The Effects of Mafia Infiltration on Public Procurement Performance

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Abstract

We examine the effects of Mafia infiltration on public procurement performance based on a sample of 68,063 public work contracts (PWC) awarded by Italian municipalities over the period 2012-2017, of which 687 are identified as Mafia-infiltrated either because of being awarded by municipal councils subsequently dissolved due to Mafia infiltration or because of being won by Mafia-owned firms.

Our results reveal that Mafia infiltration is positively associated with number of submitted bids, awarding rebates and execution cost overruns, whereas it is negatively associated with delivery delays for PWC. The effect of Mafia infiltration on execution cost overruns and the probability of their occurrence is weaker for larger PWC and the elections of the new municipal councils, after the dissolution of the previous ones, do not significantly influence the performance of PWC.

Our findings suggest the presence of collusive schemes among bidding firms within the Mafia network and provide new insights for the implementation of more sound policies to tackle practices associated with Mafia infiltration in public procurement.

Keywords: corruption; Mafia infiltration; public procurement.

Abbreviations in the paper: ANAC (National Anti-Corruption Authority); ISTAT (Italian Institute of Statistics); MPWC (Mafia-infiltrated public work contracts); PP (public procurement); PWC (public work contracts).

1 Introduction

Public procurement (PP) plays an important economic role within the EU countries given that publicly procured expenditure on works, goods and services in 2015 represents approximately 13.1% of the EU GDP (European Commission, 2016) and 29% of general government expenditure (OECD, 2016). Therefore, an effective and efficient PP system is of strategic importance for governments to avoid mismanagement and waste of public funds (OECD, 2016). PP can be defined as a contract for pecuniary interest concluded between a purchasing public authority and a supplying private economic operator for the provision of works, products, or services needed to pursue institutional goals (Baldi et al., 2016).

There is broad consensus that public authorities should aim to pursue "value for money" in the management of PP (Guccio et al., 2012). However, the relevance of PP also lies in its consideration as a policy instrument to achieve public strategic objectives such as fostering domestic economic growth, innovation, inclusion of SMEs, social responsibility, and sustainability (Flynn, 2017). In this vein, from April 2016, recent EU Directives (2014/24/EU, 2014/25/EU and 2014/23/EU) have imposed the inclusion of these broader social goals as well as measures to achieve higher efficiency and transparency within the national PP regulation of the EU member states (Baldi et al., 2016).

Nonetheless, the pursuit of these objectives introduced by EU Directives may be full of obstacles especially in certain social and institutional contexts facing issues like corruption, favouritism, conflict of interests, and other public institution flaws (Baldi et al., 2016). In particular, the extreme vulnerability of PP to corruption, even within the OECD countries, arises from the great magnitude of financial transactions and variety of stakeholders involved, as well as from close interactions between public officials and private businesses (Hessami, 2014; OECD, 2016). The direct social costs of corruption consist of misallocation and waste of public funds, whereas the indirect costs lie in distortion of business competition and underfunding of public policies for social and economic development (OECD, 2015).

In this regard, Italy, as well as being one of the most corrupted nations in EU, according to the 2018 Corruption Perception Index[1], is plagued by the presence of Mafia organizations that exert pervasive control over the economic, political and social activities of the country (Caneppele et al., 2009). The Mafia infiltration for the control of both PP and political institutions is historically so typical that it is embedded in the definition of the Mafia-type

[1] https://www.transparency.org/cpi2018

association crime according to the article 416-bis of the Italian criminal law. In this context, the inefficiency of the Italian PP system and the consequent under-provision of infrastructures are not surprising (Guccio et al., 2014).

That said, in this paper we examine the effects of Mafia infiltration on the performance of PP, using a sample of 68,063 public work contracts (PWC) awarded by Italian municipalities over the period 2012-2017, to seek evidence of inefficiencies possibly linked to embezzlement and rent-seeking in favour of Mafia organizations. Within this sample, we infer Mafia infiltration in 687 PWC based on two pieces of evidence.

The first piece of evidence is the dissolution of Italian municipal councils, through decree of the President of the Republic, because of verified connections of local administrators with the Mafia. All awarded PWC arising from public tenders published during the term of office of the dissolved elective municipal councils are assumed to be Mafia-infiltrated. In this respect, the 2018 report of the Minister of the Interior on the municipalities dissolved due to Mafia infiltration states that "the operational modalities of the infiltration are mostly concentrated in the sector of PWC on which the economic interests of the organized crime mainly converge" (Ministero dell'Interno - Dipartimento per gli Affari interni e territoriali, 2018).

On the other hand, the second piece of evidence is based on firms seized by judicial authorities because of the accusation of Mafia-type association against their owners. Indeed, the above-mentioned article 416-bis of the Italian penal code provides for the seizure of all the assets, including firms, of the Mafia-associated person, representing the proceeds of the crime or their investment. All PWC awarded to firms controlled by the Mafia, before their seizure, are also assumed to be Mafia-infiltrated.

To test the effect of Mafia infiltration, we use several measures of public work procurement performance, including delivery delays, cost overruns, and awarding rebates, widely used in previous studies on Italian PP as efficiency indicators (Coviello et al., 2018a; Decarolis, 2014; Decarolis and Palumbo, 2015; Guccio et al., 2014). All these performance dimensions may have significant implications for the social welfare addressed by the procured public works (Guccio et al., 2014). Furthermore, we control for several possible determinants of PP performance that include characteristics of the tender, the institutional, social and political context, the awarding firms, the municipalities and their financial health.

Overall, our results support our hypotheses on the positive association of Mafia infiltration with PWC awarding rebates and PWC execution cost overruns. On the other hand, Mafia infiltration is associated with shorter delivery delays for PWC. Our estimations, including municipality fixed effects, are robust to several matching procedures, to address selection bias,

as well as to instrumental variable methods and the procedure developed by Oster (2019), to address omitted variable bias. Additional analyses reveal that the positive effect of Mafia infiltration on execution cost overruns, as well as on the probability of their occurrence, is weaker for larger PWC, whereas the effect on awarding rebates and delivery delays is not moderated by the size/complexity of PWC. Furthermore, Mafia infiltration is associated with a higher number of valid bids submitted in the related public tenders, providing further support for the thesis of collusion among bidders within the Mafia network, aiming to influence the awarding of PWC. Finally, we find that the elections of the new municipal councils, after the dissolution of the previous ones, do not significantly affect the prior performance of PWC, suggesting that the dissolution of the Mafia-infiltrated municipalities may be ineffective in eliminating the influence of the Mafia on PWC.

To our knowledge, our study is the first attempt to analyse the effects of Mafia infiltration on PP performance, using a wide sample of PWC over a 6-year period. In particular, we contribute to the related literature by providing empirical evidence of opportunistic strategies, recently documented in anti-Mafia judicial investigations (Caneppele and Martocchia, 2014; DIA, 2016; Martocchia et al., 2014; Spartà, 2016), whereby, to exclude more efficient and capable competitors, colluded companies within the Mafia network get PWC awarded through abnormally high rebates that are subsequently offset with price renegotiations, leading to cost overruns.

As a further contribution, our study supports the usage and analysis of PP performance measures, as red flags for corrupted and collusive schemes, in combination, rather than in isolation, to avoid drawing wrong conclusions. In this regard, the widely used corruption risk indicator in PP based on the single bidding (Fazekas and Tóth, 2018) is not valid in our context. Furthermore, the interpretation of the PP performance measures should also consider the characteristics of PWC, such as complexity and legal requirements, as well as the socio-institutional context that may together influence the strategies adopted by the criminal organizations.

Finally, among the studies on political corruption (e.g., Hessami, 2014; Solé-Ollé and Sorribas-Navarro, 2018), our study is the first to indicate that to eradicate criminal infiltrations and corruption from public administration, it may not be enough to intervene on and renew the elected political bodies. Indeed, although the newly elected politicians may have a higher educational level (Daniele and Geys, 2015), the criminal contamination could concern the administrative apparatus of the permanently employed public officials who survive the renovation of the elected political bodies.

The remainder of the paper proceeds as follows: section 2 presents some theory and develops the hypotheses; section 3 describes the research design and sample data; section 4 presents empirical results; section 5 includes concluding remarks.

2 Theoretical Considerations

Several studies examine the effects of corruption on PP performance. For example, Fazekas and Tóth (2018) find that corruption inflates prices of public infrastructure contracts in EU, over the period 2009-2014, by 30-35% on average, with largest excesses in high corruption risk regions. In PP, the main effect of corruption is to steer the awarding of public contracts to favoured bidders, by avoiding competition, in violation of principle of fair and equitable treatment for potential suppliers (Fazekas and Tóth, 2018; OECD, 2016). The restriction of competition prevents more efficient and qualified firms, outside the corruption network, from winning public contracts. Indeed, these are instead awarded to less capable firms at higher prices for lower quality, even because the costs of corruption incurred by dishonest firms must be amortized (Boehm and Olaya, 2006).

Prior research documents that corruption is intrinsic to the way the Mafia infiltrates the Italian PP (Canonico et al., 2012; Martocchia et al., 2014; Spartà, 2016; Transcrime, 2013). Specifically, Caneppele and Martocchia (2014) state that the infiltration of the Mafia in PP occurs "when a natural person or a legal entity, belonging to or linked to a Mafia-type organization, or with a view to facilitate a Mafia-type organization, affects a public contract in order to obtain an unfair advantage". The infiltration of the Mafia in the legal economy, and specifically in PP, is mostly widespread in some areas of southern Italian regions like Sicily, Calabria and Campania (Caneppele et al., 2009).

PP represents an opportunity for Mafia-type organizations to launder dirty money as well as to earn profits, control the economy of their territories, and earn social legitimacy by providing job opportunities in areas with high unemployment (Ravenda et al., 2019). Indeed, PP guarantees a stable supply of significant and locally available financial resources over time. In addition, the weakness of control mechanisms in Italian public administration makes public sector crimes difficult to pursue (Calderoni and Caneppele, 2009).

The Entrepreneurial *modus operandi* of the Mafia is characterized by the usage of illegal criminal methods (e.g. intimidation, threats and corruption) to discourage competitors (Ravenda et al., 2019). The extortion practiced against the economic operators involved in the realization of the public works represents a further source of income for the Mafia (DIA, 2018). In addition,

to achieve immunity from prosecution, the Mafia infiltrates the local political institutions and public administration by influencing political elections and interfering in the market for votes (Buonanno et al., 2016). Specifically, the Mafia supports politicians by procuring them votes and funding their campaigns in exchange for awarding of public contracts, favourable laws and immunity (Ravenda et al., 2019).

Based on the analysis of law enforcement agency reports, Caneppele et al. (2009) identify two types of infiltration of the Mafia in PP, namely the direct and the indirect. The direct infiltration occurs when a firm controlled by the Mafia directly gets a public contract awarded. This commonly involves the usage of apparently clean firms, sometimes specifically created and indirectly controlled (through figureheads and strawmen) by the Mafia, to circumvent anti-Mafia controls required by Italian PP law (Caneppele and Martocchia, 2014). This is more common for smaller public contracts whose tender participation requirements and public controls are relatively weaker (Caneppele and Martocchia, 2014).

In contrast, the indirect infiltration takes place when the public contract awarding firm is not directly controlled by the Mafia, but it is committed or extorted to provide the Mafia with subcontracts to its firms, jobs and kickbacks (protection money) to its affiliated, and other economic benefits (Canonico et al., 2012; Spartà, 2016). The indirect infiltration is more frequent for high-value and complex public contracts whose greater legal, technical and financial requirements as well as stricter anti-Mafia controls may hinder the participation of Mafia-controlled firms that are usually small-medium and less qualified (DIA, 2018). In our study, the infiltration in PP is direct for public contracts awarded to Mafia-controlled firms. On the other hand, for contracts awarded by Mafia-infiltrated municipalities, to firms with no evidence of Mafia control, we cannot determine whether the infiltration is direct or indirect.

Previous case studies (Canonico et al., 2012; Martocchia et al., 2014; Spartà, 2016; Transcrime, 2013) document that, to get public contracts awarded, the Mafia may mostly discourage competition through three methods: 1) the systematic recourse to intimidation, threats, pressures or attacks on goods or people to induce undesired companies not to show up for the tender or to withdraw their offer; 2) document falsifications and alteration of the procedures to exclude rival companies by bringing to light formal defects of their bids; 3) strategic tailoring of tender participation requirements and specifications to favour Mafia-connected firms to the detriment of competitors. However, Caneppele et al. (2009) state that the infiltration of Mafia in PP has recently become more sophisticated and requires more complex knowledge on PP and business procedures and regulation, commonly provided by professional experts, to disguise the criminal activities behind a veil of legitimization.

