Subcontracting in Public Works: Contract Performance and Workplace Safety*

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Abstract

Subcontracting in the procurement of public works may alleviate private execution frictions by expanding firm boundaries or by insuring contractors against unforeseen circumstances that impede timely and complete project delivery. However, delegation of tasks to external companies can generate uncertainty about ultimate accountability and weaken incentives to protect workplace safety. To investigate this trade-off, we draw on comprehensive data covering the universe of public works tenders in Italy, enriched with information on contractors, subcontractors, and workplace accidents. Leveraging a difference-in-differences design, we show that reforms easing restrictions on subcontracting accelerated public works completion and reduced cost overruns, despite lower competition at the tender stage. This evidence suggests that flexible use of subcontracting can allow firms to better internalize overall project costs in their bidding strategies. On the downside, firms with higher workplace accident risk tend to select into subcontracting arrangements, while the results do not support the moral hazard or risk-shifting hypotheses. Our evidence highlights a policy-relevant tension between effective contract execution and workplace safety.

JEL classification: H57, D22, J28.

Keywords: subcontracting, public procurement, public works, workplace safety, work-related accidents.

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1 Introduction[1]

The use of subcontracting - delegation of certain tasks by the main contractor to third parties - is pervasive in public procurement and deeply contested. On the one hand, subcontracting may foster the contractors' ability to make efficient supply-chain decisions by expanding the firms' boundaries (Lafontaine and Slade, 2007), allowing them, for example, to access specialized inputs from outside the firm. Moreover, it may serve as an insurance against unforeseeable circumstances that disrupt the execution of the project or delay its completion. Also, subcontracting may help smaller firms, that otherwise would lack sufficient scale or qualifications, to participate in larger projects by executing specialized tasks (Giunta, Nifo, and Scalera, 2012; Accetturo, Giunta, and Rossi, 2011) or may be explicitly used to promote their participation in the public procurement market via affirmative action policies targeting disadvantaged business entities as subcontractors (e.g., Marion, 2009; De Silva, Kosmopoulou, and Lamarche, 2012; Rosa, 2024).

On the other hand, concerns about efficiency, labor standards and oversight may emerge. The involvement of a multitude of actors on overlapping tasks can lead to coordination difficulties with resulting delays and cost overruns or less smooth execution. Moreover, the risk of moral hazard may increase over the longer contract chain – because of higher monitoring costs (Ha, 2021) or fragmented responsibilities – and thus lower investment and compliance with safety regulation. The latter concern has continuously gained attention in Italy amid persistently high workplace accident rates, and workplace safety liability in subcontracting arrangements was recently the object of a referendum.

This paper aims to examine the links between subcontracting in public procurement, contract performance, and the incidence of workplace accidents in Italy. Public procurement plays a central role in the Italian economy, with annual spending exceeding 100 billion euros. Between 2012 and 2023, around a quarter of this spending was allocated to public works, where subcontracting – the delegation of contract parts to third parties – is common and appears in nearly 20% of contracts. At the same time, 70% of accidents on construction sites are estimated to occur under subcontracting arrangements according to Fillea Cgil, a construction worker union (Monticelli, 2024).

We combine detailed data on public works contracts in the period 2012–2023, their

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awarding, subcontracting and execution outcomes with information on total costs associated with the project. We further complement these data with firm-level information on work-related accidents for the universe of employees of a large sample of small-to-medium sized firms. To address challenges to identification, we leverage the evolution of subcontracting regulation that gradually liberalized the formerly rigid use of subcontracting and present empirical evidence on the relationship between subcontracting, contract performance, and safety outcomes.

More specifically, difference-in-differences estimation builds on a natural experiment: a gradual removal of a cap to the sub-contractable amount resulting in a fully flexible regime that allows delegation of up to the entire contract amount to another firm conditional on justification of circumstances. These reforms, therefore, only affect tenders that contain a clause foreseeing the possibility of subcontracting and only alter the intensive margin of the extent to which the contract's execution can be outsourced. The results show that liberalization of the use of subcontracting reduced project duration and lowered cost overruns with respect to the awarding price (and overall costs with respect to the auction base price). These effects are net of less aggressive bidding at the tender stage, presumably due to lower tender competition: some potential bidders may opt to indirectly enter the public procurement market via subcontracting. All in all, this evidence suggests that the flexibility to resort to third-parties in tender execution may help firms better internalize overall project costs in their bidding strategies and deliver public works in a timely manner, without additional unforeseen expenses to public agencies.

On the other hand, subcontracting may have undesired effects: longer contractual chains may dilute monitoring and supervision with negative repercussions on execution quality. We focus on workplace safety as one of the most salient and policy-relevant dimensions in public works delivery. More specifically, we rely on firm-level data on leave-of-absence due to work-related injuries and study how firms' activity in the public procurement market overall and, specifically, in subcontracting relate to the incidence of accidents. While we find no consistent evidence of the presence of moral hazard in subcontracting, there is evidence of negative selection into subcontracting: firms that serve as outsourcing partners seem to exhibit a higher incidence of workplace accidents. Finally, there is no evidence of risk-shifting from the contract awardee to the firm acting as a subcontractor. These results shed light on the potential trade-off between effectiveness in works' execution and workplace safety.

This article provides three main contributions. First, it speaks to the literature on the effect of subcontracting in public procurement on performance, which has primarily focused on bidding behavior and price outcomes (Moretti and Valbonesi, 2015; Camboni, Rondi, and Valbonesi, 2021). On top of studying a broader set of public works, our evidence advances

over this line of inquiry by presenting estimates from a quasi-experimental setting with a plausibly causal interpretation. Moreover, our focus goes beyond a comprehensive analysis of downstream outcomes in public works and sheds light on a social dimension heavily impacted by procurement of public works, i.e., safety on the worksite.

Second, we connect to the heated debate, both in policy making and in the academic community, on the costs and benefits of discretion in public procurement (Manelli and Vincent, 1995; Bajari, McMillan, and Tadelis, 2009; Spagnolo, 2012; Coviello, Guglielmo, and Spagnolo, 2018; Di Tella and Schargrodsky, 2003; Szucs, 2024; Baltrunaite et al., 2021; Bosio et al., 2022). Our primary contribution to this literature is to focus on a new dimension along which discretion may be used, i.e., the "make-or-buy" decision[2].

Third, by shedding light on workplace safety we contribute to the literature on nonstandard work arrangements and workplace environment. The use of such arrangements (e.g., contract labor) facilitates firm growth and boosts their productivity (Bertrand, Hsieh, and Tsivanidis, 2021; Bostanci, 2025). Yet, a number of studies indicate that outsourced workers are not treated at par with the regular employees: firms pay them lower wages (Goldschmidt and Schmieder, 2017), even for comparable tasks and on the same worksite (Drenik et al., 2023), and spend less on workplace safety (Kalleberg, Reskin, and Hudson, 2000; Nenonen, 2011). Outsourced workers are also found to experience more workplace injuries, likely due to lower legal liability faced by the hiring firm (Ha, 2021). We contribute to this scant literature by showing that firms exhibit directionally higher rates of workplace accidents when they work under subcontracts than compared to their "regular" activity, in line with lower oversight resulting from such contractual arrangements.

All in all, our work bridges the gap between literatures on procurement design, firm-strategic behavior in subcontracting, and labor-safety externalities in fragmented labor relations. While prior work has established that subcontracting matters for competitive bidding in public procurement, there remains a need to understand how these arrangements affect what happens after the awarding: how contracts are delivered and how the safety of workers in the subcontracting chain is affected. Our analysis addresses both these dimensions – the performance of public-works contracts following the regulatory liberalization of subcontracting, and the associated safety trade-offs at firm level when acting as subcontractors – and advances our understanding of how supply-chain design in the public sector affects multiple dimensions of value and risk.

[2]Although indirectly, this aspect speaks to the long-standing literature on firm boundaries. Lafontaine and Slade, 2007 provide an overview of empirical studies on backward and forward vertical integration decisions, their determinants and effects for economic outcomes. We show that outsourcing some procurement tasks rather than executing them with the firm's own resources speeds up the completion of the project and lowers its total cost, but may compromise workers' safety.

This paper is structured as follows. Section 2 introduces the institutional context. Section 3 presents the data sources employed in the empirical analysis. Section 4 provides descriptive evidence. Section 5 presents estimates of the effect of subcontracting on contract performance in a difference-in-differences model. Section 6 presents estimates of the relationship between (sub)contracting and workplace accidents. Section 7 concludes.

2 Institutional Context

Subcontracting has long been a contested feature of Italian public procurement, to the point of being the subject of a recent referendum (for a glimpse at the public debate around the referendum, see, e.g., Pogliotti, 2025). As argued previously, while it allows contractors to delegate specialized tasks, it raises concerns over accountability, cost control, and compliance with labor and safety regulations. For these reasons, until recently subcontracting was subject to tight regulation in Italy. This led the European Commission to formally notify the Italian government in early 2019 that the Italian regulatory framework on subcontracting was allegedly not compliant with European Union law (European Commission, 2019).

Until 2021, the Public Procurement Code only allowed subcontracting of up to 30% of the total value of a contract, regardless of the nature of the project, the capabilities of the contractor, or the market structure. The cap was justified by policymakers as a safeguard against organized crime, which was believed to be operating through subcontracting to extract rents from main contractors (Commissione parlamentare d'inchiesta sul fenomeno della mafia e sulle altre associazioni criminali similari, 1994; Senato della Repubblica, 1993). In practice, however, it may have constrained flexibility, preventing contractors from making efficient use of specialized firms and limiting the participation of smaller firms that depended on subcontracting to access larger projects. In 2019, the European Court of Justice ruled against Italy's regime, holding that a blanket ceiling was incompatible with EU law (Court of Justice of the European Union, 2019). This ruling, together with mounting pressure to accelerate infrastructure projects and ensure efficient absorption of EU recovery funds, set the stage for reform.

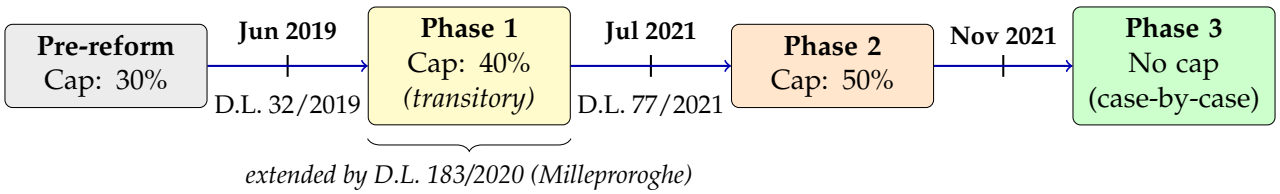
Starting from mid-2019, the Italian legislator engaged with the subcontracting discipline to ease its use. The first set of reforms was of a transitory nature and was enacted out of the need to accelerate execution of public works: the cap on the sub-contractable amount was temporarily raised to 40% by D.L. No. 32/2019 (the so-called *Sblocca cantieri* decree). Its initial validity of 7 months was then extended by D.L. No. 183/2020 (the so-called *Milleproroghe* decree).

The structural regulatory change was then enacted in May 2021 when subcontracting reg-

ulation was overhauled as part of a broader reform of the Public Procurement Code, aimed at simplifying procedures and speeding up the implementation of the National Recovery and Resilience Plan (PNRR). Decree Law No. 77/2021 (*Semplificazioni bis*) temporarily raised the subcontracting cap to 50% and fully removed quantitative limits on subcontracting from 1 November 2021. The quantitative cap was replaced by a procedural safeguard whereby contracting authorities were to impose limits on subcontracting when justified by the specific characteristics of the project (e.g., technical complexity, security considerations). The reform still required subcontracts to be submitted to the responsible procuring agency for prior approval. The reform thus shifted the regulatory focus from a uniform ceiling to a more flexible approach with a greater emphasis on transparency and accountability. In principle, this change was expected to reduce inefficiencies associated with the stringent regulation under the old regime, while still addressing concerns about oversight. We exploit the easing of access to subcontracting in our empirical strategy.

Figure 2.1 summarises the chronology of the regulatory changes exploited in the empirical analysis.

Figure 2.1: Timeline of subcontracting regulation reforms in Italian public procurement



The figure illustrates the three phases of regulatory change to the quantitative cap on the sub-contractable share of a public works contract. Phase 1 (D.L. 32/2019, *Sblocca cantieri*, June 2019) raised the cap from 30% to 40% on a transitory basis, subsequently extended by D.L. 183/2020 (*Milleproroghe*). Phase 2 (D.L. 77/2021, *Semplificazioni bis*, July 2021) raised it further to 50%. Phase 3 (November 2021) fully removed the quantitative ceiling, replacing it with a case-by-case procedural safeguard.

3 Data

For the analysis in the paper, we combine multiple data sources for the period 2013–2023:

- The National Anti-Corruption Authority (ANAC) provides open data with detailed information on the universe of public work tenders, including contract amount, type of works, awarding entities, contractors, and the use of subcontracting. There is also information on public works' execution status and the end date (data coverage, however, is incomplete,

possibly due to partial compliance with the reporting obligations from the contracting authorities). The unit of observation is the single tender ("project").

- Cerved provides financial reports for the universe of limited liability companies containing the firms' main financial indicators. They are combined with data from the National Social Security Institute (INPS) to generate measures of the occupational structure of firms and to estimate firm productivity.
- INPS also provides records on workplace accidents at the worker-firm-year level for the firms covered by the Bank of Italy's *Invind* survey and a representative sample of firms with 20 or fewer employees. All accidents that result in absence from work longer than 7 days are recorded. The data also contains information on the number of weeks each worker received partial or full compensation from INPS due to injury-related incapacitation.
- SIOPE-Plus data contains detailed information on payments made by local administrations linked to public procurement contracts. The sample coverage for this dataset is limited to the 2019–2023 period.
- Association of Private Construction Contractors (ANCE) data on construction sites include additional information on the execution phase of public works, such as progress updates, for the period 2021–2023.

4 Descriptive Evidence

4.1 Sample overview

Our sample includes all the awarded contracts for public works for which a tender procedure was published between 2013 and 2023. Results that rely on payment data only use data from 2019 to 2023. As shown in Figure A.1, during the 2013–2023 period we observe 434,952 contracts (246,791 in the 2019–2023 period alone). The number of contracts is fairly stable until 2016–2017, when it increases from roughly 30 thousand per year to more than 50 thousand in the most recent years. Total spending, reported in Figure A.2, follows a similar pattern. A first period with average annual spending in public works projects of around 20 billion euros is followed by an increase in the most recent years, with a high of 60 billion euros in 2022. The largest contract issuer was the central administration (which refers to all national-level entities). The remaining geographic heterogeneity roughly tracks the distribution of population across regions (Figure A.3).

Almost 60% of the tenders contain a clause that foresees the possibility of subcontracting; private contractors actually use it in the execution of 17% of the projects. As Figure A.4 shows, subcontracting patterns are fairly stable over time on the extensive margin, with no *prima facie* evident change in subcontracting practices in response to the 2019 or 2021 reforms. Cross-validating the data on subcontracting in our main dataset with that provided by ANCE reveals coverage in excess of 90% (Table A.1) and suggests that underreporting of subcontracts to ANAC is limited.

Figure A.5 additionally shows that the behavior of firms is consistent with the reform on the intensive margin. Before the first reform period, the incidence of contracts whose subcontracted amount is above the maximum of 30% is low[3]. A large mass of contracts is at or slightly below the threshold. As the cap is increased to 40% and 50% and then lifted, the distribution moves to the right. Interestingly, at each stage there is some excess mass at the previous thresholds, suggesting that part of the firms readjusts slowly to rapid changes in regulatory environment.

