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Intermunicipal cooperation in public procurement

Giampaolo Arachi[a], Debora Assisi[b*], Berardino Cesi[c**], Michele G. Giuranno[a] and Felice Russo[a]

ABSTRACT

This study evaluates the impact of intermunicipal cooperation on public procurement (PP) performance, based on the Italian experience. We use both a fixed-effects regression model and alternative matching estimators to analyse a sample of 50,905 Italian public works contracts awarded by municipalities and municipal unions (MUs) between 2012 and 2020. Our results indicate that while local centralisation does not necessarily lead to significant cost savings in the procurement phase, MUs outperform individual municipalities in the execution phase, especially in terms of reducing delivery delays. We conclude that while MUs do not necessarily lead to strong economies of scale, they do improve efficiency during contract execution. This highlights the alternative benefits of PP centralisation beyond cost savings.

KEYWORDS

public procurement; intermunicipal cooperation; local cooperation; local centralisation; performance evaluation

JEL C13, H57, H77

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1. INTRODUCTION

To enhance public procurement (PP) performance, European directives (18/2004, 2014/24/EU, 2014/25/EU) have established clear guidelines on the centralisation of PP that European countries must adhere to when defining their national PP regulations (Albano & Nicholas, 2016).[1] A number of empirical studies have focused on the effects of centralisation at both the national (Albano & Sparro, 2010) and regional (Ferraresi et al., 2021) levels. However, there is still a lack of studies on the centralisation of PP at the local level, where intermunicipal cooperation (IMC) can produce unexplored effects in terms of efficiency in the realisation of public works in urban areas. This study addresses this gap by analysing the differences in the performance of contracts managed at the municipal and supra-municipal levels. Our results address whether centralising PP procedures at the local level enhances procurement activity performance.

As Casula (2020) points out, collaboration among fragmented local municipalities for service delivery is an underresearched but common issue in Europe. Factors that influence such cooperation include policy implications for municipalities (Strebel & Bundi, 2023), intermunicipal interdependence (Elston et al., 2023), the personal interests of council members influenced by political dynamics (Bergholz & Bischoff, 2018), structural and organisational strategies (Elston & MacCarthaigh, 2016), and social factors, such as social capital (Han, 2017).

From an international perspective, the challenges of intermunicipal collaboration in local procurement are pervasive (Casula, 2020), regardless of demographics or governance structures. Whereas centralised procurement may offer benefits in terms of bargaining power, the effect on economies of scale are somewhat unclear (Bartolini & Fiorillo, 2011; Elston et al., 2023; Elston & MacCarthaigh, 2016; Niaounakis & Blank, 2017). Also, maintaining local autonomy is of paramount importance. Countries with fragmented municipalities often struggle to achieve efficient procurement in smaller localities (Hulst & van Montfort, 2007; Schwab et al., 2017). In Italy, where 70% of municipalities have fewer than 5000 inhabitants, municipal unions (MUs) or *unioni di comuni*, operate as a solution to this issue (Junior, 2013). Notably, MUs can function as central purchasing bodies (CPBs)[2] at the intermunicipal level by overseeing key procurement decisions. Through its use of MUs, Italy is a pioneer in tackling the main local procurement challenges by addressing the balance between centralisation and decentralisation at the local level.

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A distinctive aspect of Italian MUs is that member municipalities retain the flexibility to collaborate and jointly manage local functions, and thus adhere to the principle of subsidiarity (Giuranno, 2010). Regarding PP, the Italian Central Authority on Public Procurement database (from 2014, the National Anti-Corruption Authority – ANAC), which tracks municipality tenders, records both decentralised and centralised bids within MUs.

Within this framework, in which member municipalities can either collaborate by delegating contract management to the MU or operate independently, we are particularly interested in discerning whether tenders administered by an MU demonstrate superior performance relative to those overseen by individual member municipalities. This investigation offers new insights into the global debate on decentralised versus centralised cooperative PP, all within the purview of local and subregional governance. Our study also expands the scope by providing valuable insights to the body of literature that explores the impact of regional reforms on the efficiency of local public expenditure.[3]

Our investigation focuses on awarding contracts for public works in Italy. We assessed the impact of IMC on PP performance by examining a dataset of 50,905 public work contracts (PWCs), each valued at over €40,000, issued by Italian MUs and municipalities between 2012 and 2020.

We focused on PP performance during both the awarding and execution stages. Specifically, in the econometric strategy, we first estimate a fixed-effects regression model to infer whether works contracts awarded by an MU are characterised by better performance in terms of winning rebates (the successful bid translated into a percentage discount from the auction base price), delivery delays and execution cost overruns compared with contracts awarded by member municipalities. Moreover, we conducted additional robustness checks to compare more homogeneous samples and control for factors related to possible heterogeneity. To address selection bias concerns, we adopted two alternative matching estimators to properly control for observable time-varying confounder differences among the comparison groups. Our estimations, including the full set of town fixed effects, are robust to the matching procedures.

Our main findings indicate that tenders awarded by MUs do not necessarily incur lower costs during the award phase. Interestingly, our findings suggest that IMC enhances performance during the execution stage of tenders. While cost overruns do not change significantly across the contracting authorities considered, PWCs awarded by MUs are delivered in fewer days than those awarded individually by the member municipalities of the MU.

1.1. Related literature

This paper bridges two streams of literature. The first focuses on the potential efficiency gains achievable through IMC without, however, considering aspects related to PP (among many others, see Arcelus et al., 2015; Banaszewska et al., 2022; Bel & Warner, 2015; Bergholz & Bischoff, 2018; Breuillé et al., 2018; Di Porto et al., 2017; Ferraresi et al., 2018; Frère et al., 2014; and Luca & Modrego, 2021). The second stream examines centralisation in PP (Albano & Sparro, 2010; Baldi & Vannoni, 2017; Junior, 2013; Karjalainen, 2011), but does not include the urban dimension.[4]

In general, the literature on IMC identifies the advantages of local centralisation as the reduction of costs (Bel et al., 2014; Bel & Elston, 2023; Bel & Warner, 2015; Blesse & Rösel, 2017; Elston et al., 2023) due to: (1) economies of scale and scope (Bartolini & Fiorillo, 2011; Niaounakis & Blank, 2017); (2) internalisation of externalities (Bergholz, 2018; Frère et al., 2014); and (3) the greater specialisation of centralised authorities (Bel & Sebő, 2021). In particular, Elston et al. (2023) examine the impact of IMC on cost efficiency and the quality of public service management, and identify specific scenarios in which IMC may not simultaneously meet both objectives.

Several empirical studies investigate IMC by focusing on its effect on taxes and public spending. To date, the research has yielded mixed results. On the revenue side, Breuillé et al. (2018) analyse the effects of IMC on business, residence, property on developed land and undeveloped land taxes in France, and their findings do not support the theoretical argument in favour of tax cuts induced by foreseeable economies of scale.

Regarding public spending, Ferraresi et al. (2018) examine the efficiency of cooperation among municipalities in the Italian region Emilia-Romagna. They report reduced per capita current expenditure for municipalities that are members of a union compared with municipalities that are not, without downsizing local services. Recently, Luca and Modrego (2021) expanded Ferraresi et al.'s (2018) analysis by focusing not on expenditure and output separately but on a measure of administrative technical efficiency for all Italian municipalities. Their results do not strongly support the hypothesis of a significant link between IMC and efficiency. Similarly, Frère et al. (2014) found no effects of municipal cooperation on spending reductions in French municipalities. These studies concentrate on aspects such as taxation, public expenditure, management of public services, and cost efficiency, and do not extensively explore how IMC might specifically influence crucial areas of public spending, such as PP.[5] Our paper addresses this oversight and demonstrates that when assessing the impact of IMC through the lens of strategic competitive PP procedures, the outcomes on these variables could differ from the conclusions drawn in prior literature.