In this vein, previous analyses of case studies document the strategy of Mafia-connected firms to compensate high awarding rebates (underbidding), to secure the win of the tender, with subsequent contract renegotiations during the execution stage, leading to cost overruns for the public authority, and with lower quality and quantity of the delivered works (Martocchia et al., 2014; Spartà, 2016). In this regard, prior studies find that strongly competitive PP procedures may increase the risk of aggressive bidding of some participants either as an opportunistic strategy to maximize the chance of winning a contract and then renegotiate it or as a derivation of information incompleteness about the 'true' value of contracts (Coviello et al., 2018b; Guccio et al., 2012). Aggressive bidding may be attributed to adverse selection of the contractor that takes advantage of asymmetric (private) information on its production costs at the expense of the public buyer (Baldi et al., 2016; Bucciol et al., 2013).

In the case of Mafia-connected firms the adverse selection leading to underbidding may be exacerbated by the fact that for Mafia-connected firms the risk of a penalty application is lower, and they can count with greater certainty on the opportunity to renegotiate the highly discounted awarding price, because of the infiltration in the political and administrative bodies of municipalities (Spartà, 2016). In this line, Board (2007) shows that bidders with lower penalty from reneging on their bids are more likely to bid more aggressively, win standard PP auctions and subsequently renegotiate the contracts. In addition to the greater renegotiation opportunities, the competitive advantages of Mafia-controlled firms over competitors, granted by criminal methods (e.g., availability of illicit financial resources and low labour costs), give them greater capacity to financially sustain high price rebates in PP tenders (Ravenda et al., 2019).

On the other hand, recent research and reports of Italian Anti-Mafia Investigation Directorate (Caneppele and Martocchia, 2014; DIA, 2016; Martocchia et al., 2014; Spartà, 2016) describe how, to circumvent stricter anti-Mafia controls, the Mafia (especially *Camorra* and *'Ndrangheta*) have begun to adopt the so-called "*Metodo del Tavolino*" (Table Method), under which colluded companies, forming a cartel within the Mafia network, participate in public tenders by offering harmonised and abnormally high price rebates, previously agreed and economically unbearable for *non-mafiosi* competitors, and take turns winning contracts based on a rotational bidding scheme. Prior illicit agreements, in addition to disguising the Mafia presence, avoid the generation of conflicts and complicate the detection by authorities (DIA, 2016).

In this respect, some studies highlight the risks of collusion among bidders, that may coordinate their bids to pilot the contract awarding and favour a designated winner, in

competitive PP procedures (Bucciol et al., 2013). Collusive bidding schemes in PP often result in higher costs for public buyers as prices are artificially inflated (World Bank, 2014). Reeves-Latour and Morselli (2017) show that these collusive agreements may involve losing firms submitting phantom bids to convey an appearance of competition in the tender process. In our context, collusive practices to infiltrate PP are more likely as the Mafia may be well-entrenched in local socio-political context through relation networks among politicians, entrepreneurs, public officials, etc. (Calderoni and Caneppele, 2009).

Based on this depicted scenario of Mafia infiltration strategies in PP in recent times, we formulate the following two hypotheses:

Hypothesis 1. *Ceteris paribus*, Mafia infiltration is associated with higher awarding rebates for PWC.

Hypothesis 2. *Ceteris paribus*, Mafia infiltration is associated with higher execution cost overruns for PWC.

Another PP performance measure employed in prior research, that may by associated with the previous two, is delay. In particular, delay in work completion, with respect the length agreed in the public contract, may not only lead to cost overrun for the contracting authority, but may also affect social welfare by generating negative externalities for citizens who are users and beneficiaries of public works (Guccio et al., 2012).

Nonetheless, Decarolis (2014) finds a weak correlation (0.04) between cost overruns and delivery delays within a sample of Italian PWC. The author explains this partially counterintuitive finding, especially for high-value contracts, by envisaging that, to avoid penalties for delay, commonly linked to the awarding price (D'Alpaos et al., 2013), contractors may prefer renegotiating contract prices in terms of percentages of the awarding price, rather than delaying the contract completion.

In addition, delivery delays may also lead to the unwelcome effect of delaying payment of the contracting authority. Finally, political actors, colluded with the Mafia and searching for legitimacy, may want to minimize public work delivery delays that are more visible to citizens and then costlier than cost overruns in terms of electoral consensus (Canonico et al., 2012).

In summary, conflicting arguments and mixed incentives related to delaying public work delivery lead us to address empirically the effect of Mafia infiltration on public work delay and formulate the following null hypothesis, without any directional prediction:

Hypothesis 3. *Ceteris paribus*, Mafia infiltration does not significantly influence delivery delays for PWC.

3 Empirical Strategy and Data

3.1 Data and Sample Selection

Our full sample consists of 68,063 public work contracts (PWC) with value above € 40,000[2], published and awarded by Italian municipalities over the period 2012-2017. The information is extracted from a national database of public contracts managed by the National Anti-Corruption Authority (ANAC). This database, whose data are only available upon justified request, includes all public contracts published in Italy since 2007, related to public works, services and supplies, with the indication of all relevant characteristics of the tenders and their outcomes.

In our study, we only include PWC above € 40,000 for which all data, needed for our variable computation, are available for the period 2012-2017. Furthermore, we only examine municipalities for several reasons. First, municipalities manage the largest share of public works in Italy (Baldi et al., 2016). Second, focusing on a single type of public buyer may avoid institutional heterogeneity affecting our analysis, considering that previous studies document significant PP efficiency variability across distinct Italian public institutions (Guccio et al., 2014). Third, municipalities may be, on the one hand, more prone to corruption and more permeable to local criminal groups and lobbies (Baldi et al., 2016). On the other hand, relative to other more central institutions, municipalities may be more severely subject to the scrutiny of citizens and reflect more closely local culture, social capital and values.

Out of these 68,063 PWC, we extract 687 MPWC through an identification strategy supported by two pieces of evidence. Specifically, we consider as MPWC 521 awarded PWC arising from public tenders published during the term of office of 127 elective municipal councils that ended up dissolved by Italian authorities because of being infiltrated by the Mafia[3] (see Appendix A.2 for a description of the dissolution procedure).

In addition, out the full sample of PWC, we consider as MPWC 166 PWC awarded to firms controlled by the Mafia, before being seized by judicial authorities, following the accusation of Mafia-type association (article 416-bis of the Italian penal code) against their owners. The list of 388 Mafia-controlled firms that we use is an updated version of the sample built in previous studies examining the accounting information of these firms (Ravenda et al., 2019).

[2]According to Italian PP law (Legislative Decree 12 April 2006 N. 163) in force in the period under study, public contracting authorities can directly award public works with estimated value below € 40,000 to a designated contractor (direct assignment), even without consulting with two or more competing economic operators.

[3]A complete and updated list of municipalities dissolved for Mafia infiltration is kept by the association *Avviso Pubblico* and available on: https://www.avvisopubblico.it/home/home/cosa-facciamo/informare/documenti-tematici/comuni-sciolti-per-mafia/amministrazioni-sciolte-mafia-dati-riassuntivi/. Historical open-data on the terms of office of all municipal administrators, including councillors, and related election dates are available on the web page of the Ministry of the Interior.

Specifically, the sources used by these studies to collect the sample of firms seized to the Italian Mafias are: AIDA database[4], online newspapers, and the National Agency for the Management and Assignment of Seized and Confiscated Assets (ANBSC). It should be noted that 9 PWC awarded to Mafia-controlled firms are also awarded by Mafia-infiltrated municipalities, therefore the total number of MPWC, examined in our study, is 678.

Table 1 shows the distribution of PWC, excluding MPWC, and MPWC by Italian region[5] and year. The regions are grouped into their higher first-level NUTS[6] (North West; North East; Centre; South; Islands).

(Insert Table 1 here)

Pearson Chi-squared tests of independence, performed for each year[7], show that the distribution of PWC across the Italian regions significantly differs from that of MPWC. Specifically, it is no surprise that, within our sample, the highest percentage (39.7%) of MPWC are awarded in the region of Calabria, followed by Sicily (18.6%), Campania (11.4%), and Apulia (9%). Indeed, these are the regions where Mafia organizations such as *'Ndrangheta*, *Cosa Nostra*, *Camorra*, and *Sacra Corona Unita*, respectively, are historically more widespread and dominant (Transcrime, 2013). This is confirmed by the fact that 96.50% of the 314 Italian municipalities dissolved for Mafia infiltration over the period 1991-2018 belong to these 4 regions (Ministero dell'Interno - Dipartimento per gli Affari interni e territoriali, 2018).

3.2 Baseline Regression Model and Variables

To test our hypotheses, we estimate regression models by including as dependent variables PP performance proxies linked to our hypotheses and as independent variable the binary variable ***MafiaPWC****,* which takes a value of 1 for MPWC and 0 otherwise. The sign and statistical significance of *MafiaPWC* will provide our best evidence of the type of influence, if any, of Mafia infiltration on PP performance. Furthermore, we include a variety of control variables that previous studies show to be significantly associated with PP performance

[4]AIDA is a database managed by Italian Bureau Van Dijk, including financial statements and other details, such as the seized status, of 1 million Italian companies.

[5]Italy is divided into 20 regions, representing the first-level administrative divisions whose autonomy levels and powers are defined in the Italian Constitution. Each region is divided into provinces and each province into municipalities.

[6]NUTS (Nomenclature of Territorial Units for Statistics) is a geocode standard, developed by the European Union, for referencing the administrative divisions of EU countries for statistical purposes.

[7]The results of the Chi-squared tests are: 1) year 2012: $\chi^2(19) = 1{,}100$, $p < 0.01$; 2) year 2013: $\chi^2(19) = 749.17$, $p < 0.01$; 3) year 2014: $\chi^2(19) = 673.72$, $p < 0.01$; 4) year 2015: $\chi^2(19) = 551.21$, $p < 0.01$; 5) year 2016: $\chi^2(19) = 345.87$, $p < 0.01$; 6) year 2017: $\chi^2(19) = 406.43$, $p < 0.01$.

measures within the Italian context (Baldi et al., 2016; Coviello et al., 2018b, 2018a; Coviello and Gagliarducci, 2017; Decarolis, 2014; Guccio et al., 2014).

As regards the dependent variables, the winning rebate (***REBATE***), included in the hypothesis 1, is computed as the percentage discount over the reserve price (starting value of PWC) offered by the PWC winning firm. It is commonly defined as an ex-ante PP performance measure (Coviello et al., 2018a) and high awarding rebates may initially appear as cost savings for the contracting authority. However, abnormally high rebates may: arise from opportunistic aggressive bidding (underbidding), be unsustainable for the winning firms, lead to breach of the contract and/or subsequent PWC renegotiations implying additional costs for the contracting authority (Finocchiaro Castro et al., 2014; Guccio et al., 2012).

The execution cost overrun (***COSTOVER***) is the ex-post PP performance measure (Coviello et al., 2018a; Guccio et al., 2012) included in the hypothesis 2. It is computed as the difference between the final actual cost and the awarding price (reserve price discounted by the winning rebate) divided by the awarding price, expressed as a percentage of the awarding price.

Finally, delay in PWC completion and delivery (***DELAY***) is the ex-post PP performance measure included in the hypothesis 3 (Coviello et al., 2018a; Decarolis, 2014; Guccio et al., 2014, 2012). It is calculated as the difference in days between the actual completion date and the expected (contractual) completion date, computed by the contracting authority's engineers, divided by the expected duration of the works, in percentage.

The control variables included in our hypothesis-related regression model and described below can be classified into four main categories: PWC characteristics, contracting municipality characteristics, winning firm characteristics, and socio-institutional characteristics.

1) PWC characteristics. Variable ***RES_PRICE*** is the natural logarithm of the reserve price of the contract. The reserve price is the maximum price that the municipality is willing to pay for a PWC before its awarding. In prior studies, the reserve price is used as a proxy for the complexity of the PWC (Guccio et al., 2014, 2012) and/or the size of the works to be performed (Bajari et al., 2014; Baldi et al., 2016; Coviello et al., 2018b). The reserve price is the result of an estimate of the total costs of the public work, performed by an engineer using standard prices, set yearly at regional level, for the inputs needed to complete each specific work (Branzoli and Decarolis, 2015; Coviello and Gagliarducci, 2017). Hence, the contracting municipality, even if Mafia-infiltrated, may not be in full control of the reserve price (Coviello et al., 2018b; Decarolis, 2014).