4.2 Subcontracting and contract performance

We further show descriptive evidence shedding light on the general patterns of the use of subcontracting in Italian public works. Figures A.6–A.8 plot average contract outcomes in the overall sample and by subcontracting status, i.e., distinguishing between whether subcontracting is allowed or not and whether it is actually utilized or not. We focus on contract duration and on several cost-related variables: price rebates with respect to the base auction price, relative cost overruns with respect to the award price, and total excess costs measured as the deviation from the final price paid for the contract with respect to the base price.

Figure A.6 illustrates that, unconditionally, projects that were subcontracted tend to last longer on average. Similarly, projects for which the main contractor has resorted to a third party for execution tend to have larger cost overruns (Figure A.7). Subcontractable (and subcontracted) projects also tend to receive more offers in the tender phase and see larger average rebates. The counteracting forces of larger cost overruns and larger rebates lead subcontractable projects to ultimately face lower excess costs compared to the baseline tender amount with respect to the non-subcontractable ones, while subcontracted projects are in line with the non-subcontracted ones (Figure A.8).

Subcontracting is also correlated with project size. Figure A.9 shows that larger contracts are more likely to allow or use subcontracting. Since size is itself an important determinant

[3]These cases of noncompliance are likely due to cost overruns increasing the total cost of the project with respect to the awarded contract amount, which we use here as the denominator to compute the subcontracted share.

of duration and project costs, this correlation strongly cautions against interpreting causally the above differences. Selection likely plays a relevant role, inasmuch as subcontracting is used to tackle the execution of more complex contracts.

We further study heterogeneity in terms of the characteristics of winning firms, which are observed in cases where the contract is awarded to a limited liability company with financial statement data.[4] Table A.2 compares firms executing projects separating them by their subcontracting status using linear regression analysis (for easier visualization, the same results are also shown in Figure A.10). The results indicate that winning firms that resort to subcontracting are on average smaller, both in terms of employment and revenues. Their workforce composition is tilted towards white-collar workers, suggesting that they may rely on external low-skill workers in project execution. While subcontracting firms appear to be older, they are less profitable and have lower labor productivity. These differences persist once project-level controls are included. This pattern is consistent with a scenario where subcontracting allows relatively smaller or less productive firms to participate in public procurement projects and to outsource some of the related activities, for example, by specializing in certain tasks and delegating (part of) the others to third parties.

The above descriptive evidence suggests that subcontracting is plausibly used for a selected sample of contracts, e.g., in terms of size, sector, or winning firms' characteristics. These differences, moreover, persist even if we control for selection and investigate the effect of subcontracting under the assumption of selection on observables. To this end, we resort to several matching and regression techniques: propensity score matching, lasso matching with a linear outcome model, ordinary least squares (OLS), and, where appropriate, Poisson regressions. The results are shown in Appendix B.1 and confirm that subcontracting is associated with longer durations, higher cost overruns, and higher excess costs across all specifications. All these approaches, however, rely on the assumption of selection on observables, while there are many reasons to suspect that unobservables play a role. We further address the endogeneity in the difference-in-differences analysis that relies on a quasi-experimental setting in Section 5.

4.3 Subcontracting and workplace accidents

The data on work-related injuries provided by INPS covers the universe of workers in a large sample of Italian limited liability firms (see Section 3 for more details). Each reported accident event (resulting in at least 7 days of absence) is recorded, along with the number of

[4] A significant amount of tenders (106,712 out of 434,952) are awarded to individuals working under a license or to unipersonal firms that do not file ordinary financial statements to Cerved.

weeks during which the worker received partial or full compensation from INPS due to their accident-related productivity loss. Figure A.11(a) illustrates that the incidence of accidents hovers around 7 accidents per year every 1,000 workers in our sample period and is fairly stable (with the exception of 2020, when the Covid-19 pandemic hit and many high-contact sectors, such as construction, saw a collapse in activity mirrored by a reduction in workplace accidents). In particular, the number of weeks with total pay reduction (due to severe injuries) also remains fairly stable over time at around 10 weeks per 1,000 workers every year (Figure A.11(b)). The overall falling trend in the total number of weeks of accident-related leave is instead driven by a reduction in the number of weeks with partial pay reduction, for less severe injuries, falling from around 30 to 25 weeks per 1,000 workers every year.

In Table A.3 we instead compare firms with and without accidents in the two samples of firms: those that do not have any public procurement contracts (or subcontracts) in the sample period and those that, instead, are active in the public procurement market. In both sub-samples, the pattern that emerges is rather consistent: firms with accidents are more often in the manufacturing sector, and more rarely in services. Interestingly, construction firms are also somewhat less represented among those experiencing workplace accidents than among those that do not. Furthermore, firms experiencing accidents are overall larger, more profitable and more productive, clearly reflecting the size gradient whereby the larger the firm, the more likely it is that one of its many workers incurs an injury. Across the two samples, firms in the procurement market tend to face more accidents, both on the extensive (18% vs. 9%) and the intensive margin (4.5 vs. 3 accidents yearly).

Finally, Figure A.12 compares the incidence of work-related injuries according to firms' activity in the public procurement market. Firms that do not participate in public procurement have the lowest incidence of injuries. Among the firms active in public procurement, instead, the highest incidence of injuries is observed among firms that act both as contractors and subcontractors, possibly reflecting their higher business activity. We investigate this relationship further in the regression analysis in Section 6 where we attempt to address these endogeneity concerns.

5 DID Analysis for Contract Performance

The evidence introduced in Section 4 suggests that subcontracting is associated with longer contract durations and cost overruns. The interpretation of this relationship can be two-fold. On the one hand, the use of subcontracting may lead to worse procurement outcomes, for instance because delegating contract execution to a third party with no direct contract with a public administration reduces accountability; or because possibly less efficient firms im-

plement the works on behalf of the winner; etc. On the other hand, subcontracting may be endogenously chosen to deal with the more troublesome projects, even holding a number of observable dimensions constant: for example, if some unforeseen circumstances emerge after the contract is signed. To address these identification-related issues, we exploit a natural experiment that affected the extent to which firms can resort to subcontracting and use this time variation to obtain causal estimates of the relationship between the use of subcontracting and contract execution outcomes.

The public procurement reforms discussed in Section 2 gradually removed a 30% cap on the amount of a contract which can be subcontracted. These reforms only affected the intensive margin of subcontracting, i.e., the monetary value of the tender that is sub-contractable. The *possibility* for the winning firm to resort to subcontracting, instead, is stipulated in tender documents beforehand by the public administration and was not affected by these legislative changes. Therefore, tenders without the clause foreseeing the possibility to subcontract constitute a natural control group to study whether liberalizing the use of subcontracting changes public works' execution outcomes in a difference-in-differences analysis. To the extent that the reform exogenously increased the amount that firms subcontract, this model provides estimates of the effect of unconstrained subcontracting on selected outcomes for contracts with the subcontracting clause (the average treatment effect for the treated).

An important supporting condition for the validity of the difference-in-differences design is that the allocation of the subcontracting clause across tenders did not itself respond to the reforms. If, for example, procuring authorities strategically inserted or removed the clause in anticipation of the regulatory changes, the composition of the treated and control groups would shift endogenously over time, threatening the parallel trends assumption. Figure A.4 (left panel) addresses this concern directly: the share of tenders carrying a subcontracting clause is stable throughout the sample period, exhibiting no visible discontinuity around any of the three reform dates. This stability suggests that the treatment indicator is effectively predetermined with respect to the reforms and that the treatment assignment is not related to the legislative changes.

We consider the following DID model, estimated by ordinary least squares:

$$y_{it} = \gamma_1 \text{Treated}_i + \sum_s \gamma_{2,s} \mathbb{1}_{(s=t)} + \gamma_3 \text{Treated}_i \times \mathbb{1}_{(t \geq T)} + X'_{it}\beta + \mu_c + \epsilon_{it}, \tag{1}$$

where

- y_{it} is an outcome (e.g., duration, cost overruns, rebates, number of offers, and excess costs) for contract i whose tender was published in quarter t;

- $\text{Treated}_i = 1$ if the offer contains the clause that foresees the possibility of subcontracting;
- $\mathbb{1}_{(s=t)}$ is a time dummy for period s;
- T is the quarter when the first step of the reforms was rolled out, i.e., 2019q3, so $\text{Treated}_i \times \mathbb{1}_{(t \geq T)}$ is an "active treatment" indicator; we note that the full statutory treatment only happens in 2021q4, while the intermediate periods separately capture the effects of transitory norms;
- X_{it} is a vector of contract-specific controls: region, awarding procedure, contract dimensional class, type of awarding authority, main contract category according to the classification of public works;
- μ_c are contracting authority fixed effects.

We supplement this DID model with one unpacking the ATET in each reform period. Each of the reform-period coefficients corresponds to the additional effect of that step of the reform on top of the previous setting. In both cases, standard errors are clustered at the contracting authority level.

Identification relies on the parallel trends assumption: in the absence of regulatory changes, outcomes for contracts with and without the subcontracting clause would have evolved similarly. We assess the plausibility of this assumption using event-study plots shown in Figures A.13–A.17, which report quarter-specific treatment effects over the whole period. Not only do they serve to test the identifying assumption, but they also illustrate the effect dynamics in each of the reform periods in a transparent manner. Panel A of Table 5.1 reports the estimated cumulative ATET. Panel B reports the ATET for each reform period, expressed as the differential effect on top of the previous phase.

Project duration Figure A.13 shows that while there is no systematic evidence of divergent trends between exposed contracts and other contracts in the pre-reform period, the contract execution is faster for the treated contracts after the full cap's removal. Interestingly, there are no effects of the transitory cap raises in Phase 1, plausibly because of the high normative ambiguity regarding the interpretation and applicability of the *Sbloccacantieri* decree. Table 5.1, column 1 shows the estimate of the total average treatment effect for the treated of roughly 14 days over the average of almost 400 days in the pre-treatment period, entirely driven by shorter contract durations after the statutory reform raised the cap to 50% and then removed it shortly after.

Cost overruns Figure A.14 shows the dynamic treatment effects on cost overruns measured as the deviation between the total amount paid by the public administration for the

Table 5.1: DID regression results for contract performance

	(1) Project duration	(2) Cost overrun	(3) Rebate rate	(4) Number of offers	(5) Excess costs
Panel A: Overall treatment effect					
Active treatment	-13.69***	-0.0131**	-0.0104***	-2.795***	-0.0111*
	(4.583)	(0.00641)	(0.00153)	(0.295)	(0.00594)
Panel B: Phase-by-phase treatment effects					
Subc. allowed × After 40% inc.	-1.470	0.00707	-0.00404**	-1.184***	-0.00223
	(5.022)	(0.00668)	(0.00171)	(0.301)	(0.00604)
Subc. allowed × After 50% inc.	-11.13**	-0.0169***	-0.00750***	-2.527***	-0.00197
	(5.200)	(0.00527)	(0.00174)	(0.287)	(0.00430)
Subc. allowed × After cap rem.	-15.95***	-0.0310***	-0.00466***	-0.303	-0.0202***
	(4.219)	(0.00480)	(0.00179)	(0.251)	(0.00417)
Observations	266464	167729	435781	357184	168019
Tender controls and agency FEs	Yes	Yes	Yes	Yes	Yes
Adjusted R2 (top)	0.359	0.213	0.365	0.382	0.251
Adjusted R2 (bottom)	0.359	0.215	0.365	0.383	0.251
Outcome mean (pre)	400.8	0.189	0.167	13.25	0.00295

The table reports estimated average treatment effects on the treated (ATET) of the subcontracting reform on contract performance outcomes, using specification (1). A contract is treated if its tender documents include a clause with the possibility of subcontracting. Outcomes include contract duration (days), relative cost overruns (the percentage deviation of the total amount paid for the project with respect to the awarding price), rebate rate (the percentage deviation of the awarding price with respect to the tender base price), the number of offers in the tender, and excess costs (the percentage deviation of total payments for a project with respect to its tender base price). All regressions control for contract characteristics. Negative coefficients indicate an improvement in performance (shorter durations, lower costs or cost overruns). Coefficients in Panel B should be interpreted as additional effects on top of the previous reform period. Standard errors are in parentheses.

given contract and the awarded amount. Due to the shorter time period with the payments data available, there are only two pre-treatment periods that, nonetheless, confirm the lack of differences between treated and control contracts. The dynamics exhibit a similar pattern to that of contract duration: cost overruns diminish after the full cap's removal, while the initial reform period appears ineffective. The estimated average treatment effect for the treated in column 2 of Table 5.1 amounts to 1 percentage point reduction over the pre-treatment outcome mean of 19 percent. The effect is is substantially larger following the full removal of the cap, amounting to 3 percentage points.

This result indicates that not only does greater discretion in the use of subcontracting allow to complete projects faster, it also limits the excess costs with respect to the contracted sum for the public agency. However, the awarded amount itself depends on the degree of competition in the bidding process. Because procurement regulation restricts possibilities for unsuccessful auction bidders to participate as subcontractors, the more extensive use of subcontracting may result in some firms not entering the bidding process in expectation (with or without prior cooperation agreement with other bidders) of entering the contract execution through subcontracting. Alternatively, the expanded use of subcontracting may incentivize firms that otherwise lack specific competences or specializations to bid for the tender and, in case of victory, use the possibility to outsource these tasks in the execution phase. The resulting effects on tender competition and awarding prices are therefore ambiguous *ex ante* and need to be examined empirically. To this end, we investigate two additional outcomes: the number of offers received for the particular tender and the rebate rate measured as the percentage deviation of the awarding price with respect to the base price.

Number of offers To assess changes in competition in the bidding process we focus on the number of firms that compete for the contract. In particular, we use additional data provided by ANAC to construct a measure of the number of offers received for a given auction (for example, for negotiated procedures, the effective number of bidders is the number of firms that submit their offers to the contracting authority).[5] Figure A.16 shows the time pattern that is broadly consistent with that observed for other procurement performance measures: the differences between treated and control contracts are inappreciable in the period with the 40% cap, while competition seems to react to full liberalization of subcontract use when it systematically decreases. The estimated effect in column 4 of Table 5.1 shows an average reduction in tender competition with the number of offers falling by 2.7 participants with respect to the pre-treatment average of 13. In line with the graphical evidence, the effect is rather small, amounting to a reduction of around 1 bid, during the first reform period and

[5]This measure does not cover our full original sample; however, we have verified that the effects on rebates also hold in this subsample.

is amplified in the period after the further expansions of the cap on the sub-contractable amounts.

Rebate rate We then investigate whether lower competition translates into lower rebate rates in Figure A.15. The dynamic treatment effects show that rebate rates are systematically lower, in particular after the full removal of the subcontracting cap. The estimated effect shown in Table 5.1, column 3, amounts to a 1 percentage point reduction over the 17 percent pre-treatment mean. The coefficients indicating the additional effect of each reform period show an increasing pattern whereby the rebate rate reduction is gradually amplified as the cap increases.

Excess costs All in all, the evidence suggests that lower competition reduces price discounts obtained in tenders affected by the subcontracting liberalization. Given the contrasting effects on the awarded price (higher due to the lower rebate rate) and the final costs (lower due to the reduction in cost overruns), we assess the overall effect on costs to the public sector. To this end, we study relative excess costs measured as the percentage deviation of total payments for a contract with respect to its auction base price. Figure A.17 and Table 5.1, column 5, confirm that the likelihood of effectively exceeding the baseline price goes down with the reform, with the average effect size of 1 percent (if we only focus on the last reform period, the effect is larger and amounts to 2 percent).