The PP literature highlights how economies of scale allow cost reductions in the case of highly standardised products and services (Dimitri et al., 2006). Another possible advantage of PP centralisation is the high specialisation and diffusion of information, which usually characterise larger organisations (Albano & Sparro, 2010). However, cost reduction is not the only goal in

characterising an efficient PP system; the primary goal of PP activities is to improve value for money (Albano & Sparro, 2010; Rizzo, 2013). To effectively evaluate procurement activity, several studies have focused on performance measurement of PP contracts and the analysis of factors that may have an impact on their performance (among others, see Bandiera et al., 2009; Chiappinelli, 2020; Coviello et al., 2018; Finocchiaro Castro et al., 2014; Guccio et al., 2014; and Ravenda et al., 2020).[6] However, by focusing on different tiers of government, from the most (state administrations) to the less centralised ones (municipalities), previous studies (Bandiera et al., 2009; Chiappinelli, 2020; Guccio et al., 2014) do not adequately account for potential differences in local-level centralisation. In contrast to the literature, this study aims to contribute by specifically exploring the effects of MUs on PP performance.

The remainder of the paper proceeds as follows. Section 2 describes the Italian institutional environment. Section 3 discusses the empirical strategy used to evaluate the impact of IMC on PP performance. Section 4 presents the data, descriptive statistics and univariate analysis. Section 5 presents the main results. Section 6 concludes.

2. ITALY'S INSTITUTIONAL FRAMEWORK

Italy has four primary levels of government: central state, regions, provinces (including metropolitan cities) and municipalities, with the latter representing the lowest level. The country has almost 8000 municipalities, 70% of which have fewer than 5000 inhabitants. MUs were designed to help municipalities jointly manage services, with each municipality joining only one MU. These unions receive funding primarily from member municipalities, regional and central governments, and the European Union (Arachi et al., 2016).

Our analysis focuses on service delivery organisations (MUs) because of their flexible cooperation. Municipalities in an MU can choose how to manage services, including PP. By contrast, service delivery agreements are typically limited to a specific service with a predetermined management structure (Arachi et al., 2016).

Originally, MUs were introduced to encourage the merging of small municipalities. However, due to their reluctance to do so, laws evolved. This led to the 'Spending Review' in 2012, which required that municipalities with fewer than 5000 inhabitants jointly provide core services (Giacomini et al., 2018). However, many municipalities have resisted this (Bolgherini et al., 2018), which resulted in the national government's offer of incentives for greater cooperation.

In this context, the new Italian Public Procurement Code (PPC), which took effect on 1 July 2023, underscored the role of MUs in PP.[7] The code has qualification levels based on contract values, which dictate how procurement processes are conducted. Municipalities that lack the necessary qualifications must operate through a qualified central purchasing entity. This emphasises the MUs' significance, since such qualification is clearly denied to non-MU municipal aggregations. The ANAC has set limits on who can award PP projects based on contract values, which thus reinforces the central role of MUs.

Essentially, the updated procurement code elevates MUs' role in municipal procurement. This study seeks to understand the impact of belonging to an MU on procurement. We examine the effect separate from the reasons municipalities join an MU, which could also depend on factors that are not necessarily related to procurement. The study highlights the influence of IMC on PP performance, acknowledges the growing importance of MUs in procurement, and suggests that they can further centralise PP. The study also reconciles the ongoing debate on procurement centralisation in this new institutional scenario.

2.1. The role of the regions

Regions in Italy are pivotal for creating guidelines for municipal functions (Sergio, 2023), promoting integration and cooperation among municipalities, and supporting the growth of MUs. They draft the *Local Authority Reorganization Plan*, which details the framework and incentives for the IMC. Before July 2023, municipalities could decide on their own whether to join a union without considering centralised PP management. However, with the new procurement code implemented in July 2023, MUs may gain more importance in handling tenders and possibly affect municipal autonomy. Moreover, while the central government retains some funds, it transfers IMC-specific financial support to regions,[8] provided the latter have implemented proper incentive regulations and promotes local cooperation.

3. EMPIRICAL STRATEGY

Our analysis evaluates whether IMC boosts PP performance. In this project, IMC refers to municipalities within an MU that cooperate in PP management, in which the MU handles the tendering process. Later sections detail our identification strategies and discuss how they reveal the impact of local cooperation.

3.1. Baseline model and variables

This section presents our first strategy for identifying the effect on PP performance when the contracting authority awarding the tender is an MU. We start by estimating a fixed-effects regression model in which the dependent variable is alternatively one of the main PP performance proxies: winning rebates, normalised delays and cost overruns.

The independent variable of main interest for our analysis is a dummy, *PWCs_by_union*, which takes the value of 1 in the years when a contracting authority is an MU, and 0 otherwise. The sign and statistical significance of *PWCs_by_union* provide evidence of the performance gained from IMC.

Moreover, to disentangle the strategic effect of being in the union on procurement activity from the ex ante choice of joining an MU, in a further specification we compare

the performance of MUs with that of municipalities that will be/are part of an MU by considering, as independent variables, *PWCs_by_municipalities_in_union* and *PWCs_by_municipalities_before_union*. The former is denoted by a dummy equal to 1 when the contracting authority is a municipality that is part of an MU but manages the tender individually outside the union, and the latter is a categorical variable that takes a value of 1 when the municipality is not in a union in a specific year but will join a union in the following years in our sample period.

Regarding the dependent variables, we focus on PP performance at both the winning and execution stages and use three PP performance measures suggested in the literature (among others, see Chiappinelli, 2020; Decarolis, 2014; Guccio et al., 2014; and Ravenda et al., 2020). The first is the winning rebate (*winning_rebate*), which is the winning bid expressed as the percentage discount over the auction base. This represents an ex ante performance measure because high rebates are usually associated with cost savings for contracting authorities (Chiappinelli, 2020; Decarolis, 2014; Ravenda et al., 2020). One of the ex post PP performance measures considered here refers to execution delays, computed as the difference in days between the actual completion date and the completion date agreed upon in the contract as estimated by the contracting authority's engineers. To consider the complexity of the tender, this difference is taken as a percentage of the contractual time (Decarolis, 2014; Guccio et al., 2014). We term this variable normalised delay (*norm_delay*). Lastly, we also analyse the extra execution costs (*cost_overrun*) measured by the difference between the actual final cost and the award price (as a percentage of the awarding price; Ravenda et al., 2020; see also Decarolis, 2014). We estimate the following regression model:

$$\text{performance}_{ijt} = \beta_0 + \sum_h \beta_1^h CA_{ijt}^h + \sum_k \beta_2^k X_{ijt}^k + m_j + y_t + c_i + \varepsilon_{ijt}, \quad (1)$$

where performance_{ijt} is one of the three PP performance measures defined above for PWC *i* awarded by contracting authority *j* at time *t* over the period 2012–20. CA_{ijt}^h refers to the dummy that denotes the *h* contracting authority awarding the tender, which, as previously stated, is *PWCs_by_union* in the first specification and *PWCs_by_union*, *PWCs_by_municipalities_in_union* and *PWCs_by_municipalities_before_union* in the alternative specification. In the empirical analysis, we control for *k* factors that may impact PP performance proxies (X_{ijt}^k). In particular, we control for a series of PWC characteristics. Of these, *reserve_price* (expressed in thousands of euros) measures the total costs required to complete the work, as estimated by engineers using standard prices for the inputs. This is usually assumed to be a proxy for the complexity of public contracts (Guccio et al., 2014) or to account for the heterogeneity among purchases (Chiappinelli, 2020). As clarified by Arts 21–27 of the PPC (Dlgs 50/2016), in Part I, the 'business plan' of the procurement procedure (planning, organisation and projecting), the reserve price is also usually a proxy for the budget available to the buyer. However, it is important to specify that the reserve price does not necessarily coincide with the intrinsic market value of the object of the contract. Instead, it defines the utility the public administration assigns to the object of the contract, which is technically defined as the congruity value.[9] According to the Italian regulatory framework, the reserve price is one of the technical variables of procurement tendering. Therefore, the public buyer has great discretion in setting its value, with the limitation that the choice should not appear irrational, disproportionate, or against competition, fairness, or equality of treatment. The variable *bidders* is the number of valid bids and is usually considered an indicator of the degree of participation allowed in the tender. We also control for the type of procedure using dummy variables related to *open*, *restricted*, and *negotiated* auctions. The binary variable *lowest_price* takes a value of 1 if the criterion used to select the winner is the lowest price and zero if the award criterion is the most economically advantageous offer (as defined by Art. 108, Part 2 of the PPC). Another contract characteristic included in the analysis is a categorical variable equal to 1 when public work is new and 0 when the contract refers to repair or restructuring works (*new*).