The Italian law (Legislative Decree No. 159/2011) requires public buyers to verify, through an anti-Mafia certification (C*omunicazione Antimafia*) obtained from the Prefecture, the absence of Mafia infiltration evidence for firms participating in public contracts with reserve price exceeding € 150,000, or even below this threshold for some types of works at greater risk of Mafia infiltration. Furthermore, to participate in tenders for PWC with reserve price above € 150,000, firms should show to be fully qualified to perform the works by obtaining from companies authorized by the National Anti-Corruption Authority (ANAC) a specific certification (*Attestazione SOA*). To grant the certification, the certifying companies are required to assess the fulfilment of legality requirements as well the economic and technical capacity of the applicants (regulation: DPR October 5, 2010, n. 207). The relevance of the € 150,000 threshold leads us to add the dummy variable ***CERTIF***, taking a value of 1 for PWC with reserve price above € 150,000, and 0 otherwise.

Variable ***NBIDS*** is the number of valid bids, submitted by the bidders in the tender, that may provide evidence of the competitive environment and intensity in the PWC awarding procedure (Finocchiaro Castro et al., 2014; Onur et al., 2012) and may finally affect PP performance.

Binary variable ***AWARD_CRTR*** takes a value of 1 if the awarding criterion for determining the winner is the lowest price, and 0 if the awarding criterion is the most economically advantageous offer. This latter criterion considers, as well as the price, other qualitative and quantitative parameters of the work, whose assigned weights are specified beforehand in the call for tender (Baldi et al., 2016; Decarolis and Giorgiantonio, 2015).

CPV is a list of dummy variables for each two-digit Common Procurement Vocabulary (CPV) code. CPV is a classification proposed by the European Union in 2007 to describe the subject of public contracts (Guccio et al., 2012).

PROCED indicates dummy variables for each type of tender procedure for the assignment of the public contract, regulated by PP law (Legislative Decree 12 April 2006 N. 163). More specifically, we identify three main procedures, namely: open auction (***Open***), restricted auction (***Restricted***) and negotiated procedure (***Negotiated***) (Baldi et al., 2016; Coviello et al., 2018a; Decarolis and Giorgiantonio, 2015). In the open action every qualified and certified firm may bid following the call for tender, whereas in the restricted auction only pre-selected firms, fulfilling the tender requirements, are invited to bid. On the other hand, in the negotiated procedure the contracting authority not only invites a minimum number of bidders, but also negotiates with them specific characteristics of the project as well as the conditions of the contract, before awarding it.

NEW is a dummy variable taking a value of 1 when the public work is new, and 0 otherwise (repair or restructuring works). We expect the degree of complexity, and thus the likelihood of low performance, to be higher for new works (Finocchiaro Castro et al., 2014; Guccio et al., 2014), which provide more opportunities for illicit rent-seeking due to the higher degree of information asymmetry (Fazekas and Tóth, 2018).

2) Contracting municipality characteristics. Variable ***RELATION*** measures the continuity of the relationship between winning firm and contracting authority, based on the number of PWC awarded to each winning firm by the same authority, over the sample period (Guccio et al., 2014, 2012). Guccio et al. (2014) document lower delivery delays for more continuous relationships between awarding firm and contracting authority, due to a possible better coordination between the two entities during the execution of the work.

Variable ***SURPLUS*** is the municipal budget deficit (surplus) over the total revenues at year level, in percentage[8], to control for the efficiency of the municipal administration (Coviello and Gagliarducci, 2017).

Variable ***COLLECT*** measures the fiscal efficiency for each municipality-year, often used in public finance, (Branzoli and Decarolis, 2015; Decarolis, 2014) and it is computed as collections of assessed revenue from taxation over total assessed revenue from taxation, in percentage.

Variable ***EXPER*** measures the experience of the municipality in the management of public tenders and it is computed as the number of public work tenders run by the municipality over the sample period 2012-2017 (Branzoli and Decarolis, 2015; Bucciol et al., 2013; Decarolis, 2014).

3) Winning firm characteristics[9]. ***CONSORT*** is a dummy variable taking a value of 1 when the winning firm is part of a temporary association of firms, and 0 otherwise. Indeed, firms can pool their resources and qualifications by forming a consortium or temporary joint venture to participate in a given public tender (Branzoli and Decarolis, 2015).

Variable ***DIST*** is the natural logarithm of the distance in kilometres of the winning firm headquarter from the municipality centroid (Coviello et al., 2018a).

[8]Financial ratios for Italian municipalities are available on the Italian Institute of Statistics (ISTAT) data warehouse, called PubblicaAmministrazione.Stat, at http://dati.statistiche-pa.it/Index.aspx.

[9]Data for the computation of all financial variables related to winning firm characteristics are extracted from AIDA database (see also note 5).

Variable ***ROA*** is return on assets, a measure of company efficiency and profitability, computed as accounting net income divided by total assets, in the fiscal year prior to the publication of the tender.

Variable ***DEBT*** measures the level of indebtedness of the winning firm as the ratio of total debts over total assets, reported in the financial statements, in the fiscal year prior to the publication of the tender. We expect less profitable and/or more indebted firms to be more aggressive in their bidding, leading to higher rebates, in order to secure the WPC awarding that may foster their business. In addition, higher WPC cost overruns may arise from the relatively low efficiency of these firms as well as from their inability to sustain high awarding rebates.

Variable ***SIZE*** is the size of the winning firm, computed as the natural logarithm of the total assets reported in their balance sheet, in the fiscal year prior to the publication of the tender. Variable ***AGE*** is the age of the winning firm in years, in the year of the publication of the tender.

4) Socio-institutional characteristics. Variable ***TRIALDUR*** is the duration of first instance civil trials in days per year and province[10] (Coviello et al., 2018b; D'Alpaos et al., 2013). It is an indicator of judicial efficiency, measured as the average time which is required to get a first sentence. In this regard, using a dataset of Italian PWC, Coviello, Moretti, et al. (2018) find that inefficient courts may incentive PWC suppliers' opportunism and then negatively affect PP performance, leading, among others, to longer delays in PWC delivery. Indeed, in this context, public buyers may be discouraged from enforcing contractual rights to avoid the enhanced enforcement costs.

Variable ***POPUL*** is the natural logarithm of the resident population of the contracting municipality in the year of the tender publication, obtained from the Italian Institute of Statistics (ISTAT).

Variable ***CORRUPT*** is the proxy for corruption in PP works proposed by Golden and Picci (2005). It is computed at the provincial level as the difference between amounts spent by public authorities to complete public infrastructure in each province and the estimated monetary value of the existing physical infrastructure. Larger differences between public spending and existing public infrastructure are interpreted as more money siphoned off in corrupt transactions.

Variable ***SOCCAP*** is a proxy for social capital at the provincial level. In sociology, social capital is broadly defined as the benefits and opportunities, arising from shared values and social ties, for individuals belonging to a community (Guiso et al., 2004). When the level of

[10]Data on civil trials are obtained from the General Directorate of Statistics and Organizational Analysis of the Italian Ministry of Justice at https://webstat.giustizia.it/StatisticheGiudiziarie/civile/Procedimenti%20Civili%20-%20durate.aspx.

social capital is low, politicians and public servants may put their own interests ahead of those of social welfare and corruption is more likely to occur (Finocchiaro Castro et al., 2014). This may lead to weak accountability of contracting public authorities and poor PP performance (Guccio et al., 2014). Previous studies within the Italian context follow Guiso et al. (2004) and use blood donations per capita in 1995 at the provincial level as a proxy for social capital (Guccio et al., 2014). Following the same principle, we adopt a more updated proxy for social capital, consisting in the number of declarations of intention, for every 1000 inhabitants at province level, to consent to the donation of one's organs and tissues after death, recorded in the municipalities as of 04/17/2019 and available on the transplant information system of the Italian Ministry of Health.

In summary, our baseline regression model is the following:

$$PWC\_PERFORM_{ijt}=\beta_0+\beta_1 MafiaPWC_{ijt}+\sum_r \beta_r PWC\_CHAR^r_{ijt}+\sum_k \beta_k MUNICIP\_CHAR^k_{ijt}+$$
$$\sum_s \beta_s FIRM\_CHAR^s_{ijt}+\sum_v \beta_v SOC\_CHAR^v_{ijt}+m_j+p_t+\varepsilon_{ijt} \quad (1)$$

Where, for PWC i awarded by municipality j in year t, over the period 2012-2017, *PWC_PERFORM* is one of the three PWC performance proxies previously defined: *REBATE*, *COSTOVER*, or *DELAY*; PWC_CHAR^r are the r control variables related to PWC characteristics; *MafiaPWC* is the previously defined independent dummy variable identifying the Mafia-infiltrated PWC; $MUNICIP\_CHAR^k$ are the k control variables related to contracting municipality characteristics; $FIRM\_CHAR^s$ are the s control variables related to winning firm characteristics; SOC_CHAR^v are the v control variables related to socio-institutional characteristics; m is municipality fixed effects[11]; p is awarding year fixed effects; ε is the standard error term.

3.3 Descriptive Statistics and Univariate Analysis

Table 2 shows descriptive statistics for the continuous (Panel A) and categorical (Panel B) variables included in the Eq. (1) regression model and their mean and median comparison tests between PWC and MPWC. Continuous dependent variables are winsorized at the top and bottom 1 percent of their annual distributions to avoid the influence of outliers that may also arise from PWC data misreported in the ANAC database.

[11]In some estimations, specifically indicated, municipality fixed effects are replaced with region or province fixed effects.

(Insert Table 2 here)

As regards the dependent variables measuring PP performance, the means and medians of the variables *REBATE* and *COSTOVER* are significantly ($p < 0.01$) higher for MPWC relative to PWC, providing a preliminary support for hypotheses 1 and 2, respectively. On the other hand, there is no significant difference in the means and medians of the variable *DELAY* between MPWC and PWC, failing to reject the null hypothesis 3.

Turning to the continuous control variables (Panel A), all of them are significantly ($p < 0.01$) different between MPWC and PWC, with the sole exception of *ROA*. Specifically, MPWC have, on average, a higher reserve price (*RES_PRICE*) and their tenders receive a significantly ($p < 0.01$) higher number of bids (*NBIDS*). Under normal conditions, a higher number of bids may provide evidence of greater competition in PWC tenders (Finocchiaro Castro et al., 2014; Onur et al., 2012). However, in our context it is more likely to indicate collusive agreements among companies, forming a cartel within the Mafia network and submitting previously agreed phantom bids to get PWC awarded in turn, while conveying an appearance of competition in the tender process (Caneppele and Martocchia, 2014; DIA, 2016; Martocchia et al., 2014; Spartà, 2016).

Interestingly, municipalities awarding MPWC are, on average, significantly ($p < 0.01$) less efficient both in terms of budget surplus generation (*SURPLUS*) and in terms of ability to collect revenue from taxation (*COLLECT*). It is no surprise that Mafia infiltration is associated with public mismanagement and embezzlement (Ministero dell'Interno - Dipartimento per gli Affari interni e territoriali, 2018).

As regards the control variables related to winning firm characteristics, it is noteworthy that MPWC winning firms are located significantly ($p < 0.01$) further away (*DIST*) from the contracting municipality. In this regard, establishing the head office of a company in a region or province different from that of the contracting municipality may represent a strategy to avoid anti-Mafia controls by law enforcement agencies that are usually carried out at provincial level (Caneppele et al., 2009).

In addition, MPWC winning firms are significantly ($p < 0.01$) more indebted (*DEBT*), smaller (*SIZE*), and younger (*AGE*). Indeed, Mafia organizations may use newly created "clean" companies, mostly financed with debts, to conceal injections of illicit financial resources (money laundering), and represented by figureheads with no criminal record, to avoid law enforcement controls and then win PWC tenders (Caneppele et al., 2009; Ravenda et al., 2019).

Finally, it is no surprise that MPWC are mostly awarded in Italian provinces with higher corruption (*CORRUPT*), lower level of social capital (*SOCCAP*), and higher judicial inefficiency (*TRIALDUR*) that may intuitively be associated with the presence of the Mafia.

