Reputation and Entry[1]

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*** PRELIMINARY ***

ABSTRACT

This paper reports results from a laboratory experiment designed to explore the relationship between reputation and entry. There is widespread concern among regulators that favoring suppliers which have extensive histories of good past performance, a standard practice in private procurement, may hinder entry by new (smaller or foreign) firms in public procurement markets. While this concern is present on both sides of the Atlantic, EU regulation constrains the use of past performance information in selecting contractors while US regulation encourages it. Our results suggest that while some reputational mechanisms may indeed reduce the frequency of entry besides increasing quality so that the concern is indeed warranted, well designed reputational mechanisms with positive entry reputation need not hinder entry and may actually stimulate it. Moreover, we find that the pronounced increase in quality induced by reputational incentives is not accompanied by a significant increase in prices, so that the introduction of reputation generates large welfare gains for the buyer.

Key-words: Bid preference programs, Bid subsidies, Entry, Feedback mechanisms, Incomplete contracts, Limited enforcement, Incumbency, Multidimensional competition, Participation, Past performance, Procurement, Quality, Relational contracts, Reputation, Vendor Rating

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1. Introduction

Does reputation deter entry? Do buyers relying on reputational indicators based on past performance reduce the ability of new sellers to enter the market? The US Senate's concern that past performance-based selection criteria could hinder small businesses' ability to enter and successfully compete for public contracts recently led to an intriguing but rather inconclusive report by the General Accountability Office.[3] European regulators appear to have always been convinced that allowing the use of reputational indicators as criteria for selecting contractors would lead to manipulations in favor of local incumbents that could hinder cross-border procurement and common market integration. For this reason EU Procurement Directives prohibit taking suppliers' track records into account when comparing their bids, and EU regulators continue to resist the requests from many European public buyers to allow the use of reputational indicators in the bid evaluation process.[4]

The reason European public buyers and their national representatives are pushing to allow the use of past performance indicators in selecting contractors is apparently that they consider reputational indicators essential to obtain good value for money for the taxpayer. If these indicators deter entry, there may then be a trade-off between the price/quality ratios buyers can secure using reputational indicators and the ability of new suppliers to enter the market.

In this paper we build a simple model of repeated procurement with limited enforcement and potential entry and implement it in the laboratory to try to give some answers to the above mentioned questions. We focus on reputation as an incentive system to limit moral hazard on quality as well as on its effect on selection through entry. Toward this end, we assume that some costly-to-produce quality dimension of supply cannot be specified in a court-enforceable contract and that the potential entrant is more efficient than incumbents. We study how quality, price, entry and welfare change when a reputational mechanism is introduced that rewards an incumbent contractor who provides high quality after winning the current auction with a bid subsidy (of

[3] (GAO-12-102R, 2011). The inquiry had a qualitative nature and in our reading did not reach clear conclusions.

[4] See the EU Green Book 2011, and the Replies to the Consultation that followed it. The curious thing is that a firm's past performance can be taken into account to decide whether a firm can participate in a call for tender or should be excluded ex ante, which sounds rather inconsistent given that being excluded is a much stronger penalty for a firm that performed poorly in the past than having fewer points from the scoring rule.

varying size) in the next procurement auction; and that may award a positive reputational score even to an entrant that never produced before.

Reputational mechanisms that reward past performance are an important governance mechanism for private transactions (Bannejee and Duflo 2000). Court-enforced contracts are often not sufficient to achieve a satisfactory governance of the exchange, and since procurement is rarely occasional reputational forces may complement and improve substantially on what formal contracting can achieve. Private buyers, however, are only concerned about price and quality of the good they buy. Regulators in charge of public procurement, instead, are often interested in objectives other than the price/quality ratio of the publicly purchased goods. They are also typically concerned that the public procurement process is transparent and open for obvious accountability reasons. The need to prevent favoritism and corruption led lawmakers around the world to ensure that open and transparent auctions where bidders have equal treatment - even when in some crucial dimensions they have very different track records - are used as often as possible.

In public procurement open competition is not only seen as an instrument to achieve efficiency and value for taxpayer money, but also to keep public buyers accountable by limiting their discretion in the allocation of public funds. The fact that limiting discretion to ensure public buyers' accountability could come at the possibly large cost of not allowing reputational forces to complement incomplete procurement contracts was stressed by Kelman (1990), who pushed for a deep reform of the US system when he was the head of public procurement during the Clinton administration. The reform pointed at reducing the rigidity of procurement rules in the Federal Acquisition Regulations and allowing public buyers to adopt more flexible purchasing practices common in the private sector, including giving more weight to suppliers' past performance.[7] Since the Federal Acquisitions Streamlining Act in 1994, US Federal Departments and Agencies are expected to record past contractors' performance evaluations and share them through common platforms for use in future contractor selection.

The European Union has instead been moving in the opposite direction. An important concern driving procurement regulation in Europe is helping the process of common market integration by increasing cross-border procurement, i.e., the amount of goods and service each EU state buys from contractors based in other states. The EU Procurement Directives that coordinate public procurement regulation in the various European states considerably limit the possibility of using

[7]As in the case of independent central banks, maintaining accountability after an increase in public buyers' ex-ante discretion (independence) requires more stringent ex-post controls in terms of performance measurement and evaluation. A real of perceived lack of stronger ex-post performance controls may be at the root of recent concerns that this process may have led to excessive discretion and poor accountability in US public procurement (e.g. Yukins 2008).

past performance information in the process of selecting offers. This has been one of the features under broader attack during the 2011 consultation for the revision of the EU Directives.[8] [9]

But regulators would also like to ensure that small businesses are not excluded from public procurement, a concern that in the US led to large programs like the Small Business Act, with its rules limiting bundling and establishing the Small Business Agency, and the 'set aside' common in many types of procurement auctions (see e.g. Athey and Levine 2011; Krasnokutskaya, forthcoming). This brings us back to our main research question. It is natural to think that if past performance is important incumbent firms are likely to have an advantage that might deter new entrants. However, in the case of public procurement and of firms' vendor rating systems, we are talking about reputational mechanisms based on public rules, known and accepted by suppliers, like on eBay. Formal mechanisms and rules give commitment power to the buyer and can be designed in quite different ways. A common mistake made by many is to assume that reputation mechanisms must be designed along the line of the eBay feedback system, where new sellers start with zero reputation. A buyer with some commitment power on its rules for information aggregation and diffusion and for selecting suppliers may well award a positive rating to new entrants - e.g. the maximum, or the average rating in the market – and ensure that this is taken into account by the scoring rule that selects the contractor, even if the contractor never interacted with the buyer before. And indeed, private corporations often have vendor rating systems in which suppliers start off with the same maximal reputational capital - a given number of points - and then lose points when performing poorly and may recover them by performing well, but keeping below or at best maintaining the initial level. In these quality assurance systems incumbents that already served the buyer may have lost some of the initial reputational capital while any new entrant would start off with the full initial reputational capital. This type of vendor rating system creates an advantage for new suppliers, stimulating rather than hindering entry. This suggests that it is possible to design a reputational mechanism in public procurement that sustains, at the same time, quality and entry.

[8]See the summary of the replies to the consultation at http://ec.europa.eu/internal_market/consultations/docs/2011/public_procurement/synthesis_document_en.pdf .

[9] Curiously enough, current European regulation acknowledges the importance of reputation for some types of procurement. For example, the European Research Council (ERC) funds top researchers in Europe, selected through peer review, and the track record of the researchers is then the main awarding criterion. ERC funding is distributed almost only on reputation criteria in order to reach the best and the brightest. Other European instruments for the procurement of research, such as the FET-OPEN program, are based on a completely anonymous evaluation instead. On the dedicated homepage of these programs one reads that: "The anonymity policy applied to short proposals has changed and is strictly applied. The part B of a short STREP proposal may not include the name of any organization involved in the consortium nor any other information that could identify an applicant. Furthermore, strictly no bibliographic references are permitted."

To verify this conjecture we develop here a simple three-period model of competitive procurement with non-contractible quality provision/investment and possible entry by a more efficient competitor in the third and final period, and implement it in the lab. We use it to ask whether reputation-based procurement must necessarily deter entry and to investigate the effects of a vendor rating system on quality and price when an entrant can have a positive entry reputation. A reputational scheme rewarding past provision of high quality with a bid subsidy in the next auctions is then introduced. The potential entrant in the third period has also a bid subsidy in some of the treatments.

We find that in the absence of a reputation mechanism quality provided is low in all periods, prices are higher than production costs, and there is a high frequency of entry. When a "standard" reputation mechanism is introduced that rewards an incumbent firm that produced high quality in the previous period with a bid subsidy but assigns the lowest possible reputation to new entrants, quality is high, prices are not much higher than they were without a reputation mechanism, but entry declines. This result confirms that the concern about reputational criteria hindering the entry ability of small and foreign firms is legitimate. However, when the reputational mechanism is designed so that entrants as well are awarded a positive entry reputation (bid subsidy), quality remains high and entry increases relative to the case without a reputation mechanism. Moreover, it seems that the introduction of a reputational mechanism intensifies competition: contrary to what happens to quality, the price paid by the buyer does not increase. These latter patterns in our data suggest that well designed reputational mechanisms may generate large gains for the buyer while, at the same time, maintaining or increasing the rate of entry by more efficient outsiders.