The set of variables X_{ijt}^k's also includes a series of contracting authorities' characteristics that may affect PP performance, such as *experience*, which is computed as the number of tenders run by the same contracting authority over the sample period (Gori et al., 2017). We control for intensity in the screening procedure for the winner selection with the variable *screening_intensity*, which is computed as the difference in days between the date of bid closure and the date of contract award. The variable *relationship* shows the continuity of the relationship between the winning firm and the contracting authority, and is measured by the number of contracts awarded to each firm by the same authority.

We also control for a set of economic and demographic characteristics, such as the size of the contracting authority (*population*), which is the natural logarithm of the number of resident inhabitants in the contracting authority in the year of tender publication; the level of taxable income per capita (*income*); and the number of active firms (*active_firms*) within the territorial jurisdiction of the contracting authority over the years considered in the analysis.

Finally, for each specification, we control for town (m_j), year of award (y_t) and contract category[10] (c_i) fixed effects. ε_{ijt} is the disturbance term. Town fixed effects – that is, a set of dummies for Italian towns in which the contracting authority has an office – allow us to control for unobserved local characteristics such as the levels of social capital, corruption, accountability and, in general, those institutional characteristics that may affect PP performance and either do not change or change slowly over time (Chiappinelli, 2020). The year of award fixed effects account for possible time effects that affect all observations in the same manner. Including the public work fixed effects category allowed us to control for

other unobservable and unchanging factors associated with the specific attributes of each work.[11]

Given the repeated tenders of the same municipality over time, a fixed-effects estimation strategy is attractive for two primary reasons. First, it offers a means of reducing potential omitted variable bias and related forms of endogeneity, provided that the unobserved heterogeneity among subjects is time-invariant throughout the sample period. In other words, by controlling for all stable characteristics of the observed units, we limited potential sources of bias to time-varying factors that may be correlated with the independent and outcome variables.

Second, it allows us to solely examine variations over time within each municipality. Consequently, only municipalities that switch contracting authorities affect the estimates of PP performance. Our emphasis is on the role of local cooperation. Therefore, the fixed-effects framework seems suitable for our research question, since we are particularly interested in exploiting, as a source of variation, the within-unit dimension of the data in order to evaluate the performance of municipalities already in the MU, which cooperate by allowing management of the tender by the MU.[12]

However, concerns persist regarding the potential presence of a self-selection mechanism. Selection bias issues can arise when the choice to cooperate occurs non-randomly, based on both observed and unobserved time-varying factors that might affect municipalities' decisions. In this case, when an MU manages the tender, the dummy that denotes the contracting authority might be endogenous to PP performance measures. As a result, the residual in the estimating equation, ε_{ijt}, could be correlated with the aforementioned binary variable.

While the inclusion of fixed effects allows us to remove the bias of impact estimates due to time-invariant (un)observables, the potential endogeneity of the binary treatment is not entirely removed. In the following section, we attempt to control for the non-exogeneity of the treatment variable by assuming an observable selection bias, as detailed by Rosenbaum and Rubin (1983) and Heckman and Vytlacil (2001).

3.2. Matching estimator

The current estimation methodology may be susceptible to selection bias. Such an issue emerges when the decision to cooperate becomes endogenous owing to differences in the attributes of the contract and the contracting authority. To address this, we re-estimate regression model (1) using two samples constructed through two alternative matching procedures. Matching serves as a preprocessing step designed to reduce covariate imbalances (Imbens, 2004). The goal is to reweigh the observational data to achieve experimental-like balanced samples. Based on a series of observed potential confounders, we aimed to identify a group of PWCs managed by municipalities (control units) that were similar to those managed by MUs (treated units).

Thus, we address selection bias by minimising observable differences between the treatment and control groups. As a result, any systematic dissimilarities in our alternative measures of PP performance (outcomes) can be more confidently attributed to the treatment rather than to the characteristics of contracting authorities and tenders.

The first method we used was coarsened exact matching (CEM). This is a form of stratum matching that first coarsens the covariates by creating bins, then performs exact matching on the coarsened data and returns only uncoarsened matched data (Blackwell et al., 2009).[13] In particular, we used Sturge's rule-binning algorithm (Iacus et al., 2012) for the variables *reserve_price* and *bidders* to coarsen the variables and identify the best corresponding strata.

On the other hand, we exactly match without any coarsening tenders managed by municipalities to those managed by MUs based on variables that denote other tender characteristics, such as: the type of procedure (*open*, *restricted* or *negotiated*); award criterion (*lowest_price*); dummies for the 20 Italian regions (*regional dummies*) and year of award (*year_award*). Finally, we exactly match on a relevant demographic characteristic: the size of the contracting authority (*population*).[14]

We exclude all PWCs awarded by municipalities that were or will be part of an MU from the control group. Given our specific interest in IMC in the procurement sector, this exclusion allows us to focus on whether tenders awarded by an MU (treated units) perform better than those awarded by the individual member municipalities of an MU.

We adopt the nearest neighbour with the Mahalanobis distance as our second matching method. We exactly match the treated and control units according to the same variables used in the CEM. For the other matching variables, *reserve_price* and *bidders*, we employed the Mahalanobis distance between pairs of observations to match each treated unit with the closest controls. We opted for the Mahalanobis distance measure over the more common propensity score matching. This is because Mahalanobis distance-paired units have close values for all covariates to which this distance is applied, whereas propensity score-paired units may be close just according to the propensity score (King & Nielsen, 2019; Luca & Modrego, 2021).

Although we extracted matched samples to control for observable confounders, selection bias may still be present. Matching estimators cannot ensure that observations are not self-selected into the treatment when considering the unobservable time-varying factors present in the disturbance term, which could be correlated with the decision to allow the MU to manage the tender. In this respect, a standard instrumental variable approach would recommend identifying the appropriate instruments for our potentially endogenous treatment variables to mitigate selection bias concerns. These instruments should be exogenous, trigger variations in local cooperation choice (no weak instruments), and have no direct impact on PP performance proxies. In general, identifying an effective instrument is not trivial. To the best of our knowledge, no previous study has explored the determinants that guide municipalities in choosing contracting authorities

for the tender process. This may explain our inability to identify suitable instruments.

As a result, our study is susceptible to unobserved bias. Nonetheless, we incorporate a comprehensive set of covariates in our estimated model, which are grounded in prior research on PP performance, to control for PWC features and contracting authorities' economic and demographic characteristics. Furthermore, concerns about time-varying confounding components can be alleviated to the extent that unobservable time-varying covariates are correlated with the observed features either used for matching procedures (e.g., population) or included in our estimations (Stuart, 2010).

It is also crucial to note that, through matching procedures, we sacrificed data to achieve more comparable treatment and control groups. As Rosenbaum (2004, 2005) points out, observational studies vary markedly in sensitivity to unobserved biases, and reducing unit heterogeneity diminishes both sampling variability and sensitivity to bias from unobserved confounders.

4. DATA, DESCRIPTIVE STATISTICS AND UNIVARIATE ANALYSIS

We used a rich dataset of national public contracts provided by the ANAC and extracted information for an initial sample of 50,905 PWCs with a reserve price above €40,000, published by Italian MUs and municipalities over the period 2012–20 and completed by April 2021. Personal and income data on contracting authorities are from the Italian Ministry of Economy and Finance. Data on the population and number of active firms in the municipalities and MUs were obtained from the National Institute of Statistics (ISTAT) census, and other data were obtained from the Italian Ministry of the Interior.

In the empirical analysis, we focus only on contracts for which all the data needed to compute our variables are available for the period considered. Moreover, we focus only on municipalities and MUs because we are interested in the PP performance gained through cooperation at the local level.

Of the 50,905 PWCS, we identified 1315 that were published and awarded by MUs. Missing data for some control variables slightly reduced the sample size to 50,752 participants. To avoid the influence of outliers that sometimes arise from misreporting caveats in the databases, continuous dependent and independent variables were winsorised at the top and bottom 1% of the annual distributions. We tested for collinearity among all control variables using the Pearson pairwise correlation matrix and did not find any major multicollinearity issues.[15]

Table 1 reports the distribution of the PWCs in the sample by region and year, distinguishing between those published by municipalities (*PWCs_by_municipalities*) and MUs (*PWCs_by_union*). We grouped regions into five macro-areas (Nomenclature of Territorial Units (NUTS) level 1): Northwest, Northeast, Centre, South and Islands. Pearson chi-squared tests of independence performed for each year and for the total sample reported in Table 1 show that the distribution of PWCs published by municipalities significantly differs from that of MUs. Regions with the largest shares of contracts awarded by MUs were Tuscany (32.6%), Emilia-Romagna (17.4%) and Piedmont (13.4%). In general, the percentage of public work tenders managed by unions is very low for other regions and even null for Trentino-South Tyrol, Calabria and Campania.

