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Abstract

This paper assesses the effects of intermunicipal cooperation on public procurement (PP) performance, based on the Italian experience. We estimate a fixed effect regression model using a sample of 50,905 Italian public works contracts awarded both by municipalities and by municipal unions (MU) from 2012 to 2021. Results prove MU are more efficient than single municipalities at the execution, rather than the winning stage, of the tender. Public tenders awarded by MU show lower winning rebates, shorter delivery delays and, for less complex works, lower final execution extra costs. Furthermore, we investigate whether intergovernmental transfers may enhance PP performance.

Keywords: Public procurement, centralization, local cooperation

JEL Classification: C13, H57, H77

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1. Introduction

In order to increase public procurement (PP) performance, the European directives have encouraged centralization involving all layers of government.¹ A number of empirical studies have focused on the effects of such centralizations at the European, national and regional levels. However, there is still a lack of studies on the centralization of PP at the local level, where inter-municipal cooperation can produce still unexplored effects in terms of greater efficiency in the realization of public works in urban areas. This paper fills the gap in the literature by analyzing the differences in the performance measures of contracts managed at the municipal and supra-municipal level.

The issue is becoming increasingly relevant in the light of the ongoing implementation of the National Recovery and Resilience Plan (NRRP), which requires a strengthening of local cooperation for the management of the massive public contracts linked to the Plan. Since policies that stimulate inter-municipal cooperation in PP are largely used, an assessment of their impact on the performance of PP becomes increasingly important from the point of view of the NRRP.

We address the issue of inter-municipal cooperation in PP by studying the Italian case, where 70% of the municipalities are too small to efficiently manage public tenders having less than 5000 inhabitants. To overcome this dimensional problem, the Italian law has introduced the unions of municipality (MU) (*unioni di comuni*) where municipalities can cooperatively co-manage a wide range of functions. MUs can, in turn, act as *Central Purchasing Bodies* (CPBs) at the inter-municipal level, where a CPB is the subject responsible for the most important decisions in the procurement process, such as price negotiation and selection of supplies (Junior, 2012). These characteristics make the Italian case an important laboratory in the field of urban and subregional economics.

Municipalities tend to cooperate little voluntarily and instead respond to incentives that come from above in the form, mainly, of vertical transfers. The latter can either be directed straight to the unions of municipalities, or impose minimum dimensions in order to gain access to vertical funding, which induce small municipalities to collaborate. Whatever form the stimulus policies of inter-municipal cooperation takes, they cannot be based on alleged efficiency gains. This work addresses the issue by studying the differences in performance between public procurement managed by MUs and those managed by municipalities individually. This, in turn, allows us to compare the decentralization of PP with the centralized solution, always remaining in the local and subregional context. One of the goals of this study is to understand whether the stimulus policies of local centralization can actually improve the performance of public procurement at the local level. In order to do that, we investigate the impact of intra- and supra-regional vertical transfers, i.e. regional, national and European, on the performance of PP.

We focus on PP performance both at the winning and the execution stage. Specifically, we estimate a fixed effect regression model in order to infer whether contracts awarded by a municipal union are

¹ See the European Directive 18/2004, updated with the Directives 2014/24/EU and 2014/25/EU that have regulated the centralization of PP in more detail.

characterized by a better performance in terms of winning rebates, delivery delays and execution costs overrun compared to those contracts awarded by municipalities.

Overall, our results show that tenders awarded by municipal unions do not benefit from lower costs during the winning stage. The winning rebate, in fact, slightly reduces when the contracting authority is a municipal union. The cost overruns, instead, do not significantly change across the contracting authorities considered. More interesting, we observe that public work contracts awarded by municipal unions tend to be delivered in fewer days, suggesting that local cooperation leads to a better performance during the execution stage of the tender. The results are overall confirmed when we consider two alternative subgroups of the total sample which are more homogeneous in terms of the contract value. We, in fact, re-estimate the regression model distinguishing between works with a value above and below 150,000 Euro. Additionally, a (weakly significant) negative effect on execution cost overrun is estimated for contracts with a value below 150,000 Euro. Lastly, the results of main interest are confirmed also after performing a battery of robustness checks.

Our findings suggest that tenders awarded by municipal unions are characterized by lower rebates that, to some extent, remunerate shorter delay and ensure from unexpected costs variations during the execution stage.

When evaluating the stimulus policies to local cooperation in the form of external financing for public works tenders, we find that these do not impact significantly on ex-post performance on contract awarded by unions whereas worsening the ex-ante performance.

This study links two streams of literature: one that focuses on the potential efficiency gains achievable through local cooperation without, however, considering aspects related to PP (Bel and Warner, 2015; Di Porto et al., 2017; Breuillé et al., 2018; Bergholz and Bischoff, 2018; Frère et al., 2014; Luca and Modrego, 2021; Banaszewska et al., 2022; Arcelus et al., 2015; Ferraresi et al., 2018) and the other that studies centralization in public procurement (Bandiera et al. 2009; Junior, 2012; Karjalainen, 2011; Baldi and Vannoni, 2017; Albano and Sparro, 2010) without, conversely, looking at the urban dimension. Although these two lines of research are receiving increasing attention, they have seldom been studied jointly.

In general, the literature on inter-municipal cooperation identifies the advantages of local centralization in the reduction of costs due to economies of scale and scope, to the internalization of externalities and to the greater specialization of centralized authorities. In this respect, the PP literature highlights how economies of scale allow cost reductions in the case of highly standardized products and services.² Furthermore, another possible advantage stemming from the centralization of PP is the high degree of specialization and the production of lots of information, which usually characterize larger organizations.³ On the other hand, cost reduction is not the only goal to be achieved in the design of an efficient PP system. The broader goal of a PP is to provide the highest possible efficiency in terms of improving the value for money, a concept (Albano and Sparro, 2010; Rizzo, 2013). To answer the fundamental question

² Dimitri et al. (2006).