The phased nature of the reform A notable pattern in the evidence is that the first two reform phases – the transitory raise of the cap to 40% and, to a lesser extent, the interim increase to 50% – produce little or no detectable effect on the outcomes studied, while it is the full removal of the quantitative ceiling in November 2021 that drives virtually all the estimated effects. Two complementary explanations are consistent with this pattern. First, there was substantial normative ambiguity around the early phases: the first cap raise was enacted as a temporary measure that was debated among legal practitioners, with considerable uncertainty about its applicability and duration.[6] Under such uncertainty, firms and contracting authorities may have rationally waited for a stable legal framework before adjusting their behavior. Second, a 10-percentage-point increase in the allowable cap (from 30% to 40%) may simply have been insufficient to relax the constraint for most affected contracts: if the binding constraint for many firms lay above the 40% threshold, only the full removal would free them to optimally re-allocate tasks. Together, these explanations suggest that the performance gains documented in this paper are primarily attributable to the qualitative shift from a rigid quantitative rule to a flexible, case-by-case regime – a finding

[6] See, for example, https://www.altalex.com/documents/news/2022/01/10/il-subappalto-nei-contratti-pubblici-dopo-il-dl-77-2021.

with broader implications for the optimal design of subcontracting regulation.

SMEs participation A more extensive use of subcontracting may allow easier access for small and medium enterprises (SMEs) to public procurement if they expect to outsource specific tasks they potentially lack themselves. In this way, subcontracting may incentivize SMEs' participation in public tenders even in the absence of explicit affirmative action policies. To investigate this possibility, we analyze whether the composition of firms that are awarded tenders changes in response to the reforms that expand the use of subcontracting.[7] On average, one quarter of tender winners are business entities without limited liability that are not required to file ordinary financial statements; we therefore cannot assess their size by conventional measures such as revenues or employment. Hence, we first proxy firm size by its corporate structure: i.e., consider the probability that a tender winner is a limited liability firm and, second, conditional on a firm being incorporated, we study their size: i.e., the probability that a tender winner is a SME based on its employment. The results in Panel a and Panel b of Figure A.18, respectively, indicate the lack of significant changes in the size composition of firms that are awarded tenders after the expansion of the sub-contractable amount. The empirical evidence seems to suggest that the relaxation of limits on subcontracting alone is not sufficient to increase the competitiveness of small businesses in public procurement.

SOA qualifications In the Italian public procurement system, for public works contracts with the base value above €150,000, SOA (*Societa Organismo di Attestazione*, certification body tasked with issuing certificates attesting to a firm's economic and organizational qualifications) qualification certificates are required to execute each specific category of public works (e.g., roads, maintenance, dams, etc.). For multi-category works, subcontracting is mandatory for secondary categories if the main contractor does not possess necessary qualifications. The main contractor is in any case required to be qualified for the main category of works. Given these qualification requirements, we investigate how the relaxation of limits to subcontracting interacts with the selection of firms based on their SOA qualifications.

In Figure A.19, Panel a, we first investigate whether the compliance with the requirement to hold a SOA certification changes in reaction to the reforms. On average, around 90% of tender winners are observed to hold a SOA certificate for the main category of works indicated in the tender[8]. The level of compliance does not appear to be affected by the relaxation of the sub-contractable amount limits. This pattern is also confirmed when we consider the

[7] Due to data limitations, we are currently unable to directly study the size composition of bidders.

[8] The remaining cases likely pertain to the use of the institute of *avvalimento*, i.e., the reliance on the capacities of other entities in the execution of public works and/or some imputation errors in the data (e.g., a mistake in a fiscal code, etc.).

compliance of all firms executing the project: Figure A.19, Panel b, shows that the probability that for each project's category either the main contractor or the subcontractor(s) hold a required certification does not change after the cap's removal.

Finally, we do observe that following the removal of the cap, main contractors, on average, tend to hold fewer SOA certifications required for the project's execution – the share of tender categories for which the main winner holds a SOA certification seems to decline slightly, as shown in Figure A.19, Panel c. Mirroring this pattern, the same share increases over time among subcontractors (Figure A.19, Panel d). This evidence suggests that tender winners, in fact, may utilize subcontracting to outsource tasks for which their own qualifications are not sufficient (or certified). This reallocation of tasks to better-qualified subcontractors provides one plausible mechanism linking the reform to improved execution performance: firms are better able to match tasks to the most appropriate executors once the quantitative constraint on the extent of outsourcing is lifted.

All in all, while the expanded access to subcontracting appears to lower competition – likely owing to strategic considerations by firms on how to enter the public procurement market – the overall effects on public works performance seem favorable. The projects are delivered faster and with a lower incidence of unforeseen costs overruns to the public administration (that are costly not only in monetary terms, but also in terms of administrative activity needed to renegotiate the contract). Replacing a rigid quantitative cap with a more discretionary use of subcontracting seems to alleviate some frictions in public procurement execution. Potential mechanisms are related to the greater flexibility granted to contractors, who can freely optimize the allocation of tasks in case of unforeseen events, or their improved ability to fully internalize expected project costs without the need of strategic underbidding.

The evidence so far suggests that more flexible subcontracting improves the *efficiency* of public works delivery. This is, however, only one side of the ledger. Longer contractual chains and the proliferation of subcontracting relationships may dilute accountability and oversight, with potential adverse consequences for the workers engaged in execution. The remainder of the paper turns to this question, investigating whether the use of subcontracting is associated with a higher incidence of workplace accidents. The analysis is necessarily different in design from the contract-performance DID: rather than exploiting the reform variation – which operates at the contract level – we study the relationship between firms' subcontracting activity and their accident records in a firm-level panel, and use the comparison between cross-sectional and within-firm estimates as the primary source of identification. This approach allows us to characterize the nature of any observed accident-subcontracting association: whether it reflects the enduring characteristics of firms that se-

lect into subcontracting roles (selection), or changes in firm behavior conditional on contracting type (moral hazard).

6 Regression Analysis for Workplace Accidents

While swifter and cheaper contract execution under flexible subcontracting appears to benefit public buyers, one may suspect that outsourced activities may be exposed to higher risks for workers, for example, due to lower oversight and investment in safety standards, more complex process organization, or higher time pressure. We therefore turn to analyzing whether the use of subcontracting may have negative effects on workplace quality. In particular, we focus on safety concerns and investigate the relationship between subcontracting practices and workplace accidents. The empirical analysis exploits firm-level yearly panel data with universal coverage of all reported work accidents resulting in more than 7 days of absence (as described in detail in Section 3). While we are unable to link accident information to a single private or public project, we shed light on the selection of firms into the public procurement market, either as main contractors or as subcontractors, and also investigate whether the accident risk changes within the firm based on its activity type.

The empirical strategy in this section provides the comparison between two sets of estimates. *Cross-sectional* (pooled OLS) regressions identify the relationship between a firm's subcontracting activity and its accident incidence by comparing, at a given point in time, firms that are active in subcontracting with those that are not. This comparison captures both any causal effect of subcontracting on safety and any pre-existing differences between the types of firms that select into subcontracting arrangements. *Within-firm* (fixed-effects) regressions, by contrast, exploit only variation in subcontracting activity within the same firm over time, thereby absorbing all time-invariant firm-level heterogeneity. The divergence between these two sets of estimates is itself informative: if the within-firm estimates are substantially smaller than the cross-sectional ones and statistically indistinguishable from zero, this pattern is consistent with *selection* being the primary driver – firms that are inherently more accident-prone sort into subcontracting roles – rather than *moral hazard* – whereby firms become less safety-conscious when operating under subcontracts. Conversely, if the within-firm estimates are large and significant, this would point to a direct causal effect of subcontracting on safety-related *behavior*.

Table A.3 shows descriptive statistics for the samples of year-firms by the incidence of workplace accidents. Among firms that report at least one injury in a given year, the average number of injuries is over 5. These firms tend to be older, larger and more profitable. Overall, they tend to operate in the manufacturing and construction sectors more frequently

compared to firms without workplace injuries, and be more actively involved in the public procurement market, either as main contractors or as subcontractors. Finally, holding firm size constant, they rely more on blue-collar workers.

We estimate pooled cross-section and firm fixed-effects regressions to assess the relationship between the incidence of work-related accidents at the firm level and its participation in the public procurement market, in the given year, in the following (mutually non-exclusive) modes: (a) whether the firm has any public works contracts; (b) whether the firm has any subcontracts; and (c) whether the firm has subcontracted some of its public contracts to other firms. We consider as main outcome of interest the probability of the firm reporting at least one accident and estimate the following regression model:

$$y_{it} = \gamma_1 \text{Contractor}_{it} + \gamma_2 \text{Subcontractor}_{it} + \gamma_3 \text{Subcontracts out}_{it} + X'_{it}\beta + \alpha_i + \epsilon_{it}. \quad (2)$$

Furthermore, to better understand the effects on the intensive margin, we replicate this regression model in the sample of firms active in the public procurement market in a given year in contracting or subcontracting. We use the logarithm of the number of accidents as the dependent variable and the logarithms of the total amount in public works contracts and the total amount in public works subcontracts. The regressions also control for the firm's total yearly revenues and an indicator for whether the firm is subcontracting to other firms, to account for, respectively, its overall workload and the delegation of tasks with risk-shifting potential.

Columns 1 and 4 of Table 6.1 show the estimates from parsimonious specifications that only control for year fixed effects, while we add controls for firm size in terms of employees in columns 2 and 5, and a set of firm characteristics, including firm size in terms of employees and sector-year fixed effects in columns 3 and 6. Columns 4–6 also absorb firm fixed effects α_i that account for all time-invariant firm-level heterogeneity.

The pooled cross-sectional regressions in columns 1–3 of Table 6.1 indicate that participation in public procurement is associated with a higher likelihood of workplace accidents. Having been awarded at least one contract is consistently estimated to have a positive effect on the likelihood of observing accidents, the effect amounting to 4 percentage points when firm-level controls are included in column 3. Interestingly, firms that subcontract to others also exhibit a higher workplace injury risk, amounting to 5 percentage points. Comparing the coefficients of the two explanatory variables across columns 1 to 3 shows that the role of observable characteristics in attenuating the estimates is substantially stronger for firms' overall participation in procurement rather than their activity in outsourcing some tasks. This pattern suggests that while selection into public procurement activity is mostly

Table 6.1: Public (sub)contracting status and the probability of any workplace accident

	Across firms			Within firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Main contractor	0.272***	0.0727***	0.0400***	0.0206***	0.00423	0.00406
	(0.00834)	(0.00583)	(0.00587)	(0.00588)	(0.00566)	(0.00566)
Subcontractor	0.184***	0.130***	0.111***	0.0243***	0.0119*	0.0112
	(0.00920)	(0.00744)	(0.00740)	(0.00721)	(0.00702)	(0.00703)
Subcontracts to others	0.129***	0.0602***	0.0509***	0.0203**	0.00712	0.00571
	(0.0110)	(0.00836)	(0.00834)	(0.00847)	(0.00811)	(0.00809)
Observations	1106185	1106185	1106185	1105525	1105525	1105525
Outcome mean	0.165	0.165	0.165	0.165	0.165	0.165
Firm FE	No	No	No	Yes	Yes	Yes
Size controls	No	Yes	Yes	No	Yes	Yes
Sector-year FE	No	No	Yes	No	No	Yes

Standard errors clustered at the firm level in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The table reports pooled cross-sectional (columns 1–3) and firm fixed-effects (columns 4–6) estimates of the effect of public procurement participation on the likelihood that a firm experiences at least one workplace accident in a given year. The predictors of interest are indicators for (i) having any public works contract, (ii) having any public works subcontract, and (iii) having any public works contract subcontracted out to other firms. Controls are progressively added across specifications: firm size dummies in terms of employees and sector-year fixed effects.

explained by firm observable characteristics, firms' choice to delegate project execution to other firms may be to a large extent driven by unobservable shocks. The positive sign of both coefficients, instead, provides evidence against the risk-shifting hypothesis whereby main contractors strategically avoid accident-prone tasks: in years when firms choose to resort to subcontracting, their accident probability does not seem to diminish, conditional on their activity status in procurement or subcontracting. Last but not least, being a subcontractor results in a higher accident risk compared to the main contractor, amounting to over 11 percentage points, and suggests that there is a negative selection in the pool of firms that participate in the execution of public works through a private contract with the main contractor.

The *within-firm* estimates in columns 4–6 of Table 6.1 show that while the signs of the coefficients on the explanatory variables of interest remain positive, their size diminishes substantially: the estimates are not statistically distinguishable from zero and do not provide support for the moral hazard hypothesis whereby negligence regarding workplace safety is higher in years in which a firm operates in the public procurement market compared to years in which its revenues entirely come from private sector contracts.

Next, in Table 6.2 we use the number of accidents as the dependent variable and focus on the intensity of the firms' contracting with the public sector, i.e., the total amount of all its public works contracts and that of its subcontracts. To isolate the effects on the intensive margin, we ignore firms that have had no public procurement contracts, directly or through subcontracting, in the period 2013–2023.

Estimates in columns 1–3, Table 6.2, reveal that among firms that were ever involved in the public procurement market, those that draw their revenues to a higher extent from public projects do not seem to be negatively selected: the coefficients on *Log Contract amount*, if anything, show lower accident intensity. The number of reported accidents, instead, appears to increase with the firm's amount of subcontracts for the execution of public works. The estimated elasticity implies that a 10 percent change in subcontracting revenues is associated with a 0.1 percent change in the number of accidents, holding other variables constant. While the *within-firm* estimates in columns 4–6 confirm the signs of the coefficients of interest, they are generally smaller and statistically indistinguishable from zero.

Taken together, the cross-sectional and within-firm estimates tell a coherent story. The large and significant cross-sectional association between subcontracting activity and accident risk, combined with the near-zero within-firm estimates, points to *negative selection* as the dominant mechanism: firms that take on subcontracting roles are inherently more accident-prone, and this characteristic is stable over time. The within-firm design effectively absorbs this stable heterogeneity, leaving no residual variation attributable to the firm's sub-

Table 6.2: Public works (sub)contract revenues and the number of workplace accidents

	Across firms:			Within firms:		
	(1)	(2)	(3)	(4)	(5)	(6)
Log contract amount	-0.000980	-0.000119	-0.000930	0.000329	-0.000440	-0.000459
	(0.00121)	(0.000959)	(0.000964)	(0.000563)	(0.000528)	(0.000527)
Log subcontract amount	0.00692***	0.0105***	0.00986***	0.00102	0.000471	0.000320
	(0.00140)	(0.00112)	(0.00111)	(0.000779)	(0.000733)	(0.000736)
Observations	38302	38302	38302	38280	38280	38280
Outcome mean	0.165	0.165	0.165	0.165	0.165	0.165
Firm FE	No	No	No	Yes	Yes	Yes
Size controls	No	Yes	Yes	No	Yes	Yes
Sector-year FE	No	No	Yes	No	No	Yes

Standard errors clustered at the firm level in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The table reports pooled cross-sectional (columns 1–3) and firm fixed-effects (columns 4–6) estimates of the effect of public procurement revenues on the logarithm of the number of reported accidents in a given year. The predictors of interest are (i) the logarithm of the firm's revenues from public works contracts and (ii) the logarithm of the firm's revenues from public works subcontracts. The regressions control for firms' activity in outsourcing their public works contracts to other firms and the logarithm of revenues. The sample includes firms active in the public works market in a given year either by contracting or subcontracting. The specification and progression of controls follow those in Table 6.1.

contracting status in a given year. This pattern is *not* consistent with moral hazard – firms differentiating their safety investments based on whether they operate under a subcontract in a given year – nor with risk-shifting from the awarding contractor to the subcontractor. The policy implication is therefore less about changing firms' incentives within existing subcontracting arrangements and more about the screening and monitoring of firms that enter the subcontracting market: the pool of firms willing to act as subcontractors appears to be systematically higher-risk, independent of any particular contractual incentive structure.