As regards the categorical control variables related to PWC characteristics, it should be noted that most of MPWC (55.6%) are awarded through open auction procedures (*Open*) that are significantly ($p < 0.01$) more frequent for MPWC relative to PWC (15.8%), according to the Pearson $\chi 2$ test. On the other hand, the negotiated tender procedures (*Negotiated*) are significantly ($p < 0.01$) less frequent for MPWC (40.7%) than for PWC (82.3%). The prevalence of open auctions for MPWC may be due to a strategy to ward off suspicions of Mafia infiltration and manipulation by keeping an appearance of greater transparency and objectivity that are commonly attributed to open auctions with respect to negotiated procedures (Bajari et al., 2014; Baldi et al., 2016).

Finally, the variance inflation factor (VIF) and Pearson pairwise correlations for all covariates, presented in the Appendix A.3, do not show any major multicollinearity issue.

4 Results

4.1 Baseline Results

Table 3 presents the results of the estimations of the Eq. (1) regression model for each of the three PP performance proxies.

(Insert Table 3 here)

We report two specifications for each PP performance proxy. Specifications (1) only include control variables related to socio-institutional municipality characteristics as well as region fixed effects. Region fixed effects, rather than municipality fixed effects, allow estimating coefficients on variables *CORRUPT* and *SOCCAP* that are measured at the provincial level and are invariable over the period. The purpose of specifications (1) is to ensure that our estimations are robust to the inclusion of bad control variables (Angrist and Pischke, 2009). More specifically, bad control variables are variables that might be outcome variables causally determined by the variable of interest and whose inclusion in the regression model may bias the causal effect of interest (Angrist and Pischke, 2009). We adopt the most conservative strategy, then, in specifications (1), we only include variables that are fixed and/or predetermined to Mafia infiltration, namely those related to socio-institutional characteristics. Consequently, these variables cannot be logically affected by Mafia infiltration. On the other hand, specifications (2) include the full set of control variables as well as municipality fixed effects.

It is noteworthy that the coefficient on the variable of interest *MafiaPWC* is positive and significant ($p < 0.01$ and $p < 0.05$, respectively) both in the *REBATE* regressions and in the *COSTOVER* regressions, providing support for the hypotheses 1 and 2, respectively. Therefore, higher rebates in the awarding of MPWC may provide evidence of recently documented opportunistic strategies of colluded companies within the Mafia network to get PWC awarded through abnormally high rebates (Caneppele and Martocchia, 2014; DIA, 2016; Martocchia et al., 2014; Spartà, 2016). These abnormal rebates are subsequently offset with price renegotiations, granted by Mafia-connected municipalities, and leading to cost overruns in the execution stages.

On the other hand, the coefficient on the variable *MafiaPWC* is negative and significant ($p < 0.05$) in the *DELAY* regressions, leading to the rejection of the null hypothesis 3. Therefore, MPWC outperforms the rest of PWC in terms of delivery delays. These findings may support our aforementioned arguments on political actors, colluded with the Mafia, that may want to minimize PWC delivery delays to legitimize themselves in front of the citizens and gain electoral consensus (Branzoli and Decarolis, 2015; Canonico et al., 2012). Furthermore, Mafia-connected winning firms may prefer to speed up cash collections from contracting municipalities, that commonly follow the delivery of works, to reduce the risks of judicial interventions.

As regards the control variables of the *REBATE* regression, consistent with prior research, higher winning rebates (*REBATE*) are associated with: a higher number of bids submitted (*NBIDS*), indicating stronger competition (Finocchiaro Castro et al., 2014; Onur et al., 2012); the awarding criterion based on the lowest price rather than the most economically advantageous offer (Baldi et al., 2016; Decarolis and Giorgiantonio, 2015); the open auction (*Open*) tender procedure, fostering a greater participation of bidders, rather than restricted auction (*Restricted*) or negotiated procedure (*Negotiated*) (Baldi et al., 2016; Coviello et al., 2018a; Decarolis and Giorgiantonio, 2015).

As regards the variables related to the municipality characteristics, more continuous relationships between the winning firm and the contracting municipality (*RELATION*) are associated with lower rebates (*REBATE*), supposedly because of a more likely collusion between both parties that may restrict the competition.

It is noteworthy that winning firms more distant from the contracting municipality (*DIST*), more indebted (*DEBT*), and smaller (*SIZE*) may be more aggressive in bidding due to the associated higher rebates (*REBATE*).

Finally, regarding the variables related to socio-institutional characteristics, more inefficient judicial courts in terms of civil trial duration (*TRIALDUR*), more local corruption in public administration (*CORRUPT*), and lower social capital (*SOCCAP*) are related to higher rebates (*REBATE*). These latter results cumulatively suggest that abnormally higher rebates, although apparently beneficial for the contracting authorities, may arise from opportunistic aggressive bidding of suppliers that, based on an adverse selection mechanism, may take advantage of asymmetric (private) information at the expense of the public buyers (Baldi et al., 2016; Bucciol et al., 2013). This may be supported by the similar association, in terms of sign and statistical significance, of the same socio-institutional variables with the execution cost overruns (*COSTOVER*) in the corresponding regression.

Turning to the *COSTOVER* regression, we find similar associations in terms of sign and level of statistical significance with some few exceptions. In particular, unlike the awarding rebates (*REBATE*), cost overruns (*COSTOVER*) are significantly greater for PWC with higher reserve price (*RES_PRICE*), a proxy commonly used for the complexity and/or the size of the PWC (Baldi et al., 2016; Coviello et al., 2018b; Guccio et al., 2014, 2012)**.** Indeed, larger and more complex projects may imply more uncertainty and difficulties in planning contingent events and related costs that may occur during the execution of the contract and require changes in the initial contract design (Guccio et al., 2012). Moreover, cost overruns are greater (*COSTOVER*) in less populated contracting municipalities (*POPUL*), whereas awarding rebates (*REBATE*) are lower.

Finally, looking at the *DELAY* regression, it should be noted that, consistent with the findings of Coviello, Moretti, et al. (2018), more inefficient civil courts in terms of trial duration (*TRIALDUR*) are associated with longer delays (*DELAY*) in PWC delivery. Indeed, inefficient courts may discourage contracting municipalities from enforcing penalties for late delivery by inducing suppliers to opportunistically delay PWC delivery. In addition, delays in PWC delivery are longer where both local corruption in public administration (*CORRUPT*) and social capital (*SOCCAP*) are lower.

4.2 Robustness Checks

4.2.1 Matching Procedures

To address selection bias concerns, we re-estimate the Eq. (1) regression model within a matched sample built using the coarsened exact matching (CEM) procedure. Previous studies (Iacus et al., 2012) show that CEM outperforms other commonly used matching procedure to reduce imbalance, model dependence, estimation bias, and errors. CEM consists in temporarily

coarsening each matching variable into substantively meaningful strata that preserve information, exact matching on these coarsened data, and then retaining only the original (uncoarsened) values of the matched data (Blackwell et al., 2009). Treated and control observations not included in any stratum are pruned from the matched sample.

We exactly match, without any coarsening, PWC to MPWC based on the variables: *PROCED* dummies (*Open, Restricted, Negotiated*), *AWARD_CRTR*, *REGION* dummies (dummy variables for the 20 Italian regions), and *YEAR* dummies. On the other hand, for the other matching variables *RES_PRICE* and *POPUL* we apply the Sturge's rule binning algorithm (Iacus et al., 2012) to automatically coarsen the variables and define the best corresponding strata[12]. It is noteworthy that we exclude from the control group all PWC awarded by municipalities that at any time over the period have been dissolved because of Mafia infiltration, even though the awarding occurs after the dissolution. After performing CEM, the global imbalance within our sample, measured by the L_1 statistic (Iacus et al., 2012), is reduced from 0.997 of the unmatched data to 0.629[13]. Table 4 shows the estimations with the CEM sample, including region fixed effects[14].

(Insert Table 4 here)

Importantly, the coefficient on the variable of interest *MafiaPWC* is positive and significant ($p < 0.01$) both in the *REBATE* regression and in the *COSTOVER* regression, whereas it is negative and significant ($p < 0.05$) in the *DELAY* regression. Therefore, consistent with the full sample estimations, the estimations with the CEM sample provide support for the hypotheses 1 and 2 and lead to reject the hypothesis 3, respectively.

In addition, we test some more common propensity score matching (PSM) methods to further relieve selection bias concerns[15]. More specifically, we use a logit model to estimate the propensity score (Rosenbaum and Rubin, 1985), namely the probability of a PWC being identified as Mafia-infiltrated, conditional on the set of control variables. The propensity score is then used as a matching criterion based on different procedures. As in the CEM procedure, we exclude from the control group all PWC awarded by municipalities that at any time over the period have been dissolved because of Mafia infiltration.

[12]We use the STATA command *cem* (Blackwell et al., 2009) to execute the CEM procedure.

[13]L_1 ranges from 0, indicating perfect global balance, to 1, indicating complete separation (imbalance) between the groups.

[14]We include region fixed effects rather than municipality fixed effects as for dissolved municipality we only include in the matched sample PWC assumed to be Mafia-infiltrated. Therefore, Mafia infiltration does not vary over time for each municipality.

[15]We us the STATA program *psmatch2* (Leuven and Sianesi, 2018) to execute the PSM procedures.

The purpose of PSM is to balance the distribution of covariates in the treated and control samples and it relies on the key assumption of strongly ignorable treatment assignment (SITA) (Rosenbaum and Rubin, 1985). SITA assumption states that the treatment assignment (Mafia infiltration identification) is independent of the potential outcomes (PP performance proxies), given a set of observable covariates unaffected by the treatment (Stuart, 2010). This implies that all variables influencing both the treatment and the potential outcomes should be observable and included in the model (Caliendo and Kopeinig, 2008).

In our study, this strong assumption may be partially supported by the fact that we include in our estimations a rich set of covariates theoretically supported by prior studies on PP performance. In addition, unobservable covariates could bias our estimations only if unrelated to the observed covariates used for the matching (Stuart, 2010).

To satisfy the SITA assumption we then include in the PSM logit all variables potentially related to PP performance and even possibly to Mafia infiltration, whereas we exclude control variables that may have been affected by the Mafia infiltration treatment (Stuart, 2010). Therefore, we include all variables related to socio-institutional characteristics, variable experience (*EXPER*), from the contracting municipality characteristics, and variables reserve price (*RES_PRICE*), awarding criterion (*AWARD_CRTR*) and dummies for tender procedure (*PROCED*), from the PWC characteristics. Indeed, these variables are fixed and/or predetermined to the treatment or we assume them to be hardly affected by the Mafia infiltration (Caliendo and Kopeinig, 2008). On the other hand, we consider that Mafia infiltration may affect the rest of the excluded variable such as number of bids (*NBIDS*), the other contracting municipality characteristics as well as all variables related to winning firm characteristics. Finally, we include *REGION* dummies and *YEAR* dummies as in the CEM matching procedure.

A further requirement for PSM is the common support condition. This implies that there must be an overlap in the range of propensity scores across the treatment and control groups to ensure that proper matches can be found. To address this requirement, following Austin (2011), we set a caliper of 0.2 times the standard deviation of the logit of the propensity score, equal to 0.366, and we match on the logit of the propensity score. Hence, only matches within the caliper (area of common support) are included in the final matched sample.

We test different PSM methods and we choose the 5-nearest neighbours with replacement that leads to the best covariate balance after matching (Stuart, 2010). The other PSM methods tested are 1-nearest neighbours with replacement, 3-nearest neighbours with replacement, the radius matching, the kernel matching, and the local linear regression.

To assess the covariate balance after matching and select the best PSM algorithm, we use the "standardized bias" (SB), defined as difference of sample means in the treated and matched control subsamples as a percentage of the square root of the average of sample variances in both groups (Rosenbaum and Rubin, 1985). Therefore, we select the method (5-nearest neighbours with replacement) that yields the lowest mean SB and the smallest SB (below the commonly accepted 5% threshold (Caliendo and Kopeinig, 2008)) across the largest number of covariates used in the PSM logit estimations. Furthermore, t-tests show insignificant differences in covariate means for the two groups after 5-nearest neighbours PSM. Table A.3 in the Appendix A.4 shows SB and t-tests for most of the tested PSM methods.

Finally, we re-estimate the baseline regression model with the PSM matched sample by including the full set of control variables, as well as region fixed effects. Indeed, the regression adjustments may remove possible residual covariate imbalances between the groups (Stuart, 2010). Importantly, as shown in Table 5, the estimations with PSM matched sample are fully consistent, in terms of hypothesis support, with those with the full and CEM samples.