Table 2 reports descriptive statistics of the dependent and independent variables and compare *PWCs_by_municipalities* with *PWCs_by_union* on one side and *PWCs_by_union* and *PWCs_by_municipalities_in_union* (i.e., in the latter case, the contracting authority is a member municipality of an MU but manages the tender individually) on the other. To this end, we used a two-tailed *t*-test for differences in the mean of continuous variables (Table 2, panel A) and the Pearson chi-squared test of independence for categorical variables (Table 2, panel B).

Regarding the variables that measure PP performance, we observe a significant difference between municipalities and MUs only for the variable *norm_delay*. In particular, the data show that MUs perform significantly better than municipalities in terms of delivery delays: PWCs managed by unions tend to be completed in fewer days on average than those managed by municipalities. On the other hand, we did not observe a significant difference in the means of *winning_rebate* and *cost_overrun*.

Instead, when we compare contracts published by MUs and member municipalities of an MU, we do not observe any significant differences between the two groups in terms of delivery delays, even if contracts published by unions are delivered with shorter delays. Only the winning rebate is, on average, (weakly) statistically different between the two groups; in particular, it is slightly higher for contracts published by MUs than for those published by municipalities within unions.

Continuous independent variables were significantly different between the two groups. PWCs published by municipalities are characterised by higher values (*reserve_price*) and more *bidders* and thus it seems that municipalities manage more complex tenders for which they allow greater competition. Moreover, they have greater experience. On average, control variables were nearly identical between MUs and municipalities within the MUs. As we can see, the most pronounced difference stems from the *experience* variable, which is notably higher for MUs.

Shifting focus to the categorical control variables, it is noteworthy that, on average, MUs award more contracts using a negotiated procedure and select them based on the lowest-price criterion. These differences, when compared with both municipalities and member municipalities of an MU, were significant at the 1% level.

Table 1. Distribution of public work contracts by Italian region and year.

	2012		2013		2014		2015		2016		2017		2018		2019		2020		Total, 2012–20			
																			pwc_m		*pwc_u*	
Region	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***pwc_m***	***pwc_u***	***N***	**%**	***N***	**%**
Liguria	127	0	298	0	342	0	206	0	187	2	182	2	147	5	153	3	29	0	1671	3.40%	12	0.90%
Lombardy	266	5	509	6	605	6	783	18	650	11	1136	21	1493	28	1267	10	523	1	7232	14.60%	106	8.10%
Piedmont	206	0	283	1	312	3	327	17	285	29	418	36	405	66	346	21	125	3	2707	5.50%	176	13.40%
Aosta Valley	64	0	119	0	115	0	83	3	92	1	78	1	105	1	69	0	13	0	738	1.50%	6	0.50%
Total North West	663	5	1209	7	1374	9	1399	38	1214	43	1814	60	2150	100	1835	34	690	4	12,348	25.0%	300	22.9%
Emilia-Romagna	248	4	709	23	652	31	626	44	487	31	427	45	423	32	452	14	113	5	4137	8.30%	229	17.40%
Friuli-Venezia Giulia	120	0	186	2	258	0	304	0	221	3	246	7	176	6	203	15	71	2	1785	3.60%	35	2.70%
Trentino-South Tyrol	363	0	749	0	709	0	795	0	790	0	989	0	937	0	728	0	176	0	6236	12.60%	0	0.00%
Veneto	322	1	734	1	808	7	808	22	711	33	660	13	572	6	763	2	195	2	5573	11.20%	87	6.60%
Total North East	1053	5	2378	26	2427	38	2533	66	2209	67	2322	65	2108	44	2146	31	555	9	17,731	35.7%	351	26.7%
Lazio	129	0	174	0	152	0	125	0	124	1	101	1	160	2	118	1	53	0	1136	2.30%	5	0.40%
Marche	133	0	372	0	296	0	347	6	221	6	256	5	275	12	261	8	101	1	2262	4.60%	38	2.90%
Tuscany	225	24	522	61	643	108	633	81	486	52	542	50	554	32	506	18	160	3	4271	8.60%	429	32.60%
Umbria	88	0	148	0	162	0	159	0	89	0	109	0	102	2	93	0	28	0	978	2.00%	2	0.20%
Total Centre	575	24	1216	61	1253	108	1264	87	920	59	1008	56	1091	48	978	27	342	4	8647	17.5%	474	36.1%
Abruzzo	83	0	187	0	192	0	230	0	98	6	128	2	125	1	111	0	61	0	1215	2.50%	9	0.70%
Basilicata	30	0	70	0	69	0	209	0	77	1	60	0	87	0	96	0	10	0	708	1.40%	1	0.10%
Calabria	69	0	172	0	214	0	220	0	81	0	69	0	64	0	104	0	29	0	1022	2.10%	0	0.00%
Campania	94	0	172	0	344	0	233	0	112	0	135	0	131	0	129	0	32	0	1382	2.80%	0	0.00%
Molise	26	0	86	1	157	0	93	3	44	1	33	5	44	1	31	1	21	0	535	1.10%	12	0.90%
Apulia	227	1	389	0	480	0	537	31	192	22	144	16	105	14	156	11	50	1	2280	4.60%	96	7.30%
Total South	529	1	1076	1	1456	0	1522	34	604	30	569	23	556	16	627	12	203	1	7142	14.5%	118	9.0%
Sardinia	178	3	202	1	189	2	301	8	139	1	137	1	239	10	255	7	95	8	1735	3.50%	41	3.10%
Sicily	202	0	354	0	374	0	355	10	176	8	156	4	135	6	166	3	69	0	1987	4.00%	31	2.40%
Total Islands	380	3	556	1	563	2	656	18	315	9	293	5	374	16	421	10	164	8	3722	7.5%	72	5.5%
Overall total	3200	38	6435	96	7073	157	7374	243	5262	208	6006	209	6279	224	6007	114	1954	26	49,590	100%	1315	100%
Chi-square test																						
χ^2 (19)	179.36		400.92		644.79		279.35		178.61		236.98		282		138.59		55.85		1506.3			
p-value	***		***		***		***		***		***		***		***		***		***			

Note: *pwc_m* and *pwc_u* denote public work contracts (PWCs) managed by municipalities (*PWCs_by_municipalities*) and municipal unions (*PWCs_by_union*), respectively. χ^2 (19) is the Pearson chi-square test of independence with 19 degrees of freedom. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively.
Source: Authors' calculations based on data provided by the National Anti-Corruption Authority (ANAC).

Table 2. Descriptive statistics: *pwc_m* versus *pwc_u* and *pwc_u* versus *pwc_mlNu*.

(A) Continuous variables

	pwc_m			*pwc_u*			***pwc_m* versus *pwc_u***	*pwc_mlNu*			***pwc_mlNu* versus *pwc_u***
Variables	**Obs.**	**Mean**	**SD**	**Obs.**	**Mean**	**SD**	***t*-test**	**Obs.**	**Mean**	**SD**	***t*-test**
winning_rebate	49,590	18.178	12.199	1315	17.713	12.154		11,778	17.12	11.718	*
norm_delay	49,590	75.466	112.57	1315	68.918	102.09	**	11,778	70.292	108.42	
cost_overrun	49,590	6.9474	12.265	1315	6.909	12.134		11,778	6.5115	11.442	
reserve_price	49,590	181.87	168	1315	162.13	151	***	11,778	162.8	155.6	
bidders	49,590	7.4512	10.21	1315	6.1323	8.2557	***	11,778	6.9425	9.8765	***
screening_intensity	49,590	34.346	38.26	1315	35.031	35.284		11,778	33.217	37.475	*
experience	49,590	67.71	104.78	1315	50.049	54.936	***	11,778	31.255	41.762	***
relationship	49,590	1.7119	1.1903	1315	1.9696	1.4521	***	11,778	1.52	0.98661	***
population	49,590	9.22	1.55	1315	10.13	0.99	***	11,778	8.61	1.33	***
income	49,513	13,628	3077.5	1307	17,887	2648.2	***	11,756	12,977	2974.5	***
active_firms	49,521	2480.7	3850.4	1307	8028.4	5643.9	***	11,748	1074.4	2004.3	***
PA_qualification	49,058	0.21993	0.10582	1301	0.23572	0.11169	***	11,558	0.23434	0.10986	