³ Albano and Sparro (2010).

asking whether the procurement system is able to achieve the main objective sets, several authors have focused on the performance measurement of PP contracts, and on the main factors that may have an impact on their performance (Guccio et al., 2014; Castro et al., 2014; Coviello et al., 2018; Chiappinelli, 2020; Ravenda et al., 2020). However, by focusing on different tiers of government - from the most (State administrations) to the less centralized ones (municipalities) - the existing studies do not properly account for possible differences in centralization at the local level.

The remainder of the paper proceeds as follows: first, we provide a review of existing findings, section 2 describes the Italian institutional environment, section 3 presents the empirical strategy and the sample data, section 4 describes the main results and finally section 5 concludes.

2. The institutional framework

In Italy there are four constitutional layers of government: the central government, regions, provinces (including metropolitan cities) and municipalities. There are nearly 8000 municipalities which represent the lowest level of government. About 70% of the municipalities have a population lower than 5,000 inhabitants. In addition to the Constitutional layers of government, the ordinary law introduced in 1990 the MU as the main form of local centralization with the aim of increasing efficiency in local public spending. MU represent an important level of inter-municipal cooperation of a generalist type in which municipalities can co-manage a multitude of local functions. Each municipality can be part of only one MU. Their revenues derive mainly from transfers from member municipalities, regional and central governments and European Union.

The role of MU is also defined by the Public Procurement Code (PPC), which states that the unions of municipalities may qualify as Central Purchasing Body (*Centrali di committenza*).⁴ In particular, it states that municipalities that are not provincial capitals, if not qualifies as CPB, may in turn join a union of municipalities and benefit from its purchasing functions as long as the union is qualified. Furthermore, if the union is qualified as CPB, it may specifically: 1) award, sign and execute public contracts on behalf of the contracting authorities (*amministrazioni aggiudicatrici*) or the contracting entities (*enti aggiudicatori*); 2) sign framework agreements (*accordi quadro*) that qualified CPB may use to award their public contracts, 3) manage Dynamic Purchasing System (DPS) and electronic markets.

3. Empirical analysis

The aim of the analysis is to empirically investigate whether local cooperation leads to an improvement in PP performance. To test this hypothesis, we estimate a fixed effect regression model where the dependent variable is alternatively one of the main PP performance proxies suggested by the literature. We compare

⁴ See art 37 and art 38 of PPC.

the performance of public tenders managed by municipalities with those managed by municipal unions. To this end, the independent variable of main interest for our analysis is a dummy named *union* which takes value one in the years when a contracting authority is a municipal union and zero otherwise. The sign and the statistical significance of *union* will provide evidence on the performance gained from local cooperation. Moreover, in order to investigate whether there are specific characteristics of municipalities joining a municipal union, in a further specification we also consider as contracting authorities of interest *municipalities_in_union* and *municipalities_before_union*. The former indicates a dummy variable equal to one when the contracting authority is a municipality that is part of a municipal union but manage the tender outside the union; the latter is a categorical variable assuming value one when the municipality is not in a union in a specific year but will join a union in the following years.

As regards the dependent variables, we focus on PP performance both at the winning and the execution stage and use alternatively three different PP performance proxies (Decarolis, 2014; Ravenda et al., 2020). The first is the winning rebate (*winning_rebate*), the winning bid expressed as a discount with respect to the reserve price (in percentage of the reserve price). It represents an ex-ante performance measure, as high rebates are usually associated with costs savings for the contracting authority (Chiappinelli, 2020; Ravenda et al., 2020).

One of the ex-post PP performance measures considered here refers to the execution delays, and it is computed as the difference in days between the actual completion date and completion date agreed upon in the contract, as estimated by contracting authority's engineers. To properly take into account the complexity of the tender, this difference is taken in percentage of the expected duration of the work (Guccio et al., 2014). We call this variable normalized delay (*norm_delay*). Finally, we also perform the analysis on the execution extra costs (*cost_ouerrun*) measured by the difference between the actual final cost and the awarding price (in percentage of the awarding price). We estimate the following regression model:

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

where *performance_{ijt}* is alternatively one of the three PP performance measures defined above, for public work contract *i* awarded by contracting authority *j* in time *t* over the period 2012 – 2020. *CA_{ijt}^h* refers to the dummy denoting the *h* contracting authority awarding the tender, which, as previously said, is *union* in a first specification and *union*, *municipalities_in_union* and *municipalities_before_union* in the alternative specification. In the empirical analysis we control for *k* factors that may have an impact on the PP performance proxies (*X_{ijt}^k*). In particular, we control for a series of public work contract characteristics. Among these, the variable *reserve_price* (expressed in thousands of Euro) measures the total costs of the public work as estimated by engineers using standard prices for the inputs needed to complete the work. It is usually assumed to be a proxy for the complexity of public contracts (Guccio et al., 2014) or to account for heterogeneity among purchases (Chiappinelli, 2020). As clarified by art 21-27 of the PPC, in part I “business plan” of the procurement procedure (planning, organization and projecting), the reserve price is

also usually a proxy of the budget available for the buyer. However, it is important to specify that the reserve price does not necessary coincide with the intrinsic market value of the object of the contract, but it defines the utility the public administration gives to the object of the contract, technically defined as congruity value. According to the Italian regulatory framework, the reserve price belongs to the technical variables of a procurement tendering. Therefore, the public buyer can set its value with great discretion, the limit being that the choice should not appear irrational, disproportionate and against competition, fairness and equality of treatment. The variable *bidders* represents the number of valid bids, and is usually considered as an indicator for the degree of competition allowed in the tender. We also control for the type of the procedure identifying the three main procedures with dummy variables related to *open*, *restricted* and *negotiated* auctions. The binary variable *lowest_price* takes a value one if the criterion used to select the winner is the lowest price, and 0 if the awarding criterion is the most economically advantageous offer (as defined by the art 95, part 2 of the PPC). Another contract characteristic included in the analysis is a categorical variable equal to one when the 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 characteristics of the contracting authority that may affect PP performance, such as the variable *experience* computed as the number of tenders run by the same contracting authority over the sample period. We control for the intensity in the screening procedure for the selection of the winner with the variable *screening_intensity*, which is computed as the difference in days between the date of bids closure and the date of awarding of the contract. 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. Finally, we control for the size of the contracting authority with the variable *population*, which is the natural logarithm of the number of resident inhabitants of the contracting authority in the year of the tender publication.