(Insert Table 5 here)

4.2.2 Endogeneity Concerns

We infer Mafia infiltration in PWC based on official sources which, by definition, are unlikely to capture all Mafia-infiltrated municipalities and/or Mafia-controlled firms winning PWC. Therefore, Mafia infiltration is measured with error, which may lead to a measurement error estimation bias. Nonetheless, as in Daniele and Geys (2015), our identification strategy does not require that all Mafia-infiltrated municipalities/firms be captured. Indeed, the undetected MPWC are unlikely to have a significant weight within the PWC control group, in which they remain, and, above all, they can only bias the estimates of the effect of Mafia infiltration towards zero. On the other hand, PWC erroneously classified as MPWC would also bias our point estimates towards zero, being unproblematic for our identification strategy.

Nonetheless, the decision to dissolve a municipality or seize a firm because of Mafia infiltration is not random and may be correlated with unobserved municipality-specific and time-varying determinants of PP performance. For example, conflicts among different Mafia clans, connected firms and political groups may simultaneously affect PP performance and lead some affected parties to report, in retaliation, irregularities to public authorities, that may activate dissolution or seizure procedures.

Conversely, reverse causality is unlikely to be an issue as public actions against municipalities or firms are based on wider symptomatic elements of Mafia infiltration

(Ministero dell'Interno - Dipartimento per gli Affari interni e territoriali, 2018) than our PP performance proxies.

That said, to address related endogeneity concerns that may arise from omitted variables, correlated with the independent variable *MafiaPWC*[16], we estimate an endogenous binary-variable model, through a two-step consistent procedure (Cameron and Trivedi, 2010)[17], by using the Mafia-presence index by province (*MPI*) (Transcrime, 2013) as an instrument for the variable *MafiaPWC*.

MPI measures the presence of Mafia organizations on the Italian territory and it was developed within the project "Mafia Investments – PON" (Transcrime, 2013) by the Transcrime research centre of the Catholic University of Milan[18]. It is computed based on the distribution of various reported Mafia crimes and related judicial actions and reports over the period 2000-2011. If the source of measurement error of variable *MafiaPWC* is similar to that of *MPI*, the instrumental variable procedure may deal with the measurement error problem, leading to consistent estimates.

In particular, *MPI* may be highly correlated with the dummy variable *MafiaPWC* given that it may positively influence public authorities' proceedings against the Mafia, even in the form of dissolution of Mafia-infiltrated city councils or seizure of Mafia-controlled firms, that underlie our identification strategy of MPWC. On the other hand, *MPI* may be exogenous in our regression model as it may be uncorrelated with unobserved determinants of PP performance. Therefore, if our assumptions are correct, *MPI* could be a valid instrument for the dummy variable *MafiaPWC*. Table 6 shows the estimations of the endogenous binary-variable model using a two-step procedure and *MPI* as an instrument for *MafiaPWC*. They include region fixed effects rather than municipality fixed effects, given that *MPI* varies only at the provincial level.

(Insert Table 6 here)

The untabulated first-step probit estimates show that the instrumental variable (IV) *MPI* is a strong and significant determinant of the dependent variable *MafiaPWC.* Indeed, as expected, the coefficient on *MPI* is positive and significant ($p<0.001$) and the F-test on the significance of the instrument is 326.85, far above the value of 10 that is the minimum threshold commonly used in the academia to assess the relevance of an instrument (Cameron and Trivedi, 2010).

[16]The results of the Durbin–Wu–Hausman test for endogeneity ($(F(1,56710) = 495.93)$ leads to reject the null hypothesis of exogeneity of the independent variable *MafiaPWC* with a p-value<0.001.

[17]We use the STATA 15 command *etregress*.

[18]*MPI* ranges from a minimum of 0.01 for the province of Medio Campidano, located in the region of Sardinia, to a maximum of 101.57 for the province of Naples, located in the region of Campania.

Regarding the final IV regressions, the coefficient on *MafiaPWC* is positive and significant ($p < 0.01$) both in the *REBATE* regression and in the *COSTOVER* regression, whereas it is negative and significant ($p < 0.05$) in the *DELAY* regression. Overall, these results confirm the results of the non-instrumented estimations that fully support the hypotheses 1 and 2 and reject the null hypothesis 3, respectively.

Assuming that the bias arising from observed control variables can approximate the bias from omitted variables, concerns on omitted variable bias may be relieved by the fact that, as shown in the next Table 7, the coefficient on the variable of interest *MafiaPWC* does not show significant changes after adding the full set of control variables to the restricted model including only *MafiaPWC* and municipality fixed effects.

To strengthen this argument, we apply the method proposed by Oster (2019) to assess the robustness of our results to omitted variable bias. Specifically, under the proportional selection assumption, that the relationship between the variable of interest and the observed control variables is proportional to the relationship between the variable of interest and unobserved omitted variables, Oster (2019) shows that the bias-adjusted treatment effect is a function of the changes in the coefficient of interest and R^2, after including control variables in the restricted model, and of the two parameters δ and R_{max}.

The parameter δ denotes the degree of proportionality, namely the degree of importance of unobserved variables relative to observed control variables in explaining the independent variable of interest. Therefore, $\delta = 1$ implies an equal importance of unobserved and observed variables, whereas $\delta > 1$ ($\delta < 1$) implies higher (lower) importance of unobserved variables relative to observed variables.

On the other hand, R_{max} represents the R^2 of a hypothetical regression including the independent variable of interest and both observed and unobserved controls. Due to measurement error, R_{max} is unlikely to be equal to 1. Hence, following Oster (2019), we assume R_{max} to be equal to 1.3 times R^2 of the Eq. (1) baseline regression. Then, based on this R_{max} value assumption, we adopt the Oster's (2019) approaches to assess the robustness to omitted variable bias.

Hence, in Table 7 we report: 1) the value of the degree of proportionality δ for which the coefficient on the variable of interest (β) would equal zero; 2) an identified set bounded by *MafiaPWC* coefficient from the Eq. (1) baseline regression on one side, and the corresponding bias-adjusted coefficient on the other side. The set assumes $\delta = 1$, which is the most

conservative choice of the interval (between 0 and 1) suggested by Oster (2019)[19], and it should contain the true effect of Mafia infiltration on PP performance, if the underlying assumptions are correct.

(Insert Table 7 here)

Interestingly, for the three PP performance regressions, δ for β = 0 is far above 1, which is the minimum threshold commonly considered appropriate to support the robustness of the results to omitted variables (Altonji et al., 2005; Oster, 2019). More specifically, δ is greater than 6 for *REBATE* and *DELAY* regressions, whereas it is greater than 17 for *CUSTOVER* regression. Therefore, the influence of unobservable omitted variables should be at least 6 times as strong as that of the included control variables to nullify the significant effect of *MafiaPWC* in any of the PP performance regressions. We consider this scenario reasonably unlikely due to the wide spectrum of control variables that we include in the Eq. (1) baseline regression, based on previous literature on PP performance and theoretical arguments.

On the other hand, for the three regressions, 0 is not included in the identified bounded set and the bias-adjusted coefficient lies within the 95% confidence interval around the estimated *MafiaPWC* coefficient from the Eq. (1) baseline regression. Hence, the inclusion of unobservable omitted variables is unlikely to nullify the effect of *MafiaPWC* on PP performance in any of the three regressions. In summary, the Oster's (2019) method suggests that our estimations are unlikely to be significantly biased by omitted variables.

4.3 Extensions

4.3.1 The Impact of Contract Size/Complexity

To test whether the size and/or complexity of PWC, proxied by the reserve price variable (*RES_PRICE*), influences the effects of Mafia infiltration on our PP performance measures, we re-estimate the Eq. (1) regression model by interacting the variable *RES_PRICE* with the independent variable *MafiaPWC.* Table 8 displays the results of these estimations.

(Insert Table 8 here)

Interestingly, the size and/or complexity of PWC (*RES_PRICE*) only moderates the effects of Mafia infiltration on execution cost overruns (*COSTOVER*). Indeed, the coefficient on the interacted variable *MafiaPWC*RES_PRICE* is negative and significant ($p < 0.01$) only in the *COSTOVER* regression, whereas it is not significant at conventional levels in the other two regressions.

[19]We use the STATA program psacalc, developed by Oster (2019), to estimate δ for β = 0 and the bounded set.

Lower cost overruns for larger/more complex MPWC may arise from the fact that Mafia infiltration for these contracts is more likely to be indirect (Caneppele et al., 2009), due to their greater legal, technical and financial requirements as well as their stricter anti-Mafia checks that may hinder the direct participation of the small-medium Mafia-controlled firms (DIA, 2018).

Furthermore, in more complex PWC may be easier to offset abnormally high rebates or paid bribes with work quality or quantity below the required standards (Caneppele and Martocchia, 2014), rather than with price renegotiations, due to the higher degree of information asymmetry (Fazekas and Tóth, 2018), which can hinder the detection of inferior quality or quantity.

Finally, in absolute terms a given percentage of cost overrun corresponds to a higher amount for larger value PWC relative to smaller value PWC. Therefore, the percentage of cost overrun for larger PWC can be lower to recover prior inefficiencies.

4.3.2 The Effect of Mafia Infiltration on Probability of Cost Overrun and Delay

We additionally determine whether Mafia infiltration not only affects the magnitude of the execution cost overruns and delivery delays, but also the probability of their occurrence. For this purpose, we estimate logit regressions on the dependent indicator variables *COSTOVER_IND*, taking a value of 1 if the cost overrun variable *COSTOVER* is greater than 0[20], and *DELAY_IND*, taking a value of 1 if the delivery delay variable *DELAY* is greater than 0[21]. Table 9 shows the results of the logit estimations[22].

(Insert Table 9 here)

For each indicator variable we estimate two logit regressions of which the number 2 also includes the interacted variable *MafiaPWC*RES_PRICE*. As regards the *COSTOVER_IND* regressions, the coefficient on *MafiaPWC* is positive, although it is only significant ($p < 0.01$) in the regression 2, where the coefficient on *MafiaPWC*RES_PRICE* is negative and significant ($p < 0.01$). These results indicate that mainly smaller MPWC are more likely to incur cost overruns. This picture is consistent with the moderating effect of *RES_PRICE* on the relationship between Mafia infiltration and *COSTOVER* showed in Table 8.

[20]Unreported estimations produce results qualitatively analogous to those presented, whether, to define the indicator variable *COSTOVER_IND*, we consider values of the variable *COSTOVER* greater than 0.05, 0.10, 0.15, 0.20, 0.25, or 0.30, respectively.

[21]Unreported estimations produce results qualitatively analogous to those presented, whether, to define the indicator variable *DELAY_IND*, we consider values of the variable *DELAY* greater than 0.05, 0.10, 0.15, 0.20, 0.25, or 0.30, respectively.

[22]The variable *REBATE* is also included within the PWC characteristic control variables.

On the other hand, within the *DELAY_IND* regressions, the coefficient on *MafiaPWC* is negative, although it is only significant ($p < 0.01$) in the regression 1. These outcomes provide evidence that MPWC are less likely to be delivered with delay, relative to the other PWC, regardless of their size, proxied by the reserve price. Overall, these results suggest that, on average, Mafia infiltration not only enhances the magnitude of the execution cost overruns and delivery delays for PWC, but also their probability to occur.

4.3.3 The Effect of Mafia Infiltration on the Number of Valid Bids

To find out whether Mafia infiltration is associated with a larger participation of firms in the public tenders, we estimate a regression model with the number of submitted bids (*NBIDS*) as dependent variable and the same control variables as the Eq. (1) regression model, excluding the variables related to the winning firm characteristics[23]. A higher number of valid bids for MPWC may strengthen our arguments on likely collusions among bidders within the Mafia network, taking turns winning contracts through abnormally high rebates, consistent with recently documented practices (Caneppele and Martocchia, 2014; DIA, 2016; Martocchia et al., 2014; Spartà, 2016).

Following prior studies on the determinants of entry for PP auctions (Bajari et al., 2006; Onur et al., 2012), we use a negative binomial regression model for count data (Cameron and Trivedi, 2010). The adoption of this model, rather than a poisson regression, commonly used for count data like our variable *NBIDS*, is also justified by the existence of over-dispersion in the distribution of the dependent count variable *NBIDS* across the two groups of PWC and MPWC[24]. Furthermore, an untabulated goodness-of-fit χ^2 test, performed after estimating a poisson regression, indicates that the poisson model is inappropriate. Table 10 shows the results of the negative binomial model estimation.