7 Conclusions

This paper studies the effects of subcontracting on public works performance and workplace safety, exploiting rich administrative data from Italy and the quasi-experimental variation generated by a series of regulatory reforms between 2019 and 2021 that progressively relaxed a long-standing quantitative cap on the sub-contractable share of public contracts. Our analysis produces three sets of findings that together characterize the costs and benefits of flexible subcontracting as a tool of public procurement design.

Main results The difference-in-differences estimates show that the liberalization of subcontracting – and in particular the full removal of the quantitative cap in November 2021 – significantly improved contract-level outcomes. Projects covered by a subcontracting clause were completed approximately 14 days faster following the reform and experienced cost overruns that were 3 percentage points lower relative to the awarding price. The overall budgetary cost to the public sector, measured as excess payments relative to the tender base price, fell by around 2 percentage points. These gains came despite a modest reduction in competition at the tender stage: the number of bidders fell by approximately 2.7 and rebate rates declined by 1 percentage point, reflecting the fact that some firms may enter the market through the subcontracting channel rather than as direct bidders. The performance improvements appear to be driven by the full removal of the cap rather than the intermediate raises, consistent with the hypothesis that a qualitative shift from rigid rules to flexible, case-by-case discretion is necessary to generate efficiency gains.

The SOA qualification evidence provides a window into the mechanism: following the reform, main contractors hold fewer of the required qualifications for project categories themselves, while subcontractors pick up the corresponding certifications. This suggests that subcontracting is used, at least in part, to match tasks to better-qualified firms – a form of productive specialization that the rigid cap previously constrained. More broadly, the results are consistent with two complementary channels: improved cost internalization at the bidding stage (firms can bid more accurately when they have a realistic option to outsource unforeseen tasks) and enhanced flexibility in task allocation during execution (firms can respond to unexpected circumstances without the binding constraint of the cap).

The firm-level panel analysis reveals a significant association between subcontracting activity and workplace accidents in the cross-section: firms acting as subcontractors face accident rates more than 11 percentage points higher than comparable main contractors. However, within-firm estimates that absorb stable firm-level heterogeneity yield coefficients close to zero and statistically insignificant, indicating that this association reflects negative selection rather than moral hazard. Firms that participate in the subcontracting market are inherently more accident-prone; their accident risk does not measurably change when they take on subcontracting work relative to other years. Risk-shifting from main contractors to subcontractors is also not supported by the data.

Policy implications Our findings carry several concrete implications for procurement design. First, the evidence on contract execution suggests that flexible, case-by-case regulation delivers superior outcomes compared to those under rigid quantitative caps. Regulatory frameworks in other countries that maintain blanket subcontracting ceilings may benefit

from similar reforms.

Second, the competition effects of liberalization warrant attention. While our estimates reveal a reduction in bidder participation and resulting lower rebates, the overall budgetary impact was favorable, and project durations shorter. Although market contestability may constitute a potential concern for the policy maker on its own, the lack of adverse effects in contract execution suggests bid aggressiveness may not be the only channel through which public agencies ensure satisfactory performance.

Third, and perhaps most importantly from a social perspective, the evidence on workplace safety calls for targeted intervention. The fact that firms entering the subcontracting market are systematically higher-risk – independent of the contractual incentive structure – suggests that the policy lever lies in entry screening and ongoing monitoring of subcontractors, rather than in altering the incentives of established relationships. Strengthening prequalification requirements for subcontractors, expanding inspection capacity on multi-firm worksites, and clarifying the legal liability chain for accidents in subcontracting arrangements are all policy directions consistent with our findings.

Limitations and future work The workplace safety results are necessarily descriptive in the absence of a clean instrument for subcontracting choice at the firm level, as the within-firm design mitigates omitted variable bias but cannot fully establish causality. Future work exploiting the reform variation at the firm level – for instance, through a DID analysis of how accident rates evolve in firms whose public contracts were directly affected by the cap removal – would provide sharper causal evidence on the safety consequences of subcontracting liberalization.

References

Accetturo, Antonio, Anna Giunta, and Salvatore Rossi (2011). *The Italian Firms between Crisis and the New Globalization*. en. SSRN Scholarly Paper. Rochester, NY. DOI: 10.2139/ssrn.1849865. URL: https://papers.ssrn.com/abstract=1849865.

Bajari, Patrick, Robert McMillan, and Steven Tadelis (2009). "Auctions Versus Negotiations in Procurement: An Empirical Analysis". In: *The Journal of Law, Economics, and Organization* 25.2, pp. 372–399. ISSN: 8756-6222. DOI: 10.1093/jleo/ewn002. URL: https://doi.org/10.1093/jleo/ewn002.

Baltrunaite, Audinga et al. (2021). "Discretion and Supplier Selection in Public Procurement". In: *The Journal of Law, Economics, and Organization* 37.1, pp. 134–166. ISSN: 8756-6222. DOI: 10.1093/jleo/ewaa009. URL: https://doi.org/10.1093/jleo/ewaa009.

Bertrand, Marianne, Chang-Tai Hsieh, and Nick Tsivanidis (2021). *Contract Labor and Firm Growth in India*. Working Paper. DOI: 10.3386/w29151. URL: https://www.nber.org/papers/w29151.

Bosio, Erica et al. (2022). "Public Procurement in Law and Practice". en. In: *American Economic Review* 112.4, pp. 1091–1117. ISSN: 0002-8282. DOI: 10.1257/aer.20200738. URL: https://www.aeaweb.org/articles?id=10.1257/aer.20200738.

Bostanci, Gorkem (2025). *Productivity Gains from Labor Outsourcing: The Role of Trade Secrets*. en. URL: https://gorkembostanci.github.io/Paper_JM.pdf.

Camboni, Riccardo, Laura Rondi, and Paola Valbonesi (2021). "Temporary partnership and subcontracting: Pre- vs. post- award outsourcing in public procurement". In: *European Journal of Political Economy* 66, p. 101950. ISSN: 0176-2680. DOI: 10.1016/j.ejpoleco.2020.101950. URL: https://www.sciencedirect.com/science/article/pii/S0176268020300987.

Commissione parlamentare d'inchiesta sul fenomeno della mafia e sulle altre associazioni criminali similari (1994). *Relazione conclusiva*. Italian. Parliamentary inquiry. Roma: Italian Parliament. URL: https://legislature.camera.it/_dati/leg11/lavori/stampati/pdf/36370.pdf.

Court of Justice of the European Union (2019). *Vitali SpA v Autostrade per l'Italia SpA*. URL: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:62018CJ0063.

Coviello, Decio, Andrea Guglielmo, and Giancarlo Spagnolo (2018). "The Effect of Discretion on Procurement Performance". In: *Management Science* 64.2, pp. 715–738. ISSN: 0025-1909. DOI: 10.1287/mnsc.2016.2628. URL: https://pubsonline.informs.org/doi/10.1287/mnsc.2016.2628.

De Silva, Dakshina G., Georgia Kosmopoulou, and Carlos Lamarche (2012). "Survival of contractors with previous subcontracting experience". In: *Economics Letters* 117.1, pp. 7–9. ISSN: 0165-1765. DOI: 10.1016/j.econlet.2012.04.071. URL: https://www.sciencedirect.com/science/article/pii/S0165176512002121.

Di Tella, Rafael and Ernesto Schargrodsky (2003). "The Role of Wages and Auditing during a Crackdown on Corruption in the City of Buenos Aires". In: *The Journal of Law and Economics* 46.1, pp. 269–292. ISSN: 0022-2186. DOI: 10.1086/345578. URL: https://www.journals.uchicago.edu/doi/full/10.1086/345578.

Drenik, Andres et al. (2023). "Paying Outsourced Labor: Direct Evidence from Linked Temp Agency-Worker-Client Data". In: *The Review of Economics and Statistics* 105.1, pp. 206–216. ISSN: 0034-6535. DOI: 10.1162/rest_a_01037. URL: https://doi.org/10.1162/rest_a_01037.

European Commission (2019). *Costituzione in mora – Infrazione n. 2018/2273*. Italiano.

Giunta, Anna, Annamaria Nifo, and Domenico Scalera (2012). "Subcontracting in Italian Industry: Labour Division, Firm Growth and the North–South Divide". In: *Regional Studies* 46.8, pp. 1067–1083. ISSN: 0034-3404. DOI: 10.1080/00343404.2011.552492. URL: https://doi.org/10.1080/00343404.2011.552492.

Goldschmidt, Deborah and Johannes F. Schmieder (2017). "The Rise of Domestic Outsourcing and the Evolution of the German Wage Structure". In: *The Quarterly Journal of Economics* 132.3, pp. 1165–1217. ISSN: 0033-5533. DOI: 10.1093/qje/qjx008. URL: https://doi.org/10.1093/qje/qjx008.

Ha, Sangeun (2021). *Outsourcing Workplace Safety*. en. SSRN Scholarly Paper. Rochester, NY. DOI: 10.2139/ssrn.3976070. URL: https://papers.ssrn.com/abstract=3976070.

Kalleberg, Arne L., Barbara F. Reskin, and Ken Hudson (2000). "Bad Jobs in America: Standard and Nonstandard Employment Relations and Job Quality in the United States". EN. In: *American Sociological Review* 65.2, pp. 256–278. ISSN: 0003-1224. DOI: 10.1177/000312240006500206. URL: https://doi.org/10.1177/000312240006500206.

Lafontaine, Francine and Margaret Slade (2007). "Vertical Integration and Firm Boundaries: The Evidence". en. In: *Journal of Economic Literature* 45.3, pp. 629–685. ISSN: 0022-0515. DOI: 10.1257/jel.45.3.629. URL: https://www.aeaweb.org/articles?id=10.1257/jel.45.3.629.

Manelli, Alejandro M. and Daniel R. Vincent (1995). "Optimal Procurement Mechanisms". In: *Econometrica* 63.3, pp. 591–620. ISSN: 0012-9682. DOI: 10.2307/2171909. URL: https://www.jstor.org/stable/2171909.

Marion, Justin (2009). "How Costly Is Affirmative Action? Government Contracting and California's Proposition 209". In: *The Review of Economics and Statistics* 91.3, pp. 503–522.

ISSN: 0034-6535. DOI: 10.1162/rest.91.3.503. URL: https://doi.org/10.1162/rest.91.3.503.

Monticelli, Luca (2024). "Infortuni, sette su dieci accadono in subappalto". it. In: *La Stampa*. URL: https://www.lastampa.it/cronaca/2024/02/17/news/infortuni_lavoro_sette_su_dieci_subappalto-14079653/.

Moretti, Luigi and Paola Valbonesi (2015). "Firms' Qualifications and Subcontracting in Public Procurement: An Empirical Investigation". In: *The Journal of Law, Economics, and Organization* 31.3, pp. 568–598. ISSN: 8756-6222. DOI: 10.1093/jleo/ewv001. URL: https://doi.org/10.1093/jleo/ewv001.

Nenonen, Sanna (2011). "Fatal workplace accidents in outsourced operations in the manufacturing industry". In: *Safety Science* 49.10, pp. 1394–1403. ISSN: 0925-7535. DOI: 10.1016/j.ssci.2011.06.004. URL: https://www.sciencedirect.com/science/article/pii/S092575351100141X.

Pogliotti, Giorgio (2025). "Referendum on contracts: the reasons for yes and no to the question on joint and several liability of the contracting company in case of accidents at work". In: *Il Sole 24 Ore*. URL: https://en.ilsole24ore.com/art/referendum-on-contracts-reasons-yes-and-no-question-joint-and-several-liability-of-the-client-company-in-the-case-of-work-accidents-AHdXAGL.

Rosa, Benjamin V (2024). "Subcontracting requirements and the cost of government procurement". en. In: *The RAND Journal of Economics* 55.1, pp. 3–32. ISSN: 1756-2171. DOI: 10.1111/1756-2171.12456. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1756-2171.12456.

Senato della Repubblica (1993). *Domanda di autorizzazione a procedere contro il senatore Michelangelo Russo*. Italian. URL: https://www.senato.it/Web/AutorizzazioniAProcedere.nsf/f1592a575eef7066c1257be500556921/4d85b1960a61336ac1256eae0032e7d8/$FILE/DOC.%20IV,%20N.%20208.pdf.

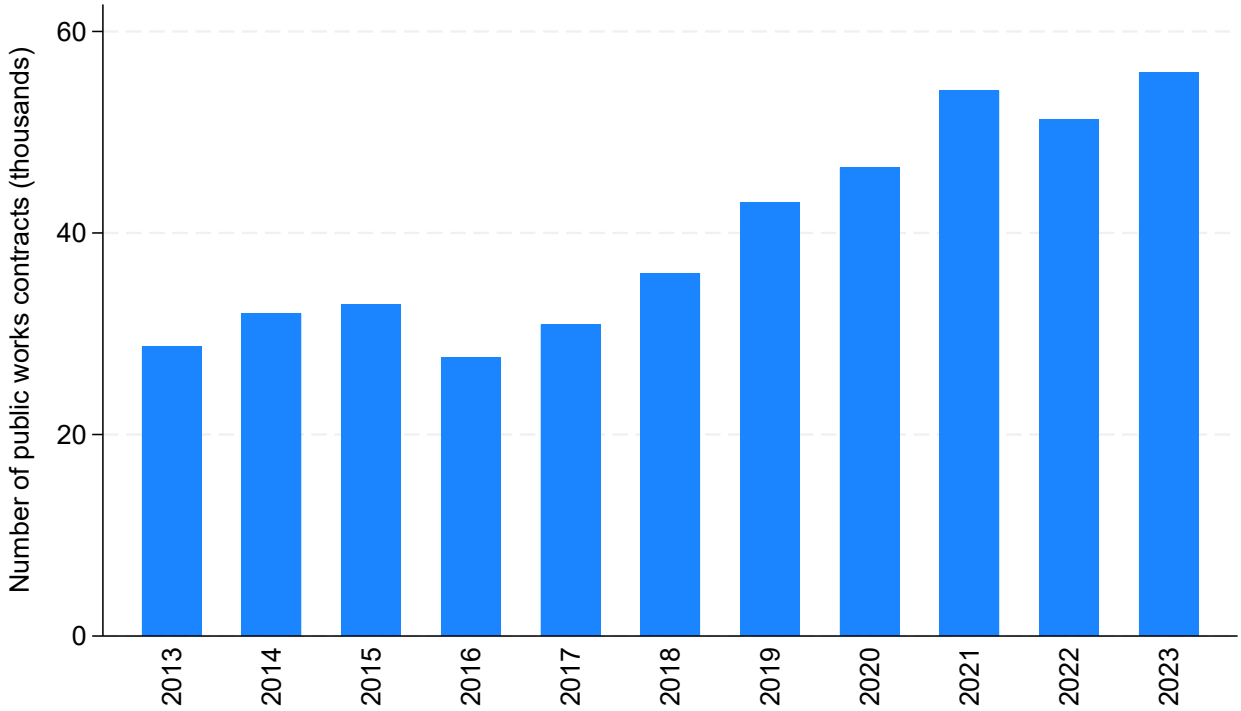
Spagnolo, Giancarlo (2012). "Reputation, competition, and entry in procurement". In: *International Journal of Industrial Organization* 30.3, pp. 291–296. ISSN: 0167-7187. DOI: 10.1016/j.ijindorg.2012.01.001. URL: https://www.sciencedirect.com/science/article/pii/S0167718712000033.

