue liabilities paid spontaneously or due to compulsory collection⁴.

¹Owing to their specific characteristics, these municipalities are excluded from the analysis.

²Minzyuk and Pansini (2024) indicates that, due to insufficient processing capacity, municipalities in Southern Italy face higher waste service costs and, consequently, higher TARI rates. Moreover, waste management costs, and thus TARI burdens, tend to increase with municipal population size.

³Containing both financial accounting and accrual-based information.

⁴The TARI is assessed on an accrual rather than a cash basis. In municipal balance sheets, the full amount of annual TARI liabilities, corresponding to the total cost of the waste management service, is recorded as revenue due. Actual collections are then reported separately, distinguishing between payments related to current-year liabilities and those referring to previous years. Revenues from sanctions or penalties are excluded, as they are registered under distinct budget items. This accounting framework allows for the construction of an accurate indicator of voluntary tax compliance based on the ratio be-

3.3. Why TARI is a natural case for studying compliance

Beyond its fiscal and institutional relevance, the TARI presents several distinctive features that make it an exceptionally informative setting for analysing the impact of social capital on voluntary tax compliance. Taken together, these characteristics allow for a cleaner identification of behavioural and contextual determinants of compliance, minimizing the influence of confounding institutional factors that typically affect national-level taxation.

First, the TARI provides an unusually precise measure of compliance at a highly disaggregated level, approximating the neighbourhood context in which social interactions are likely to occur. Unlike estimates of national tax evasion, which often rely on indirect methods (such as VAT gaps or discrepancy approaches), TARI, in fact, compliance can be computed directly from administrative records of assessed liabilities and actual payments. Second, it reduces the confounding influence of alternative determinants of compliance, such as those related to the perceived quality of public goods provision. In the case of the TARI, compliance is unlikely to be substantially shaped by potential mismatches between taxpayers' preferences for public goods and their willingness to pay, a dynamic that is considerably more salient in the context of national taxation, where territorial disparities are pronounced. Moreover, the benefits of waste management services financed through the TARI are immediate and tangible for all members of the community and the costs are largely borne collectively.

Finally, the variability in compliance across municipalities is unlikely to reflect differences in enforcement capacity. Because enforcement of local taxes in Italy is delegated to the National Tax Agency and governed by uniform procedures, variation in compliance is unlikely to stem from differences in enforcement capacity. An additional source of variability can be identified in the internal efficiency of the administration in tax collection, a factor that will be incorporated in the subsequent analysis. This institutional homogeneity strengthens the causal interpretation of compliance as driven by social and contextual factors rather than by administrative efficiency.

tween current revenues and total assessed liabilities. A similar measure cannot be derived for the property tax (IMU), which is recorded on a cash basis.

4. Data and variable description

This section describes the data sources, variable construction, and sample selection procedures used in the empirical analysis. It also discusses the steps taken to ensure the comparability and accuracy of fiscal and social indicators across municipalities.

Our empirical analysis is based on a not balanced panel covering the period 2017-2023 and consisting of 46,407 observations for 6,846 Italian municipalities. Municipalities that underwent administrative mergers during this period are treated as consolidated entities in all years.

The dataset integrates information from multiple administrative sources, including standardized municipal financial statements (BDAP), monthly cash revenue flows (SIOPE), municipal-level personal income tax records (Ministry of Economy and Finance), property cadastral data (Italian Revenue Agency), demographic indicators (ISTAT), and survey-based proxies for social capital.

TARI revenues and assessed values from municipal balance sheets are used to construct our measure of voluntary compliance. This is defined as the ratio of current TARI revenues to total assessed liabilities. To isolate voluntary payment behaviour, both the numerator and denominator exclude values derived from control activities, as these are likely reflect post-detection recoveries rather than spontaneous tax compliance. Table A1 reports the decomposition of assessments and revenues into regular and controls related components over the period 2017-2023. We construct two additional control variables at the municipal level using balance sheet data. First, the fiscal autonomy index is defined as the share of own-source revenues in total municipal revenues and captures fiscal independence from intergovernmental transfers. Second, tax enforcement capacity is proxied using the Fondo Crediti di Dubbia Esigibilità (FCDE) from municipal accounts. This measure⁵ reflects the average historical recovery rate of outstanding tax liabilities and serves as an indicator of the municipality’s effectiveness in tax collection. Given the changes in the rules governing the calculation of recovery rates between 2016 and 2019, which make the values differ across years, the variable is calculated as difference from the annual average value. Payment timing

⁵We are aware that the FCDE may also reflect municipalities’ accounting and budgeting strategies rather than purely their tax enforcement capacity; however, it remains a useful proxy to capture cross-sectional differences in collection efficiency.

and administrative efficiency are captured using monthly revenue data from SIOPE. We compute two indicators: *(i)* the share of annual TARI revenues collected during the first quarter, and *(ii)* the month of peak revenue collection. A high concentration of collections in the first quarter may signal administrative delays in the approval of TARI regulations. Although municipalities are legally required to approve TARI rates together with budgets by December 31 of the preceding year, this deadline is frequently postponed due to administrative inefficiencies and delays in contractual negotiations with waste service utilities. Furthermore, annual extensions to budget approval deadlines are routinely granted.⁶ As a result, billing delays may cause the final instalment of year- t TARI payments to shift into early year $t + 1$, potentially biasing compliance downward. The first-quarter collection share controls for this bias, while the peak payment month captures heterogeneity in municipal payment patterns.