(Insert Table 10 here)

It is noteworthy that the coefficient on *MafiaPWC* is positive and significant ($p < 0.01$), suggesting that Mafia infiltration is associated with a higher number of valid submitted bids. The higher participation in MPWC tenders is consistent with the higher winning rebates found in the estimations of the Eq. (1) regression model. The untabulated coefficients on the other control variables, as well as the overall model, are all significant at the 0.01 level.

[23]Winning firms are designated after the receipt of the tender bids and cannot logically affect the number of valid bids.

[24]The variance of the variable *NBIDS* is about 100 times larger than the mean within PWC and about 85 times larger than the mean within MPWC.

4.3.4 The Impact of New Municipality Elections

To determine whether after the holding of the elections, to replace the dissolved Mafia-infiltrated municipal council, there is a significant impact on the performance of the PWC awarded by the new municipal administration, we estimate a difference in differences model with two groups and multiple time periods (Wing et al., 2018), given that the dissolutions and the elections took place on different dates.

Specifically, we only examine PWC awarded by Mafia-infiltrated municipalities and exclude MPWC awarded to Mafia-controlled firms by municipalities with no evidence of Mafia infiltration. Then, we create the dummy variable ***MafiaMunic*** that takes a value of 1 for PWC published and awarded by the Mafia-infiltrated municipalities, both before and after the new elections. In addition, we create the dummy variable ***NewElect*** that takes a value of 1 for PWC awarded by the newly elected municipal councils of the previously dissolved municipalities. The total number of these latter PWC within our sample is 291.

The requirement to include time fixed effects for the correct specification of the difference in differences model is addressed by year fixed effects (*YEAR FE*). Table 11 presents the results of the estimations of the difference in differences model, including province fixed effects[25].

(Insert Table 11 here)

It should be noted that the coefficient on the variable *NewElect* is not significant at conventional level in any estimated regression, suggesting that the election of the new municipal councils has no significant impact on the performance of PP within the Mafia-infiltrated municipalities.

These results confirm previous reports on the activities of the extraordinary commissions appointed for the management of the dissolved municipalities until new elections are held (Ministero dell'Interno - Dipartimento per gli Affari interni e territoriali, 2018; Parlamento Italiano, 2018). In particular, the dissolution of Mafia-infiltrated municipal councils, that effectively affects the political structure, fails to remove the criminal infiltration from the administrative structure that supports the elected bodies. This structure may include public officials appointed by and, therefore, colluded with the Mafia, whose positions are characterized by greater stability and duration, and hence attractiveness for the Mafia interests.

Importantly, we show that the effects of Mafia infiltration on PP are not significantly mitigated by the likely increase in the ability level (years of education) of the newly elected

[25]We include province fixed effects rather than municipality fixed effects as variable *MafiaMunic* does not vary at the municipality level over time.

politicians after the dissolution, which Daniele and Geys (2015) detect in their analysis based on 200 Italian municipalities dissolved due to Mafia infiltration over the period 1991-2012.

5 Conclusions and Discussion

We examine the effects of Mafia infiltration on the performance of PP, based on a sample of 68,063 PWC awarded by Italian municipalities over the period 2012-2017. Within this sample, 687 PWC are identified as Mafia-infiltrated, either because of being awarded by municipal councils subsequently dissolved due to Mafia infiltration (521) or because of being won by Mafia-owned firms (166), before being seized by judicial authorities, following the charge of Mafia-type association against their owners.

Our results reveal that Mafia infiltration is associated with higher awarding rebates, higher execution cost overruns, and shorter delivery delays for PWC. In addition, the effect of Mafia infiltration on execution cost overruns and the probability of their occurrence is weaker for larger and, most likely, more complex PWC. The positive effect of Mafia infiltration on awarding rebates is consistent with its positive influence on the number of valid bids submitted in the public tenders, that may indicate the presence of collusive schemes among bidders within the Mafia network. Finally, the elections of the new municipal councils, after the dissolution of the previous ones, do not significantly influence the performance of PWC awarded by the municipalities.

Overall, our results could suggest several policy implications to curb Mafia infiltration and the associated corruption in PP. Specifically, stricter requirements and larger transparency in the renegotiations and amendments of PWC, during their implementation, may discourage collusive strategies leading to aggressive bidding in the public tenders.

In addition, the adoption of more qualitative parameters, including social and environmental criteria, to determine the PWC winner, may also discourage these aggressive bidding strategies. The greater discretion of this criterion may not deteriorate PP performance or increase corruption risk, if transparency throughout the whole tender procedure is guaranteed and measures to foster integrity and accountability of public officials involved in PP are put in place. These measures could include internal whistle-blowing policies to safeguard civil servants reporting corrupt practices.

On the other hand, it might be useful to enhance the social capital of the local context where the Mafia mostly operates. Indeed, it is the complicity of the social fabric, including entrepreneurs, professionals and the civilian population, as well as the public officials, that

allows the Mafia to establish the network essential to operate in the local socio-institutional context. In this vein, as well as strengthening the audit and investigative institutions, a wider involvement of civil society organizations (e.g., NGOs, trade unions, free media) in awareness-raising campaigns may enhance the efficiency and legality of PP.

Finally, the high cost and technical difficulties of assessing the reliability of low bids and qualitative parameters may require a central awarding body to remedy the lack of technical capabilities within the local authorities. In this respect, due to the higher permeability of local municipalities to Mafia infiltration, a more centralized management of PWC procedural and screening aspects, may hinder the Mafia influence on PP as well as giving opportunities to capitalize on economies of scale and on more adequate competences.

Future research could examine the effects of Mafia infiltration on the quality or quantity of PWC, that recent judicial investigations find to be affected, and seek to uncover the specific mechanisms whereby the collusive schemes in public tenders, that we indirectly infer, are carried out.

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Appendix A.

A.1 Definition of Variables

(Insert Table A1 here)

A.2 The Dissolution for Mafia Infiltration

The dissolution of municipal and provincial councils for Mafia-type infiltration is an institution of the Italian law provided for by articles 143-146 of Legislative Decree 267/2000, called the Consolidated Law on Local Authorities (CLLA). The dissolution of the elected bodies is a preventive measure aiming to interrupt a relationship of connivance with, or subjection towards, the Mafia clans of the local administration, able to influence its choices through recourse to the corruptive method or by means of pressure and intimidating acts. The dissolution is established by decree of the President of the Republic, upon proposal of the Minister of the Interior, after deliberation of the Council of Ministers, at the end of a complex

verification procedure, carried out by the competent prefect for the territory through a special commission of inquiry.

Condition of the dissolution is the existence of "concrete, univocal and relevant" evidence of direct or indirect connections with the Mafia-type organized crime of local administrators (e.g., mayors, presidents of the provinces, councillors, etc.) and of forms of conditioning of the same, such as to determine “an alteration of the process of formation of the will of the administrative bodies and to compromise the good performance and impartiality of the municipal and provincial administrations”, negatively affecting the functionality of the elected bodies and the provided public services (see sentence of Constitutional Court n. 103/1993). As previously described, Mafia conditioning is particularly widespread in PP.

The dissolution decree retains its effects from twelve to eighteen months, extendable to twenty-four in exceptional cases. In particular, it determines the termination of all holders of elected and governing roles, as well as the dissolution of all temporary management positions that are not renewed by the extraordinary commission. Indeed, with the dissolution decree an extraordinary commission is appointed for the management of the institution until new elections are called and the resulting municipal council is established. Importantly, one of the tasks of the extraordinary commission consists in verifying all tenders and concessions supposedly infiltrated by the Mafia with the power to cancel the related public contracts already concluded (art. 145, paragraph 4, CLLA).

A.3 Check of Multicollinearity

Table A2 shows the variance inflation factor (VIF) for all covariates included in the Eq. (1) regression model as well as Pearson pairwise correlations among the same variables.

(Insert Table A2 here)

The mean VIF is 1.52 and the VIF for individual variable ranges from a minimum of 1.03 (*MafiaPWC*) to a maximum of 3.15 (*RES_PRICE*) that is far below the value of 10, a generally accepted maximum threshold to exclude severe multicollinearity issues in the regression model (Cameron and Trivedi, 2010). These VIF values may even relieve some multicollinearity concerns due to relatively high Pearson correlation coefficients between *CERTIF* and *RES_PRICE* (0.79) and *POPUL* and *EXPER* (0.67). Given that the rest of correlation coefficients are all below 0.5, we can conclude that multicollinearity is unlikely to bias our estimations.

A.4 Variable Balance after PSM Methods

(Insert Table A3 here)

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

	2012		2013		2014		2015		2016		2017		Total 2012-2017			
													PWC		MPWC	
Region	PWC	MPWC	PWC	MPWC	PWC	MPWC	PWC	MPWC	PWC	MPWC	PWC	MPWC	N	%	N	%
Liguria	531	0	434	0	680	2	460	1	394	2	322	1	2,821	4.2%	6	0.9%
Lombardy	2,108	2	1,647	3	1,847	0	2,352	1	1,651	1	1,849	2	11,454	17.0%	9	1.3%
Piedmont	1,253	9	732	5	646	1	589	0	400	0	362	0	3,982	5.9%	15	2.2%
Aosta Valley	180	0	134	0	125	0	99	0	105	0	77	0	720	1.1%	0	0.0%
Total North West	4,072	11	2,947	8	3,298	3	3,500	2	2,550	3	2,610	3	18,977	28.2%	30	4.4%
Emilia-Romagna	821	3	851	0	855	0	910	1	715	1	632	2	4,784	7.1%	7	1.0%
Friuli-Venezia Giulia	408	0	305	0	379	0	448	1	355	0	397	1	2,292	3.4%	2	0.3%
Trentino-South Tyrol	814	0	875	0	822	0	861	0	732	0	997	0	5,101	7.6%	0	0.0%
Veneto	1,051	2	1,024	2	1,154	0	1,218	2	1,043	2	1,000	2	6,490	9.6%	10	1.5%
Total North East	3,094	5	3,055	2	3,210	0	3,437	4	2,845	3	3,026	5	18,667	27.7%	19	2.8%
Lazio	887	36	351	4	347	9	291	2	188	6	166	2	2,230	3.3%	59	8.7%
Marche	404	0	482	0	426	0	489	0	303	0	308	0	2,412	3.6%	0	0.0%
Tuscany	728	5	799	3	837	7	960	8	712	7	686	3	4,722	7.0%	33	4.9%
Umbria	324	0	230	0	266	0	323	1	189	0	216	0	1,548	2.3%	1	0.1%
Total Centre	2,343	41	1,862	7	1,876	16	2,063	11	1,392	13	1,376	5	10,912	16.2%	93	13.7%
Abruzzo	310	1	287	0	286	0	421	1	157	0	183	0	1,644	2.4%	2	0.3%
Basilicata	109	0	136	0	90	0	274	0	125	0	73	0	807	1.2%	0	0.0%
Calabria	369	77	352	55	487	63	394	42	176	19	107	13	1,885	2.8%	269	39.7%
Campania	282	19	339	19	918	28	577	10	198	1	150	0	2,464	3.7%	77	11.4%
Molise	179	0	147	0	346	0	177	0	106	0	62	0	1,017	1.5%	0	0.0%
Apulia	661	4	690	14	767	18	895	16	357	7	232	2	3,602	5.3%	61	9.0%
Total South	1,910	101	1,951	88	2,894	109	2,738	69	1,119	27	807	15	11,419	16.9%	409	60.3%
Sardinia	1,206	0	772	0	709	0	951	1	413	0	390	0	4,441	6.6%	1	0.1%
Sicily	583	25	515	32	673	37	674	24	283	7	241	1	2,969	4.4%	126	18.6%
Total Islands	1,789	25	1,287	32	1,382	37	1,625	25	696	7	631	1	7,410	11.0%	127	18.7%
Overall Total	13,208	183	11,102	137	12,660	165	13,363	111	8,602	53	8,450	29	67,385	100%	678	100%

Source: Authors' elaborations on data provided by National Anti-Corruption Authority (ANAC), 2018.