If confirmed by other experiments, these findings imply that there is no real trade-off between reputation and entry, i.e. there is no need to give up reputation and quality to increase entry and cross-border procurement in the EU. It is sufficient to appropriately design the reputational mechanism. Moreover, since the reaction of prices we observe to the presence of bid subsidies is relatively weak , the increase in quality may come at no cost for the taxpayer.

The remainder of the paper proceeds as follows. In the next section, we discuss closely related literature. In Section 3, we discuss our simple theoretical model and, in the following section, present our experimental design. In Section 5, we present the results from our experiment. The last section provides some concluding remarks.

2. Related literature

Our study is related to a large literature investigating reputation using laboratory or field experiments. One strand of this literature implements games mirroring closely Kreps and Wilson's (1982) chain store paradox game in the lab: a long-run player faces a sequence of short-run players; the long-run player's preferences are his or her private information; this history of long-run players' interactions with short-run players are observable, allowing short-run players to form beliefs about the long-run player's preferences. In this setting, the short run players' equilibrium beliefs *are* the long-run player's reputation. Such beliefs-based reputation can have a beneficial effect for the long-run player, allowing her to earn higher payoffs than possible, in equilibrium, without reputation. Early studies show that experimental participants' behavior fits reasonably well with theoretical predictions, lending credence to the importance and potential benefit of beliefs-based reputation (Camerer and Weigelt, 1988). Subsequent studies investigate more finely both the fit between observed behavior and theoretical predictions as well as the precise mechanisms generating this fit. The results have been mixed (Neral and Ochs 1992; Brandts and Figueras, 2003). For example, Bolton, Katok and Ockenfels (2004) show that reputation can be beneficial for the long-run player even absent uncertainty about her preferences, calling into question the mechanism through which reputation operates. More recently, Grosskopf and Sarin (2010) investigate one alternative mechanism and show that beliefs-based reputational effects are weaker than theory predicts and other-regarding preferences play a non-trivial role. We sidestep the debate about the source and strength of reputation by, differently from this strand of the literature, considering a game with complete and perfect information and implementing a formal reputation mechanism in the form of a bid multiplier.

A more closely related strand of the experimental literature investigates beliefs-based reputation in the specific context of auctions. Dufwenberg and Gneezy (2002) implement 10 periods of first-price sealed bid auctions and vary whether the history of losing bids is observable, finding that when previous losing bids are observable winning bids are higher (i.e., competitive forces are weaker), suggesting reputation between bidders affects efficiency. Brosig and Heinrich (2011) implement two types of auctions, a standard first price auction where the seller with the lowest bid always wins, and another type of auction in which the buyer observes bids and sellers' past histories of quality provision and has complete freedom to choose the winning seller. They find that: sellers invest in reputation by providing high quality when the buyer can choose the winner but not when the buyer has no discretion; buyer discretion therefore increases market efficiency; and that buyers benefit from buyer discretion but sellers do not. Morgan, Orzen, Sefton and Sisak (2010) study how strategic risk and luck affect entrepreneurs' decisions to enter into a market in a repeated competition setting with persistent six-member groups, The role of reputation is minimized by making entry decisions anonymous within groups—in each competition, each entrepreneur observes only how many other group members enter, not which ones. The authors find that when success depends on luck, there is excess entry. Differently from this strand of literature, we implement a formal transparent reputation mechanism not based on beliefs in auctions with complete and perfect information and the possibility of entry. Moreover, our reputation mechanism does not feature buyer discretion.

Reputation has also been studied in the context of exchange platforms where buyers and sellers can leave public feedback about previous interactions. Familiar examples include many popular on-line trading platforms: eBay, Amazon, Cnet, etc. Results have been mixed as to whether this type of reputation mechanism induces more honest behavior or more trade. Bolton et al. (2004) study how such feedback influences honesty and trade in experimental auctions where agents interact repeatedly. They find reputational feedback provides weaker incentives for honest behavior than traditional markets with long-lasting relationships among agents. They argue this is because reputational feedback mechanisms generate a public goods problem: benefits from honest behavior are not fully internalized by the agents. Bolton, et al., (2007) conduct online market games to test how competition and reputation in social networks interact. On the competition dimension they consider three cases: i) no competition (buyers cannot choose with whom they are matched); ii) matching competition (buyers choose sellers on the basis of reputation information); and iii) price competition (buyers choose sellers on the basis of reputation information and price offers by sellers). They consider two types of networks: partners networks (buyer-seller pairs persist) vs. strangers networks (a particular buyer seller interacting at most once). They find that competition in strangers networks increases total gains from trade: with competition and reputation, buyers can discriminate between sellers creating incentives for seller honesty. Finally, Bolton, et al., (2011) provide experimental evidence on how reciprocity in feedback affects reputation exchange platforms, reducing efficiency. Modifying the standard feedback system by i) making conventional feedback blind (feedback is given simultaneously) and ii) adding a detailed seller rating system, they find that both feedback blindness and allowing a detailed seller rating system increase the informational content of feedback. Our paper differs from Bolton et al (2004, 2007, 2011) in that we focus on reputation based on actual quality delivered rather than (possibly false) messages about past quality.

Dulleck et al (2009) study the determinants of efficiency in markets for credence goods varying liability, verifiability, reputation building and competition. Differently from our approach, but similar to much of the literature, reputation in their experimental framework is beliefs-based. They find liability has a crucial effect on efficiency relative to verifiability whereas allowing sellers to build up reputation has little influence; moreover, competition—consumers' ability to choose among sellers—yields lower prices and maximal trade but not higher efficiency when liability is violated.

On the theoretical side, our work is closely related to the first formal analyses of reputation for quality in the 1980s, including Klein and Leffler (1981), Shapiro (1983), Allen (1984) and Stiglitz (1987), that were directly concerned with the relationship between the ability of reputational forces to curb moral hazard and the competitive conditions prevailing in the market. A central question this literature tried to address is precisely how reputational forces, which require a future rent as reward for good behaviour, could be compatible with free entry. Recent analyses in this direction include Kranton (2003), Bar-Isaac (2005) and Calzolari and Spagnolo (2009), which suggest that when important dimensions of the exchange are not contractible and there are many competing suppliers, limiting entry and competition may indeed be beneficial for the buyer. Hoerner (2002) shows that if prices can be used as signals of quality there are also equilibria in which competition strengthens reputational forces, but this would not be possible in public procurement in which prices are a dimension of the scoring rule selecting the winner and cannot therefore be used to signal quality.

Our work is also related to the literature on the efficient design of "feedback mechanism" sparked by the emergence of eBay and its well known reputation system, surveyed in Dellarocas (2006). To our knowledge, however, the relationship between the design of the reputation system and entry in a market has not been analysed in this literature.

More indirectly related are theories describing how reputation can be used to deter entry, like the classic studies by Kreps and Wilson (1982) and Milgrom and Roberts (1982), and the recent literature on when reputation may have permanent effects and under which condition it has stronger effects, well summarized in Bar-Isaac and Tadelis (2008) and Mailath and Samuelsson (2006).

3. The theoretical framework

The game

We develop a simple game consisting of a sequence of three first-price auctions and three players: two Incumbent firms and one Entrant firm. Only Incumbent firms can participate in the first two auctions. We will refer to the first auction as Auction 1, the second as Auction 2 and the last as Auction 3. Three is the minimum number of stages that allow for investing in building reputation (in Auction 1) and for reaping the gains for such investment (in Auction 2) before entry may occur and the game ends (in Auction 3).

In each auction the lowest bid wins. Ties are broken by selecting a winner (uniformly) randomly from among the firms submitting the lowest bid. The winning firm must produce a good but can choose whether to produce a high quality good, which costs the firm c_H, or to produce a low quality good which costs the firm $c_L < c_H$.

While producing high quality is relatively costly, it may yield reputational benefits. We model this in a simple way using a bid multiplier that applies for one auction only. Specifically, for $t \in \{2,3\}$, if an Incumbent firm won auction $t-1$ and produced high quality in that auction, and then the same firm wins auction t, that firm is paid a multiple B of the auction t bid, with $B>1$. In this way, Incumbent firms that choose to produce high quality today enjoy an advantage in tomorrow's auction, since the minimum bid required to ensure a positive profit is lower for such firms.

Entrant firms cannot participate in the first two auctions but do observe all bids and outcomes. They earn a fixed per-auction reservation wage, w. Entrant firms may participate in Auction 3 if they choose to. Specifically, before Auction 3 begins, the Entrant firm decides whether to enter, and forgo w, or to stay out of the auction and earn w. The entrant firm has a cost advantage in producing low quality, i.e. $c_L^e = c_L - k$, where c_L is the Incumbent firms' (common) cost of producing low quality and k a constant capturing the Entrant firms' higher efficiency.