Local wealth is captured using two indicators: *(i)* the total cadastral value of the municipal building stock from the Italian Revenue Agency, and *(ii)* average personal income IRPEF. Since cadastral values form the tax base for the municipal property tax (IMU), decentralized to municipalities in 2012, local governments may have updated cadastral values strategically to enhance revenues. To address potential endogeneity, we instrument current cadastral values using their 2013 levels, which avoid strategic adjustments following IMU decentralization.

Demographic controls include population age structure, the share of foreign residents, and educational attainment, drawn from ISTAT.

Measures of social capital, namely generalized trust and civic participation, are derived from micro-data from the 2023 MEFOP annual survey, which includes 6,015 respondents and is regionally representative. Although the municipality of residence is known for each respondent, the limited number of observations prevents the construction of reliable municipal estimates. To address this issue, we apply a spatial kernel interpolation that uses the geographic centroids of municipalities to generate smoothed, municipality-level estimates consistent with the underlying regional distribution of the survey data.

Finally, several sample restrictions are implemented in the construction of

⁶Extended deadlines during our sample period: February 28 (2017-2019, 2023); May 31, 2020 (Covid-19 emergency); March 31 (2021-2022).

the analytical dataset, beyond observations lost due to missing data (primarily in BDAP, SIOPE, and ISPRA). First, we restrict the sample to 2017-2023 because of the reform of municipal accounting standards in 2016, which harmonized financial reporting across local authorities. Pre-reform BDAP data are not comparable with post-reform data, and harmonized reporting practices were incorporated into SIOPE only from 2017 onward.

Second, we exclude municipalities that potentially apply tariff-based systems either partially or fully in lieu of the TARI tax. Some municipalities operate mixed tax-tariff regimes in which waste collection and recycling are financed through tariffs, while fixed costs (*e.g.*, street cleaning, administrative overhead) are financed through TARI, others adopt fully tariff-based regimes. Due to the lack of comprehensive administrative data distinguishing these regimes, we identify and exclude municipalities with zero or anomalously low per capita TARI assessments or/and those who have revenue and assessment values associated with waste tariffs, which are likely to reflect tariff-based arrangements. Following this procedure, we exclude 6,330 observations corresponding to 1,212 municipalities.

Table 1 reports the descriptive statistics of the dependent variable and of the controls used in our econometric analysis while Table A2 reports descriptive statistics for per capita TARI assessments in both the retained and excluded samples.

5. Empirical strategy and results

5.1. Baseline fixed-effects model

To estimate the determinants of tax compliance, we adopt a dynamic panel framework that accounts for persistence, unobserved heterogeneity, and potential endogeneity in key explanatory variables such as civic engagement and interpersonal trust using a standard fixed-effects panel specification of the form:

$$\text{Compliance}_{it} = \alpha_i + \lambda_t + \rho \text{Compliance}_{i,t-1} + \beta' \mathbf{X}_{it} + \varepsilon_{it}, \quad (1)$$

where α_i denotes unobserved municipal effects, λ_t year dummies, and $\mathbf{X}_{it}$ a vector of fiscal, socio-demographic, and administrative covariates. The inclusion of the lagged dependent variable captures persistence in compliance behaviour, while fixed effects control for time-invariant unobserved heterogeneity across municipalities.

Variable	Mean	Std. Dev.	Min	Max	Obs.
<i>Dependent variable (BDAP)</i>					
TARI compliance rate (%)	65.87	24.76	0	100	46,407
<i>Fiscal variables and administrative capacity (BDAP)</i>					
Financial autonomy (%)	0.59	0.21	0.02	1.00	46,407
Tax enforcement capacity (%)	0.75	26.12	0	63.47	46,407
<i>Payment timing (SIOPE)</i>					
First-quarter TARI payments share (%)	13.30	14.53	0	100	46,407
Peak payment month	8.18	2.73	1	12	46,407
<i>Wealth indicators (AE/MEF)</i>					
Cadastral value of building stock (€per capita)	586.65	457.16	0	13,647.51	46,407
Personal income IRPEF (€per capita)	12,393.51	3,608.63	1,834.64	76,314.39	46,407
<i>Demographic characteristics (ISTAT)</i>					
Population aged 65+ (%)	25.83	5.57	7.23	71.23	46,407
Immigrant residents (%)	6.66	4.29	0.10	46.94	46,407
University graduates (%)	0.48	0.27	0	3.45	46,407
Log of population	7.82	1.39	3.37	14.87	46,407
<i>Social capital (MEFOP)</i>					
Trust in family	0.76	0.03	0.64	0.83	46,407
Trust in others	0.35	0.02	0.28	0.42	46,407
Civicness	0.79	0.02	0.73	0.86	46,407

Table 1: Descriptive statistics of main variables

Variable	Mean	Std. Dev.	Min	Max	Observations
Compliance (overall)	65.37	24.15	0	100	$N = 46,407$
between		20.48	0	100	$n = 6,846$
within		13.45	-17.26	144.88	$\bar{T} = 6.77$

Table 2: Panel structure of the TARI compliance dataset

NOTES: Panel data for Italian municipalities, 2017-2023. Compliance is measured as the percentage of TARI collected relative to amounts due. The “between” component captures variation across municipalities, while the “within” component captures variation over time within municipalities. N is the total number of observations, n is the number of municipalities, and $\bar{T}$ is the average number of years per municipality.