Finally, in each specification we control for municipality (m_j), year of award (y_t) and contract category⁵ (c_i) fixed effects. ε_{ijt} is the standard error term.

Municipality fixed effects - i.e. a set of dummies for Italian towns where the contracting authority has the office - allow to control for unobservable local characteristics such as the levels of social capital, corruption, accountability and, in general, those institutional characteristics that may affect PP performance (Chiappinelli, 2020).

Equation (1) is estimated using ordinary least squares (OLS) and following existing literature (Guccio et al., 2014; Chiappinelli, 2020) we cluster the standard errors at contract category level.⁶

To investigate whether there is evidence of heterogeneity, we implement some robustness checks and re-estimate the regression model by controlling for other factors. In particular, we add as control variable a dummy named *large* which takes on the value of one if the municipal population or the population of at

⁵ Contract categories in our dataset are identified through the first level classification of the common procurement vocabulary (CPV) codes.

⁶ We also perform estimations clustering the standard errors for each contract-specific category description and the results do not significantly change.

least a municipality in the union is above the average population of all Italian municipalities (around 8,000 inhabitants). Another source of heterogeneity across different authorities that may affect the performance in the management of public tenders is the qualification of local politicians. Therefore, we include a variable which measure the share of politicians in the contracting authorities' administration that have at least a college degree (*CA_qualification*).⁷

3.1. Data

We use a rich dataset of national public contracts provided by the National Anti-Corruption Authority (ANAC) and extract information for a sample of 50,905 public work contracts with a value above € 40,000 published by Italian municipal unions and municipalities over the period 2012-2020 and completed by April 2021. The personal data of the contracting authorities, on the other hand, come from the Italian Ministry of Economy and Finance. The data on the population in the municipalities and municipal unions are obtained from the ISTAT census data, while other data sources come from the Italian Ministry of the Interior.

In the empirical analysis we only focus on contracts for which all data needed for the computation of our variables are available for the period considered. Moreover, we only focus on municipalities and municipal unions since we are interested in the PP performance gained by cooperation at local level.

Out of these 50,905 we identify 1,315 public work contracts published and awarded by municipal unions. Table 1 reports the distribution of the work contracts in the sample by Italian region and year distinguishing between those published by municipalities (*pwc_m*) and those published by municipal unions (*pwc_u*). We group Italian regions into five macro-areas (NUTS 1 level), which are North West, North East, Centre, South and Islands. The Pearson Chi-squared tests of independence performed for each year and for the total sample, reported in the table, show that the distribution of the public work contracts published by municipalities significantly differ from those of the municipal unions. Regions with the largest share of contracts awarded by municipal unions are 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 the other regions and even null for Trentino-South Tyrol, Calabria, and Campania.

Descriptive statistics of the dependent and independent variables used in the empirical analysis are reported in table 2. We also perform some comparison tests between *pwc_m* and *pwc_u*, which are the two tailed t-test for the differences in mean of continuous variables (panel A, table 2) and the Pearson chi-squared test of independence for categorical variables (panel B, table 2).

In order to avoid the influence of outliers that sometimes comes from misreporting caveats in the ANAC database, continuous dependent and independent variables are winsorized at the top and bottom 1 percent of their annual distribution.

⁷ Our data refer to the municipal council (*Consiglio Municipale*) and the executive committee (*Giunta Comunale*) within municipalities. For municipal unions we take the average share among all the municipalities forming the union.

As regards the variables measuring PP performance, we observe a significant difference between municipalities and municipal union only for the variable *norm_delay*, and in particular the data show that municipal unions perform significantly better than municipalities in terms of delivery delays. In fact, public work contracts managed by unions tend to be completed on average in fewer days than those managed by municipalities. On the other hand, we do not observe a significant difference in the means of the variables *winning_rebate* and *cost_ouerrun*.

Continuous independent variables are in general significantly different between municipalities and unions, except for the *screening_intensity* which is slightly higher for municipal union, but the difference is not statistically significant. Public work contracts published by municipalities are characterized by higher values (*reserve_price*) and more *bidders*, thus it seems that municipalities manage more complex tender for which they allow greater competition. Moreover, they exhibit more experience and have more qualified administrators.

Turning the attention to the categorical control variables, what is worth noting is that municipal unions award, on average, more contracts based on a negotiated procedure and applying the lowest price as award criterion, both the differences with the values for municipalities are significant at 1 percent.

We test for the presence of collinearity among all the control variables using the Pearson pairwise correlation matrix and do not find any major multicollinearity issue.⁸

4. Results

In table 3 we report the estimation results for our baseline specification. The table shows the main effects on the three PP performance proxies considered in the analysis: winning rebate (*winning_rebate*), normalized delay (*norm_delay*) and execution costs overrun (*cost_ouerrun*).

For each PP performance proxy, we report two specifications, in the first (columns 1, 3, 5, 7, 9, and 11) the contracting authority of interest is the municipal union (*union*), while in the second (columns 2, 4, 6, 8, 10 and 12) we also include municipalities that have joined (*municipalities_in_union*) and that will join (*municipalities_before_union*) a municipal union.

We first estimate regression equation (1) by only including the control variable related to the socio institutional characteristics of the contracting authority (*population*) as well as the complete set of fixed effects introduced in the previous 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 municipal union. This is useful to detect whether the results are robust to the inclusion of the other control variables that may potentially be causally determined by the variable of interest.

Then, in the other columns of table 3 we include the full set of control variables. Overall, the findings are robust for both the specifications tested.

⁸ Results available upon request.