To investigate the effects of a reputational mechanism on Entrant firms' behaviour, incorporating the idea that such a mechanism may well assign a positive reputational score to a new firm/entrant, we introduce and vary the level of a reputational bonus β assigned to the entrant. We consider three cases, and assign: i) a bid multiplier equal to that of an Incumbent firm with high reputation ($\beta=B$); ii) a bid multiplier equal to the average of the maximum and minimum possible, i.e. $\beta = \frac{B+1}{2}$; and iii) no bid multiplier for the entrant ($\beta=1$). These rules are common knowledge among all players.

Equilibria of the game

We solve this game for the three different values of "entry reputation" β and find the parameter conditions that allow for two possible pure strategy equilibria. In a first, "entry-accommodation," equilibrium, the winning Incumbent firm exploits his reputational advantage acquired at the end of the first auction by winning the second auction, receiving his (multiplied) winning bid and then producing low quality. In this way, the incumbent firm accommodates entry in the last period since the more efficient Entrant firm will, in equilibrium, win the last auction producing low quality and making positive profits given its cost advantage.

In a second equilibrium that we call "entry-deterrence," the Incumbent firm who wins Auction 1 keeps its reputational advantage by winning and producing high quality also in Auction 2. Since in Auction 3 an Incumbent firm has a pricing advantage through the bid multiplier, the Entrant firm does not enter. The existence of this equilibrium depends on both the Entrant firm's bid multiplier, *β,* and its efficiency advantage, *k*.

Predictions and Parameter Values

Solving the model, we find restrictions on parameter values yielding the two equilibria mentioned above.

Provided that B ∈ $\left[\frac{3c_H - c_L}{2c_L}, \frac{c_H + 3c_L}{2c_L}\right]$,

- in the case of an Entrant firm with bid multiplier *β=B,* if $k < w$ only the "entry-accommodation" equilibrium exists;
- in the case of an Entrant firm with no bid multiplier (*β=1),* if $k < w + c_L - \frac{c_L}{B}$ only the "entry-deterrence" equilibrium exists;
- in the case of an Entrant firm with bid multiplier $\beta = \frac{B+1}{2}$, if $k = w + c_L - c_L\frac{\beta}{B}$ then an Entrant firm is indifferent between entering or not and both the "entry-deterrence" and the "entry-accommodation" equilibria exist.

Given the conditions mentioned above, we chose the following parameter values for our experiment which imply entry deterrence is the unique equilibrium prediction when *β=1*, and that either entry accommodation or entry deterrence are possible when $\beta \in \{\frac{B+1}{2}, B\}$: $w = 1$; $c_L = 1.5$ and $c_H = 2$; $B = 2$; $k = 1.375$. For more details on the model and its solutions, see Section C of the Appendix.

4. Experimental Design

The basic structure

All sessions of the experiment were conducted at the Einaudi Institute for Economics and Finance in Rome, Italy, using the software z-tree (Fischbacher, 2007). Twelve sessions were conducted involving a total of 243 participants.

The experiment consisted of four different treatments, which we describe below. In all of the treatments participants played multiple rounds of the game described above, where a complete three-auction sequence constitutes a round. Before each round, participants were randomly and anonymously (re-)divided into groups of three and then randomly assigned one of two roles: two participants in each three-person group were assigned the role of "Incumbent firm," while the third person in each group was assigned the role of "Entrant firm."[10] Within each three-person group, in each round, participants played the sequence of three first-price sealed-bid auctions described above.

Each treatment consisted of from 12 to 15 rounds of the three first-price sealed-bid auctions, with groups being randomly and anonymously re-formed between each round. Participants were instructed that at the end of the experiment one round would be randomly chosen to count toward their experimental earnings.

Within each round, play proceeded as follows. Incumbent firms participated in all three auctions of a round. By contrast, Entrant firms did not participate in the first two auctions, but instead earned a fixed outside wage of 1 euro and observed all bids and outcomes of the first two auctions within their 3-person group. Before the third auction of the round began, Entrant firms decided whether to participate in this last auction and forgo their outside wage, or to stay out of even this last auction and earn their outside wage of 1 euro. Incumbent firms never earned an outside wage in any period.

Within each auction, bids were submitted simultaneously with the lowest bid winning the auction. Ties were broken by randomly choosing among the firms submitting the lowest bid. The winning firm then decided to produce either a low quality good at cost c_L (c_L - k for Entrant firms), or a high quality good at cost $c_H > c_L$. Losing firms earned nothing, while the earnings of winning firms varied by treatment (detailed below). At the end of each auction, participants learned the bids of the other firm(s), and the production decision of the winning firm, in their own three-person groups. Participants never learned anything about choices in groups other than their own. Finally, before

[10] We use the terms "Incumbent" and "Entrant" here for clarity of exposition. Neutral language was used in the experiment. Specifically, roles were referred to as "Firm A" "Firm B" and "Firm C," with the first two being incumbents and the latter the entrant.

the third auction began participants were informed of the entry decision of the Entrant firm in their group.

Four treatments

The basic structure outlined above was common to all sessions. Three treatments involved a formal reputational mechanism. In the fourth, "Baseline," treatment no formal reputational mechanism was implemented. Let us first consider the treatments with a reputational mechanism.

The reputational mechanism we implemented took the form of the simple bid multiplier described earlier. For incumbents, this bid multiplier B was the same in all treatments involving reputation. In particular, we set B=2, so that for $t \in \{2,3\}$ an incumbent firm that won Auction *t-1* and produced high quality in that auction and then subsequently also won Auction *t* with winning bid *b*, would be paid 2*b*, so that profits from Auction *t* would be $2b - c$, where $c \in \{c_H, c_L\}$ according to the firm's quality production decision. In Auction 1, no firm received any bid multiplier.

What we varied across the three treatments involving a reputational mechanism was the bid multiplier for Entrant firms: β. In the High Bonus (HB) treatment, we set $\beta = B = 2$; in the Medium Bonus (MB) treatment $\beta = 1.5$; and in the Low Bonus (LB) treatment there was no entrant reputation, i.e. $\beta = 1$. Since Entrants participated in (at most) the third auction, this bonus was not contingent on previous production decisions. Specifically, an Entrant firm winning Auction 3 with bid *b* earned $\beta * b - c$, where $c \in \{c_H, c_L - k\}$ according to the Entrant firm's quality production decision.

Baseline treatment

In our baseline treatment, we omitted the bid multiplier for both Incumbent firms and Entrant firms (we set $\beta = B = 1$). Hence, this baseline treatment involved no (formal) reputational mechanism. Otherwise, the design was identical to the three treatments (HB, MB, LB) detailed above. Winning Incumbent (Entrant) firms earned their bid minus the cost of production, $b - c$, where $c \in \{c_H, c_L\}$ ($c \in \{c_H, c_L\text{-}k\}$) depending on the firm's production decision.

Risk aversion measure

At the end of every session, after all rounds of the auction game were completed but before participants knew which round would be chosen to determine their earnings, we collected an incentive compatible measure of participants' risk aversion. Participants were given a sheet of paper with 20 decisions, in table format. Each row of the table consisted of a choice between a sure payoff of 5 euro or a lottery paying 2.5 euro with a 50 percent chance and a larger amount with a 50 percent chance. The larger amount increased from 7.5 euro to 17 euro in steps of 50 cents. Participants were informed that one row of the table would be chosen at random to actually count toward their experimental earnings. If the chosen row involved a lottery, uncertainty would be resolved by the experimenters flipping a coin.

Participants were paid individually. Which row of the risk test counted was determined by having each participant draw a numbered poker chip from an opaque bag. Average earnings in the experiment were approximately 12 euro and each session lasted about two hours.

Information on all four treatments is summarized in Table 1.

[Insert Table 1 about here]

5. Results

Descriptive Statistics

In this section we provide a descriptive analysis of winning bids, quality provision, profits and entry by treatment and, within treatment, by auction. Unless otherwise noted, all results involve pooling over all (12-15) rounds of the three-auction game.[11]

In Table 2A we report average winning bids. Two patterns are apparent: winning bids generally decrease over the sequence of three auctions; and, irrespective of auction number, introducing our formal reputation mechanism lowers winning bids, on average. [12] Table 2B reports the average

[11] We report in the Appendix, Section B, formal tests for dynamic trends across rounds which partially justify pooling the data. Specifically, in order to check for trends across rounds, we regressed a set of round dummies on each of the variables considered in this section (winning bid, quality provision, entry and profits). We find that the period dummies often are not significant—implying not significant trends across rounds. When they are significant (e.g., for winning bids), then we typically observe a steep decline over the first three rounds of game play and no uniform pattern afterwards implying substantial initial learning and quick convergence to relatively stable strategies. Removing observations from the first 3-5 rounds of play does not change our results qualitatively.