The dependent variable, defined as the percentage of collected tax revenues relative to the total assessed, exhibits substantial geographical variation across municipalities; Figure 1 also shows the distribution of TARI coverage and the municipalities excluded due to the application of alternative tariffs.

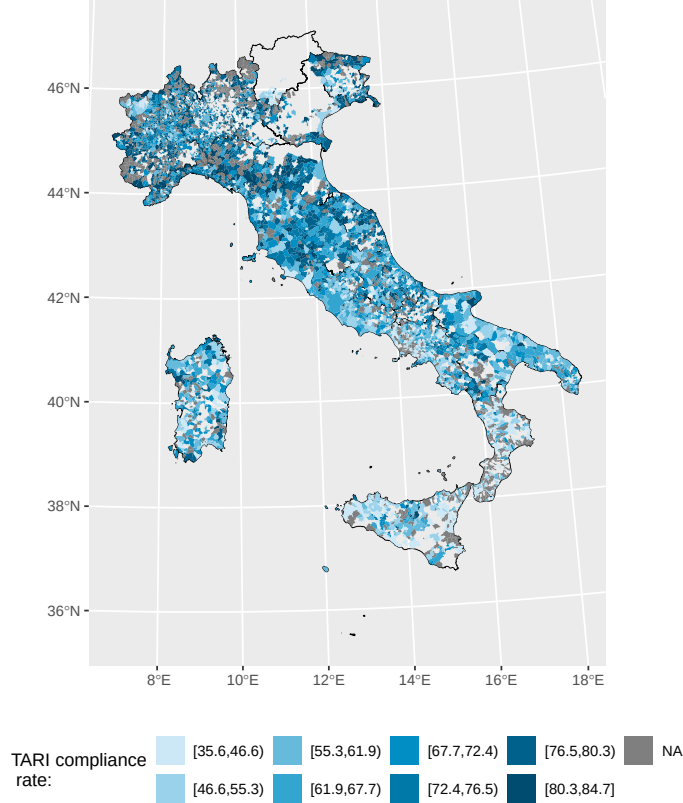


Figure 1: TARI compliance rate

Building on the empirical setting defined in the previous section and on the insights from the literature on tax compliance, Table 3 reports the results of the baseline fixed-effects model including a lag of the dependent variable as well as several socio-demographic and fiscal covariates.

Variable	Coefficient	Robust Std. Error
L1.Compliance rate	0.0294***	(0.0099)
Population aged 65+	0.0756	(0.1175)
Immigrant residents	-0.0363	(0.1085)
University graduates	-0.1623	(0.4210)
Log Population	-11.2021	(6.9312)
Personal income IRPEF	-0.0496***	(0.0133)
Financial autonomy	1.2617*	(0.7580)
Tax enforcement capacity	-0.0523***	(0.0058)
First-quarter TARI payments	-0.4303***	(0.0151)
Cadastral value of building stock	-0.0073	(0.0087)
Month of maximum payments	0.1649***	(0.0531)
Trust in family	Omitted (collinearity)	
Trust in others	Omitted (collinearity)	
Civicness	Omitted (collinearity)	
Year 2019	-0.3151*	(0.1907)
Year 2020	-10.7608***	(0.3204)
Year 2021	-5.1696***	(0.3494)
Year 2022	-3.5600***	(0.3338)
Year 2023	-4.5374***	(0.3416)
Constant	164.2202***	(58.1039)
Observations		33,176
Groups (id)		6,135
Within R ²		0.2342
Between R ²		0.1063
Overall R ²		0.1221
F(16, 6134)		283.89
Prob > F		0.0000
σ_u		22.0081
σ_e		12.3206
ρ (u_i share)		0.7614

Table 3: Fixed Effects Regression Results

NOTES: Robust standard errors clustered at municipal level; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The inclusion of the lagged dependent variable reveals a small but statistically significant degree of persistence in tax collection performance ($\beta = 0.029$, $p < 0.01$), indicating that municipalities with higher compliance in the previous year tend to maintain slightly better results over time. This limited inertia suggests that past performance has only a marginal influence

on current outcomes once fiscal and administrative factors are controlled for. Among the latter, fiscal autonomy remains positively associated with compliance, while Personal income IRPEF and inefficiencies in residual collection exert negative and highly significant effects, confirming that fiscal discipline and enforcement capacity are key drivers of municipal performance. The strong negative coefficient on late payments highlights that poor payment discipline directly undermines voluntary compliance, whereas earlier collection months are associated with higher performance, reflecting greater administrative coordination⁷.

Year dummies capture the expected disruption in 2020, consistent with the suspension of enforcement during the pandemic, followed by an incomplete recovery in subsequent years. Overall, the results indicate that municipal tax performance is primarily driven by structural efficiency and fiscal responsibility rather than by demographic characteristics or temporary dynamics.