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

Region	2012		2013		2014		2015		2016		2017		2018		2019		2020		Total 2012 - 2020			
	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	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	12348	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	17731	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	49590	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 managed by municipalities and municipal unions, respectively. χ^2 (19) is the Pearson chi-square test of independence based in 19 degree of freedom. *, ** and *** denote significance level at 10%, 5% and 1% respectively. Source: authors' elaboration based on data provided by ANAC (2021).

Table 2. Descriptive statistics – *pwc_m* versus *pwc_u*

Panel A: continuous variables							
Variables	pwc_m			pwc_u			pwc_m vs pwc_u
	Obs.	Mean	St. Dev.	Obs.	Mean	St. Dev.	t_test
winning_rebate	49590	18.18	12.20	1315	17.71	12.15	
norm_delay	49590	75.47	112.58	1315	68.92	102.09	**
cost_ouerrun	49590	6.95	12.27	1315	6.91	12.13	
reserve_price	49590	181.87	167.99	1315	162.13	151.00	***
bidders	49590	7.45	10.21	1315	6.13	8.26	***
screening_intensity	49590	34.35	38.26	1315	35.03	35.28	
experience	49590	67.71	104.78	1315	50.05	54.94	***
relationship	49590	1.71	1.19	1315	1.97	1.45	***
population	49590	9.23	1.56	1315	10.13	0.991	***
CA_qualification	47701	37.63	18.72	590	30.75	16.46	***

Panel B: categorical variables							
Variables	pwc_m			pwc_u			pwc_m vs pwc_u
	Obs.	Mean	St. Dev.	Obs.	Mean	St. Dev.	χ2 test
open	49590	0.12	0.33	1315	0.10	0.29	***
restricted	49590	0.01	0.11	1315	0.01	0.08	***
negotiated	49590	0.60	0.49	1315	0.74	0.44	***
lowest_price	49590	0.77	0.42	1315	0.83	0.38	***
new	49590	0.24	0.43	1315	0.25	0.44	
large	49590	0.16	0.37	1315	0.65	0.48	***

Note: Descriptive statistics based on the full sample contracts for the period ranging from 2012 – 2020. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed t-test for the differences in means of continuous variables and the Pearson chi-square independence test for categorical variables.

As regards the coefficient on the main variable of interest, *union*, it is negative and statistically significant for winning rebate and normalized delay in both the specifications tested. Moreover, we observe that the winning rebate is negative and significant also for *municipalities_in_union* and *municipalities_before_union* (columns 2 and 4), suggesting that there may be specific characteristics of municipalities deciding to join a municipal union that probably drive the results.

Our findings are, however, amplified when the contracting authority awarding the tender is the *union*.⁹ Thus, municipal unions and municipalities joining a union award tenders with lower rebates compared to the omitted category.

On the other hand, it seems that cooperation implies better performance at the execution stage. In fact, the negative and statistically significant coefficient for *union* on the *norm_delay* in columns 5 to 8 suggests that public work contracts awarded by municipal unions outperform the rest of public works in terms of delivery delays. Execution timing savings for *union* ranges from around -18% (column 5) to -33% (column

⁹ In both columns 2 and 4, the coefficient for *union* is stronger (in absolute terms) in magnitude with respect to the coefficients for *municipalities_in_union* and *municipalities_before_union*.

8). The estimated coefficients on the *norm_delay* for municipalities joining a union are, in contrast, not statistically significant at conventional levels across columns 5 to 8, although they are still negative.

Table 3. Baseline estimation results on PP performance proxies

Variables	winning_rebate				norm_delay				cost_overrun			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>union</i>	-2.15** (0.89)	-5.06*** (1.27)	-1.61* (0.87)	-4.65*** (1.23)	-18.09** (9.14)	-30.65** (13.03)	-18.66** (9.21)	-33.07** (13.04)	1.14 (1.00)	-1.44 (1.43)	0.87 (1.00)	-1.66 (1.41)
<i>municipalities_in_union</i>		-2.81*** (0.91)		-2.96*** (0.87)		-13.03 (9.31)		-14.73 (9.27)		-2.42** (1.02)		-2.40** (1.00)
<i>municipalities_before_union</i>		-3.24*** (0.95)		-3.34*** (0.92)		-11.28 (9.78)		-13.62 (9.74)		-3.15*** (1.07)		-2.98*** (1.06)
<i>reserve_price</i>			0.0004 (0.0003)	0.0004 (0.0003)			0.02*** (0.003)	0.02*** (0.003)			-0.01*** (0.0004)	-0.01*** (0.0004)
<i>bidders</i>			0.19*** (0.01)	0.19*** (0.01)			0.05 (0.07)	0.05 (0.07)			0.10*** (0.01)	0.10*** (0.01)
<i>open</i>			-0.49* (0.26)	-0.48* (0.26)			11.05*** (2.72)	11.08*** (2.72)			-0.38 (0.29)	-0.37 (0.29)
<i>restricted</i>			2.33*** (0.47)	2.33*** (0.47)			16.89*** (4.95)	16.87*** (4.95)			1.73*** (0.54)	1.72*** (0.54)
<i>negotiated</i>			2.42*** (0.15)	2.42*** (0.15)			15.67*** (1.56)	15.70*** (1.56)			1.96*** (0.17)	1.97*** (0.17)
<i>lowest_price</i>			4.39*** (0.16)	4.39*** (0.16)			-11.90*** (1.65)	-11.90*** (1.65)			0.94*** (0.18)	0.94*** (0.18)
<i>new</i>			-0.49*** (0.12)	-0.49*** (0.12)			12.61*** (1.23)	12.62*** (1.23)			-0.31** (0.13)	-0.31** (0.13)
<i>experience</i>			0.004 (0.003)	0.005 (0.003)			-0.01 (0.03)	-0.01 (0.03)			-0.01 (0.004)	-0.01 (0.004)
<i>screening_intensity</i>			0.02*** (0.001)	0.02*** (0.001)			0.10*** (0.02)	0.10*** (0.02)			0.01*** (0.002)	0.01*** (0.002)
<i>relationship</i>			-0.23*** (0.04)	-0.23*** (0.04)			-0.21 (0.47)	-0.20 (0.47)			-0.01 (0.05)	-0.01 (0.05)
<i>population</i>	1.46** (0.70)	1.51** (0.70)	0.66 (0.68)	0.70 (0.68)	17.88** (7.17)	17.69** (7.18)	17.28** (7.22)	17.17** (7.23)	-0.58 (0.79)	-0.49 (0.79)	-0.39 (0.78)	-0.33 (0.78)
Municipal 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 Cat. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50,905	50,905	50,905	50,905	50,905	50,905	50,905	50,905	50,905	50,905	50,905	50,905
R²	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 based on the full sample contracts for the period ranging from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