[12] Pairwise non-parametric Mann-Whitney tests are reported in the Appendix, Section A.

transfer paid by the buyer – i.e., the winning bid multiplied by any relevant reputational bid multiplier. Surprisingly, transfers do not rise substantially either in any single auction, or across all three auctions, even though in some treatments the bid multiplier is large. The appearance of non-significant variation in transfers is confirmed in more formal regression analyses (Table A6, Appendix).

[Insert Table 2 about here]

In Table 3, we report the average proportion of winning firms providing high quality. As expected, quality provision is lowest in the baseline treatment where there is no formal reputational mechanism. The all auction column shows that in average going from the baseline to the treatments with formal reputational mechanism increase quality provision of 4 times.

In all treatments except baseline, there is a marked decline in quality provision when moving from the second to the third auction. This was also expected, because Auction 3 is the last stage and there is no incentive to maintain a good reputation while in Auction 2 such an incentive may be reduced if the Entrant is expected to enter and win Auction 3 because he has a positive entry reputation.

In Auction 1 and Auction 2, Mann-Whitney tests on quality provision show that the baseline treatment is significantly different from the other treatments, while all other treatments are not significantly different from each other.[14]

[Insert Table 3 about here]

In Table 4, we report the proportion of Entrant firms choosing to enter in the third auction. It is evident that entry is relatively uncommon in LB. This is the effect the US Senate and the European Commission are concerned about. Indeed, naively introducing a "standard" reputational mechanism with zero reputation for the entrant ensures that Entrant firms face the worst disadvantage relative to an Incumbent with reputation. The significance of this effect in our experiment is confirmed by

[14] In Auction 3, the baseline treatment is significantly different from the LB and MB treatments, but not different from the HB treatment. Quality provision does not differ significantly between LB and MB, but differ significantly between MB and HB. Finally the Baseline treatment and HB are not significantly different.

Mann-Whitney tests which show that entry in the LB is significantly different from entry in all other treatments. In fact, considering all pairwise tests the only non-significant difference is between the MB and the HB treatments.

These patterns suggest that the introduction of a well conceived reputation mechanism where new entrants start off with a positive reputational score not only does not hinder entry, it can actually foster entry over and above the entry rate without a reputational mechanism.

[Insert Table 4 about here]

In Table 5, we report average profits of Entrant firms. The left panel reports profits irrespective of entry, while the right panel of Table 5 conditions on entry. In each panel, the left-most column includes reservation wages while, in the right-most column, we set Entrant firms' profits equal to zero if the firm does not enter Auction 3. From the table it is evident that Entrant firms earn less in the LB and more in MB and HB than in the baseline treatment, which is in line with what observed in table 4. [15]

[Insert Table 5 about here]

Table 6 reports average profits by auction, pooling over both types of firms. We see that, in Auction 1 profits are generally highest in the baseline treatment. In Auctions 2 and 3, however, profits tend to be higher in the treatments with a reputational mechanism (LB, MB and HB). The all auction column shows that when we include the reservation wage the highest profits are in the baseline treatment followed by HB.

A series of Mann-Whitney tests suggest that profits do not differ significantly across treatments or auctions with the lone exception of profits in the baseline treatment in Auction 1.

[15] Pairwise Mann-Whitney tests show that the Entrant firms' profits are significantly different in the baseline compared to LB and HB, while profits in MB are typically not significantly different from profits in the baseline treatment (Appendix, Table A3).

[Insert Table 6 about here]

Table 6b reports average buyers transfers, i.e. effective payments to suppliers, by auction and treatments. The all auction column shows that in average *the buyers transfer are highest in baseline treatment*, followed by the HB, while they are slightly lower in LB and MB . In particular the buyer payments in the baseline are highest in the first auction and lowest in the third, compared to the other treatments. In HB the buyer cost are lower than the baseline in the first auction and higher in the second and third auction. This table shows that when we introduce a reputational mechanism, the buyer does not pay a higher price and may actually pay a lower one, even though he receives high quality four times more often. and entry is not reduced.

[Insert Table 6b about here]

Finally, we consider incumbency. By incumbency we mean the probability that the bidder winning Auction *t* also wins Auction *t+1*, for $t \in \{1,2\}$. We report incumbency propensity in the experimental data in Table 7. Notice that in the baseline treatment incumbency is generally the lowest. This makes sense given that winning a prior auction conveys no (formal) advantage in later auctions in the baseline. Also notice that, going from Auction 2 to Auction 3, incumbency propensity is the highest in LB. Again, this makes sense given that entry accommodation by Incumbent firms with reputation is not an equilibrium of LB.

[Insert Table 7 about here]

Regression and probit analyses

Having described general patterns in the data, let us now dig a bit deeper and formally estimate models. In Table 8 we consider winning bids and ask whether there is a significant difference across treatments. We use winning bids as the left-hand side variable and regress this on a set of treatment dummies (baseline being the excluded category). We control for learning by including the round of game play (“Round”) as a right-hand-side variable. Consistent with our descriptive analysis above, we find in all treatments and all auctions, winning bids are lower when there is a formal reputational mechanism (LB, MB, HB) than when there is not (baseline). Moreover, except in one case—Auction 3 of LB—this difference is statistically significant.

In terms of economic significance, Table 8 suggests that winning bids are about 46 percent lower in Auction 1 in MB than in the baseline treatment. For Auctions 2 the winning bids for all treatment are either 37 or 39 percent lower than the baseline. Finally in auction 3, winning bids in MB and HB are respectively 31 and 39 percent below those in the baseline treatment. Overall, the results suggest that the presence of a reputation incentive has a strong effect in lowering prices, but the strongest effect is when there is also an entry incentive (MB and HB). The all auction column confirm all this and show that the stronger overall effect is in MB.

[Insert Table 8 about here]

Next, we consider how quality provision varies across treatments (Table 9). Specifically, for each auction we estimate a probit model using as the dependent variable the winning firm's (binary) decision to provide high quality and, as explanatory variables, indicator variables for our different treatments (baseline being the excluded case) as well as experimental round. We report marginal effects from these estimated probit models in Table 9. We find that the lowest incidence of quality provision occurs in the baseline treatment, as expected, since there is no formal incentive to provide high quality there. In Auctions 1 and 2, quality provision is significantly higher in LB, MB and HB relative to the baseline treatment. On the other hand, in Auction 3, only in MB are winning firms significantly more likely to provide high quality than in the baseline treatment. Quality provision generally declines significantly over rounds, although the estimated marginal effect is quite small.

Turning from statistical significance to economic significance, our results suggest that the effect on quality provision of providing a formal reputational mechanism can be quite large in percentage terms. For instance, in Auctions 1 and 2, winning firms are from 30 percent (MB, Auction 2) to 41 percent (LB, Auction 1) more likely to provide high quality than in the baseline treatment. In the all auction results we see that in the tree treatment with a reputational mechanism the likelihood of providing high quality increase from 60 percent to 62 percent.

[Insert Table 9 about here]

Next, we focus on how providing a reputational mechanism affects entry. In Table 10 we report the marginal effects from an estimated probit model which uses, as the dependent variable, an indicator taking the value one whenever an Entrant firm decides to enter Auction 3 rather than stay out. We use our usual set of independent variables. From Table 10 we see that entry is (economically and statistically) significantly more likely in MB and HB than in the baseline treatment (10% and 8% more likely, respectively). A reputation mechanism does not always increase entry, however, as in the LB treatment entry was less likely than in the baseline treatment, this is because in LB, $\beta=1$ while $B=2$. Although this last effect is not statistically significant, it gives some justification to the concern that a (poorly calibrated) reputational mechanism can hinder entry

[Insert Table 10 about here]

Finally, we consider how firms' profits vary across our treatments and, within treatments, across auctions. In Table 11 we pool all firms—both Incumbent firms and Entrant firms—and report simple OLS estimates of profits as a function of treatment and auction number. We find that introducing a reputational mechanism tends to significantly reduce profits in Auction 1, in Auction 2 profits are not significantly different from the baseline treatment, while and profits in Auctions 3 increase significantly only when w is excluded. When we look at the results over all auctions the profits are not significantly different from the baseline.

[Insert Table 11 about here]

In table 12, we focus exclusively on Entrant firms' profits and estimate how profits for these firms vary over our treatments. Here, we see that Entrant firms do worse under a poorly designed reputational mechanism (LB) than without a reputational mechanism (baseline). However, in some cases Entrant firms enjoyer higher profits with a reputation mechanism than without. In particular, an intermediate bonus level (MB) leaves Entrant firms no worse of profit-wise than if there were no reputational mechanism, while a relatively generous reputational bonus (HB) allows Entrant firms to make significantly more profit than in the baseline treatment, which lacks a formal reputation system.