Szucs, Ferenc (2024). "Discretion and Favoritism in Public Procurement". In: *Journal of the European Economic Association* 22.1, pp. 117–160. ISSN: 1542-4766. DOI: 10.1093/jeea/jvad017. URL: https://doi.org/10.1093/jeea/jvad017.

Appendix A Tables and Figures

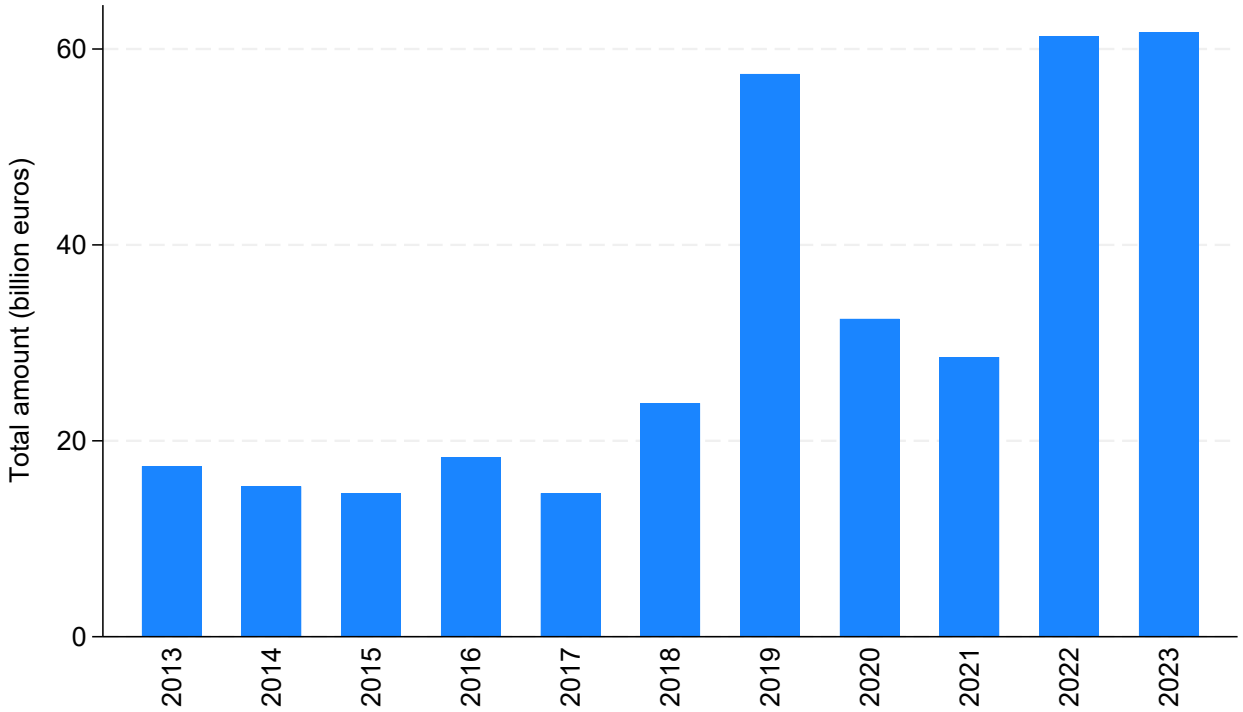
A.1 Descriptive evidence

Figure A.1: Number of public works contracts awarded yearly (2013–2023)



The figure shows the number of awarded contracts that are classified as public works by year of publication of the corresponding tender procedure for the 2013–2023 period.

Figure A.2: Total amount of public works contracts awarded yearly (2013–2023)



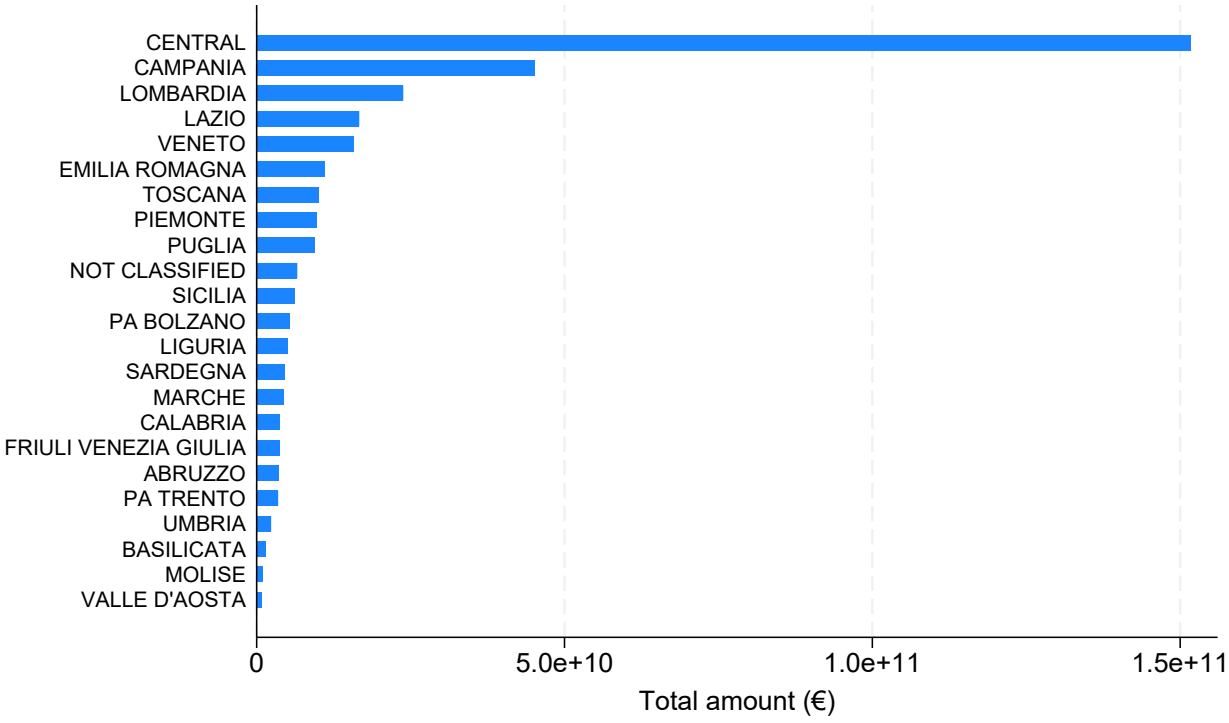
The figure shows the total amount of awarded contracts that are classified as public works by year of publication of the corresponding tender procedure for the 2013–2023 period.

Table A.1: Validation of ANAC data coverage using ANCE construction site data

	Recorded	Not recorded	% not recorded
2021	50,571	3,501	0.06
2022	45,955	5,219	0.10
2023	49,745	6,099	0.11
Total	146,271	14,819	0.09

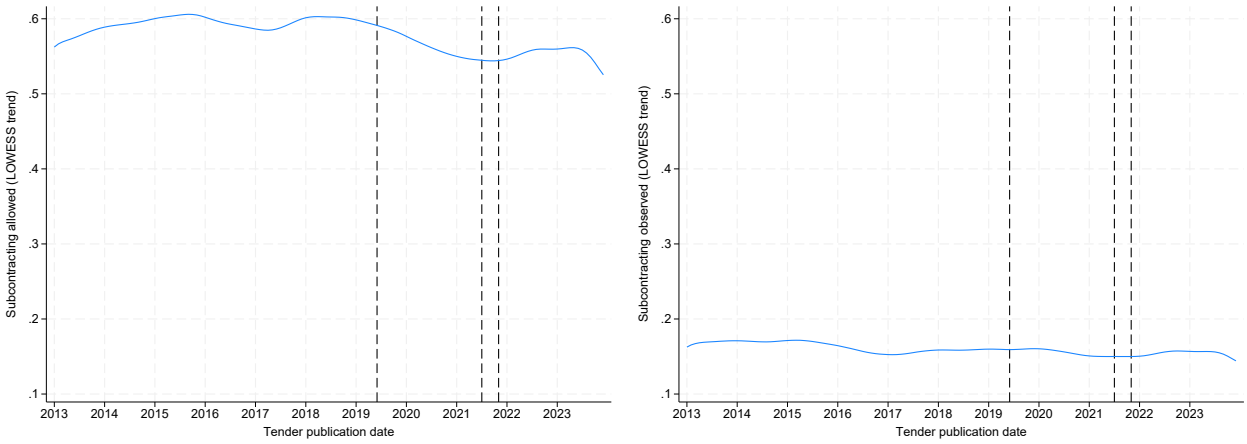
The table reports how many of the firms identified by ANCE are recorded in the ANAC open data we use as well. ANCE provides surveys of building sites reporting which firms are operating there. Column "Recorded" ("Not recorded") reports the number of firms included (not included) in the ANAC open data out of those reported by ANCE, limited to the set of contracts we use in our main analysis.

Figure A.3: Total amount of public works contracts awarded by region (2013–2023)



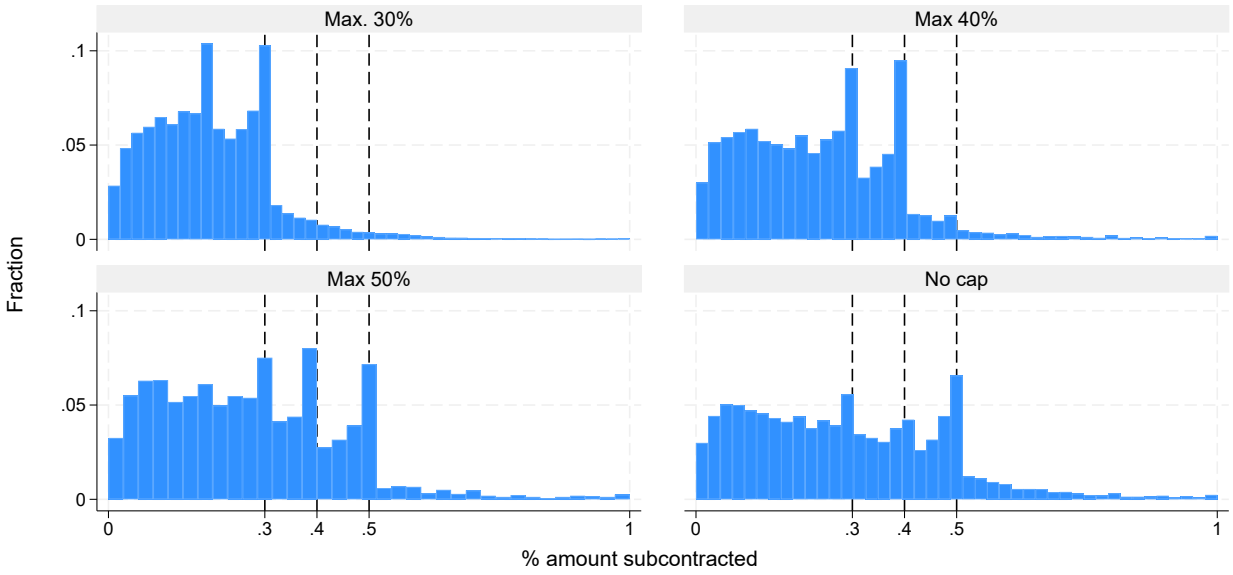
The figure shows the total amount of awarded contracts that are classified as public works by region for the 2013–2023 period.

Figure A.4: Incidence of the subcontracting clause and of subcontracting over time



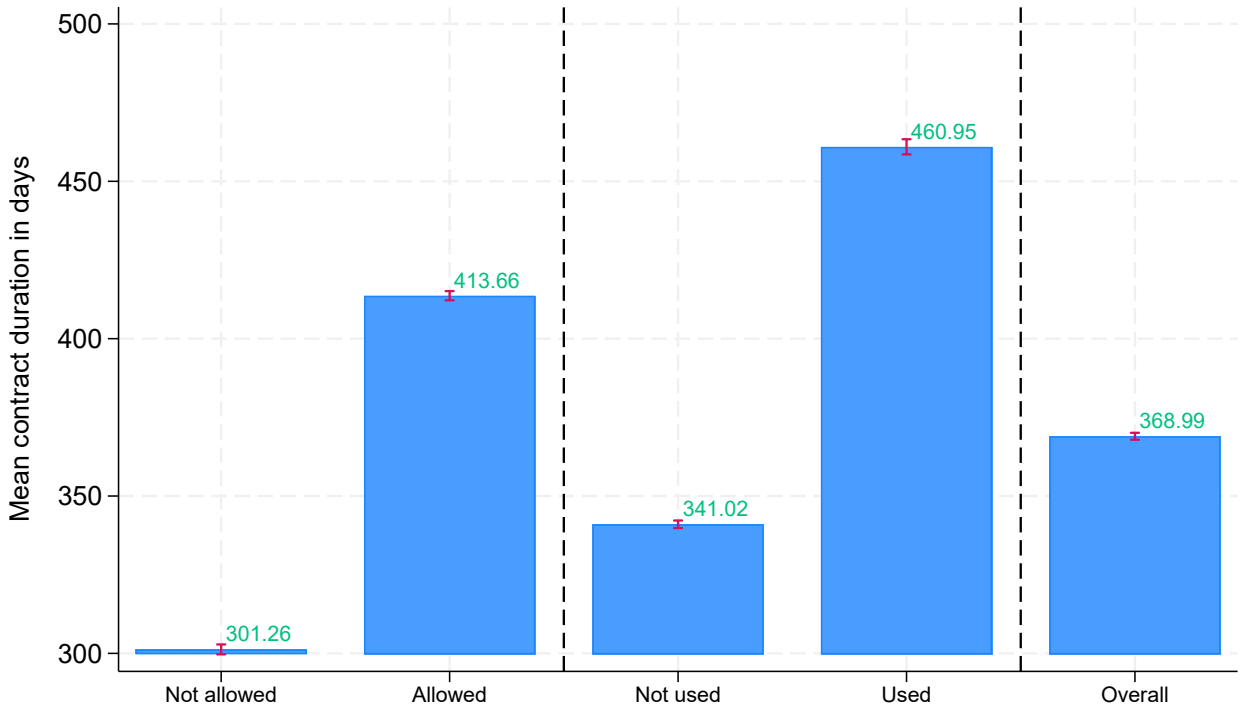
The panel on the left shows a moving average of the incidence of the subcontracting clause over time. The panel on the right shows a moving average of the incidence of subcontracting over time. Values for a date are averaged over a period of 90 days centered on the date. The vertical lines correspond to the dates when each reform phase started: June 1st, 2019, July 1st, 2021, and November 1st, 2021.