Finally, we do not observe any difference on the execution cost overrun stemming from cooperation, as the coefficient on *union* is, in fact, not statistically significant across columns 9 to 12. This is quite comfortable in the light of the result on the winning rebate, suggesting that, even if characterized by lower rebates, tenders managed by municipal unions do not suffer from higher extra cost in the execution stage. Overall, our findings on the PP performance proxies give support to the conclusions by Decarolis (2014) suggesting the presence of a trade-off between cost savings ex-ante and performance ex-post. We, in fact, find that public tenders awarded by the centralized entity (*union*) compared to those managed by the less centralized one (*municipalities*) are characterized by a worst performance ex-ante (lower rebates) but a better performance ex-post (shorter delays and no extra costs).

The potential loss caused by lower rebates is, however, not severe in monetary terms. Considering, in fact, an average winning rebate of 18.6 percent and an average reserve price of about 181 thousand of Euro for the total sample, an estimated rebate of -4.65 percent (column 4 of table 3) will result in *ex-ante* lower savings of about 1,500 Euro.

Turning our attention on 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 1%) for the normalized delay, and finally turn to be negative for the cost overrun. Thus, it seems that tenders with a higher reserve price are associated with longer delays but lower execution extra costs.

Tenders characterized by stronger competition (*bidders*) are associated with higher rebates, confirming the results in the literature (Chiappinelli, 2020; Ravenda et al., 2020), and with higher extra costs. Contracts awarded through the *lowest_price* criterion (rather than the most economically advantageous offer) are associated with higher rebates and cost overrun and with shorter delays. Concerning the variables related to the contracting authority characteristics, there is no significant effect of the *experience* on neither of the PP performance proxies analyzed, whereas the presence of a strong *relationship* between the contracting authority and the winning firm has a significant (negative) effect only on the *winning_rebate*. For the *screening_intensity*, we observe that the greater the intensity in the screening procedure for the selection of the winner, the more the tender experience a costs savings at the winning stage, and higher delays and extra costs at the execution phase of the works.

4.1. Robustness tests

4.1.1. Homogeneous samples

In order to further investigate possible differences in PP performance stemming from local cooperation we estimate the regression model (1) on two alternative subgroups of public work contracts, which are more homogeneous in terms of their values. In table 4 we thus report estimation results on public work contracts with a value above (columns 1 to 3) and below (columns 4 to 6) 150,000 Euro. We report results only for our preferred model where both the whole set of contracting authorities of interest and all controls are considered.¹⁰

What is worth noting first, is that the majority of public work contracts in the total sample has a value below 150,000 Euro: municipalities and municipal union publish mostly contracts that are small in terms of their estimated value.

In general, the sign of the estimated coefficients on the independent variable of interest is confirmed also when splitting the total sample. When a tender is managed by a municipal union it is characterized by

¹⁰ From now on, we will report just the coefficients estimate related to the contracting authorities of main interest. The full set of results is available upon request.

lower percentages of rebates and shorter delays. In comparison with the previous findings related to the full sample, the effect on winning rebate, however, is always weaker in terms of statistical significance. More interestingly, in column 6 of table 4 we observe a (weakly significant) negative effect of *union* on the execution extra costs, suggesting that cooperation may produce a cost saving in the ex-post stage of the tender for public work contracts with a value below Euro 150,000.

Table 4. Estimation results on PP performance proxies based on contract value

Variables	Above 150,000€			Below 150,000€		
	winning_rebate (1)	norm_delay (2)	cost_overrun (3)	winning_rebate (4)	norm_delay (5)	cost_overrun (6)
<i>union</i>	-5.22** (2.33)	-54.96** (25.26)	-0.72 (2.81)	-2.88* (1.66)	-35.67** (17.69)	-3.63* (1.87)
<i>municipalities_in_union</i>	-3.65** (1.78)	-23.13 (19.39)	-1.12 (2.15)	-2.30** (1.12)	-12.52 (11.96)	-3.41*** (1.26)
<i>municipalities_before_union</i>	-3.85** (1.84)	-25.01 (19.99)	-1.22 (2.22)	-2.70** (1.19)	-8.94 (12.70)	-4.50*** (1.34)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes
CA characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes
Year Award FE	Yes	Yes	Yes	Yes	Yes	Yes
Contracts Cat.FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,522	19,522	19,522	31,383	31,383	31,383
R²	0.50	0.32	0.36	0.46	0.27	0.29

Note: Estimation results based on two sub-samples based on contracts values. In columns 1, 2 and 3 we report the results for public work contracts with a value above € 150,000, while in columns 4, 5 and 6 results for contracts with a value below 150,000€. Estimation period ranges from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

Overall, these results confirm that some possible benefits from local cooperation in the PP sector can arise only during the execution phase. Public work contracts published and awarded by municipal unions are characterized by quite shorter delivery delays and (for works below Euro 150,000) lower final extra costs. During the winning stage, on the other hand, we observe that municipal unions award contracts with lower rebates. Moreover, what is worth noting is that if a tender below Euro 150,000 is awarded by *union* the winning rebate and the cost overrun will reduce by -2.88% and -3.63%, respectively. These would produce an average per-tender less savings during the winning stage of almost Euro 420 and higher savings in the ex-post phase of about Euro 170.¹¹ Thus, *ex-post* savings allow to recover in part (approximately 40%) the lower rebates reached in the *ex-ante* stage.