[Insert Table 12 about here]

Wrapping up, we have shown that our formal reputational system has the possibility of simultaneously increasing firms' welfare (profits), increasing entry and increasing the provision of high quality goods and services. Whether this is worth the added cost of paying a bonus to the lowest bidder is not clear so far, however, as it depends on how much buyers care about quality provision and entry vis-à-vis the potentially increased expenses stemming from the bid multiplier itself. To address this question, we construct a simple welfare function for the buyer and take this to our data to estimate whether our reputational mechanism increases buyer welfare and, if so, what level of entrant bonus is (empirically) optimal.

Buyer's preferences: theoretical and empirical welfare functions

In this section we compare the welfare generated by all the treatments in two possible scenarios, i.e. i) the buyer equally weights entry, quality and price and ii) the buyer weights equally the last two and puts zero weight on entry. We derive a simple theoretical welfare function according to the parameters introduced above and check whether the predictions we obtain are consistent with the experimental data.

To construct a simple, general, theoretical welfare function we suppose that the buyer derives utility from each of three components: cost, quality and entry. In our mechanism, the buyer's cost may differ from the wining firm's bid because of the bid multiplier. Each of these components enters the buyer's welfare function with a particular weight. We suppose that these are the only three components of buyer welfare and that they enter in an additively separable manner.

We evaluate the total welfare each treatment generates by giving a specific weight to price, quality and entry. The welfare function we consider is $W = \alpha\mathcal{D} + \gamma Q + \delta Pr(E)$, where $\alpha + \delta + \gamma \leq 1$; $\mathcal{D} = \frac{4.5 - \frac{\sum_{t=1}^{3} T_t^*}{3}}{4.5}$, is the "discount" the buyer enjoys. In this last equation, T_t is the transfer from buyer to seller (i.e., [winning bid]*[relevant bid multiplier]) in Auction t, while 4.5 is the maximum allowable bid in the experiment. $Q = \frac{\sum_{t=1}^{3} \mathrm{I}[q_H]}{3}$, is the percentage of high quality delivered in three periods. $Pr(E) = Pr[\mathbb{E}\pi^{entrant} \geq 1]$ is the probability entry occurs in the last period which is 0, 0.5 or 1 if the entrant's expected profits are respectively less then, equal to or greater then 1 (entrant's reservation price w is equal 1). In order to reduce complexity in the comparative analysis of welfare, we set $\delta = (1 - \alpha - \gamma)$. [16]

Using the parameters chosen for the experiment, we then calculated the theoretical welfare by computing the values of $\mathcal{D}, Q$ and $Pr(E)$ for each treatment. Hence we simulate the welfare level of each treatment by considering two possible sets of values for α and γ, namely i) $\alpha = \gamma = \frac{1}{3}$ and ii) $\alpha = \gamma = \frac{1}{2}$. Results are reported in Table 13a.

[Insert Table 13a about here]

Under case i), society equally weights entry, quality and buyer's profits and the highest welfare is reached in the HB treatment (when B= β =2, W = 0.71). Conversely, under case ii), all the weight goes to quality and buyer's costs and the LB treatment delivers the highest welfare for society (when B=2 and β =1, W = 0.73).

These predictions are partially supported by our experimental participants' actual behaviour. To calculate an empirical welfare function, we measure quality, Q, by the average proportion of winning firms providing high quality across all three auctions and across all firms. We measure entry, E, as the average proportion of Entrant firms entering in Auction 3. Finally, as our measure of cost we simply calculate $\mathcal{D}$ according to the formula described above. Also for this empirical evaluation we consider the same two scenarios explained above, i.e. the buyer cares equally about expense, quality provision and entry vs. the buyer does not care about entry at all.

[Insert Table 13b about here]

[16] In the Middle Bonus [B = 2; $\beta = 1.5$] and Baseline [B $= \beta = 1$] treatments either the entry-accommodation or entry-deterrence may occur. In those scenarios we calculated the average expected welfare as W = $\mathbb{E}(W) = \frac{w(acc)+w(det)}{2}$, where $w(acc)$ is the welfare generated from the entry-accommodation equilibrium and $w(det)$ is the welfare generated from the entry-deterrence one.

Table 13b reports buyer welfare evaluated according to the welfare function using our experimental data. From this exercise, we see that in the first case, where the buyer cares equally about cost, quality and entry, buyer welfare is highest in our experiment in the MB treatment. On the other hand, in the latter case where entry propensity does not enter into the buyer's welfare function, implementing a reputational mechanism is still preferred to not implementing a reputational mechanism, but the difference in welfare among the relative advantage to assign to Entrant firms is not so obvious as in the former case (with only a slightly preference towards the Mid Bonus).

Table 13c reports buyer welfare evaluated according to the welfare function using our experimental data only for Auction 1. From this table we can see that the increase in welfare is higher for the first auction compared to the all auction averaged, still it shows that buyer welfare is highest in our experiment in the MB treatment.

6. Concluding remarks

In this paper we ask whether the use of reputational indicators based on past performance, while stimulating quality provision, necessarily also hinder entry by new sellers. This is an open and policy-relevant question as the US Senate's recently expressed concerns that past performance-based selection criteria could hinder small businesses' ability to enter and successfully compete for public contracts, while European regulators appear to have always been convinced that allowing the use of reputational indicators as criteria for selecting contractors would favor of local incumbents.

We investigated this question experimentally. We developed a simple model of repeated procurement competition with limited enforcement on quality and potential entry by a more efficient supplier and implemented it in the laboratory. Treatments differed by the presence and design of a past-performance based reputational mechanism.

First we show that concerns that reputation may hinder entry are justified: naively introducing a "standard" reputational mechanism in which good past performance is rewarded with a bid subsidy in the following procurement auctions increases quality provision but significantly reduces entry.

We then show that properly designed reputation mechanisms, in which new entrants are awarded a moderate or high reputation score (as often done in the private sector, or with point systems in driving licenses), do not hinder entry and actually tends to foster it, besides increasing quality.

A third important result is that prices do not increase when a reputational mechanism is introduced and (costly) quality provision increases. The introduction of bid preferences for good past performance appears to benefit the buyer/tax payer also by increasing competition for incumbency.

Our results indicate that there may not be a trade-off between the use of past-performance-based reputational mechanisms and entry by new firms into a market. In our experiment a well-calibrated reputational mechanism can increase both entry and quality provision, without increasing the cost for the procurer. Policy makers should probably stop quarrelling about whether a generic past-performance base reputational mechanism should be introduced, and focus on how such a mechanism should be designed in a context where entry has positive social value *per se*.

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Tables and Figures

Table 1: Summary of Treatments

Treatment	Incumbent			Entrant			Participants	Sessions
	Bonus	c_H	c_L	Bonus	c_H	c_L		
HB	2	2	2	2	2	0.125	51	3
MB	2	2	2	1.5	2	0.125	60	3
LB	2	2	2	1	2	0.125	42	2
Baseline	1	2	2	1	2	0.125	90	4

Table 2A: Average winning bid, by auction and treatment

	Auction 1	Auction 2	Auction 3	All Auctions
Baseline	2.14	1.97	1.57	1.90
	(0.014)	(0.014)	(0.015)	(0.012)
Low Bonus (LB)	1.87	1.60	1.41	1.63
	(0.016)	(0.015)	(0.017)	(0.013)
Medium Bonus (MB)	1.67	1.57	1.24	1.49
	(0.015)	(0.011)	(0.014)	(0.011)
High Bonus (HB)	1.91	1.58	1.22	1.57
	(0.015)	(0.015)	(0.015)	(0.012)
Observations	3033	3033	3033	3033

Notes: Robust standard errors, clustered by session, appear in parentheses.

Table 2B: Average buyer's transfer, by auction and treatments

	Auction 1	Auction 2	Auction 3	All Auctions
Baseline	2.14	1.97	1.57	1.95
	(0.014)	(0.014)	(0.015)	(0.014)
Low Bonus (LB)	1.87	2.03	1.68	1.86
	(0.016)	(0.037)	(0.032)	(0.021)
Medium Bonus (MB)	1.67	1.97	1.64	1.76
	(0.015)	(0.029)	(0.024)	(0.016)
High Bonus (HB)	1.91	1.99	1.87	1.92
	(0.015)	(0.033)	(0.034)	(0.019)
Observations	2,022	2,022	3,033	3,033

Table 3: proportion of winning firms producing high quality

	Auction 1	Auction 2	Auction 3	All Auctions
Baseline	0.06 (0.007)	0.03 (0.005)	0.02 (0.004)	0.04 (0.007)
Low Bonus (LB)	0.27 (0.020)	0.19 (0.018)	0.05 (0.009)	0.17 (0.019)
Medium Bonus (MB)	0.26 (0.017)	0.16 (0.013)	0.06 (0.008)	0.15 (0.015)
High Bonus (HB)	0.26 (0.017)	0.20 (0.016)	0.03 (0.007)	0.17 (0.017)
Observations	3033	3033	3033	3033

Table 4: Entry

	Auction 3
Baseline	0.61 (0.015)
Low Bonus (LB)	0.42 (0.022)
Medium Bonus (MB)	0.69 (0.016)
High Bonus (HB)	0.67 (0.018)
Observations	3033

Notes: Robust standard errors, clustered by session, appear in parentheses.