Figure A.5: Subcontracted share of contract amount under each reform regime



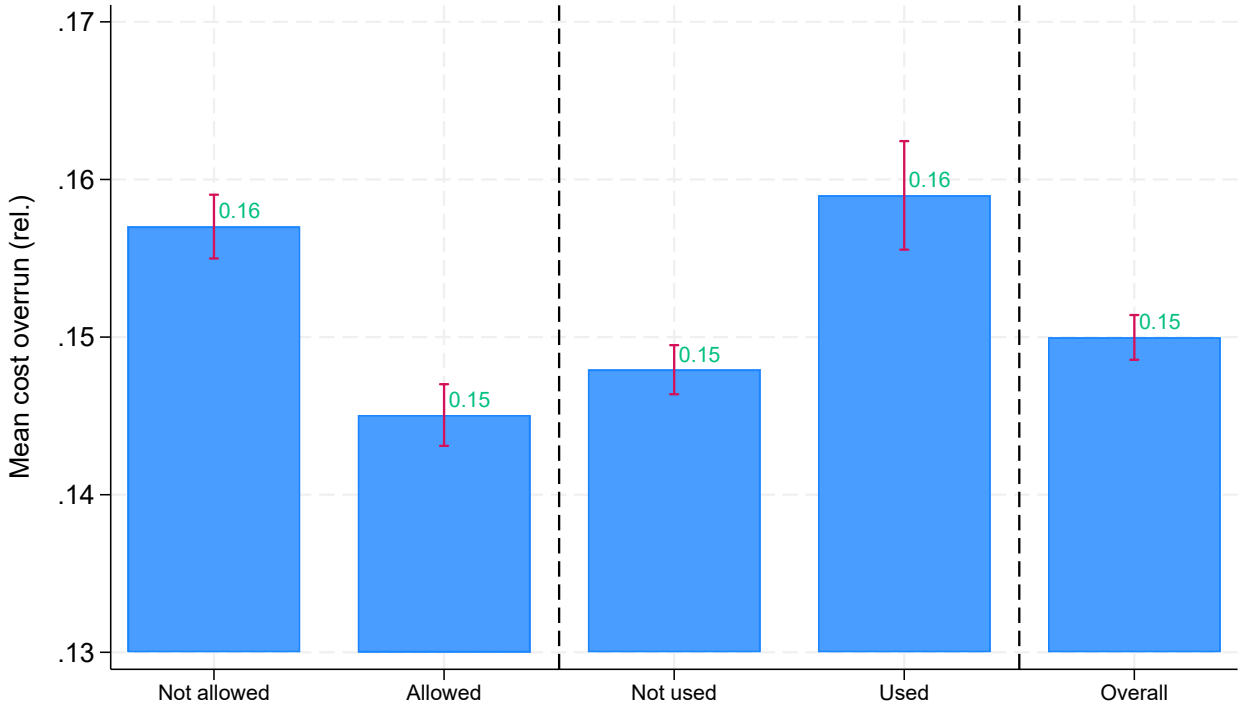
The figure shows the distribution of the awarded contract amount that is subcontracted, separately for each reform period. The first period ("Max 30%") goes until May 2019. The second period ("Max 40%") goes from 1 June 2019 to 30 June 2021. The third period ("Max 50%") goes from 1 July 2021 to 31 October 2021. The final period ("No cap") goes from 1 November 2021 to the end of the period considered (31 December 2023).

Figure A.6: Mean contract duration (in days) by subcontracting status



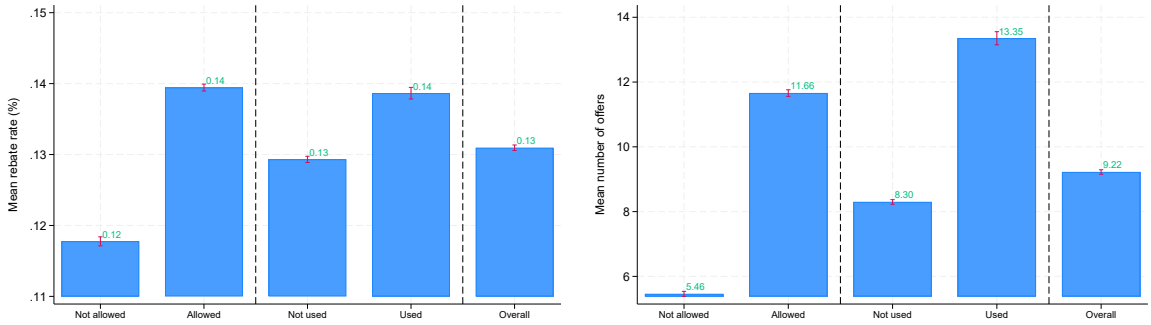
The figure displays mean contract duration (in days) across different subsamples. Bars 1—2 compare contracts by whether the tender includes the clause allowing subcontracting; bars 3—4 compare contracts by whether subcontracting actually occurs. The final bar reports the overall mean contract duration. The variable was winsorized at the top before computing the mean and the standard error of the mean, to correct for extreme observations.

Figure A.7: Mean relative cost overrun by subcontracting status



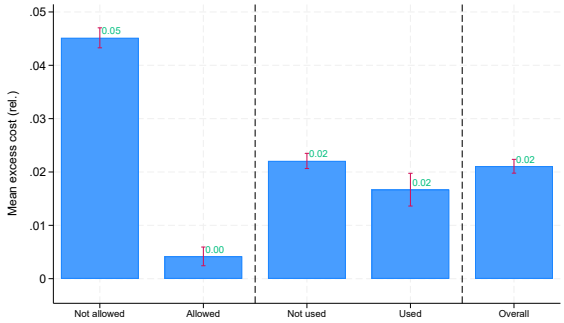
The figure displays mean relative cost overrun (relative deviation of recorded total payments from the awarded tender amount) across different subsamples. Bars 1—2 compare contracts by whether tender includes the clause allowing subcontracting; bars 3—4 compare contracts by whether subcontracting actually occurs. The final bar reports the overall mean relative cost overrun. The variable was winsorized before computing the mean and the standard error of the mean, to correct for extreme observations.

Figure A.8: Means by subcontracting status: Additional variables



(a) Rebate rate

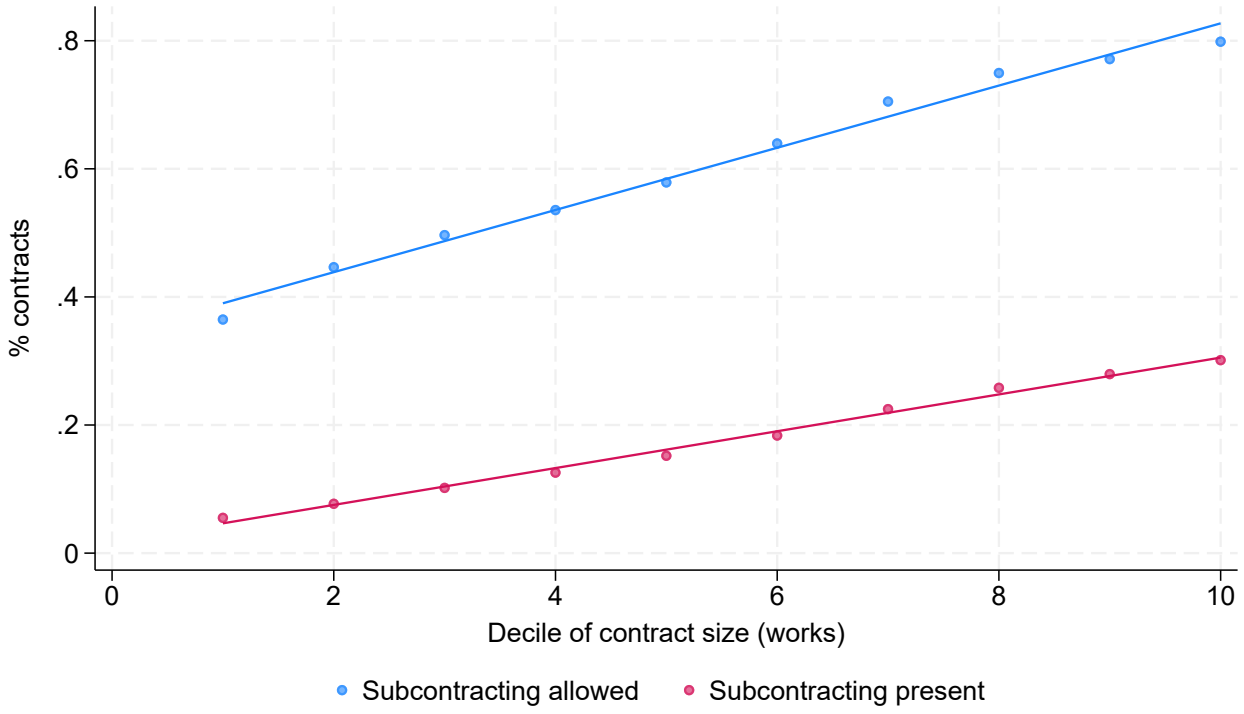
(b) Number of offers



(c) Excess costs

Figures display the mean rebate rate (relative deviation of awarded tender amount from the tender baseline amount), the mean number of offers, and the mean relative excess cost (relative deviation of recorded total payments from the tender baseline amount) across different subsamples. Bars 1—2 compare contracts by whether tender includes the clause allowing subcontracting; bars 3—4 compare contracts by whether subcontracting actually occurs. The final bar reports the overall mean. Variables were winsorized before computing the mean and the standard error of the mean, to correct for extreme observations.

Figure A.9: Relationship between contract size and subcontracting



The figure reports the share of contracts that allow for subcontracting (in blue) by decile of size of the contract, and the share of contracts where subcontracting is observed (in red) by decile of size of the contract. Linear fits are added for both variables.

Table A.2: Awardee characteristics

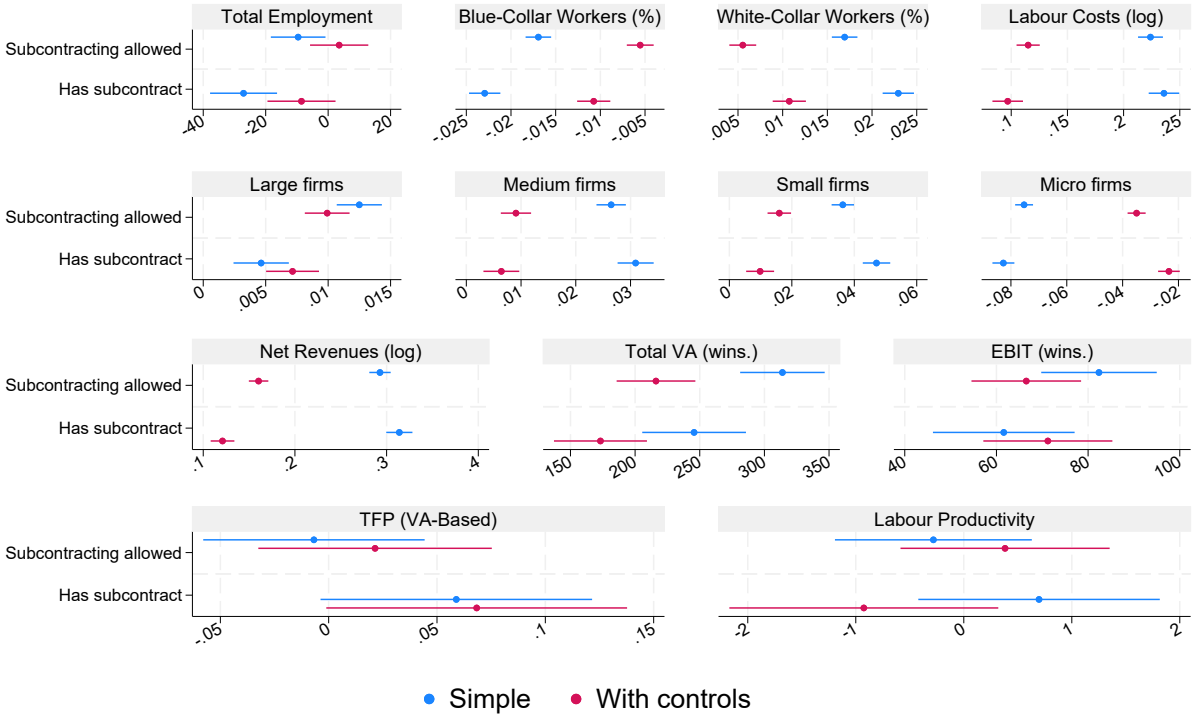
	Clause of subcontracting		Use of subcontracting	
	Simple	Controls	Simple	Controls
A. Employment				
Total Employment	-9.600*	3.532	-27.09***	-8.533
	(4.463)	(4.763)	(5.473)	(5.562)
Blue-Collar Workers (%)	-0.0169***	-0.00554***	-0.0229***	-0.0107***
	(0.000729)	(0.000767)	(0.000894)	(0.000948)
White-Collar Workers (%)	0.0169***	0.00554***	0.0229***	0.0107***
	(0.000729)	(0.000767)	(0.000894)	(0.000948)
B. Financials				
Net Revenues (log)	0.293***	0.160***	0.314***	0.121***
	(0.00593)	(0.00543)	(0.00728)	(0.00660)
Labour Costs (log)	0.224***	0.115***	0.236***	0.0969***
	(0.00565)	(0.00527)	(0.00694)	(0.00694)
EBIT (wins.)	82.37***	66.52***	61.61***	71.22***
	(6.428)	(6.101)	(7.884)	(7.183)
Total VA (wins.)	314.0***	216.2***	245.6***	173.2***
	(16.68)	(15.53)	(20.47)	(18.35)
C. Productivity				
TFP (VA-Based)	-0.00680	0.0214	0.0589	0.0683
	(0.0261)	(0.0275)	(0.0320)	(0.0354)
D. Other characteristics				
Firm age	1.684***	1.110***	2.590***	1.200***
	(0.0555)	(0.0575)	(0.0680)	(0.0685)
Large firms	0.0125***	0.00992***	0.00464***	0.00715***
	(0.000921)	(0.000914)	(0.00113)	(0.00108)
Medium firms	0.0265***	0.00907***	0.0309***	0.00641***
	(0.00137)	(0.00141)	(0.00168)	(0.00167)
Micro firms	-0.0753***	-0.0350***	-0.0827***	-0.0234***
	(0.00163)	(0.00165)	(0.00200)	(0.00198)
Small firms	0.0363***	0.0160***	0.0471***	0.00985***
	(0.00183)	(0.00192)	(0.00224)	(0.00228)
Observations	320819	320819	320819	333126

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

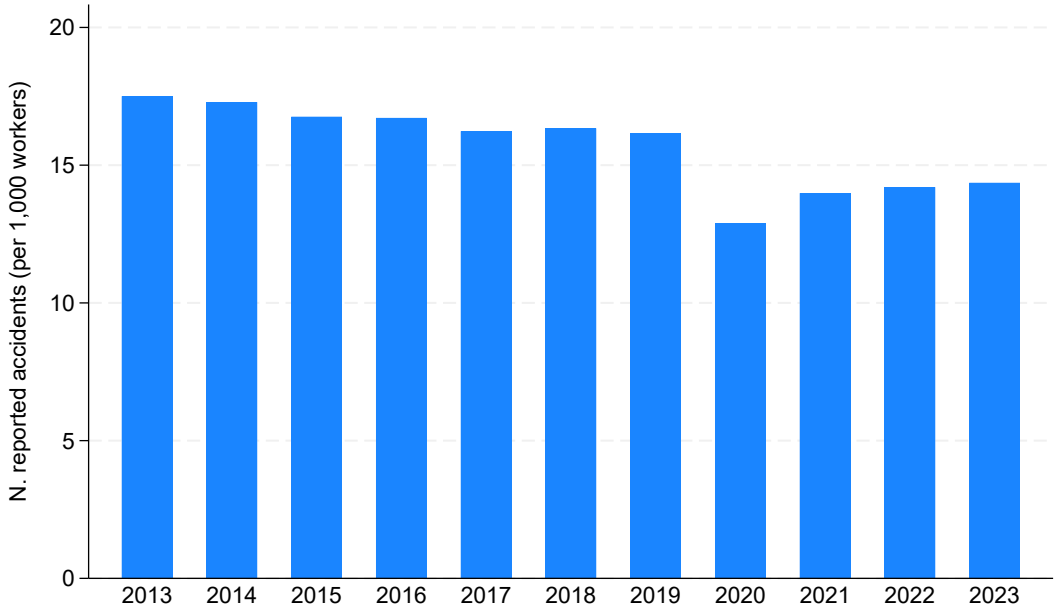
The table reports coefficients from separate regressions of each variable in the row on i) an indicator for whether the tender includes a clause foreseeing the possibility of subcontracting (columns 1–2) and ii) an indicator for whether subcontracting is used in the tender (columns 3–4). Columns 1 and 3 ("Simple") report results from univariate regressions. Columns 2 and 4 ("Controls") report results from regressions controlling for region, awarding procedure, contract dimensional class, year, and type of contracting authority.