(B) *Categorical variables*

	pwc_m			*pwc_u*			***pwc_m* versus *pwc_u***	*pwc_mlNu*			***pwc_mlNu* versus *pwc_u***
Variables	**Obs.**	**Mean**	**SD**	**Obs.**	**Mean**	**SD**	**χ^2 test**	**Obs.**	**Mean**	**SD**	**χ^2 test**
open	49,590	0.12257	0.32794	1315	0.095817	0.29445	***	11,778	0.11785	0.32244	**
restricted	49,590	0.012664	0.11182	1315	0.0060837	0.07779	***	11,778	0.012056	0.10914	**
negotiated	49,590	0.60212	0.48947	1315	0.73536	0.44131	***	11,778	0.5759	0.49423	***
lowest_price	49,590	0.77225	0.41938	1315	0.8251	0.38003	***	11,778	0.71396	0.45193	***
new	49,590	0.24289	0.42883	1315	0.25247	0.4346		11,778	0.23179	0.42199	
large	49,590	0.15876	0.36546	1315	0.65171	0.47661	***	11,778	0.65673	0.47482	

Note: Descriptive statistics are based on the full sample of contracts for the period 2012–20. *pwc_m*, *pwc_u* and *pwc_mlNu* denote public work contracts (PWCs) managed by municipalities (*PWCs_by_municipalities*), municipal unions (*PWCs_by_union*) and municipalities that are part of the union (*PWCs_by_municipalities_in_union*), respectively. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on the two-tailed *t*-test for the differences in the means of continuous variables and Pearson chi-square independence test for categorical variables.

5. RESULTS

We now examine the estimation results of our baseline specifications. Table 3 shows the main effects of IMC on the three PP performance proxies considered in the analysis: the winning rebate (*winning_rebate*), normalised delay (*norm_delay*), and execution cost overrun (*cost_overrun*).

We report two specifications for each proxy for PP performance. In the first (columns 1, 3, 5, 7, 9 and 11), the contracting authority of interest is the MU (*PWCs_by_union*), and in the second (columns 2, 4, 6, 8, 10 and 12) we include member municipalities of an MU that individually manage the tender (*PWCs_by_municipalities_in_union*) as well as municipalities that will join an MU in the near future (*PWCs_by_municipalities_before_union*).

We first estimate regression equation (1) by including only control variables related to the demographic and economic characteristics of the contracting authority (*population, income* and *active_firms*) as well as the complete set of fixed effects introduced in the empirical strategy section (columns 1, 2, 5, 6, 9 and 10). Therefore, we first include only those variables that are fixed or predetermined and thus cannot be affected by the management of public tenders by MUs. This is useful for determining whether the results are robust to the inclusion of other control variables that may be causally determined by the variable of interest. Subsequently, we include the full set of control variables in the other columns of Table 3. Overall, the findings are robust for both specifications tested.

The coefficient of the independent variable of interest, *PWCs_by_union*, is negative and statistically significant for the winning rebate and normalised delay in the second specification (columns 2 and 6, respectively). The coefficients remain negative and statistically significant when all controls are considered (columns 4 and 8, respectively). Moreover, the impact on the winning rebate is negative and significant for *PWCs_by_municipalities_in_union* and *PWCs_by_municipalities_before_union* (see columns 2 and 4). However, our findings are amplified when the contracting authority awarding the tender is a union.[16]

This preliminary evidence suggests that, in the ex ante stage, MUs seem to perform worse than more decentralised entities (i.e., the member municipalities of an MU that is managing the tender on an individual basis). On the other hand, IMC reveals better relative performance at the ex post stage when we consider execution delays. In fact, the negative and statistically significant coefficient for *PWCs_by_union* on *norm_delay* in columns 5–8 suggests that PWCs awarded by MUs outperform other PWCs in terms of delivery delays. Execution time savings for *PWCs_by_union* range from approximately −17% (column 5) to −31% (column 8). In contrast, the estimated coefficients for *norm_delay* related to the member municipalities of an MU are not statistically significant at conventional levels in columns 6 and 8, although they remain negative. While not directly comparable, our results are in line with those obtained by Guccio et al. (2014), who state that more centralised entities achieve shorter delivery delays. Finally, concerning extra costs in the execution phase of the work, the coefficient for *PWCs_by_union* is not significantly different from zero in columns 9–12. By contrast, our results reveal that the impact on *cost_overrun* is negative and significant for *PWCs_by_municipalities_in_union* and *PWCs_by_municipalities_before_union* (columns 10 and 12). Thus, tenders managed by MUs seem to suffer from higher extra costs in the execution stage compared with tenders managed by member municipalities of MUs on an individual basis.

Overall, our findings for PP performance proxies suggest the presence of a trade-off between expenditure savings (both ex ante and ex post) and work execution delays. In fact, we find that public tenders awarded by the (local) centralised entity (the MU), compared with those managed by the less centralised entity (member municipalities of an MU running the tender process), are characterised by slightly worse performance in terms of spending (lower rebates and higher extra costs) but better relative performance in terms of execution delays.[17]

Turning our attention to the control variables, we observe that the value of the tender (*reserve_price*) has a positive (albeit not significant) effect on the winning rebate. The positive coefficient becomes stronger (and significant at the 1% level) for the normalised delay, and finally becomes negative for cost overruns.

Consequently, tenders with a higher reserve price are associated with longer delays but lower execution costs. Tenders characterised by stronger competition (*bidders*) are associated with higher rebates, which confirms the results in the literature (Chiappinelli, 2020; Ravenda et al., 2020), and higher extra costs. Contracts awarded through the *lowest_price* criterion (rather than the most economically advantageous offer) were associated with higher rebates, cost overruns and shorter delays. With respect to variables related to contracting authority characteristics, *experience* does not have a significant effect on any of the PP performance proxies analysed, whereas the presence of a strong *relationship* between the contracting authority and the winning firm has a significant (negative) effect only on *winning_rebate*. For *screening_intensity,* we observe that the greater the intensity of the screening procedure for the selection of the winner, the more the tender realises cost savings in the winning stage. However, such tenders experience longer delays and additional costs during the execution phase.

5.1. Robustness tests

5.1.1. Homogeneous samples

We now explore potential differences in PP performance related to IMC by estimating the regression model (1) on two alternative subgroups of PWCs that are more homogeneous in terms of their values. Table 4 reports estimation results for PWCs with a value above (columns 1–3) and below (columns 4–6) €150,000.[18] Notably, most PWCs in the sample were valued below €150,000, which indicates that municipalities and MUs primarily

Table 3. Baseline estimation results on public procurement (PP) performance proxies.

	winning_rebate				*norm_delay*				*cost_overrun*			
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
PWCs_by_union	−1.34	−4.19***	−0.93	−3.83***	−16.92*	−27.83**	−18.19*	−30.80**	1.74	−0.95	1.41	−1.21
	(0.97)	(1.34)	(0.95)	(1.30)	(9.94)	(13.74)	(10.04)	(13.78)	(1.09)	(1.51)	(1.09)	(1.49)
PWCs_by_municipalities_in_union		−2.74***		−2.82***		−11.53		−13.06		−2.52**		−2.50**
		(0.92)		(0.89)		(9.49)		(9.45)		(1.04)		(1.02)
PWCs_by_municipalities_before_union		−3.17***		−3.18***		−9.20		−11.38		−3.21***		−3.04***
		(0.97)		(0.93)		(9.96)		(9.92)		(1.09)		(1.08)
reserve_price			0.0004	0.0004			0.02***	0.02***			−0.01***	−0.01***
			(0.0003)	(0.0003)			(0.003)	(0.003)			(0.0004)	(0.0004)
bidders			0.19***	0.19***			0.05	0.05			0.10***	0.10***
			(0.01)	(0.01)			(0.07)	(0.07)			(0.01)	(0.01)
open			−0.50*	−0.48*			11.03***	11.07***			−0.38	−0.37
			(0.26)	(0.26)			(2.72)	(2.72)			(0.29)	(0.29)
restricted			2.28***	2.28***			16.38***	16.39***			1.75***	1.75***
			(0.47)	(0.47)			(4.96)	(4.96)			(0.54)	(0.54)
negotiated			2.40***	2.41***			15.66***	15.68***			1.97***	1.97***
			(0.15)	(0.15)			(1.57)	(1.57)			(0.17)	(0.17)
lowest_price			4.39***	4.39***			−12.05***	−12.04***			0.93***	0.93***
			(0.16)	(0.16)			(1.65)	(1.65)			(0.18)	(0.18)
new			−0.50***	−0.50***			12.61***	12.62***			−0.32**	−0.32**
			(0.12)	(0.12)			(1.24)	(1.24)			(0.13)	(0.13)
experience			0.004	0.005			−0.01	−0.01			−0.01	−0.01
			(0.003)	(0.003)			(0.03)	(0.03)			(0.004)	(0.004)
screening_intensity			0.02***	0.02***			0.10***	0.10***			0.01***	0.01***
			(0.001)	(0.001)			(0.02)	(0.02)			(0.002)	(0.002)
relationship			−0.23***	−0.23***			−0.20	−0.20			−0.01	−0.01
			(0.04)	(0.04)			(0.47)	(0.47)			(0.05)	(0.05)
population	1.33*	1.39*	0.56	0.61	17.42**	17.22**	16.10**	15.98**	−0.43	−0.34	−0.08	−0.01
	(0.73)	(0.73)	(0.71)	(0.71)	(7.53)	(7.54)	(7.57)	(7.57)	(0.83)	(0.83)	(0.82)	(0.82)