Table 5: Entrant firms' profits

	Not conditional on entry		Conditional on entry	
	(Including w)	(Excluding w)	(Including w)	(Excluding w)
Baseline	1.12	0.49	1.20	0.80
	(0.018)	(0.038)	(0.028)	(0.052)
Low Bonus (LB)	1.04	0.27	1.10	0.64
	(0.015)	(0.041)	(0.034)	(0.779)
Medium Bonus (MB)	1.21	0.61	1.31	0.88
	(0.031)	(0.053)	(0.043)	(0.684)
High Bonus (HB)	1.44	0.82	1.66	1.21
	(0.049)	(0.078)	(0.066)	(0.100)

Notes: Robust standard errors, clustered by session, appear in parentheses.

Table 6: Profits by auction, pooling over roles

	Including w				Excluding w			
	Auction 1	Auction 2	Auction 3	All Auctions	Auction 1	Auction 2	Auction 3	All Auctions
Baseline	0.54	0.53	0.43	0.50	0.19	0.14	0.16	0.16
	(0.015)	(0.015)	(0.021)	(0.016)	(0.012)	(0.010)	(0.014)	(0.007)
Low Bonus (LB)	0.32	0.53	0.47	0.44	-0.01	0.20	0.21	0.14
	(0.024)	(0.031)	(0.029)	(0.022)	(0.010)	(0.029)	(0.026)	(0.015)
Medium Bonus (MB)	0.26	0.53	0.44	0.41	-0.07	0.20	0.24	0.12
	(0.021)	(0.023)	(0.026)	(0.019)	(0.010)	(0.022)	(0.025)	(0.012)
High Bonus (HB)	0.34	0.53	0.53	0.47	0.01	0.20	0.33	0.18
	(0.021)	(0.027)	(0.034)	(0.022)	(0.009)	(0.026)	(0.033)	(0.015)

Notes: Robust standard errors, clustered by session, appear in parentheses.

Table 7: Incumbency propensity

	Win auction 1 & 2		Win auction 2 & 3	
	Incumbent firm 1	Incumbent firm 2	Incumbent firm 1	Incumbent firm 2
Baseline	0.50	0.52	0.36	0.31
	(0.022)	(0.021)	(0.021)	(0.020)
Low Bonus (LB)	0.58	0.57	0.52	0.52
	(0.032)	(0.030)	(0.032)	(0.032)
Medium bonus (MB)	0.69	0.55	0.45	0.36
	(0.024)	(0.025)	(0.023)	(0.026)
High bonus (HB)	0.54	0.69	0.43	0.46
	(0.027)	(0.026)	(0.030)	(0.026)

Notes: [1] Incumbency is the probability that a particular bidder winning Auction t also wins Auction $t+1$, for $t \in \{1,2\}$.
[2] Robust standard errors, clustered by session, appear in parentheses.

Table 8: Winning bids, by auction and treatments

	Auction 1	Auction 2	Auction 3	All Auctions
Low Bonus (LB)	-0.28**	-0.37***	-0.16	-0.27***
	(0.111)	(0.094)	(0.100)	(0.087)
Medium Bonus (MB)	-0.46***	-0.39***	-0.31**	-0.38***
	(0.103)	(0.101)	(0.126)	(0.107)
High Bonus (HB)	-0.22**	-0.37***	-0.33***	-0.31***
	(0.101)	(0.100)	(0.103)	(0.100)
Round	-0.02***	-0.03***	-0.03***	-0.03***
	(0.006)	(0.006)	(0.005)	(0.005)
Constant	2.27***	2.16***	1.77***	2.07***
	(0.084)	(0.098)	(0.110)	(0.094)
Observations	2,022	2,022	3,033	3,033
R-squared	0.191	0.253	0.178	0.269

Notes: [1] Each column presents a simple OLS regression using as the dependent variable winning bids in the relevant auction (column heading). [2] Robust standard errors, clustered by session, appear in parentheses. [3] *** p<0.01, ** p<0.05, * p<0.1

Table 9: Quality provision, by auction and treatment

	Auction 1	Auction 2	Auction 3	All Auctions
Low Bonus (LB)	0.41***	0.36***	0.04	0.62***
	(0.045)	(0.052)	(0.022)	(0.108)
Medium Bonus (MB)	0.38***	0.30***	0.05**	0.60***
	(0.042)	(0.054)	(0.022)	(0.110)
High Bonus (HB)	0.39***	0.36***	0.01	0.61***
	(0.046)	(0.047)	(0.023)	(0.109)
Round	-0.00*	-0.01**	-0.00**	-0.01***
	(0.003)	(0.003)	(0.001)	(0.004)
Observations	2,022	2,022	3,033	3,033

Notes: [1] Columns 1-3 present marginal effects estimates from a (separate) probit model, using as a dependent variable a dummy taking the value one whenever the winning firm produced high quality in the relevant auction (column heading). [2] The fourth column presents results of a tobit regression in which the dependent variable is the n. of times high quality has been produced by the winning firm standardized by the n. of auctions. [3] Robust standard errors, clustered by session, appear in parentheses. [4] *** p<0.01, ** p<0.05, * p<0.1

Table 10: Entry, by treatment

Low Bonus (LB)	-0.19
	(0.125)
Medium Bonus (MB)	0.10**
	(0.040)
High Bonus (HB)	0.08**
	(0.031)
Round	-0.02***
	(0.006)
Observations	1,011

Notes: [1] Reported values are marginal effects from a probit model, using as a dependent variable a dummy taking the value one whenever the Entrant firm entered Auction 3 rather than staying out. [2] Robust standard errors, clustered by session, appear in parentheses. [3] *** p<0.01, ** p<0.05, * p<0.1

Table 11: Profits, by treatment and auction

	Including w				Excluding w			
	Auction 1	Auction 2	Auction 3	All Auctions	Auction 1	Auction 2	Auction 3	All Auctions
Low Bonus (LB)	-0.20***	0.06	0.04	-0.06	-0.20***	0.06	0.05*	-0.03
	(0.040)	(0.050)	(0.059)	(0.038)	(0.040)	(0.049)	(0.024)	(0.031)
Medium Bonus (MB)	-0.25***	0.06	0.02	-0.08*	-0.25***	0.06	0.08*	-0.03
	(0.039)	(0.042)	(0.058)	(0.044)	(0.039)	(0.043)	(0.039)	(0.039)
High Bonus (HB)	-0.18***	0.06	0.11*	-0.03	-0.18***	0.07	0.17***	0.02
	(0.040)	(0.037)	(0.057)	(0.042)	(0.040)	(0.037)	(0.032)	(0.031)
Round	-0.01*	-0.01*	-0.01***	-0.01***	-0.01*	-0.01*	-0.01**	-0.01**
	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)	(0.003)
Constant	0.55***	0.52***	0.50***	0.55***	0.22***	0.19***	0.23***	0.21***
	(0.035)	(0.042)	(0.059)	(0.043)	(0.035)	(0.043)	(0.036)	(0.034)
Observations	3,033	3,033	2,925	2,925	3,033	2,922	3,033	2,922
R-squared	0.040	0.004	0.006	0.008	0.111	0.006	0.012	0.014

Notes: [1] Each column presents a simple OLS regression using as the dependent variable firms' profits. [2] The first four columns include in this calculation Entrant firms' reservation wage, w = 1, in Auctions 1 and 2. The last four columns exclude the reservation wage from profit calculations . [3] Robust standard errors, clustered by session, appear in parentheses. [4] *** p<0.01, ** p<0.05, * p<0.1

Table 12: Entrant firms' profits, by treatment

	Including w	Excluding w
Low Bonus (LB)	-0.08*	-0.22**
	(0.040)	(0.089)
Medium Bonus (MB)	0.10*	0.13
	(0.051)	(0.079)
High Bonus (HB)	0.32***	0.34***
	(0.045)	(0.084)
Round	-0.01	-0.02
	(0.008)	(0.014)
Constant	1.19***	0.60***
	(0.070)	(0.112)
Observations	1,011	1,011
R-squared	0.081	0.047

Notes: [1] Each column presents a simple OLS regression using as the dependent variable Entrant firms' profits. [2] The first column includes in this calculation Entrant firms' reservation wage, w = 1, in Auctions 1 and 2. The second column excludes the reservation wage from profit calculations. [3] Robust standard errors, clustered by session, appear in parentheses. [4] *** p<0.01, ** p<0.05, * p<0.1