Figure A.10: Awardee characteristics

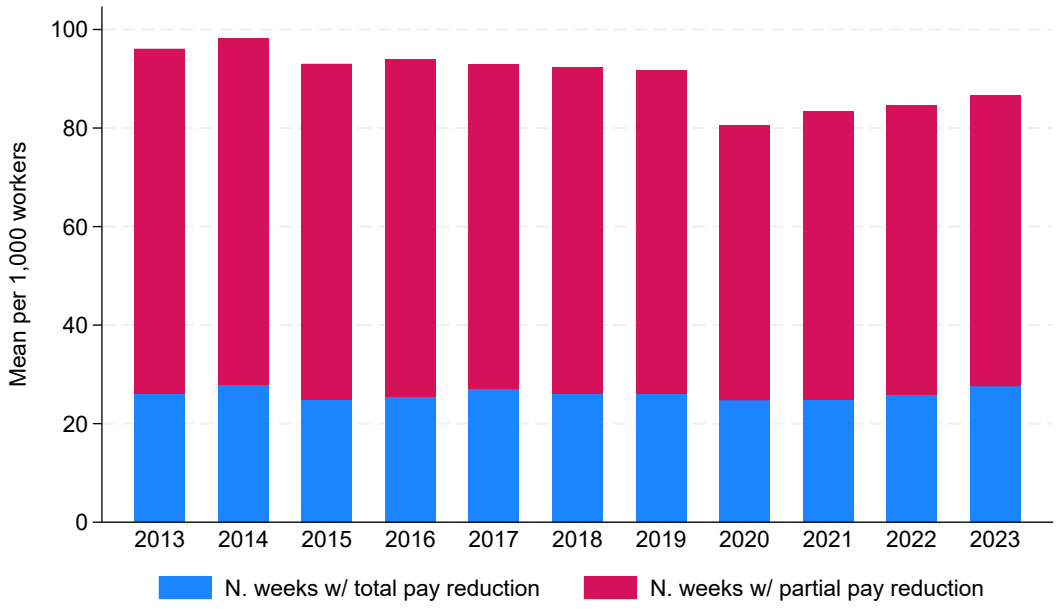


The figure plots the coefficients from the regressions in Table A.2. Each winning firm characteristic is regressed on i) an indicator for whether the tender allows for subcontracting and ii) an indicator for whether subcontracting is used in the tender. Regression results marked as "Simple" are from univariate regressions; those marked as "With controls" are from multivariate regressions controlling for region, awarding procedure, contract dimensional class, year, and type of contracting authority.

Figure A.11: Incidence of work-related injuries over time



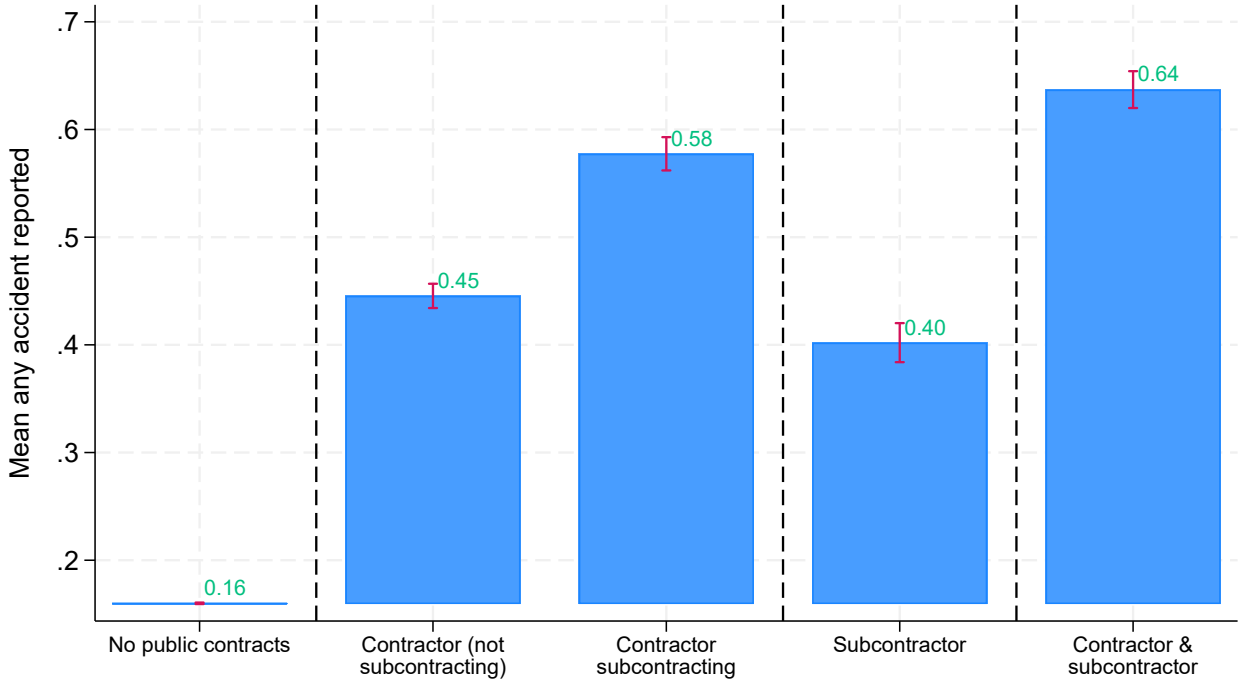
(a) Number of reported accidents over time



(b) Number of weeks with injuries over time

Panel a of the figure reports the average across firms of the number of reported accidents per 1,000 workers, separately for each year in the 2013–2023 period. Panel b reports the mean number of weeks with injuries per 1,000 workers, distinguishing between weeks with total or partial pay reduction, separately for each year in the 2013–2023 period.

Figure A.12: Firms with work-related injuries and subcontracting



The figure plots unconditional averages for: firms inactive in public works; those that are main contractors, either without or with third parties engaged as subcontractors; and those that are subcontractors, either without or with public works contracts awarded to them.

Table A.3: Firms in the INPS sample by accident status

	No accidents		Any accident		Difference	
N. accidents	0.00	(0.00)	5.49	(82.99)	-5.49***	(0.21)
Age	20.79	(14.27)	26.69	(17.25)	-5.90***	(0.05)
Main contractor	0.01	(0.10)	0.05	(0.21)	-0.04***	(0.00)
Subcontractor	0.00	(0.06)	0.02	(0.13)	-0.01***	(0.00)
Sector						
Manufacturing	0.34	(0.47)	0.51	(0.50)	-0.17***	(0.00)
Construction	0.02	(0.15)	0.06	(0.24)	-0.04***	(0.00)
Services	0.62	(0.48)	0.40	(0.49)	0.22***	(0.00)
Other activities	0.02	(0.13)	0.03	(0.17)	-0.01***	(0.00)
Size						
Big	0.01	(0.08)	0.16	(0.37)	-0.15***	(0.00)
Medium	0.05	(0.21)	0.22	(0.41)	-0.18***	(0.00)
Micro	0.41	(0.49)	0.13	(0.34)	0.29***	(0.00)
Small	0.53	(0.50)	0.49	(0.50)	0.05***	(0.00)
Net revenues	3957.04	(12891.76)	26701.40	(51884.64)	-22744.36***	(135.06)
EBIT	297.99	(1083.07)	1983.66	(4212.09)	-1685.67***	(10.97)
Employment						
Total employment	14.45	(199.97)	185.99	(1571.52)	-171.55***	(4.07)
Share blue collar	0.60	(0.34)	0.68	(0.26)	-0.08***	(0.00)
Observations	600450		149843		750293	

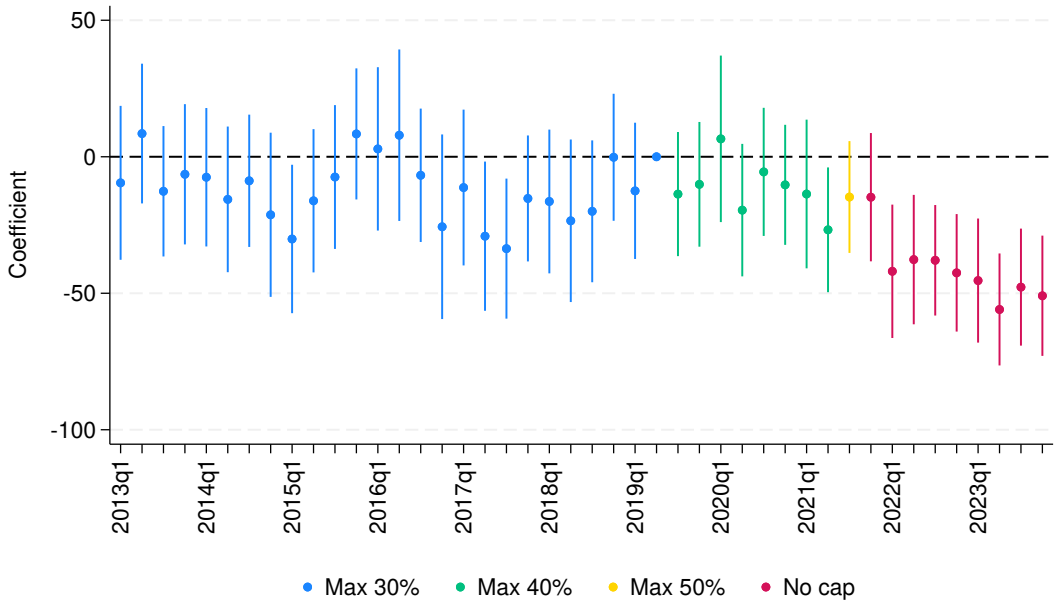
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports variables' averages distinguishing by whetherworkplace accidents are observed or not. It also reports the difference between the two groups. Standard deviations/standard errors in parentheses.

A.2 DID analysis for contract performance

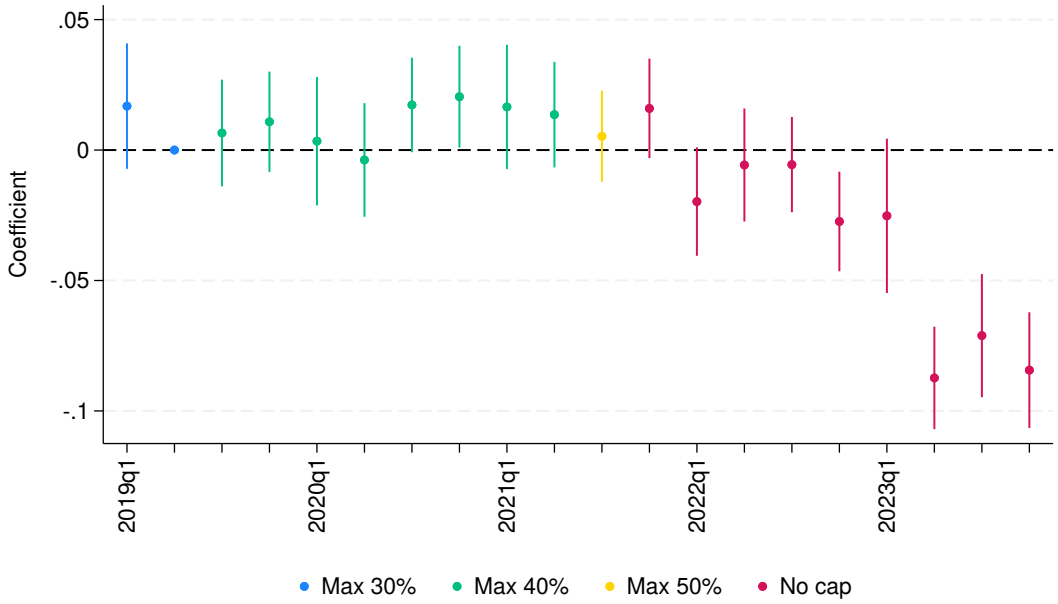
The table reporting coefficient estimates is shown in the main text.

Figure A.13: Time-specific DID coefficients for project duration



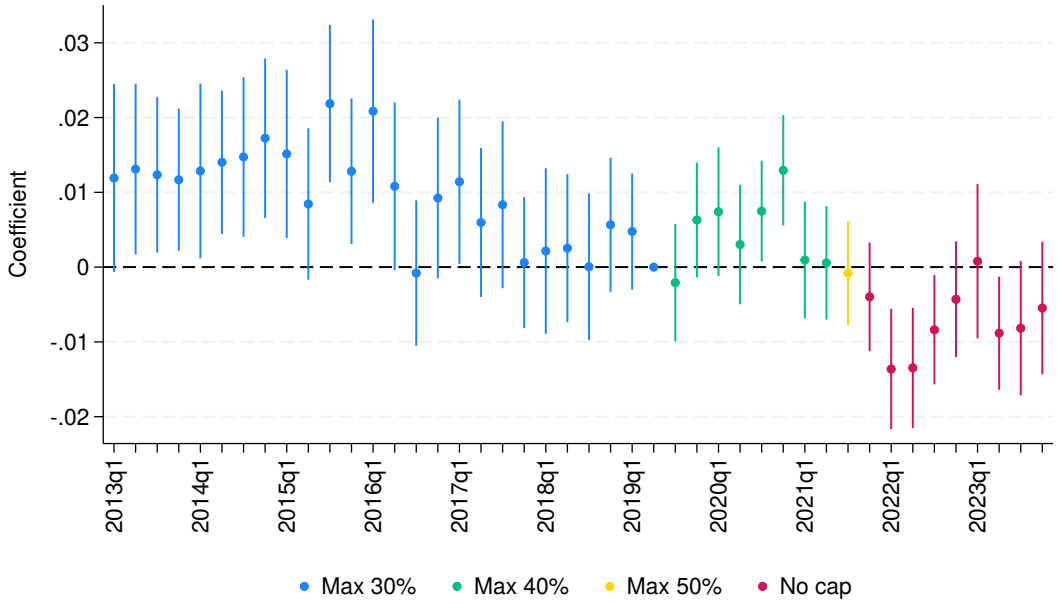
The figure plots quarter-specific ATETs of the subcontracting reforms on contract duration (in days), estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level.