Finally, to assess the potential endogeneity of civiness and trust, we performed a standard Durbin-Wu-Hausman test of exogeneity; the null hypothesis was strongly rejected at any conventional significance level ($\chi^2(2) = 231.583$, $p\text{-value} \leq 0.0000$), confirming that these variables are endogenous in our model, possibly due to reverse causality. Therefore, estimating the model using a fixed-effects estimator that assumes strict exogeneity would lead to biased and inconsistent parameter estimates.

5.2. *Dynamic specification: System GMM estimation*

The persistence of tax compliance and the potential endogeneity of social capital variables motivate, therefore, the use of a dynamic specification, which is estimated through the System GMM approach to account for both unobserved heterogeneity and simultaneity bias using the two-step System

⁷Furthermore, a potential concern is that the estimated effect of social capital may partly capture unobserved differences in local enforcement capacity. Although tax collection procedures for the TARI are governed by uniform national rules and largely delegated to the National Tax Agency, enforcement effectiveness may still vary across municipalities. To mitigate this concern, we include in the empirical specification several proxies of administrative capacity, namely, the financial soundness index, the residual collection gap, and the share of late payments, all of which strongly and significantly affect compliance. These variables account for the fiscal and operational efficiency of local administrations, thereby isolating the behavioural component of compliance from the institutional one.

GMM estimator ([Blundell and Bond, 1998](#)) with multiple lags:

$$\text{Compliance}_{it} = \sum_{j=1}^J \rho_j \text{Compliance}_{i,t-j} + \beta' \mathbf{X}_{it} + \mu_i + \eta_t + \epsilon_{it}, \quad (2)$$

where the unobserved effects μ_i are eliminated by first-differencing, and lagged levels and differences of the endogenous variables serve as internal instruments. The System GMM combines the equation in differences with the equation in levels, improving efficiency under weak instrument conditions and correcting for simultaneity bias.

In summary, while the fixed-effects model provides a basic understanding of the covariates associated with tax compliance, its validity is undermined by omitted variables, endogeneity, and the inability to estimate the effects of key variables such as civicness and trust, which calls for a dynamic panel approach; accordingly, to assess the dynamic relationship between civic capital and tax compliance at the municipal level, we estimate a two-step System GMM model (Table 4) with collapsed instruments and [Windmeijer \(2005\)](#)-corrected standard errors to account for heteroscedasticity and serial correlation ([Arellano and Bond, 1991](#); [Blundell and Bond, 1998](#); [Windmeijer, 2005](#)).

Variable	Coefficient	Std. Error	t-stat	Significance
L1.Compliance	0.2349	0.0290	8.10	***
L2.Compliance	0.1218	0.0532	2.29	**
L3.Compliance	0.1665	0.1241	1.34	
Population aged 65+	0.1536	0.0412	3.72	***
Immigrant residents	0.1057	0.0394	2.68	**
University graduates	-1.0381	0.4535	-2.29	**
Log population	-0.8650	0.1486	-5.82	***
Personal income IRPEF	0.0210	0.0101	2.08	**
Financial autonomy	6.8230	1.2635	5.40	***
Tax enforcement capacity	0.0625	0.0229	2.73	***
First-quarter TARI payments	-0.4427	0.0161	-27.44	***
Cadastral value of building stock	0.00046	0.00033	1.37	
Peak payment month	0.3084	0.0605	5.10	***
Trust in family	46.9283	6.2216	7.54	***
Trust in others	-27.6041	6.7567	-4.09	***
Civicness	36.3608	8.8028	4.13	***
Year 2021	7.2224	0.7696	9.39	***
Year 2022	9.5119	1.3413	7.09	***
Year 2023	9.7210	0.4735	20.53	***
Constant	-31.6959	7.6204	-4.16	***
Diagnostics				
AR(1) test (p-value)				0.000
AR(2) test (p-value)				0.814
Sargan test (p-value)				0.362
Hansen test (p-value)				0.432
Diff-in-Hansen (levels) (p-value)				0.318
Number of observations				22,108
Number of groups				5,956
Number of instruments				24
F-statistic (19, 5955)			25,140.88	(p = 0.000)

Table 4: Dynamic Panel Estimates (Two-Step System GMM)

NOTES: Dependent variable: percentage of tax revenue collected. Two-step system GMM estimation with Windmeijer robust standard errors. Regression includes year fixed effects. Lag structure and instruments are collapsed. Controls included as IVs. Sample: municipalities with valid data. *, **, and *** denote significance at the 10%, 5%, and 1% levels respectively. Hansen and Difference-in-Hansen tests use the robust two-step weighting matrix. No evidence of second-order serial correlation. Number of instruments below number of groups, mitigating instrument proliferation.

The Arellano-Bond tests confirm the absence of residual autocorrelation

of order two, which is a necessary condition for the consistency of the GMM estimator. Moreover, both the Sargan and Hansen tests of over-identifying restrictions fail to reject the null hypothesis of instrument exogeneity, while the difference-in-Hansen test supports the validity of the instrument subsets used for the levels equation. These diagnostics collectively indicate that the specification is econometrically sound and that the instruments are appropriate for mitigating endogeneity concerns.