(*Continued*)

Table 3. Continued.

Variables	winning_rebate				norm_delay				cost_overrun			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
income	−0.0003***	−0.0003***	−0.0002**	−0.0002**	−0.001	−0.001	−0.001	−0.001	−0.0003***	−0.0003***	−0.0002	−0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
active_firms	0.0001	0.0001	0.0000	0.0000	0.0005	0.0005	0.001	0.001	0.0001	0.0001	−0.0000	−0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Town FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year award FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contracts category FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	50,752	50,752	50,752	50,752	50,752	50,752	50,752	50,752	50,752	50,752	50,752	50,752
R^2	0.37	0.37	0.42	0.42	0.22	0.22	0.23	0.23	0.21	0.21	0.24	0.24

Note: Estimation results are based on the full sample of contracts published in the period 1 January 2012–31 December 2020. public work contracts (PWCs) by municipalities that have never been in an municipal union (MU) or were part of an MU are the omitted dummy variables. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. Standard errors in parentheses are clustered by the public work category.

issue smaller contracts. We present the results for our preferred model, in which both the entire set of contracting authorities of interest and all controls are considered.[19]

In general, the signs of the estimated coefficients of the main independent variable of interest were also confirmed when splitting the total sample. When a tender is managed by an MU, it is characterised by lower percentages of rebates and shorter delays. However, compared with previous findings related to the full sample, the effect on the winning rebate is always weaker in terms of statistical significance.

Interestingly, in column 6 of Table 4, we observe a (weakly significant) negative effect of *PWCs_by_union* on extra execution costs, which suggests that IMC may yield modest cost savings in the ex post stage of the tender for PWCs with a value below €150,000. Moreover, the findings reported in column 3 show that PWCs above €150,000, managed by MUs, have final extra costs similar to PWCs awarded by member municipalities of an MU individually.

Overall, these results confirm that some of the possible benefits of IMC in the PP sector arise only during the execution phase. PWCs published and awarded by MUs are characterised by a significant reduction in delivery delays. Interestingly, if a tender below €150,000 is awarded by the MU, the winning rebate (column 4) and cost overrun (column 6) will be reduced by −2.05% (albeit not statistically significant) and −3.75%, respectively. Thus, ex post savings may allow for partial recovery of the lower rebates awarded in the ex ante stage for an MU.

These results still suggest that the effects on the three PP performance variables seem to be interrelated. Contracts published by MUs are awarded lower rebates, but at the same time they remunerate for shorter execution delays and may somehow ensure protection ex ante against unexpected cost variations in the ex post stage.

It is interesting to examine whether the above results hold when we restrict the sample to PWCs managed solely by MUs and municipalities that have been, are currently, or will be members of an MU. In other words, we are now interested in comparing the performance between contracting authorities that, to some extent, are more similar, since we drop municipalities that never join an MU from the sample. Results of this specification are reported in Table 5.

Our main result is confirmed: MUs exhibit better performance than municipalities only at the execution stage (i.e., shorter execution delays) in this specification.

5.1.2. Heterogeneity controls

Although previous analyses included several specifications for testing the relationship between PP performance and IMC, we further investigated any evidence of heterogeneity. To do this, we perform an additional check and re-estimate the regression model (1), controlling for other factors.

We assume that a primary source of heterogeneity that may affect PP performance is the size of the municipalities that form the contracting authority relative to all Italian

Table 4. Estimation results for public procurement (PP) performance proxies based on contract value.

	> €150,000			< €150,000		
Variables	***winning_rebate*** **(1)**	***norm_delay*** **(2)**	***cost_overrun*** **(3)**	***winning_rebate*** **(4)**	***norm_delay*** **(5)**	***cost_overrun*** **(6)**
PWCs_by_union	−4.59*	−54.07**	−0.15	−2.05	−42.34**	−3.75*
	(2.44)	(26.53)	(2.95)	(1.77)	(18.86)	(1.99)
PWCs_by_municipalities_in_union	−3.86**	−25.75	−1.46	−2.10*	−13.50	−3.54***
	(1.83)	(19.89)	(2.21)	(1.14)	(12.18)	(1.28)
PWCs_by_municipalities_before_union	−4.06**	−27.20	−1.53	−2.53**	−9.36	−4.63***
	(1.88)	(20.48)	(2.27)	(1.21)	(12.92)	(1.36)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Contracting authority characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Town FE	Yes	Yes	Yes	Yes	Yes	Yes
Year award FE	Yes	Yes	Yes	Yes	Yes	Yes
Contracts category FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	19,477	19,477	19,477	31,275	31,275	31,275
R^2	0.50	0.32	0.36	0.46	0.27	0.29

Note: Estimation results are based on two subsamples differentiated by contract values. The contracts considered in the analysis were published in the period 1 January 2012–31 December 2020. Public work contracts (PWCs) by municipalities that have either never been part of an municipal union (MU) or were previously part of an MU are the omitted dummy variables. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. Standard errors in parentheses are clustered by public work category.

municipalities. Therefore, we built a new variable, *large*, which equals one if the municipal population or the population of at least one municipality in the union is above the average population of all Italian municipalities (approximately 8000 inhabitants). Thus, in these estimates, by including both the population size and the dummy *large*, we test for the possibility that the effects on PP performance may change either slowly or abruptly as a function of population size.[20]

Moreover, managing the PP process is a complex activity that requires knowledge and practical skills at each procurement phase. For instance, Guccio et al. (2014) find that the ability and experience of bureaucratic structures are crucial elements for properly carrying out the monitoring activity at the execution stage. Thus, we also controlled for a proxy measure of skilled human resources – that is, the share of personnel in contracting authorities who have at least a college degree, denoted by *PA_qualification*.[21] Table 6 reports estimates according to a stepwise logic – that is, by adding each covariate one by one, while the final model includes both variables.[22]

In general, the larger the municipality acting as the contracting authority (*large*), the higher the winning rebate and the lower the cost overrun. Thus, larger municipalities achieve higher cost savings. The overall qualifications of personnel within the contracting authority have a (weakly) significant effect only on extra execution costs. Surprisingly, more qualified entities experience an increase in cost overruns. This is counterintuitive to the common hypothesis that qualified administrative personnel should manage the procurement process more efficiently and lead to better PP performance (as in Chiappinelli, 2020).[23]

The results show that including these control variables does not significantly affect the findings for the dummy variable of main interest (*PWCs_by_union*). Consistent with the baseline results, we found that MUs awarded lower rebates to PWCs. Furthermore, during the execution phase, PWCs managed by MUs do not incur additional costs and are delivered with reduced delays compared with PWCs awarded by the member municipalities of an MU on an individual basis. The contracting authority's size seems to play an important role in explaining why the coefficient estimates for *PWCs_by_municipalities_in_union* are now not significantly different from zero for cost overruns (see columns 7 and 9). These results also suggest that not considering the dummy *large* would cause omitted variable bias.[24]

5.2. Matched samples

As discussed in section 3, to address selection bias concerns, we re-estimate regression model (1) on two samples built using two alternative matching procedures: CEM and nearest neighbour with Mahalanobis distance. We focus on PP performance differentials between MUs (treated group) and member municipalities (control group). Since the focus of this study is on local cooperation, we excluded any PWCs awarded by municipalities that were, or will be, members of an MU from the control group.[25]

In line with the baseline findings, the results in Table 7 reveal that, in both matched samples, MUs outperform member municipalities regarding execution delays (columns 2 and 5), with no final extra costs (columns 3 and 6). However, when examining the winning rebate, estimates with both matched samples differ from the full-sample estimates reported in Table 3. Specifically, the coefficient of our variable of interest, *PWCs_by_union*, is no longer statistically significant at conventional levels, even though it remains negative (columns 1 and 4).[26]

Overall, this finding indicates that delegating tender management to the central body is more efficient for member municipalities.[27] Consequently, regional government policies should focus on enhancing municipal cooperation within MUs.