Figure A.14: Time-specific DID coefficients for cost overruns



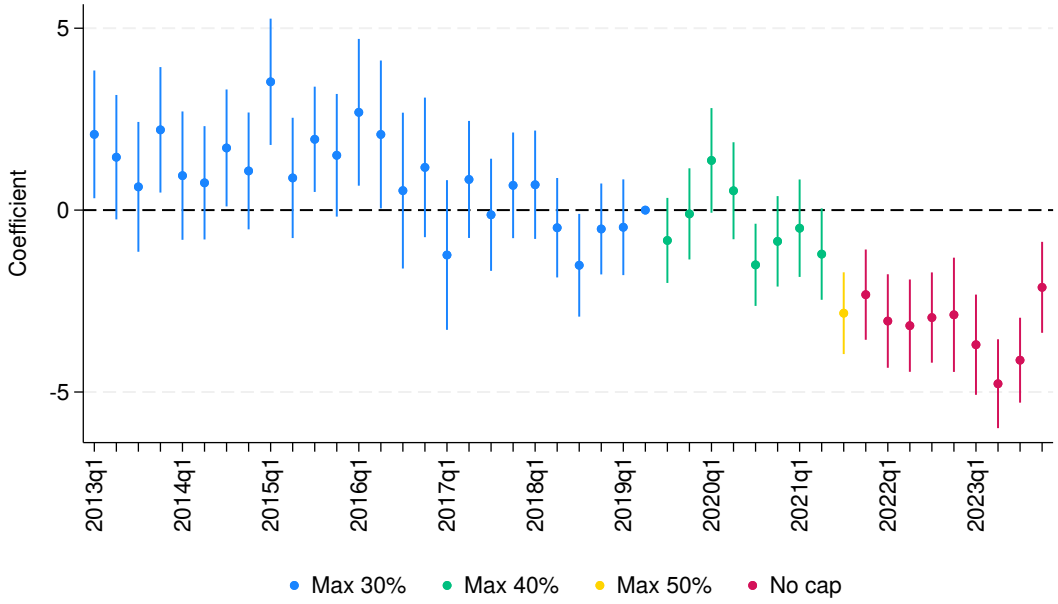
The figure plots quarter-specific ATETs of the subcontracting reforms on relative cost overruns (expressed as the percentage deviation of total payments with respect to the awarded tender amount), estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated_i. Confidence intervals are shown at the 95% level.

Figure A.15: Time-specific DID coefficients for rebates



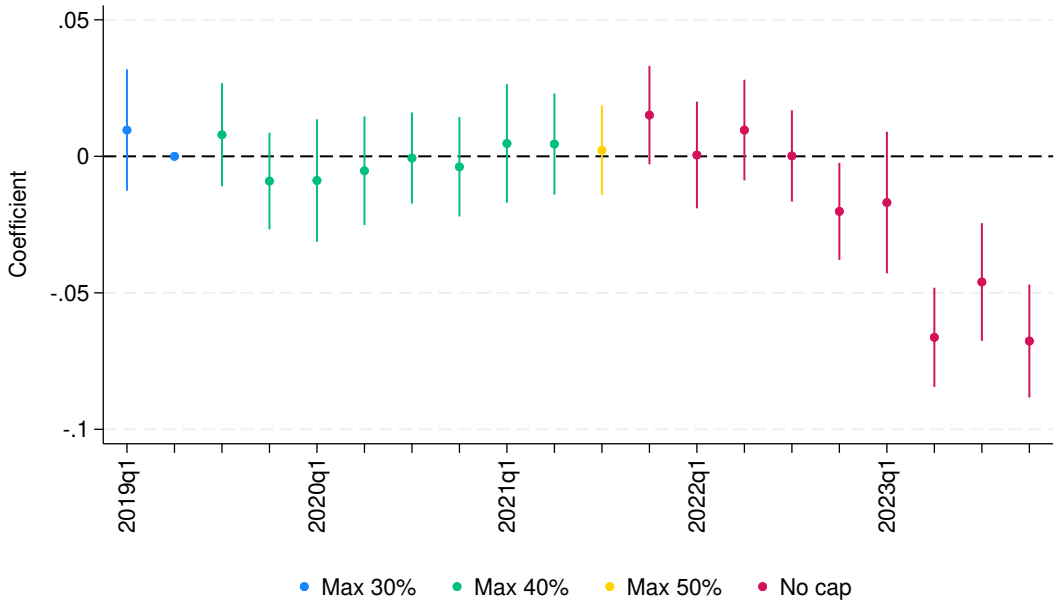
The figure plots quarter-specific ATETs of the subcontracting reforms on the rebate rate (expressed as the percentage deviation of the awarded tender amount with respect to the baseline price), estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level.

Figure A.16: Time-specific DID coefficients for the number of offers



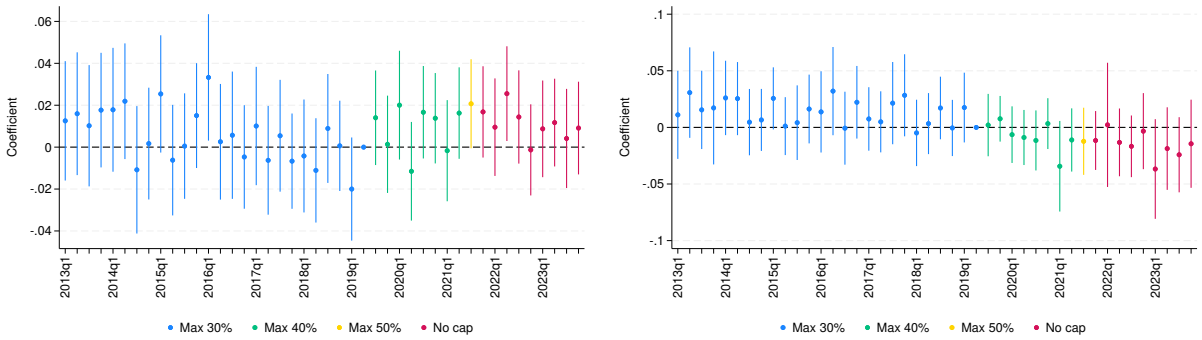
The figure plots quarter-specific ATETs of the subcontracting reforms on the number of offers, estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level.

Figure A.17: Time-specific DID coefficients for excess costs



The figure plots quarter-specific ATETs of the subcontracting reforms on relative excess costs (expressed as the percentage deviation of total payments for a contract with respect to its tender base price), estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level.

Figure A.18: Time-specific DID coefficients for winning firm size composition

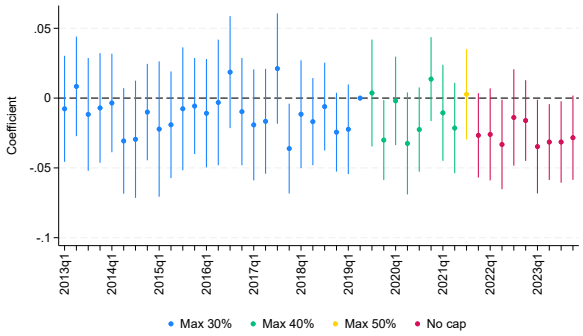


(a) Winner is incorporated

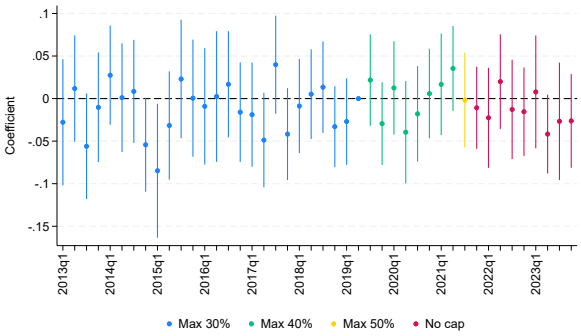
(b) Winner is SME (cond. incorporated)

The figure plots quarter-specific ATETs of the subcontracting reforms on the size composition of winning firms, estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level.

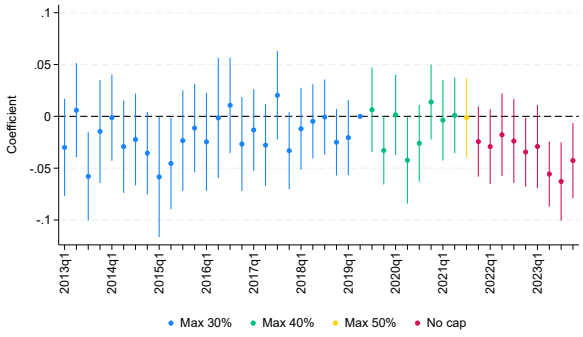
Figure A.19: Time-specific DID coefficients for firms' SOA qualifications



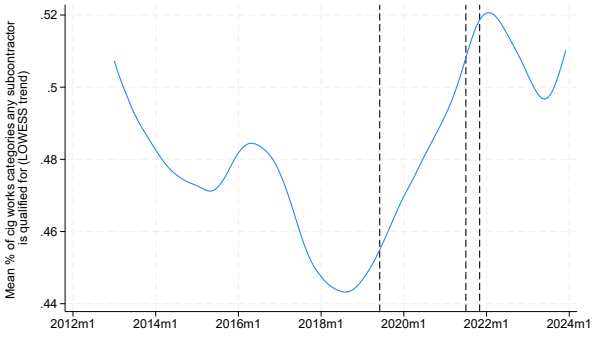
(a) Main awardees are qualified for main category



(b) Involved firms qualified for all categories



(c) % categories main awardees are qualified for



(d) % categories subcontractors are qualified for

Panels a, b, and c plot quarter-specific ATETs of the subcontracting reforms on the variables capturing SOA qualifications among winning firms, estimated from an event-study extension of specification (1) with procuring agency fixed effects. The specification includes interaction terms between each quarter and the subcontractable-contract indicator Treated$_i$. Confidence intervals are shown at the 95% level. Panel d plots a moving average of the share of works categories for which tender subcontractors hold a SOA qualification certificate. The vertical lines correspond to the dates when each reform phase started: June 1st, 2019, July 1st, 2021, and November 1st, 2021.

A.3 Regression analysis for workplace accidents

All the results are reported in the main text.

Appendix B Supplementary Materials

B.1 Matching and Regression Analysis for Contract Performance

Tables B.1–B.5 report the estimated average treatment effects of subcontracting on different outcomes of contract performance. "Matching" refers to nearest-neighbor matching on the estimated propensity score, obtained from a logistic regression of subcontracting on a rich set of contract characteristics (region, awarding procedure, contract dimensional class, type of awarding authority, main contract category according to the classification of public works). "Lasso matching" extends this analysis by allowing variable selection from a larger set of covariates (including tender and award amounts, publication date, implementation mode, two-digit CPV categories, and assignment mechanism), under the assumption of a linear outcome model. "Poisson APE" applies to nonnegative outcomes and reports average partial effects from a Poisson regression. Finally, "OLS" reports linear regression estimates. To reduce the influence of outliers, outcomes are winsorized.

Project duration Table B.1 shows that contracts involving subcontracting take longer to complete: the estimated effect of subcontracting on contract duration ranges from 12 to 14 additional days, relative to an average control duration of 383 days.

Cost overruns Subcontracting is also linked with higher cost overruns. Table B.2 reports increases of 4.3—5 percentage points in the full sample, relative to average overruns of about 14%.

Rebates Table B.3 shows subcontracting to also be significantly associated with lower rebate rates (contractors offering smaller discounts with respect to the tender baseline price). The effect size is extremely small, ranging between 0.2 and 0.45 percentage points, relative to a control mean rebate rate of about 14%.

Number of offers Estimates in Table B.4 report a positive and significant association between subcontracting and the number of offers in the tender process. The estimated effect size ranges between 1.6 and 2 additional offers in tenders where subcontracting is eventually used in the execution phase, relative to a control mean of about 11.

Excess costs Consistently with observations on cost overruns and rebates, subcontracting is linked with a larger wedge between final costs and the initial tender price. Table B.5 reports increases of 3.6–4.3 percentage points, relative to a control mean of about zero.

Table B.1: Matching and regression results for project duration

	Matching	Lasso matching	Poisson APE	OLS
Has subcontract	15.62***	14.79***	13.52***	13.81***
	(1.515)	(1.456)	(0.110)	(1.401)
Observations	162159	157730	162159	162159
Control mean	387.9	383.1	387.9	387.9

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports estimated average treatment effects of subcontracting on contract duration (in days). "Matching" refers to nearest-neighbour matching on the propensity score estimated from contract characteristics using a logistic regression. "Lasso matching" extends this by selecting covariates from a richer set using lasso, under the assumption of a linear outcome model and a logistic treatment model. "Poisson APE" reports average partial effects from Poisson regressions. "OLS" reports coefficients from linear regressions. Standard errors are in parentheses. Control mean is the average duration for the control group (contracts without subcontracting) in the reference sample.

Table B.2: Matching and regression results for cost overrun (rel.)

	Matching	Lasso matching	OLS
Has subcontract	0.0400***	0.0418***	0.0472***
	(0.00235)	(0.00227)	(0.00211)
Observations	98945	97440	98945
Control mean	0.138	0.140	0.138

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports estimated average treatment effects of subcontracting on relative cost overruns (expressed as the relative deviation of total recorded costs from the awarded amount). "Matching" refers to nearest-neighbor matching on the propensity score estimated from contract characteristics using a logistic regression. "Lasso matching" extends this by selecting covariates from a richer set using lasso, under the assumption of a linear outcome model and a logistic treatment model. "OLS" reports coefficients from linear regressions. Standard errors are in parentheses. Control mean is the average relative cost overrun for the control group (contracts without subcontracting) in the reference sample.

Table B.3: Matching and regression results for rebate rate

	Matching	Lasso matching	OLS
Has subcontract	-0.00414***	-0.00196**	-0.00437***
	(0.000589)	(0.000656)	(0.000505)
Observations	266978	265347	266978
Control mean	0.138	0.138	0.138

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports estimated average treatment effects of subcontracting on the rebate rate (expressed as the percentage deviation of the awarded tender amount with respect to the baseline price). "Matching" refers to nearest-neighbor matching on the propensity score estimated from contract characteristics using a logistic regression. "Lasso matching" extends this by selecting covariates from a richer set using lasso, under the assumption of a linear outcome model and a logistic treatment model. "OLS" reports coefficients from linear regressions. Standard errors are in parentheses. Control mean is the average rebate rate for the control group (contracts without subcontracting) in the reference sample.

Table B.4: Matching and regression results for number of offers

	Matching	Lasso matching	Poisson APE	OLS
Has subcontract	1.590***	1.490***	1.645***	1.908***
	(0.126)	(0.113)	(0.0165)	(0.101)
Observations	218446	216624	218446	218446
Control mean	10.81	10.84	10.81	10.81

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports estimated average treatment effects of subcontracting on the number of tender offers. "Matching" refers to nearest-neighbor matching on the propensity score estimated from contract characteristics using a logistic regression. "Lasso matching" extends this by selecting covariates from a richer set using lasso, under the assumption of a linear outcome model and a logistic treatment model. "Poisson APE" reports average partial effects from Poisson regressions. "OLS" reports coefficients from linear regressions. Standard errors are in parentheses. Control mean is the average number of tender offers for the control group (contracts without subcontracting) in the reference sample.

Table B.5: Matching and regression results for excess costs (rel.)

	Matching	Lasso matching	OLS
Has subcontract	0.0336***	0.0364***	0.0413***
	(0.00202)	(0.00200)	(0.00185)
Observations	99046	97473	99046
Control mean	-0.00109	0.000340	-0.00109

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table reports estimated average treatment effects of subcontracting on relative excess costs (expressed as the percentage deviation of total payments for a contract with respect to its tender base price). "Matching" refers to nearest-neighbor matching on the propensity score estimated from contract characteristics using a logistic regression. "Lasso matching" extends this by selecting covariates from a richer set using lasso, under the assumption of a linear outcome model and a logistic treatment model. "OLS" reports coefficients from linear regressions. Standard errors are in parentheses. Control mean is the average relative excess cost for the control group (contracts without subcontracting) in the reference sample.