The dynamic component of the model shows significant persistence in compliance behaviour (for an schematic overview of the results, please see Table 5). The first and second lags of the dependent variable are positive and statistically significant, implying that fiscal compliance tends to be self-reinforcing over time: municipalities with higher past compliance rates are more likely to maintain or further improve their performance. The absence of significance in the third lag suggests that this persistence fades beyond a two-year horizon.

The estimated coefficients for the explanatory variables reveal a set of patterns that are largely consistent with economic intuition. Municipalities with a larger share of elderly residents display higher compliance, reflecting greater stability and possibly stronger civic attachment. Conversely, population size exerts a strong negative effect, suggesting that larger urban areas experience more difficulties in enforcing tax compliance, likely due to administrative complexity and weaker social monitoring. The proportion of university graduates is negatively associated with compliance, a result that may reflect greater sophistication in tax avoidance strategies or the influence of complex urban environments. The share of foreign residents, however, is positively related to compliance, potentially due to the concentration of these populations in areas with stricter institutional oversight or better administrative capacity.

The institutional and administrative variables reinforce the importance of local fiscal capacity. The financial index has a large and positive effect, indicating that municipalities with more stable and efficient financial structures achieve higher levels of compliance. The share of late payments has a strong and negative association with compliance, capturing the detrimental effect of administrative inefficiency and weak payment culture. Likewise, the effectiveness in collecting residual revenues improves compliance, suggesting that the operational performance of the local tax administration directly influences taxpayers' behaviour. The timing of payments, captured by the variable for the month of maximum payment concentration, also exerts a pos-

itive effect, pointing to better coordination or targeted enforcement during key fiscal periods.

The territorial proxies for civiness and trust derived through kriging interpolation show remarkably strong and theoretically coherent effects. Higher levels of family trust and civiness are associated with greater compliance, confirming the role of social cohesion and moral norms in supporting fiscal discipline. In contrast, lower trust to others negatively affects compliance, consistent with the hypothesis that low generalized trust fosters opportunistic behaviour and weakens collective adherence to tax obligations. Although the negative association between generalized trust and tax compliance may appear counterintuitive, it can be interpreted through the conceptual distinction between bonding and bridging forms of social capital ([Beugelsdijk and Smulders, 2009](#); [Guiso et al., 2011](#)). In contexts characterized by dense, inward-looking networks, generalized trust may in fact reflect relational closure within local groups rather than openness toward institutions. When institutional trust is weak, these bonding dynamics can foster informal cooperation that substitutes for formal fiscal obligations, a phenomenon observed in parts of Southern Italy where collective norms of reciprocity may coexist with tolerance toward tax evasion. In this sense, the estimated negative effect of generalized trust does not contradict social capital theory but rather illustrates its ambivalent nature: trust promotes compliance only when it is embedded in inclusive, bridging social structures supported by credible institutions.

Finally, the year dummies indicate a progressive increase in compliance from 2021 to 2023, which may reflect improvements in administrative practices or broader institutional changes in the post-pandemic period, as well as the phasing out of the tax exemptions and reductions introduced in response to the health emergency.

Overall, the econometric evidence suggests that fiscal compliance at the municipal level is a dynamic process influenced by both structural and behavioural determinants. Persistence over time, administrative capacity, and the socio-cultural environment jointly shape the ability of municipalities to secure revenues. These findings highlight the importance of policies aimed at strengthening fiscal capacity, promoting administrative efficiency, and enhancing social trust, as complementary levers for improving tax compliance and local governance outcomes.

Variable	Sign	Economic interpretation
L1.Compliance, L2.Compliance	+	Persistence in taxpayers' behaviour: past compliance positively influences current compliance, indicating dynamic inertia.
L3.TARI compliance	n.s.	The effect of compliance fades beyond a two-year horizon, suggesting limited long-term persistence.
Population aged 65+	+	Municipalities with older populations exhibit higher compliance, consistent with greater residential stability, civic attachment, and institutional trust.
Immigrant residents	+	Higher shares of immigrant residents are associated with greater compliance, possibly reflecting stronger administrative monitoring or urban concentration effects.
University graduates	−	A higher share of educated residents is associated with lower compliance, possibly due to urban complexity and related higher administrative costs of TARI.
Log population	−	Larger municipalities display lower compliance, likely reflecting higher TARI rates related to the greater complexity of waste services, and high cost of tax administration.
Personal income IRPEF	+	Higher average personal income is associated with greater tax compliance.
Financial autonomy	+	Financially autonomous municipalities achieve higher compliance, reflecting stronger administrative capacity and fiscal discipline.
Tax enforcement capacity	+	Efficient collection of outstanding revenues signals better administrative performance, fostering higher taxpayer compliance.
First-quarter TARI payments	−	A higher incidence of TARI payments concentrated in the first quarter of the year indicates weak enforcement of the payment schedule, possibly due to delays in approving TARI rates and weak administrative capacity.
Cadastral value of building stock	n.s.	No significant effect; property wealth per capita does not directly determine compliance levels.
Month of maximum payments	+	A higher concentration of payments toward the end of the year suggests better administrative planning and more effective scheduling of payment deadlines.
Trust in family	+	Strong family-based trust networks enhance fiscal compliance through social cohesion and moral reciprocity.
Trust in others	−	Lower generalized trust correlates with opportunistic behaviour and weaker adherence to fiscal norms.
Civicness	+	Civic engagement and collective responsibility foster voluntary compliance with local tax obligations.
Year dummies (2021-2023)	+	Progressive improvement in compliance over time, reflecting policy changes and the end of exemptions due to the COVID-19 emergency.