Table 2. Descriptive statistics and variable comparison between PWC and MPWC

Panel A: Continuous Variables

	PWC					MPWC					PWC versus MPWC	
Variables	**Mean**	**Std**	**P25**	**Median**	**P75**	**Mean**	**Std**	**P25**	**Median**	**P75**	**t-test**	**Wilcoxon test**
Dependent Variables												
REBATE	19.85	13.14	8.15	21.00	29.58	26.50	11.22	20.00	30.29	33.86	***	***
COSTOVER	23.55	53.59	-3.65	0.00	19.98	38.29	72.29	-3.00	1.88	77.35	***	***
DELAY	77.68	144.77	0.00	25.12	105.82	66.55	130.92	-1.09	18.39	100.00		
Control Variables												
PWC characteristics:												
RES_PRICE	11.89	0.98	11.16	11.76	12.46	12.20	1.18	11.28	12.01	12.89	***	***
NBIDS	13.29	36.30	1.00	4.00	10.00	27.83	48.07	1.00	8.00	31.00	***	***
Contracting municipality characteristics:												
RELATION	1.90	3.08	1.00	1.00	2.00	1.42	1.08	1.00	1.00	1.00	***	***
SURPLUS	27.70	32.61	7.60	19.70	38.60	24.30	70.87	3.60	21.70	56.80	***	
COLLECT	73.14	12.68	67.00	75.60	81.90	65.29	13.57	56.80	65.80	74.70	***	***
EXPER	114.56	207.36	14.00	31.00	106.00	76.07	149.15	17.00	34.00	54.00	***	**
Winning firm characteristics:												
DIST	3.85	1.44	2.95	3.96	4.85	4.26	1.55	3.32	4.57	5.27	***	***
ROA	1.37	6.78	0.22	1.23	2.64	1.31	4.82	0.16	1.48	2.85		
DEBT	70.71	16.75	63.95	72.13	80.72	74.14	13.99	68.85	74.37	82.18	***	***
SIZE	7.92	1.44	7.13	7.84	8.55	7.53	1.50	6.82	7.29	8.15	***	***
AGE	18.79	12.24	11.00	17.34	24.33	13.55	9.71	7.33	13.20	16.23	***	***
Socio-institutional characteristics:												
TRIALDUR	385.17	218.37	224.67	324.11	471.82	641.87	216.12	545.05	625.53	705.76	***	***
POPUL	9.17	1.84	7.84	8.97	10.38	9.91	1.46	8.83	9.83	10.84	***	***
CORRUPT	1.25	0.95	0.68	0.93	1.56	2.76	1.76	1.64	2.37	2.51	***	***
SOCCAP	42.55	14.50	31.46	42.79	51.28	33.14	9.97	29.27	29.27	41.45	***	***
Number obs.			67,385					678				

Table 2. Descriptive statistics and variable comparison between PWC and MPWC

Panel B: Categorical Variables

	PWC			MPWC			PWC versus MPWC
Variables	**Obs.**	**Mean**	**Std**	**Obs.**	**Mean**	**Std**	**Pearson χ2 test**
Control Variables							
PWC characteristics:							
CERTIF	67,385	0.202	0.401	678	0.200	0.400	
AWARD_CRTR	67,385	0.874	0.332	678	0.822	0.383	***
PROCED:							
Open	67,385	0.158	0.364	678	0.556	0.497	***
Restricted	67,385	0.020	0.139	678	0.038	0.191	***
Negotiated	67,385	0.823	0.382	678	0.407	0.491	***
NEW	67,385	0.728	0.445	678	0.699	0.459	***
YEAR:							
2012	67,385	0.248	0.432	678	0.253	0.435	
2013	67,385	0.183	0.387	678	0.205	0.404	**
2014	67,385	0.175	0.380	678	0.224	0.417	***
2015	67,385	0.170	0.376	678	0.189	0.392	**
2016	67,385	0.104	0.306	678	0.077	0.267	***
2017	67,385	0.119	0.324	678	0.052	0.222	***
Winning firm characteristics:							
CONSORT	67,385	0.043	0.203	678	0.029	0.168	***

Notes: The sample full period spans 2012–2017. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on: two-tailed t-test for the differences in means of continuous variables, two-tailed Wilcoxon test for the differences in medians of continuous variables, Pearson chi-squared test of independence for categorical variables. Variables are defined in the Appendix A.1.

Table 3. Baseline regressions of PP performance proxies

	REBATE		*COSTOVER*		*DELAY*	
Variables	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
MafiaPWC	1.950***	1.616***	10.192**	10.153**	-34.460**	-37.141**
	(0.445)	(0.451)	(4.232)	(4.559)	(15.129)	(15.571)
RES_PRICE		0.007		11.004***		-0.872
		(0.091)		(0.570)		(2.010)
CERTIF		0.142		-0.656		12.317***
		(0.162)		(0.899)		(3.511)
NBIDS		0.008***		-0.007		-0.074**
		(0.002)		(0.010)		(0.036)
AWARD_CRTR		9.083***		2.400***		-12.251***
		(0.176)		(0.826)		(4.205)
CPV (dummies)		Yes		Yes		Yes
Restricted		-2.27***		0.353		0.217
		(0.415)		(1.939)		(9.719)
Negotiated		-2.15***		-3.623***		-3.672
		(0.170)		(0.914)		(4.051)
NEW		0.054		-0.937*		8.798***
		(0.113)		(0.527)		(2.496)
RELATION		-0.074***		-0.235*		0.316
		(0.023)		(0.131)		(0.404)
SURPLUS		0.016***		-0.022***		0.050
		(0.002)		(0.008)		(0.065)
COLLECT		0.002		-0.015		-0.031
		(0.005)		(0.023)		(0.142)
EXPER		-0.001***		0.004**		0.359
		(0.001)		(0.002)		(0.445)
CONSORT		-0.426*		5.467***		11.298**
		(0.221)		(1.247)		(5.283)
DIST		0.411***		0.638***		-0.861
		(0.036)		(0.167)		(0.785)
ROA		0.003		-0.070*		-0.017
		(0.007)		(0.039)		(0.167)
DEBT		0.008***		0.013		0.080
		(0.003)		(0.012)		(0.060)
SIZE		-0.455***		0.159		1.952**
		(0.043)		(0.190)		(0.899)
AGE		0.01**		-0.036*		0.009
		(0.004)		(0.019)		(0.095)
TRIALDUR	0.002***	0.005***	0.004**	0.041***	0.015*	0.020**
	(0.001)	(0.001)	(0.002)	(0.007)	(0.009)	(0.009)
POPUL	1.634***	1.578***	-0.122	-1.516***	23.481	1.834
	(0.028)	(0.044)	(0.139)	(0.207)	(14.365)	(15.949)

Table 3. Baseline regressions of PP performance proxies

	REBATE		*COSTOVER*		*DELAY*	
Variables	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
CORRUPT	1.325***		1.830***		-3.942**	
	(0.093)		(0.457)		(1.836)	
SOCCAP	-0.044***		-0.144***		-0.289***	
	(0.004)		(0.016)		(0.102)	
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes
MUNICIP. FE	No	Yes	No	Yes	No	Yes
REGION FE	Yes	No	Yes	No	Yes	No
Number of obs.	68,063	68,063	68,063	68,063	68,063	68,063
R-squared	0.137	0.226	0.054	0.120	0.048	0.275

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. Variables are defined in the Appendix A.1.

Table 4. Baseline regressions of PP performance proxies with CEM sample

Variables	*REBATE*	*COSTOVER*	*DELAY*
Variable of interest:			
MafiaPWC	1.356***	12.931**	-24.603**
	(0.485)	(5.198)	(12.198)
Control variables:			
PWC charact.	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
REGION FE	Yes	Yes	Yes
Number of obs.	4,557	4,557	4,557
R-squared	0.265	0.100	0.058

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. Variables are defined in the Appendix A.1.

Table 5. Baseline regressions of PP performance proxies with PSM sample

Variables	*REBATE*	*COSTOVER*	*DELAY*
Variable of interest:			
MafiaPWC	1.636***	8.939**	-32.756***
	(0.383)	(3.485)	(11.046)
Control variables:			
PWC charact.	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
REGION FE	Yes	Yes	Yes
Number of obs.	2,622	2,622	2,622
R-squared	0.332	0.122	0.155

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. Variables are defined in the Appendix A.1.

Table 6. Baseline IV regressions of PP performance proxies

Variables	*REBATE*	*COSTOVER*	*DELAY*
Variable of interest:			
MafiaPWC	20.012***	12.963**	-35.801***
	(1.730)	(6.414)	(13.006)
Control variables:			
PWC charact.	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
REGION FE	Yes	Yes	Yes
Instrument	*MPI*	*MPI*	*MPI*
Number of obs.	68,063	68,063	68,063

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. *MPI* is the Mafia-presence index by province (Transcrime, 2013). Variables are defined in the Appendix A.1.

Table 7. Assessing the potential bias of omitted variables

	Restricted model		Baseline model					
Outcome variable	***MafiaPWC* Coef.**	**R^2**	***MafiaPWC* Coef.**	**R^2**	**R_{max}**	**δ for β = 0**	**Identified Set (δ = 1)**	**Bound in 95% c.i. *MafiaPWC***
REBATE	1.762***	0.125	1.616***	0.226	0.294	6.189	[1.362, 1.616]	Yes
	(0.466)		(0.451)					
COSTOVER	9.708**	0.043	10.153**	0.120	0.156	17.314	[9.617, 10.153]	Yes
	(4.297)		(4.559)					
DELAY	-31.510**	0.251	-37.141**	0.275	0.357	6.765	[-77.455, -37.141]	Yes
	(15.234)		(15.571)					

Notes: The restricted model only includes the treatment (*MafiaPWC*) and municipality fixed effects. The baseline model includes all control variables (see Table 3). *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on standard errors clustered at municipality level, reported in parentheses. $R_{max} = 1.3R^2$. δ and the identified set are computed based on the respective R_{max}. The identified set and δ are determined using the Stata program *psacalc* from Oster (2016).

Table 8. Multiple regressions of PP performance proxies with interacted independent variable

Variables	***REBATE***	***COSTOVER***	***DELAY***
Variables of interest:			
MafiaPWC	8.443*	102.148***	171.560
	(4.753)	(27.875)	(-0.625)
MafiaPWC*RES_PRICE	-0.560	-7.518***	-17.271
	(0.383)	(2.268)	(11.794)
Control variables:			
PWC charact.	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
MUNICIP. FE	Yes	Yes	Yes
Number of obs.	68,063	68,063	68,063
R-squared	0.226	0.121	0.275

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. Variables are defined in the Appendix A.1.

Table 9. Logit regressions for probability of cost overrun and delay

	COSTOVER_IND		*DELAY_IND*	
Variables	**(1)**	**(2)**	**(1)**	**(2)**
Variables of interest:				
MafiaPWC	0.119	5.364***	-0.368***	-1.660
	(0.179)	(1.793)	(0.135)	(1.718)
MafiaPWC*RES_PRICE		-0.432***		0.108
		(0.146)		(0.143)
Control variables:				
PWC charact.	Yes	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes	Yes
PROVINCE FE	Yes	Yes	Yes	Yes
Number of obs.	68,063	68,063	68,063	68,063
Pseudo R-squared	0.086	0.087	0.066	0.066

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. *COSTOVER_IND* = dummy variable taking a value of 1 if the cost overrun variable *COSTOVER* is greater than 0, and 0 otherwise; *DELAY_IND* = dummy variable taking a value of 1 if the delivery delay variable *DELAY* is greater than 0, 0 otherwise. The other variables are defined in the Appendix A.1.

Table 10. Negative binomial regression of number of valid bids

Variables	***NBIDS***
Variable of interest:	
MafiaPWC	0.134***
	(0.038)
Control variables:	
PWC charact.	Yes
Municipality charact.	Yes
Winning firm charact.	Yes
Socio-institutional charact.	Yes
YEAR FE	Yes
PROVINCE FE	Yes
Number of obs.	68,063
Pseudo R-squared	0.131

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. Variables are defined in the Appendix A.1.

Table 11. Difference in differences regressions of PP performance proxies

Variables	*REBATE*	*COSTOVER*	*DELAY*
Variables of interest:			
MafiaMunic	2.117***	7.691**	-18.850*
	(0.782)	(3.037)	(10.350)
NewElect	-1.024	0.722	-3.452
	(0.938)	(5.013)	(17.051)
Control variables:			
PWC charact.	Yes	Yes	Yes
Municipality charact.	Yes	Yes	Yes
Winning firm charact.	Yes	Yes	Yes
Socio-institutional charact.	Yes	Yes	Yes
YEAR FE	Yes	Yes	Yes
PROVINCE FE	Yes	Yes	Yes
Number of obs.	68,063	68,063	68,063
R-squared	0.226	0.087	0.041

Notes: The sample period is from 2008 to 2016. *, ** and *** denote significance levels at 10%, 5% and 1%, respectively, based on two-tailed tests. Standard errors clustered at the municipality level are presented in parentheses. *MafiaMunic* = dummy variable taking a value of 1 for PWC awarded by the Mafia-infiltrated municipalities, both before and after the new elections, and 0 otherwise; *NewElect* = dummy variable taking a value of 1 for PWC awarded by the newly elected municipal councils. The other variables are defined in the Appendix A.1.