To check whether reweighting was successful in both procedures, we examined the standardised differences in means and the ratio of variances between treated and control units. A model perfectly balances covariates when the model-adjusted differences in means are equal to zero and

Table 5. Estimation results for public procurement (PP) performance proxies: homogeneous control sample.

Variables	*winning_rebate* (1)	*norm_delay* (2)	*cost_overrun* (3)
PWC_by_union	−1.70*	−23.31**	−0.80
	(0.96)	(10.47)	(1.11)
Contract characteristics	Yes	Yes	Yes
Contracting authority characteristics	Yes	Yes	Yes
Economic and demographic characteristics	Yes	Yes	Yes
Town FE	Yes	Yes	Yes
Year award FE	Yes	Yes	Yes
Contracts category FE	Yes	Yes	Yes
Obs.	15,800	15,800	15,800
R^2	0.44	0.24	0.27

Note: Estimation results for a comparison of PP performance between municipal unions and municipalities that will be/are/were part of a union (omitted dummy variable). Contracts considered in the analysis were published in the period 1 January 2012–31 December 2020. *, ** and *** denote significance at 10%, 5% and 1%, respectively, based on the two-tailed test. Standard errors in parentheses are clustered by public work category.

Table 6. Estimation results for public procurement (PP) performance proxies: heterogeneous controls.

	winning_rebate			*norm_delay*			*cost_overrun*		
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
PWCs_by_union	−4.62***	−4.07***	−4.80***	−34.38**	−31.00**	−36.63**	−0.31	−1.67	−0.67
	(1.35)	(1.32)	(1.39)	(14.37)	(14.06)	(14.73)	(1.56)	(1.52)	(1.60)
PWCs_by_municipalities_in_union	−3.62***	−2.86***	−3.59***	−16.69	−13.29	−19.01*	−1.58	−2.74***	−1.72
	(0.97)	(0.92)	(1.01)	(10.32)	(9.77)	(10.75)	(1.12)	(1.06)	(1.16)
PWCs_by_municipalities_before_union	−3.36***	−3.35***	−3.54***	−12.21	−10.68	−12.14	−2.83***	−3.40***	−3.14***
	(0.94)	(0.97)	(0.97)	(9.96)	(10.25)	(10.31)	(1.08)	(1.11)	(1.12)
large	1.09**		0.95*	4.92		7.35	−1.24**		−1.31**
	(0.53)		(0.54)	(5.63)		(5.74)	(0.61)		(0.62)
PA_qualification		0.79	0.74		1.79	1.41		3.02*	3.09*
		(1.42)	(1.42)		(15.04)	(15.05)		(1.63)	(1.63)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contracting authority characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Town FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year award FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contracts category FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	50,752	50,210	50,210	50,752	50,210	50,210	50,752	50,210	50,210
R^2	0.42	0.42	0.42	0.23	0.23	0.23	0.24	0.24	0.24

Note: Estimation results are based on the full sample of contracts with added heterogeneity controls. Contracts considered in the analysis were published in the period 1 January 2012–31 December 2020. Public works contracts (PWCs) by municipalities that have either never been in a municipal union (MU) or were part of an MU are the omitted dummy variables. *, ** and *** denote significance at 10%, 5% and 1%, respectively, based on the two-tailed test. Standard errors in parentheses are clustered by public work category.

Table 7. Estimation results for public procurement (PP) performance proxies: matched sample – *PWCs_by_union* versus *PWCs_by_municipalities_in_union*.

Variables	**CEM**			**Mahalanobis distance**		
	winning_rebate **(1)**	***norm_delay*** **(2)**	***cost_overrun*** **(3)**	***winning_rebate*** **(4)**	***norm_delay*** **(5)**	***cost_overrun*** **(6)**
PWCs_by_union	−1.97	−54.64**	−3.47	−0.58	−38.86***	0.28
	(2.43)	(25.78)	(2.56)	(1.30)	(13.55)	(1.47)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Contracting authority characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Economic and demographic characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Town FE	Yes	Yes	Yes	Yes	Yes	Yes
Year award FE	Yes	Yes	Yes	Yes	Yes	Yes
Contracts category FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3253	3253	3253	12,949	12,949	12,949
R^2	0.65	0.51	0.48	0.48	0.31	0.32

Note: Estimation results are for a comparison of PP performance between PWCs managed by municipal unions (treated units) and public work contracts (PWCs) managed by member municipalities within unions (control units) for two matched samples. Contracts considered in the analysis published in the period 1 January 2012–31 December 2020. *, ** and *** denote significance at 10%, 5% and 1%, respectively, based on the two-tailed test. Standard errors in parentheses are clustered by public work category.

the variance ratio is one. Both procedures achieve perfect balancing for variables when treated and control units are exactly matched. Regarding the continuous variables used in the match (*reserve_price* and *bidders*), test outputs show a better balance in matched samples than in unmatched samples.[28]

Despite controlling for several potential confounding characteristics, it's worth remembering that our findings should be interpreted cautiously in the absence of exogenous variation in treatment status. In this respect, a matching procedure allows us to mimic random assignment in the definitions of control and treated groups. Specifically, we operate under the assumption that municipalities' choice to cooperate by allowing the MU to manage the tender does not correlate with the levels of potential outcome variables. That is, potential outcomes should remain independent of treatment status. The descriptive statistics in Table 2 (panel A) support this assumption. As highlighted in section 4, we did not observe any significant difference between the two groups (i.e., MUs and member municipalities within an MU) in terms of delivery delays. Only the winning rebate differs (weakly) significantly between the two groups. Thus, a comparison of PP performance reduces potential concern regarding treatment selection, which provides reassuring evidence of the reliability of our empirical strategy.[29]

6. CONCLUSIONS

This study contributes to two strands of the literature. First, it investigates the performance of the PP sector, and yields pioneering work on the potential benefits of centralising PP at a sub-regional level. Second, we extend the body of literature on IMC by analysing the effectiveness of MUs in PP and highlighting their role in one of the most critical areas of municipal public policy: local PP.

Using a comprehensive dataset of Italian public works contracts from the ANAC, our study provides empirical evidence of the relationship between local centralisation in PP management and its resultant performance. Our results show that public tenders awarded by MUs are characterised by shorter delivery delays, which suggests that MUs are more efficient during the contract execution phase than municipalities in a union. However, no significant expenditure savings were observed by MUs during either the awarding or work execution phases.

By challenging prevailing views in the first strand of the literature, regarding PP centralisation (Albano & Sparro, 2010; Baldi & Vannoni, 2017; Chiappinelli, 2020; Dimitri et al., 2006; Ferraresi et al., 2021; Junior, 2013; Karjalainen, 2011), our findings suggest that at the local level, centralisation does not necessarily yield significant spending benefits, either before or after its implementation. However, we observed benefits in the work execution phase with respect to project completion timeliness.

Empirical studies on the impact of IMC on the efficiency of local governments are limited and often yield

inconsistent results (Elston et al., 2023; Luca & Modrego, 2021). Most of these studies fail to conduct a focused analysis of PPs. Our research fills this gap by emphasising that IMC does not necessarily induce economies of scale or scope in the realm of PP management (as also found by Elston et al., 2023). In analysing the tenders of MUs, our findings diverge from those of Ferraresi et al. (2018), who identified a decrease in total per capita current expenditures by comparable entities, and Arcelus et al. (2015), who found that cost efficiency in the provision of municipal services increases with the level of joint provision of services among municipalities. Instead, our observations align more closely with those of Luca and Modrego (2021) and Frère et al. (2014), who find no marked influence of IMC on the administrative prowess of their member municipalities.