Notes: Signs refer to the direction of statistically significant effects in the System GMM estimation.

Table 5: Main explanatory variables and economic interpretation

5.3. Spatial robustness

While the global System GMM model - reported in Table 4 - provides consistent and efficient estimates of the average relationships between social capital, fiscal structure, and tax compliance, it implicitly assumes spatial stationarity, that is, that the estimated parameters are homogeneous across municipalities. Yet, the geography of fiscal behaviour in Italy is marked by pronounced regional contrasts in both institutional quality and social cohesion, suggesting that the strength and even the sign of these relationships may vary spatially. This local estimation serves as a diagnostic test of the parameter homogeneity assumption underlying the global System GMM model, allowing us to assess whether behavioural responses to social capital are spatially invariant or context-dependent.

To assess this potential heterogeneity, we implement a *local System GMM* estimation, conceptually akin to the family of Geographically Weighted Regression models (Brunsdon et al., 1996; Fotheringham et al., 2002); the local System GMM extends the previous specification by allowing parameters to vary spatially:

$$\begin{aligned} \text{Compliance}_{it} = & \rho(u_i, v_i) \sum_{j=1}^J \rho_j \text{Compliance}_{i,t-j} + \\ & \beta(u_i, v_i)' \mathbf{X}_{it} + \mu_i + \eta_t + \epsilon_{it}, \end{aligned} \quad (3)$$

where (u_i, v_i) denote the geographical coordinates of municipality i , and coefficients are estimated using an adaptive bi-square kernel that assigns higher weights to geographically proximate observations.

In other terms, the global model is re-estimated for each municipality using a spatially weighted subsample of neighbouring observations. Each regression assigns higher analytical weight to municipalities geographically closer to the focal one, through an adaptive kernel of weights derived from the distance matrix. This spatial weighting scheme allows the coefficients to vary smoothly across space, generating a local distribution of estimates for every explanatory variable.

The advantages of this framework are particularly relevant for the social-capital proxies, which reflect persistent, territorially embedded cultural attributes. Allowing their coefficients to vary locally makes it possible to identify whether civiness exerts stronger effects in cohesive northern regions, while generalized trust may play a weaker or even negative role in areas characterized by bonding networks and low institutional trust.

From a broader conceptual perspective, this approach extends the classical notion of geographical space to a *relational space* in the Leibnizian sense⁸, where ”*space is not a thing in itself but an order of coexistence defined by relations between entities*”. In this interpretation, spatial proximity does not only reflect geographic distance but also social and institutional connectedness, meaning that the behavioural foundations of tax compliance are embedded within a multidimensional network of territorial relations.

Figures 2, 3, and 4 show the spatial distribution of the locally estimated marginal coefficients for *family trust*, *trust in others*, and *civicness*, respectively.⁹

⁸Leibniz, G. W. (1714), *Monadology*, §47–48. See also Massey (2005); Bathelt and Glückler (2011), who reinterpret relational space as a network of social and institutional interactions shaping territorial behaviour.

⁹Municipalities in grey denote areas where the corresponding local coefficients are not statistically different from zero.