Table 13a: Buyer's theoretical welfare

	Baseline	*LB*	*MB*	*HB*

α = γ = δ= 1/3	0.389	0.488	0.599	0.710
α = γ = ½; δ = 0	0.333	0.731	0.648	0.565

Notes: [1] Each cell reports buyer's theoretical welfare evaluated according to the model (described in text). [2] In this theorical welfare function: *α* is the weight the buyer places on cost, expressed as a discount below the maximum possible cost; *γ* is the weight the buyer places on high quality provision; and *δ* is the weight placed on entry *per se.*

Table 13b: Buyer's empirical welfare

	Baseline	*LB*	*MB*	*HB*
α = γ = δ= 1/3	0.405	0.392	0.483	0.472
α = γ = ½; δ = 0	0.303	0.377	0.379	0.372

Notes: [1] Each cell reports buyer's empirical welfare (described in text) evaluated using experimental data. [2] In this empirical welfare function: *α* is the weight the buyer places on cost, expressed as a discount below the maximum possible cost; *γ* is the weight the buyer places on high quality provision; and *δ* is the weight placed on entry *per se.*

Table 13c: Buyer's empirical welfare (only AUCTION 1)

	Baseline	*LB*	*MB*	*HB*
α = γ = δ= 1/3				
α = γ = ½; δ = 0	0.292	0.428	0.444	0.418

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Appendix

Section A: Pairwise Mann-Whitney tests

Table A1: Mann-Whitney tests on winning bids

Pairwise comparison	Auction 1	Auction 2	Auction 3
Ba vs. LB	z = 13.144 Prob > |z| = 0.0000	z = 17.877 Prob > |z| = 0.0000	z = 8.849 Prob > |z| = 0.0000
LB vs. MB	z = 6.953 Prob > |z| = 0.0000	z = 0.473 Prob > |z| = 0.6361	z = 7.958 Prob > |z| = 0.0000
MB vs. HB	z = -9.519 Prob > |z| = 0.0000	z = 0.800 Prob > |z| = 0.4237	z = 0.902 Prob > |z| = 0.3670
Ba vs. MB	z = 21.243 Prob > |z| = 0.0000	z = 22.036 Prob > |z| = 0.0000	z = 17.971 Prob > |z| = 0.0000
Ba vs. HB	z = 12.680 Prob > |z| = 0.0000	z = 19.936 Prob > |z| = 0.0000	z = 18.227 Prob > |z| = 0.0000
LB vs. HB	z = -2.228 Prob > |z| = 0.0259	z = 1.487 Prob > |z| = 0.1370	z = 8.762 Prob > |z| = 0.0000

Notes: [1] Pairwise Mann-Whitney tests reported, using the following labeling conventions: Ba = "Baseline" treatment; LB = "Low Bonus" treatment; MB = "Medium Bonus" treatment; HB = "High Bonus" Treatment.

Table A2:Mann-Whitney test on quality provision

	Auction 1	Auction 2	Auction 3
Ba vs. LB	z = -11.911 Prob > |z| = 0.0000	z = -10.735 Prob > |z| = 0.0000	z = -3.007 Prob > |z| = 0.0026
LB vs. MB	z = 0.568 Prob > |z| = 0.5702	z = 1.218 Prob > |z| = 0.2234	z = -0.812 Prob > |z| = 0.4168
MB vs. HB	z = -0.117 Prob > |z| = 0.9071	z = -1.738 Prob > |z| = 0.0823	z = 2.511 Prob > |z| = 0.0120
Ba vs. MB	z = -12.176 Prob > |z| = 0.0000	z = -10.027 Prob > |z| = 0.0000	z = -4.307 Prob > |z| = 0.0000
Ba vs. HB	z = -11.951 Prob > |z| = 0.0000	z = -11.571 Prob > |z| = 0.0000	z = -1.325 Prob > |z| = 0.1853
LB vs. HB	z = 0.442 Prob > |z| = 0.6587	z = -0.379 Prob > |z| = 0.7043	z = 1.519 Prob > |z| = 0.1289

Notes: [1] Pairwise Mann-Whitney tests reported, using the following labeling conventions: Ba = "Baseline" treatment; LB = "Low Bonus" treatment; MB = "Medium Bonus" treatment; HB = "High Bonus" Treatment.

Table A3: Mann-Whitney tests on Entrant firms' profits

	Not Conditional on Entry		Conditional on Entry	
	Including *w*	Excluding *w*	Including *w*	Excluding *w*
Ba vs. LB	3.34 (0.001)	3.73 (0.000)	2.08 (0.037)	2.51 (0.012)
LB vs. MB	-3.89 (0.000)	-3.83 (0.000)	-2.41 (0.016)	-2.68 (0.007)
MB vs. HB	-1.68 (0.093)	-1.88 (0.060)	-2.77 (0.006)	-2.92 (0.003)
Ba vs. MB	-1.94 (0.053)	-1.54 (0.124)	-2.08 (0.038)	-1.85 (0.064)
Ba vs. HB	-2.90 (0.004)	-2.73 (0.006)	-3.84 (0.000)	-3.77 (0.000)
LB vs. HB	-4.39 (0.000)	-4.54 (0.000)	-3.35 (0.001)	-3.72 (0.000)

Notes: [1] Pairwise Mann-Whitney tests reported, using the following labeling conventions: Ba = "Baseline" treatment; LB = "Low Bonus" treatment; MB = "Medium Bonus" treatment; HB = "High Bonus" Treatment. [2] z-scores from Mann-Whitney tests reported; Prob > |z| appears in parentheses.

Table A4: Mann-Whitney tests on profits, pooling Incumbent and Entrant firms

	Including w			Excluding w		
	Auction 1	Auction 2	Auction 3	Auction 1	Auction 2	Auction 3
Ba vs. LB	7.180 (0.000)	-0.518 (0.604)	-1.239 (0.215)	11.837 (0.000)	3.415 (0.001)	-0.549 (0.583)
LB vs. MB	1.307 (0.191)	-0.137 (0.891)	1.892 (0.058)	2.203 (0.028)	0.114 (0.909)	0.929 (0.353)
MB vs. HB	-1.558 (0.119)	0.384 (0.701)	-1.227 (0.220)	-2.274 (0.023)	0.318 (0.750)	-1.002 (0.316)
Ba vs. MB	9.396 (0.000)	-0.693 (0.488)	0.581 (0.561)	15.779 (0.000)	4.203 (0.000)	0.493 (0.622)
Ba vs. HB	7.686 (0.000)	-0.420 (0.675)	-0.626 (0.531)	13.035 (0.000)	4.011 (0.000)	-0.431 (0.666)
LB vs. HB	-0.171 (0.864)	0.242 (0.809)	0.790 (0.430)	0.039 (0.969)	0.393 (0.694)	0.126 (0.900)

Notes: [1] Pairwise Mann-Whitney tests reported, using the following labeling conventions: Ba = "Baseline" treatment; LB = "Low Bonus" treatment; MB = "Medium Bonus" treatment; HB = "High Bonus" Treatment. [2] z-scores from Mann-Whitney tests reported; Prob > |z| appears in parentheses.

Table A5: Mann-Whitney tests on entry

Ba vs. LB	z = 6.92 (0.000)
LB vs. MB	z = -9.50 (0.000)
MB vs. HB	z = 0.738 (0.460)
Ba vs. MB	z = -3.615 (0.000)
Ba vs. HB	z = -2.636 (0.0084)
LB vs. HB	z = -8.462 (0.000)

Notes: [1] Pairwise Mann-Whitney tests reported, using the following labeling conventions: Ba = "Baseline" treatment; LB = "Low Bonus" treatment; MB = "Medium Bonus" treatment; HB = "High Bonus" Treatment. [2] z-scores from Mann-Whitney tests reported; Prob > |z| appears in parentheses.

Table A6: Average buyer's transfer, by auction and treatments

	Auction 1	Auction 2	Auction 3	All Auctions
Low Bonus (LB)	-0.28**	0.28**	0.10	-0.09
	(0.111)	(0.110)	(0.110)	(0.078)
Medium Bonus (MB)	-0.46***	0.23*	0.10	-0.17
	(0.103)	(0.110)	(0.133)	(0.106)
High Bonus (HB)	-0.22**	0.24**	0.32**	-0.01
	(0.101)	(0.106)	(0.119)	(0.100)
Round	-0.02***	-0.04***	-0.04***	-0.04***
	(0.006)	(0.008)	(0.006)	(0.005)
Constant	2.27***	2.24***	1.85***	2.19***
	(0.084)	(0.102)	(0.113)	(0.086)
Observations	2,022	2,022	3,033	3,033
R-squared	0.191	0.056	0.077	0.102

Notes: [1] Each column presents a simple OLS regression using as the dependent variable winning bids in the relevant auction (column heading). [2] Robust standard errors, clustered by session, appear in parentheses. [3] ***p<0.01, **p<0.05, *p<0.1.[4] The dependent variable in this table is the average buyer costs (transfers) over the tree auctions.