Several factors could explain the absence of notable cost savings through IMC. For instance, MUs might not achieve effective economies of scale or optimally manage spillovers, often due to the lack of a full merger of municipalities (Di Liddo & Giuranno, 2020). Also, the inherent differences between IMC and municipal mergers can lead to activity duplication, as noted by Elston and MacCarthaigh (2016). This duplication, by reducing the volume of contracts awarded by the supra-municipal body, effectively reduces the achievable economies of scale. Duplication might also stem from bureaucratic resistance to delegating competencies to a supra-municipal body (Downs, 1966). Moreover, administrators may collaborate to reduce yardstick competition pressures and increase rent extraction (Di Liddo & Giuranno, 2016), whereas efficiency in work execution could arise from knowledge sharing and standardisation in PP management (Junior, 2013). However, some associate quicker execution times with illicit motives, and point to certain entities' urgency to finalise deals rapidly (Ravenda et al., 2020).

These findings necessitate further investigation in regional economic studies. The optimal scale for local public tasks likely hinges on specific centralisation strategies and local–regional governance systems (Bel & Warner, 2015). Elston and MacCarthaigh (2016) highlight various trade-offs in regional reforms that aim to enhance IMC, and present an intriguing research agenda. The potential benefits of IMC include economies of scale and scope, enhanced use of technology, and increased expertise. However, drawbacks such as reduced responsiveness, higher transaction costs, slower decision-making, and potential service quality decline must also be considered (Elston & MacCarthaigh, 2016). Effective regional reforms should balance these factors comprehensively – not just at a sectoral level – and tailor them to the degree of local government interdependence (Elston et al., 2023).

In light of our findings, recent regional policy reforms to promote local cooperation, such as those undertaken in Italy, may not primarily lead to cost savings. Rather, they could enhance the efficiency of local public contract execution.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. For the Italian PP code, see the most recent dlgs 36/2023 – in which Part I, Art. 62 provides a specific regulation with respect to centralisation.
2. A CPB is the subject responsible for the most important decisions in the procurement process, such as price negotiation and the selection of suppliers (Junior, 2013). In particular, Directive 2004 introduced the concept of the CPB, defined as 'a contracting authority which: acquires supplies and/or services intended for contracting authorities or awards public contracts or concludes framework agreements for works, supplies or services intended for contracting authorities'. According to Directive 2014/24/EU on PP, a CPB is responsible for handling purchases, overseeing dynamic purchasing systems and granting public contracts/framework agreements on behalf of other contracting authorities, either with or without compensation. For further details, see OECD (2014).
3. For an extensive review of this topic, see the comprehensive survey by Elston and MacCarthaigh (2016).
4. Ferraresi et al. (2021) found that centralising procurement in Italy's regional health systems decreased per capita health costs, especially in areas with weaker institutions. This suggests that corruption inefficiencies may have been reduced.
5. In OECD countries, total PP spending is around 13% of gross domestic product (GDP) and sub-central governments account for the vast majority of PP spending in their member states (OECD, 2021). Baldi et al. (2016) highlight the fact that municipalities award the largest share of PWCs in Italy.
6. Baltrunaite et al. (2021) find a high discretionary power to the bureaucrat responsible for the PP procedure on one-side benefits firms that have some connections with the local politicians; on the other side it reduces the labour productivity of the winning firms, which suggests an inefficient use of public funds. Baltrunaite et al. (2023) investigate the dynamics of public works' duration and focus on their geographical heterogeneity and the contextual drivers of public works'

performance, such as tender characteristics and types of procuring agencies.

7. See Art. 63 of Dlgs 36/2023 for the role of MUs. Art. 63 designates MUs' contracting authorities as qualified, contingent on formally submitting a qualification request to the ANAC, as clarified by the ANAC.

8. Agreements ratified within the framework of the State–Regions Conference nn. 873/2005 and 936/2006.

9. As clearly ruled by the Italian Council of State (section V, 22 October 2018; judgments nn. 6355/2019 and 8088/2019 and the PPC, Art. 14, Part 4).

10. Contract categories in our dataset are identified through the first-level classification of common procurement vocabulary (CPV) codes.

11. Following the literature (Guccio et al., 2014; Chiappinelli, 2020), we cluster standard errors at the contract-category level.

12. Allison (2009) notes that between-unit variation may be largely confounded by unmeasured characteristics of the observed units. He concludes that (1) focusing only on within-unit changes can reduce potential bias and (2) the lower the proportion of unit characteristics that are time-varying, the closer the researcher approximates unbiased estimates. Moreover, it is worth mentioning that fixed-effect models are also more prone to be subject to attenuation bias from classical measurement error, leading to conservative (smaller) coefficient estimates (Angrist & Pischke, 2009).

13. It is noteworthy that CEM has the *monotonic imbalance bounding* property of decreasing the imbalance in selected covariates without worsening the balance in other ones (Iacus et al., 2011).

14. We are grateful to an anonymous referee for suggesting this variable. For the matching procedure, we segmented the size of comparison units into distinct subgroups. We created seven dummy variables to denote contracting authorities with populations of fewer than 5000, 5000–10,000, 10,001–15,000, 15,001–20,000, 20,001–25,000, 25,001–50,000 and more than 50,000.

15. The results available from the authors upon request.

16. In both columns 2 and 4, the coefficient for the MU is greater (in absolute terms) in magnitude than coefficients for *PWCs_by_municipalities_in_union* and *PWCs_by_municipalities_before_union*.

17. However, the potential loss caused, for instance, by lower rebates is not severe in monetary terms. Considering an average winning rebate of 18% and an average reserve price of about €181,000 for the total sample, an estimate of –3.83% for *PWCs_in_union* (column 4 of Table 3) will result in ex ante lower savings of about €1300 with respect to PWCs included in the omitted dummy variable.

18. This is the threshold value set by Italian law (Legislative Decree 50/2016), above which public work tenders should be managed by a local centralised contracting authority. Although it was increased to €500,000 in July 2023, our data suggest that Italian municipalities do not always comply.

19. Going forward, for brevity, we will report only coefficient estimates related to the contracting authorities of interest. Full results will be provided by the authors upon request.

20. Following Ferraresi et al. (2018), we also estimate a specification in which the dummy *large* indicates whether MUs are composed of large municipalities, assigning a value of 1 if the population of at least one municipality in the union exceeds the average population of all Italian municipalities. Results, which are available from the authors upon request, show a reduction in the significance level for the winning rebate and stronger coefficients (in terms of magnitude) for the normalised delay.

21. Data are from the Italian Ministry of Economy and Finance. In an alternative specification, we also considered the proportion of college-educated politicians in the contracting authority's administration. The results, which are available from the authors upon request, indicate comparable effects.

22. Descriptive statistics for the two variables introduced here are reported in Table 2.

23. However, these results should be interpreted cautiously because our data cannot precisely locate the workforce managing the tender within administrations.

24. In a further specification, we considered the number of years elapsed from the date of birth of the MU and the date in which the tender was published to investigate how the effects on PP performance vary with respect to the 'seniority' of unions. Another potential source of heterogeneity we added to the baseline is the number of municipalities within unions. However, in both of these specifications, we do not find any relevant difference in our main findings. The results are available from the authors upon request.

25. For consistency with the baseline, we also compared MUs with municipalities that will join an MU within the sample period. The results are available from the authors upon request.

26. Even if not directly comparable, this result does not confirm the findings of Chiappinelli (2020), who found that centralisation is associated with higher rebates.

27. Overall, these findings are confirmed when also controlling for heterogeneity variables. The tables are available from the authors upon request.

28. The results are not reported here, but are available from the authors upon request.

29. Lastly, we investigated potential drivers of our results, considering whether PP performance can be affected by key mediating factors such as the quality of institutions or political cycle, or if performance differentials may reflect specific financing sources provided for the auction at the regional, national or European Union level. The results, which are fully reported in Appendix A in the supplemental data online, show that the higher the quality of institutions and the closer a municipality is to the renewal of the city council, the better the ex post performance in terms of delivery delays. However, the PP performance differential in *norm_delay* between MUs and member municipalities of MUs does not seem to be driven by these channels. Moreover, higher external funds from regional, national and European authorities do not significantly affect the execution timing of public works.

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