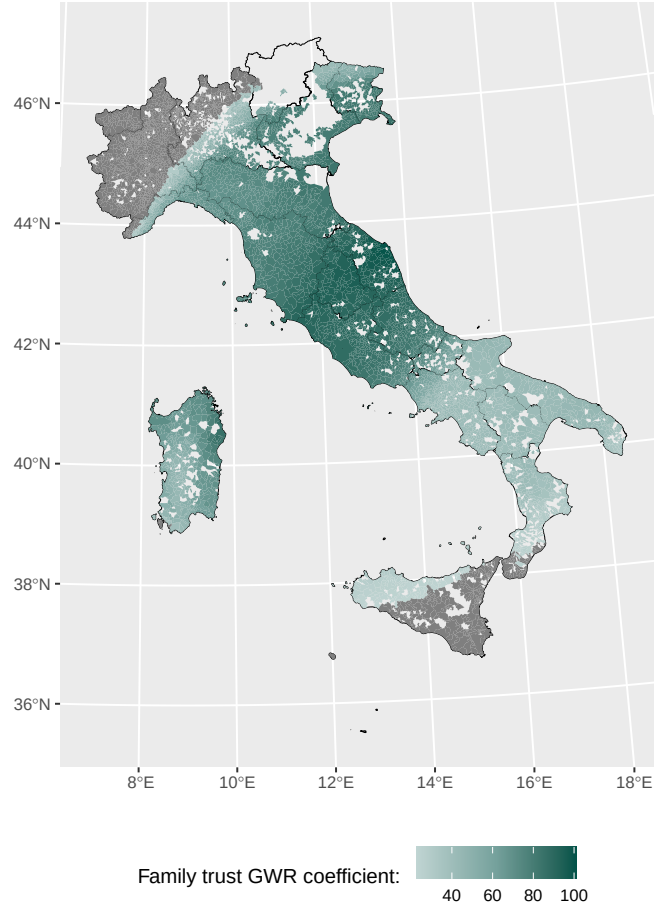


Figure 2: Family trust local coefficient map, mean coeff. = 46.93

The coefficient map for family trust (Figure 2) shows predominantly positive and statistically significant effects in northern (part of Lombardia and Emilia-Romagna) and central Italy (Toscana, Marche and Umbria). This pattern suggests that bonding social ties based on kinship and close networks may reinforce fiscal discipline where institutional quality and administrative capacity are already high. In these contexts, trust within families complements civic norms and facilitates voluntary compliance. Conversely, weaker or insignificant effects in southern municipalities indicate that strong family bonds do not necessarily translate into higher tax morale when institutional enforcement is fragile.

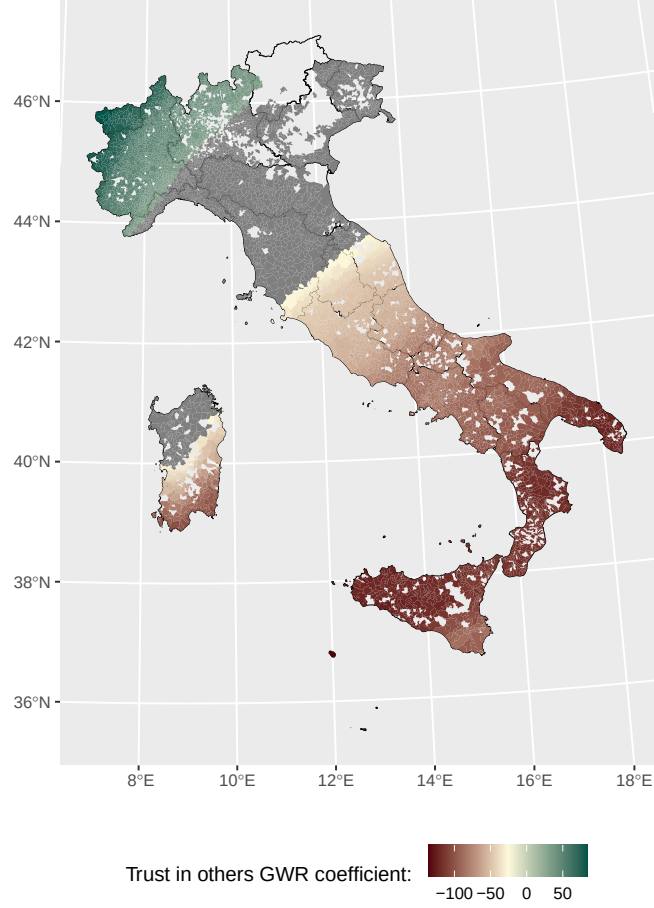


Figure 3: Trust in others local coefficient map, mean coeff. = -27.60

By contrast, the map for trust in others (Figure 3) exhibits a more complex pattern, with several southern and insular areas showing negative coefficients. This result aligns with the hypothesis that generalized trust, when detached from institutional trust, may weaken the perceived necessity of compliance or reflect environments where informal cooperation substitutes for formal fiscal obligations. The absence of significant effects in the Centre–North further suggests that interpersonal trust operates differently from civic engagement in shaping fiscal behaviour.

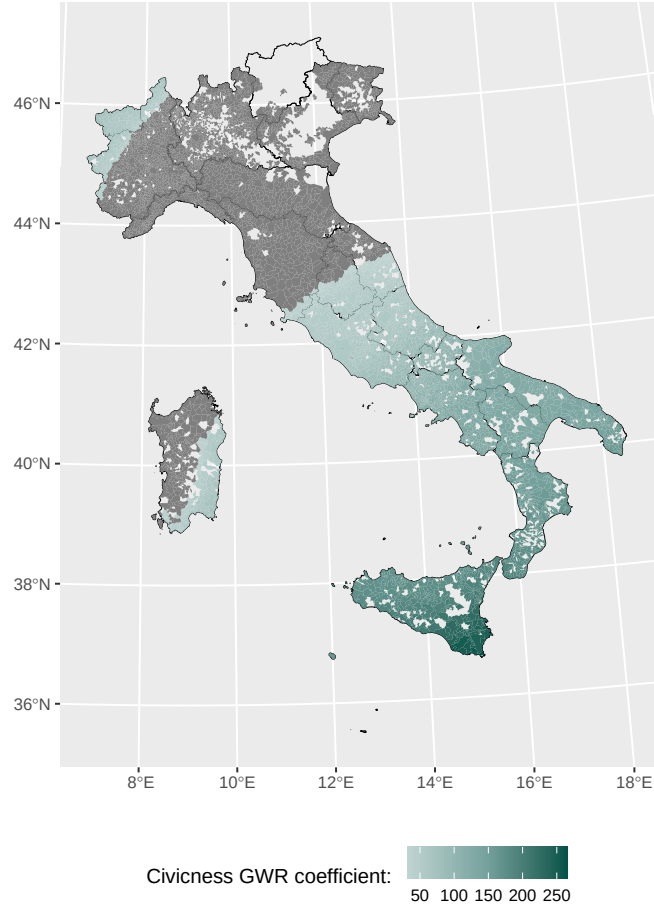


Figure 4: Civiness local coefficient map, mean coeff. = 36.36

The pattern for civiness, however, differs markedly from these dynamics. The local coefficients (Figure 4) display stronger and more significant positive effects in the South and parts of the Islands, while they are weaker or statistically insignificant in the Centre and North. This unexpected spatial gradient suggests that civic engagement may act as a compensatory mechanism where institutional performance is historically weaker: municipalities with higher local participation and social cooperation appear better able to sustain tax compliance despite administrative constraints. In contrast, in Northern regions where institutional enforcement is already strong, civiness exerts a smaller marginal contribution, likely because formal mechanisms already ensure compliance.