These results still suggest that the effects on the three PP performance variables seem to be interrelated: contracts published by municipal unions are awarded with lower rebates, but at the same time they remunerate for shorter execution delays and somehow ensure *ex-ante* from unexpected cost variation in the *ex-post* stage.

¹¹ The monetary effect on winning rebate is computed for public work contracts with an average reserve price of about 84.2 thousand of Euro and an average winning rebate of 17.26%. The effect on cost overrun is computed given an average winning bid of about 67.5 thousand of Euro and an average cost overrun for the total sample of 6.95%.

So far we have analyzed the performance by municipal unions with respect to the results achieved by a sample of municipalities that either is outside or will never join a union. Now, what is interesting to see is whether the previous results are confirmed when comparing unions with municipalities that will be/are/were part of a municipal union. In other words, we are now interested in comparing the performance between contracting authorities that, to some extent, are more similar, since we exclude from the sample municipalities that never joined a municipal union. Results for this specification are reported in table 5. Our main results are confirmed, as municipal unions seem to be more performing than municipalities also in this specification.

Table 5. Estimation results on PP performance proxies: homogeneous control sample

Variables	<i>winning_rebate</i> (1)	<i>norm_delay</i> (2)	<i>cost_overrun</i> (3)
<i>union</i>	-2.02** (0.87)	-19.30** (9.46)	-0.03 (1.00)
Contract characteristics	Yes	Yes	Yes
CA characteristics	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes
Year Award FE	Yes	Yes	Yes
Contracts Cat.FE	Yes	Yes	Yes
Observations	15,898	15,898	15,898
R²	0.44	0.24	0.27

Note: Estimation results for a comparison in the PP performance between municipal unions and municipalities that will be/are/were part of a union (omitted variable). Estimation period ranges from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

4.1.2. Matched samples

Estimation results discussed so far might suffer from selection bias concerns because the effect of the management of the tender by a contracting authority may vary according to the characteristics of the contract. To address this issue, we re-estimate the regression model (1) on two samples built using two alternative matching procedures. The goal of matching methods is to reweight observational data in order to achieve experimental-like balanced samples. Based on a series of predetermined characteristics, we thus attempt to find a group of contracts managed by municipalities (control units) which are very similar to those managed by municipal unions (treated units).

The first method used is the coarsened exact matching (CEM) which is a form of stratum matching that first coarsens the covariates by creating bins and then performs exact matching on the coarsened data, returning only the uncoarsened matched data (Blackwell et al., 2009). In particular, we exactly match without any coarsening tenders managed by municipalities to those by municipal unions based on the variables denoting specific tenders' characteristics, such as the type of the procedure (*open*, *restricted* and *negotiated*), the award criterion (*lowest_price*), the dummies for the 20 Italian regions (*regional*

dummies) and the years of award (*year_award*). On the other hand, we use the Sturge's rule binning algorithm (Iacus et al., 2012) on the variables *reserve_price* and *bidders* to coarsen the variables and find the best corresponding strata. Results are reported in columns 1 to 3 of table 6.

In the second matching procedure, we exactly match treated and control units based on the same variables used in the CEM, whereas on the variables *reserve_price* and *bidders* we apply the "Mahalanobis distance" between pairs of observations to match each treated unit to controls that are closest to it. We use the Mahalanobis distance measure, instead of a more common propensity score matching, since the former tends to work better because Mahalanobis distance-paired units will have close values on all of the covariates on which this distance is applied, whereas propensity score-paired units may be close just on the propensity score (King and Nielsen, 2019; Luca and Modrego, 2021).

Results for our preferred model where both the whole set of contracting authorities of interest and all controls are considered are shown in columns 4 to 6 of table 6.

Table 6. Estimation results on PP performance proxies: matched samples

Variables	CEM			Mahalanobis distance		
	<i>winning_rebate</i> (1)	<i>norm_delay</i> (2)	<i>cost_overrun</i> (3)	<i>winning_rebate</i> (4)	<i>norm_delay</i> (5)	<i>cost_overrun</i> (6)
<i>union</i>	-3.91 (2.57)	-91.14*** (26.77)	-2.24 (2.73)	-2.53 (3.35)	-74.99** (36.42)	0.36 (4.08)
<i>municipalities_in_union</i>	-0.70 (2.17)	-67.85*** (22.54)	-1.89 (2.30)	0.28 (3.01)	-54.27* (32.73)	-2.60 (3.67)
<i>municipalities_before_union</i>	-1.41 (2.56)	-46.72* (26.68)	-2.25 (2.72)	-0.65 (3.57)	-27.61 (38.79)	0.79 (4.35)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes
CA characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes
Year Award FE	Yes	Yes	Yes	Yes	Yes	Yes
Contracts Cat. FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,704	9,704	9,704	6,014	6,014	6,014
R²	0.55	0.36	0.38	0.60	0.39	0.42

Note: Estimation results for a comparison in the PP performance between municipal unions and municipalities not in union for two matched samples. Estimation period ranges from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

To check whether reweighting has been successful in both the procedures, we look at the standardized differences in means and at the ratio of variances between treated and control units. A model perfectly balances covariate when the model-adjusted differences in means are equal to zero and the variance ratio is one. Obviously both the procedures applied have a perfect balancing for variables on which we exactly match treated and controls units; as regards the continuous variables used in the match (*reserve_price* and *bidders*) the output from the test provides evidence of a better balance in the matched samples compared to the unmatched (slightly improving for the Mahalanobis distance method).¹²

¹² The results are not reported here but are available upon request.

Turning to the coefficients estimates, the results are overall similar between the two matched samples. The coefficient on the variable of interest *union* is imprecisely estimated for winning rebates and costs overrun in both the methods used. On the other hand, and most interestingly, consistent with the full sample estimations we find a negative and (strongly) statistically significant coefficient on *union* for the normalized delay (columns 2 and 5 of table 6). In comparison to the full sample results presented in table 3, moreover, the magnitude of the effect is very stronger for both the matched samples.