Table A1. Definitions and sources of variables

Variable	Description	Source
Dependent Variables:		
REBATE	Discount over reserve price, in percentage	Own calculations based on ANAC database
COSTOVER	Difference between actual PWC cost and awarding price divided by awarding price, in percentage	Own calculations based on ANAC database
DELAY	Difference in days between actual PWC completion date and expected PWC completion date divided by expected duration of PWC, in percentage	Own calculations based on ANAC database
Independent Variable of Interest:		
MafiaPWC	Dummy variable taking a value of 1 for Mafia-infiltrated PWC and 0 otherwise	Own identification based on ANAC database, municipalities dissolved due to Mafia infiltration (Ministry of Interior) and firms seized due to Mafia infiltration (AIDA database, ANBSC agency, online newspapers)
Control variables:		
PWC characteristics:		
RES_PRICE	Natural logarithm of reserve price	Own elaboration based on ANAC database
CERTIF	Dummy variable taking a value of 1 for PWC with reserve price above € 150,000, needed anti-Mafia certification, and 0 otherwise	Own elaboration based on ANAC database
NBIDS	Number of valid submitted bids for each contract	Own elaboration based on ANAC database
AWARD_CRTR	Dummy variable taking a value of 1 if the awarding criterion is the lowest price and 0 otherwise	Own elaboration based on ANAC database
CPV	Dummy variables for two-digit Common Procurement Vocabulary (CPV) cod	Own elaboration based on ANAC database
Open	Dummy variable taking a value of 1 for open auction tender procedures and 0 otherwise	Own elaboration based on ANAC database
Restricted	Dummy variable taking a value of 1 for restricted auction tender procedures and 0 otherwise	Own elaboration based on ANAC database
Negotiated	Dummy variable taking a value of 1 for negotiated tender procedures and 0 otherwise	Own elaboration based on ANAC database
NEW	Dummy variable taking a value of 1 when the public work is new and 0 otherwise	Own elaboration based on ANAC database
YEAR	Dummy variables for each year of tender publication over the period 2012-2017	Own elaboration based on ANAC database

Table A1. Definitions and sources of variables

Variable	Description	Source
Contracting municipality characteristics:		
RELATION	Relationships based on the number of PWC awarded to each firm by the same authority, over the sample period	Own elaboration based on ANAC database
SURPLUS	Municipal budget deficit/surplus over total revenues at year level, in percentage	Italian Institute of Statistics (ISTAT)
COLLECT	Municipal collections of assessed revenue from taxation over total assessed revenue from taxation, in percentage	Italian Institute of Statistics (ISTAT)
EXPER	Experience based on the number of public work tenders run by the municipality over the sample period 2012-2017	Own elaboration based on ANAC database
Winning firm characteristics:		
CONSORT	Dummy variable taking a value of 1 when the winning firm is part of a temporary association of firms and 0 otherwise	Own elaboration based on ANAC database
DIST	Batural logarithm of distance in kilometres of the winning firm headquarter from the municipality centroid	Own elaboration based on AIDA database
ROA	Winning firm return on assets measured as net income over total assets	Own elaboration based on AIDA database
DEBT	Winning firm indebtedness measured as total debts over total assets	Own elaboration based on AIDA database
SIZE	Natural logarithm of winning firm total assets	Own elaboration based on AIDA database
AGE	Age of the winning firm in years in the year of tender publication	Own elaboration based on AIDA database
Socio-institutional characteristics:		
TRIALDUR	Duration of first instance civil trials in days per year and province	Italian Ministry of Justice
POPUL	Natural logarithm of resident population of the contracting municipality in the year of tender publication	Italian Institute of Statistics (ISTAT)
CORRUPT	Proxy for corruption in PP works	Golden and Picci (2005)
SOCCAP	Social capital measured as the number of declarations of intention, for every 1000 inhabitants at province level, to consent to the donation of one's organs and tissues after death, recorded in the municipalities as of 04/17/2019	Italian Ministry of Health

Table A2. Variable VIF and Pearson correlations

Variables	VIF	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1.MafiaPWC	1.03	1										
2.RES_PRICE	3.15	0.03	1									
3.CERTIF	2.89	***0.00***	0.79	1								
4.NBIDS	1.70	0.04	0.25	0.24	1							
5.AWARD_CRTR	1.24	-0.02	-0.28	-0.19	0.08	1						
6.CONSORT	1.15	-0.01	0.18	0.20	-0.01	-0.08	1					
7.Restricted	1.15	0.01	0.01	***0.00***	-0.02	-0.01	***0.00***	1				
8.Negotiated	2.06	-0.12	-0.37	-0.22	-0.43	0.28	-0.05	-0.30	1			
9.NEW	1.11	-0.01	0.02	0.01	-0.04	-0.02	0.02	***0.00***	-0.01	1		
10.RELATION	1.19	-0.02	-0.01	***0.00***	-0.04	***0.00***	0.15	***0.00***	0.05	-0.04	1	
11.SURPLUS	1.16	-0.01	-0.05	***0.00***	0.04	0.04	0.01	-0.01	-0.03	***0.00***	-0.03	1
12.COLLECT	1.30	-0.07	-0.12	-0.02	-0.02	0.12	***0.00***	-0.01	0.15	-0.02	0.06	0.04
13.EXPER	1.98	-0.02	0.05	0.03	0.05	0.05	0.03	-0.03	0.04	-0.09	0.26	-0.04
14.DIST	1.12	0.03	0.09	-0.11	0.13	0.01	-0.07	***0.00***	-0.08	-0.02	-0.12	0.04
15.ROA	1.09	***0.00***	-0.01	***0.00***	***0.00***	***0.00***	0.01	***0.00***	***0.00***	0.01	***-0.01***	0.04
16.DEBT	1.16	0.02	0.08	0.04	0.05	-0.03	-0.01	***0.00***	-0.07	-0.01	***0.00***	-0.04
17.SIZE	1.53	-0.03	0.10	0.01	-0.07	-0.02	0.06	-0.01	0.14	0.01	0.11	-0.05
18.AGE	1.53	-0.05	***0.00***	0.01	-0.07	0.03	0.03	-0.01	0.13	0.01	0.02	-0.02
19.TRIALDUR	1.42	0.13	0.07	0.01	0.10	-0.14	-0.10	0.01	-0.29	-0.03	-0.08	0.07
20.POPUL	2.08	0.04	0.13	0.13	0.14	0.04	0.01	-0.02	-0.06	-0.09	0.21	-0.02
21.CORRUPT	1.24	0.17	0.11	-0.01	0.11	-0.06	-0.03	0.01	-0.23	-0.04	-0.02	0.11
22.SOCCAP	1.26	-0.07	-0.05	0.02	-0.07	0.07	-0.06	-0.01	0.17	***0.00***	0.10	-0.01
Mean VIF	1.52											

Table A2. Variable VIF and Pearson correlations (continued)

Variables	VIF	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
12.COLLECT	1.30	1										
13.EXPER	1.98	0.11	1									
14.DIST	1.12	-0.02	-0.01	1								
15.ROA	1.09	***0.00***	0.01	***0.00***	1							
16.DEBT	1.16	-0.07	***0.00***	0.01	-0.32	1						
17.SIZE	1.53	0.09	0.04	0.16	***0.00***	-0.05	1					
18.AGE	1.53	0.12	0.04	-0.02	-0.03	-0.21	0.52	1				
19.TRIALDUR	1.42	-0.24	-0.07	0.12	0.02	0.09	-0.26	-0.27	1			
20.POPUL	2.08	0.18	0.67	-0.07	-0.01	0.05	***0.00***	***0.00***	0.01	1		
21.CORRUPT	1.24	-0.20	0.06	0.07	0.02	0.07	-0.15	-0.16	0.41	0.16	1	
22.SOCCAP	1.26	0.19	0.17	-0.11	-0.01	-0.05	0.18	0.20	-0.39	0.19	-0.24	1
Mean VIF	1.52											

Notes: all the coefficients are significant at the 1% or lower level, based on a two-tailed test, except those in bold italics which are not significant at conventional levels. Variables are defined in the Appendix A.1.

Table A3. Assessing variable balance after PSM

Panel A: 5-Nearest neighbors with replacement

	Mean			t-test	
Variables	**Treated**	**Control**	**%bias**	**t**	**p > |t|**
RES_PRICE	12.195	12.130	***6.0***	0.97	0.330
AWARD_CRTR	0.827	0.836	-2.4	-0.38	0.701
Restricted	0.013	0.012	0.6	0.11	0.913
Negotiated	0.353	0.347	1.3	0.20	0.841
EXPER	92.158	92.978	-0.4	-0.08	0.939
TRIALDUR	603.230	595.620	3.4	0.57	0.567
POPUL	9.965	9.910	3.3	0.57	0.570
CORRUPT	2.177	2.197	-1.7	-0.24	0.812
SOCCAP	34.008	34.545	-4.2	-0.73	0.468
Mean Bias			2.6		

Panel B: Radius matching

	Mean			t-test	
Variables	**Treated**	**Control**	**%bias**	**t**	**p > |t|**
RES_PRICE	12.195	11.915	***26.0***	4.31	0.000
AWARD_CRTR	0.827	0.872	***-12.6***	-2.08	0.037
Restricted	0.013	0.018	-4.1	-0.69	0.490
Negotiated	0.353	0.747	***-87.5***	-14.37	0.000
EXPER	92.158	119.490	***-13.1***	-2.20	0.028
TRIALDUR	603.230	400.920	***91.3***	15.05	0.000
POPUL	9.965	9.606	***21.1***	3.52	0.000
CORRUPT	2.177	1.254	***82.2***	13.31	0.000
SOCCAP	34.008	43.686	***-75.8***	-12.59	0.000
Mean Bias			***46.0***		

Table A3. Assessing variable balance after PSM

Panel C: Kernel matching with Epanechnikov kernel

	Mean			t-test	
Variables	**Treated**	**Control**	**%bias**	**t**	**p > |t|**
RES_PRICE	12.195	12.058	***12.6***	2.05	0.041
AWARD_CRTR	0.827	0.864	***-10.3***	-1.69	0.092
Restricted	0.013	0.012	0.3	0.05	0.958
Negotiated	0.353	0.455	***-22.8***	-3.51	0.000
EXPER	92.158	91.734	0.2	0.04	0.969
TRIALDUR	603.230	533.100	***31.7***	5.05	0.000
POPUL	9.965	9.726	***14.1***	2.49	0.013
CORRUPT	2.177	1.852	***29.0***	4.24	0.000
SOCCAP	34.008	36.584	***-20.2***	-3.41	0.001
Mean Bias			***15.7***		

Panel D: Local linear regression with Epanechnikov kernel

	Mean			t-test	
Variables	**Treated**	**Control**	**%bias**	**t**	**p > |t|**
RES_PRICE	12.195	12.094	***9.3***	1.51	0.132
AWARD_CRTR	0.827	0.847	***-5.6***	-0.89	0.372
Restricted	0.013	0.011	1.5	0.28	0.780
Negotiated	0.353	0.347	1.2	0.19	0.851
EXPER	92.158	96.103	-1.9	-0.36	0.717
TRIALDUR	603.230	601.020	1.0	0.16	0.869
POPUL	9.965	9.952	0.8	0.13	0.896
CORRUPT	2.177	2.196	-1.7	-0.23	0.814
SOCCAP	34.008	35.233	***-9.6***	-1.60	0.111
Mean Bias			3.6		

Notes: %bias denotes the standardized bias computed as difference of sample means in the treated and matched control subsamples as a percentage of the square root of the average of sample variances in both groups (Rosenbaum and Rubin, 1985). Values of %bias above the threshold of 5% are in bold italics. All matchings are based on the logit of the propensity score. Caliper for 5-Nearest neighbours and Radius matchings are set to 0.366. The p-values of t-test are two-tailed. Variables are defined in the Appendix A.1.