Overall, these findings indicate that the behavioural foundations of fiscal compliance are not spatially uniform. Whereas family-based trust reinforces performance in institutionally efficient territories, civicness seems to substitute for weak institutions in the South, highlighting the dual role of social capital as both a complement and a substitute for formal enforcement across different territorial contexts.

6. Final remarks

This paper has examined the determinants of voluntary compliance with Italy’s municipal waste tax, focusing on the role of social capital within a fiscal federalism framework. While fiscal decentralization was expected to strengthen accountability and consequently improve tax morale, our findings suggest that compliance with local taxation remains strongly conditioned by underlying social structures.

The empirical evidence¹⁰ confirms that civic engagement is positively associated with higher rates of voluntary compliance, consistent with the view that active participation in community life fosters a stronger sense of collective responsibility. By contrast, generalized trust displays a negative association with compliance, a result that reflects the ambivalent nature of social ties: while trust can sustain cooperation in inclusive environments, bonding dynamics may instead encourage opportunistic behaviour in contexts of weak enforcement.

Beyond confirming the behavioural and institutional roots of tax compliance, our findings reveal that these relationships are not spatially homogeneous. The local System GMM analysis reveals a pronounced spatial asymmetry in the effects of social capital. Civicness exerts stronger and more significant positive effects in Southern municipalities, suggesting that local participation and cooperation may compensate for weaker institutions, while family trust remains a key driver of compliance in the North and Centre. By contrast, generalized trust shows weaker or even negative effects in parts of the South, where interpersonal reliance may substitute for formal fiscal norms. This spatial heterogeneity underscores that the behavioural foundations of fiscal compliance are context-dependent, reflecting deep-rooted social and institutional differences.

¹⁰Causality should be interpreted with caution, as reciprocal relationships between tax compliance and social capital may persist even after instrumentation.

These results carry important implications. First, they highlight the need to integrate fiscal policy with measures aimed at strengthening civic capital and fostering inclusive social networks. Second, they caution against assuming that fiscal autonomy or improvements in tax administration alone is sufficient to increase compliance; rather, its effectiveness depends on the social fabric that underpins taxpayer behaviour. Finally, the evidence underscores the relevance of spatially differentiated approaches: since compliance is shaped by local patterns of social capital, policy interventions may need to be tailored to the specific characteristics of municipalities.

Beyond its behavioural and institutional implications, the analysis also carries normative insights on the design of local taxation. The empirical evidence supports the idea, consistent *e.g.* with [Piketty \(2014\)](#)'s framework, that taxation grounded in tangible and territorially rooted assets fosters both fairness and accountability. By linking the tax base to observable property and local service provision, the TARI reduces informational asymmetries and opportunities for avoidance. In this sense, reinforcing asset-linked local taxation appears a promising strategy to reconcile efficiency, equity, and fiscal responsibility within decentralized public finance systems.

Finally, building on the findings of this paper, several avenues for further research emerge. First, future studies could incorporate administrative capacity and enforcement practices at the municipal level to better disentangle the interaction between social capital and institutional effectiveness. While our analysis controls for fiscal structure and demographic composition, more granular measures of local administrative efficiency may reveal complementary or mediating effects.

Appendix

Year	Assessment		Revenue	
	Regular	Controls	Regular	Controls
2017	9,312	472	5,699	98
2018	9,498	519	5,943	134
2019	9,543	504	5,987	136
2020	9,419	348	5,112	74
2021	9,493	489	5,405	107
2022	9,782	496	5,800	130
2023	9,842	555	5,865	151

Table A1: TARI Assessment and Current Revenue, 2017–2023

NOTES: Annual TARI assessment and revenue, regular and from controls (in million €). Regular assessment and revenue represent primary waste tax levying; assessment and revenue from controls represents supplementary assessments and relative revenue due to irregularities.

SOURCES: BDAP municipal balance sheets.

	Excluded	Included
Mean	76.87	168.47
10th percentile	0.00	97.26
Median	5.75	148.26
Observations	8,839	46,407

Table A2: TARI assessment, Comparison of included and excluded municipalities

NOTES: Excluded observations correspond to municipalities with TARI assessment below the 10th percentile (€52.31 per capita) or those who record assessment and revenue in waste service tariff in balance sheet.

Statistic	Value
Number of municipalities (N)	6,846
Time period	2017-2023
Number of years (T)	7
Total observations	46,407
Panel type	Unbalanced
Mean time periods per municipality	6.78

Table A3: Panel Structure of the Estimation Sample

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