At the same time, looking at the sample reached through the CEM, we find that also municipalities that have already joined (*municipalities_in_union*) and that will join (*municipalities_before_union*) a union experience a shorter delay (strongly statistically significant for *municipalities_in_union*) compared to the other municipalities (column 2 of table 6), although the estimated effect is weaker in magnitude than that on *union*.

4.1.3. Heterogeneity controls

Although the previous analyses already contain several specifications testing the relationship between PP performance and inter-municipal cooperation, as introduced in the «Empirical analysis» section we perform a further check by investigating whether there is evidence of heterogeneity. To this end we add in regression equation (1) some other control variables.¹³

We assume that a first source of heterogeneity that may affect PP performance is the size of municipalities forming contracting authorities with respect to all Italian municipalities.

Therefore, we build a new variable, named *large* which equals one if the municipal population or the population of at least a municipality in the union is above the average population of all Italian municipalities (around 8,000 inhabitants). We also control for a measure indicating the share of politicians in the contracting authorities' administration that have at least a college degree, named *CA_qualification*. Table 7 reports the estimates according to a stepwise logic, i.e. by adding each covariate one by one, whilst the final model includes all the variables. The results show that the inclusion of these control variables does not significantly affect the finding on the dummy variable of main interest (*union*).

Table 7. Estimation results on PP performance proxies: heterogeneous controls

Variables	winning_rebate			norm_delay			cost_overrun		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>union</i>	-5.49*** (1.29)	-3.75*** (1.41)	-4.699*** (1.461)	-36.55*** (13.68)	-42.44*** (14.96)	-46.610*** (15.543)	-0.77 (1.48)	-2.36 (1.62)	-1.516 (1.681)
<i>municipalities_in_union</i>	-3.80*** (0.96)	-3.02*** (0.89)	-3.973*** (0.975)	-18.21* (10.15)	-16.83* (9.46)	-21.022** (10.369)	-1.51 (1.10)	-2.53** (1.02)	-1.683 (1.122)

¹³ In a further specification we took into account the number of years elapsed from the date of birth of municipal union and the date in which the tender has been published in order to investigate how the effects on the PP performance vary with respect to the “seniority” of unions. Another control variable we added to the baseline is the number of municipalities in the union. However, in both these specifications, we do not find any relevant difference in our main findings. Results are available upon request.

<i>municipalities_before_union</i>	-3.53***	-3.30***	-3.514***	-14.42	-16.33	-17.275*	-2.78***	-3.15***	-2.953***
	(0.92)	(0.93)	(0.939)	(9.79)	(9.94)	(9.989)	(1.06)	(1.08)	(1.080)
<i>large</i>	1.14**		1.285**	4.72		5.673	-1.20**		-1.152*
	(0.53)		(0.541)	(5.61)		(5.751)	(0.61)		(0.622)
<i>CA_qualification</i>		0.001	0.002		-0.03	-0.024		-0.01	-0.007
		(0.01)	(0.006)		(0.06)	(0.063)		(0.01)	(0.007)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CA characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipal FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Award FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contracts Cat. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50,905	48,291	48,291	50,905	48,291	48,291	50,905	48,291	48,291
R²	0.42	0.42	0.42	0.23	0.23	0.23	0.24	0.24	0.24

Note: Estimation results for a comparison in the PP performance between municipal unions and municipalities not in union adding heterogeneity controls. Estimation period ranges from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

Consistent with the baseline results, we find that municipal unions award contracts with lower rebates but which during the execution phase do not suffer from higher extra costs and are delivered with shorter delays.¹⁴

The greater is the municipality forming the contracting authority (*large*), the higher will be the winning rebate and the lower the cost overrun. Thus, it seems that larger municipalities are able to achieve greater costs savings. The qualification of local politicians does not significantly affect nor of the PP performance measures.

4.2. The role of intra- and supra-regional financing

A clear concern of the policy maker is the small size of many municipalities. To overcome this drawback, stimulus policies have been implemented towards greater local centralization, which mainly resulted in vertical transfers. Here, we investigate whether it is worthwhile to stimulate local cooperation in the procurement sector.

In order to reveal the role of external funds in improving (or not) PP performance, we introduce in the analysis the source of financing of the public work contract by means of three variables denoting the share of external financing in its total funding: we distinguish among funding from regional (*regional_financing*), national (*national_financing*) and European Union (*EU_financing*) sources.

As shown in table 8, reporting some descriptive statistics of these variables, municipal unions award contracts that benefit from higher funds from regional and EU sources, compared to municipalities. The same does not happen for national sources.

¹⁴ Following Ferraresi et al. (2018) we also estimate a specification in which the dummy *large* indicates whether municipal unions are composed of large municipalities, and thus setting it equal to one only if the population of at least a municipality in the union is above the average population of all Italian municipalities. Results, available upon request, show a reduction in the significance level for the winning rebate and stronger coefficients (in terms of magnitude) for the normalized delay.

Table 8. Source of financing: descriptive statistics

Variables	pwc_m			pwc_u			pwc_m vs pwc_u
	Obs.	Mean	St. Dev.	Obs.	Mean	St. Dev.	t_test
<i>regional_financing</i>	47701	19.33	36.36	1294	26.78	42.56	***
<i>national_financing</i>	47701	7.31	25.01	1294	3.98	18.96	***
<i>EU_financing</i>	47701	4.65	20.10	1294	9.01	27.69	***

Note: Descriptive statistics based on the full sample contracts for the period ranging from 2012 – 2020. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed t-test for the differences in means.

We analyze the direct impact of the three financing sources on tenders' performance by estimating the following equation:

$$performance_{ijt} = \beta_0 + \sum_z \beta_1^z financing\ sources_{ijt}^z + \sum_z \beta_2^z financing\ sources_{ijt}^z \times union + \sum_k \beta_3^k X_{ijt}^k + m_j + y_t + c_i + \varepsilon_{ijt}, \quad (2)$$

where z denotes the three sources of financing considered in the analysis (*regional*, *national* and *EU*). For whatever contracting authority at local level, by looking at the term *financing sources* $_{ijt}^z$ we will investigate whether an increase in the share of external funds is associated with a better PP performance.

On the other hand, the interaction term *financing sources* $_{ijt}^z \times union$ catches the effect of the funding for contracts specifically awarded by municipal unions, allowing us to understand whether the financing stimulus given for the tender by regional, national and European Union authorities may act differently depending on the contracting authority.

The results in table 9 (first 3 rows) show that higher funds from regional and national authorities tend to increase the execution timing of public works (columns 5, 6 and 8). Thus, as regards the execution timing, it is reasonable to assume that incentives for efficiency are greater as the share of contracting authority own resources in the financing of public works increases.

On the other hand, when the contracts are increasingly financed by national and EU funds the winning rebate reduces, but, at the same time, the contract is characterized by lower final execution costs. It is interesting to note that, even in this case, *ex-post* savings allow to partly recover the lower rebates reached in the *ex-ante* stage. Furthermore, EU financing sources imply a worst performance at the winning stage, but a better one in the execution stage (columns 7, 11 and 12).

By looking at the specific effects of financing sources for pwcs awarded by municipal unions (rows 4-5-6), the results are never statistically significant for the *norm_delay* and the *cost_overrun*. On the other hand, it is interesting to note that regional policies, captured by regional transfers, tend to reduce the winning rebate - and only for contracts awarded by unions.

Table 9. Estimation results on PP performance proxies: financing sources

Variables	winning_rebate			norm_delay			cost_overrun					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>regional_financing</i>	0.001 (0.002)			-0.001 (0.002)	0.04** (0.02)			0.04** (0.02)	0.002 (0.002)			-0.0001 (0.002)
<i>national_financing</i>		-0.003 (0.002)		-0.01** (0.002)		0.04* (0.02)		0.05** (0.02)		-0.01** (0.002)		-0.01*** (0.003)

<i>EU_financing</i>			-0.01*** (0.003)	-0.01*** (0.003)			-0.06** (0.03)	-0.04 (0.03)			-0.01*** (0.003)	-0.01*** (0.003)
<i>regional_financing x union</i>	-0.02** (0.01)			-0.03** (0.01)	-0.002 (0.11)			-0.02 (0.11)	0.02 (0.01)			0.02 (0.01)
<i>national_financing x union</i>		0.02 (0.02)		0.01 (0.02)		0.01 (0.25)		0.01 (0.25)		0.02 (0.03)		0.02 (0.03)
<i>EU_financing x union</i>			-0.03 (0.02)	-0.04 (0.02)			-0.11 (0.20)	-0.12 (0.20)			-0.01 (0.02)	0.002 (0.02)
Contract characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CA characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipal 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 Cat.FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	48,291	48,291	48,291	48,291	48,291	48,291	48,291	48,291	48,291	48,291	48,291	48,291
R²	0.421	0.421	0.421	0.421	0.233	0.233	0.233	0.234	0.244	0.244	0.244	0.245

Note: Estimation period ranges from the 1st of January 2012 until the 2nd of April 2021. *, ** and *** denote significance level at 10%, 5% and 1%, respectively, based on the two-tailed test. In parenthesis standard errors clustered by the public work category.

5. Concluding remarks

Recently, several EU national governments, stimulated by the European Union directives, have pursued reforms in the PP sector in order to achieve significant savings in the use of public funds. One of the most debated ways to reduce purchasing costs is centralization.

In this paper we have contributed to two strands of the literature. The first relates to the performance analyzes of PP, for which the possible benefits deriving from centralization at the local level are scrutinized for the first time. The second is the literature on the performance of municipal unions that we have extended by shedding light on one of the most relevant procedures for the implementation of public policies, namely public procurement.

Our results show that public tenders awarded by municipal unions are characterized by lower rebates, shorter delays, and no final extra costs. Indeed, we observe a negative, and weakly significant, effect of municipal unions on the execution extra costs only for contracts with an estimated value below Euro 150,000. This, in turn, suggests that municipal unions tend to be more efficient than municipalities during the execution stage, and this better performance comes at the cost of lower savings during the winning stage. Our findings are confirmed even after some robustness checks aimed at comparing more homogeneous samples and controlling for factors related to possible heterogeneity. The results in this paper give support to the conclusion by Decarolis (2014), suggesting that there is a significant relationship between the three PP performance measures and a sort of trade-off between cost savings ex-ante and performances ex-post.

We conclude that, when looking at the local level and focusing on a specific procedure in public spending, as the procurement activity, moving to a more centralized system does not necessarily imply an improvement in the spending of public funds. Even if not directly comparable, our results are somehow in contrast with those obtained by Chiappinelli (2020) stating that more centralized entities achieve higher rebates.

On the other hand, our analysis showed that municipal unions perform better than non-union municipalities during the execution phase of a public tender. Consequently, the hypothesis in support of inter-municipal

cooperation for the PP sector should be based mainly on the possibility of improving the services provided, such as the delivery of public works in fewer days.

As regards the policies to stimulate the centralized and cooperative management of local public procurement, our findings have highlighted that when the public work contract is increasingly financed by external sources it implies longer delays (when the sources are regional or national), lower rebates and lower extra costs (especially for national and EU sources). With respect to the effect of the funding for contracts specifically awarded by municipal unions, the most interesting result refers to the winning rebate, for which we observed a reduction in particular when the share of regional funds increases. The factors that may drive these significant results require, however, further scrutiny and will be subject to future investigations.

Our findings assume relevance also in the light of the recent acceleration of local centralization policies linked to the application of the NRRP. The most recent legislation (law 108/2021) has further introduced stricter constraints on procedures related to the NRRP, delegating them only to qualified contracting authorities or, alternatively, to municipal unions or in general to centralized entities. This acceleration in local centralization policies will produce new analytical and policy developments.

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