Section B: Dynamic trends in our main variables, allowing for non-linear variation

Table B1: Winning Bids

	Auction 1	Auction 2	Auction 3
Period 2 (dummy)	-0.23***	-0.22***	-0.22***
	(0.055)	(0.036)	(0.044)
Period 3 (dummy)	-0.43***	-0.35***	-0.39***
	(0.063)	(0.040)	(0.048)
Period 4 (dummy)	-0.43***	-0.43***	-0.37***
	(0.075)	(0.062)	(0.056)
Period 5 (dummy)	-0.45***	-0.46***	-0.40***
	(0.077)	(0.051)	(0.063)
Period 6 (dummy)	-0.42***	-0.47***	-0.49***
	(0.093)	(0.078)	(0.074)
Period 7 (dummy)	-0.44***	-0.46***	-0.48***
	(0.083)	(0.072)	(0.053)
Period 8 (dummy)	-0.42***	-0.47***	-0.46***
	(0.090)	(0.058)	(0.043)
Period 9 (dummy)	-0.40***	-0.51***	-0.47***
	(0.074)	(0.062)	(0.060)
Period 10 (dummy)	-0.45***	-0.51***	-0.48***
	(0.080)	(0.074)	(0.050)
Period 11 (dummy)	-0.43***	-0.51***	-0.48***
	(0.082)	(0.074)	(0.077)
Period 12 (dummy)	-0.47***	-0.53***	-0.53***
	(0.069)	(0.053)	(0.078)
Period 13 (dummy)	-0.30***	-0.38***	-0.47***
	(0.086)	(0.049)	(0.069)
Period 14 (dummy)	-0.35***	-0.44***	-0.60***
	(0.099)	(0.083)	(0.088)
Period 15 (dummy)	-0.38***	-0.41***	-0.50***
	(0.096)	(0.065)	(0.051)
Low Bonus (LB)	-0.28**	-0.37***	-0.16
	(0.111)	(0.094)	(0.100)
Med Bonus (MB)	-0.47***	-0.41***	-0.32**
	(0.098)	(0.097)	(0.124)
High Bonus (HB)	-0.24**	-0.39***	-0.34***
	(0.104)	(0.102)	(0.105)
Constant	2.52***	2.38***	1.97***
	(0.105)	(0.100)	(0.103)
Observations	2,022	2,022	3,033
R-squared	0.245	0.302	0.215

Notes: [1] Each column presents a simple OLS regression using as the dependent variable winning bids in the relevant auction (column heading). [2] Robust standard errors, clustered by session, appear in parentheses. [3] *** p<0.01, ** p<0.05, * p<0.1

Table B2: Quality Provision

	Auction 1	Auction 2	Auction 3
Period 2 (dummy)	-0.58***	-0.13	-0.21
	(0.210)	(0.187)	(0.216)
Period 3 (dummy)	-0.67**	-0.31	-0.12
	(0.267)	(0.215)	(0.294)
Period 4 (dummy)	-0.94***	-0.32	-0.49
	(0.235)	(0.225)	(0.429)
Period 5 (dummy)	-0.59***	-0.49	-0.44
	(0.165)	(0.307)	(0.315)
Period 6 (dummy)	-0.95***	-0.36	-0.64*
	(0.195)	(0.247)	(0.377)
Period 7 (dummy)	-0.91***	-0.39*	-0.35
	(0.216)	(0.201)	(0.319)
Period 8 (dummy)	-0.63***	-0.16	-0.31
	(0.191)	(0.285)	(0.352)
Period 9 (dummy)	-0.81***	-0.22	-0.22
	(0.210)	(0.229)	(0.323)
Period 10 (dummy)	-0.72***	-0.22	-0.22
	(0.265)	(0.184)	(0.323)
Period 11 (dummy)	-0.87***	-0.20	-0.03
	(0.229)	(0.191)	(0.265)
Period 12 (dummy)	-0.67***	-0.13	-0.21
	(0.246)	(0.151)	(0.216)
Period 13 (dummy)	-0.75	-0.36	-0.19
	(0.493)	(0.351)	(0.338)
Period 14 (dummy)	-0.46	-0.60***	
	(0.435)	(0.200)	
Period 15 (dummy)	-1.19***	-0.88***	
	(0.352)	(0.130)	
Low Bonus (LB)	1.89***	1.27***	0.54**
	(0.188)	(0.156)	(0.275)
Med Bonus (MB)	1.75***	1.29***	0.48**
	(0.188)	(0.185)	(0.242)
High Bonus (HB)	1.77***	1.42***	0.09
	(0.220)	(0.186)	(0.279)
Constant	-0.27*	-1.48***	-1.61***
	(0.148)	(0.225)	(0.325)
Observations	1,011	1,011	985

Notes: [1] Each column presents the marginal effects from an estimated probit model using as the dependent variable winning firms' (binary) decision to provide high quality. [2] Robust standard errors, clustered by session, appear in parentheses. [3] *** p<0.01, ** p<0.05, * p<0.1

Table B3: Entry decision

	Auction 3
Period 2 (dummy)	-0.33**
	(0.144)
Period 3 (dummy)	-0.44***
	(0.090)
Period 4 (dummy)	-0.37**
	(0.164)
Period 5 (dummy)	-0.68***
	(0.106)
Period 6 (dummy)	-0.65***
	(0.120)
Period 7 (dummy)	-0.61***
	(0.147)
Period 8 (dummy)	-0.87***
	(0.179)
Period 9 (dummy)	-0.84***
	(0.147)
Period 10 (dummy)	-0.81***
	(0.162)
Period 11 (dummy)	-0.91***
	(0.153)
Period 12 (dummy)	-0.88***
	(0.215)
Period 13 (dummy)	-0.39***
	(0.120)
Period 14 (dummy)	-0.63***
	(0.217)
Period 15 (dummy)	-1.42***
	(0.100)
Low Bonus (LB)	-0.49
	(0.319)
Med Bonus (MB)	0.25**
	(0.124)
High Bonus (HB)	0.20**
	(0.091)
Constant	0.90***
	(0.090)
Observations	3,033

Notes: [1] Each column presents the marginal effects from an estimated probit model using as the dependent variable Entrant firms' (binary) decisions to enter Auction 3. [2] Robust standard errors, clustered by session, appear in parentheses. [3] *** p<0.01, ** p<0.05, * p<0.1

Table B4: Profits

	Including w			Excluding w		
	Auction 1	Auction 2	Auction 3	Auction 1	Auction 2	Auction 3
Period 2 (dummy)	-0.05**	-0.02	-0.08*	-0.05**	-0.02	-0.03
	(0.020)	(0.044)	(0.044)	(0.020)	(0.048)	(0.041)
Period 3 (dummy)	-0.12***	-0.11**	-0.15***	-0.12***	-0.10**	-0.11**
	(0.021)	(0.037)	(0.015)	(0.021)	(0.037)	(0.038)
Period 4 (dummy)	-0.10***	-0.15***	-0.14***	-0.10***	-0.16***	-0.08*
	(0.024)	(0.044)	(0.038)	(0.024)	(0.047)	(0.044)
Period 5 (dummy)	-0.13***	-0.16***	-0.18***	-0.13***	-0.15***	-0.17***
	(0.027)	(0.042)	(0.020)	(0.027)	(0.045)	(0.041)
Period 6 (dummy)	-0.10**	-0.14**	-0.20***	-0.10**	-0.13*	-0.17***
	(0.033)	(0.059)	(0.036)	(0.033)	(0.059)	(0.032)
Period 7 (dummy)	-0.11***	-0.13**	-0.17***	-0.11***	-0.13**	-0.12**
	(0.032)	(0.052)	(0.038)	(0.032)	(0.056)	(0.051)
Period 8 (dummy)	-0.11***	-0.13**	-0.18***	-0.11***	-0.13**	-0.15***
	(0.032)	(0.054)	(0.038)	(0.032)	(0.059)	(0.036)
Period 9 (dummy)	-0.10***	-0.15***	-0.16***	-0.10***	-0.15**	-0.14***
	(0.030)	(0.047)	(0.029)	(0.030)	(0.051)	(0.028)
Period 10 (dummy)	-0.12***	-0.15**	-0.16***	-0.12***	-0.14**	-0.12*
	(0.033)	(0.055)	(0.037)	(0.033)	(0.057)	(0.057)
Period 11 (dummy)	-0.11***	-0.14**	-0.18***	-0.11***	-0.14**	-0.15**
	(0.031)	(0.048)	(0.039)	(0.031)	(0.052)	(0.056)
Period 12 (dummy)	-0.13***	-0.14**	-0.22***	-0.13***	-0.13*	-0.23***
	(0.025)	(0.054)	(0.030)	(0.025)	(0.059)	(0.044)
Period 13 (dummy)	-0.07**	-0.02	-0.15*	-0.07**	-0.01	-0.10
	(0.023)	(0.036)	(0.072)	(0.023)	(0.038)	(0.083)
Period 14 (dummy)	-0.10*	-0.12	-0.25***	-0.10*	-0.11	-0.22***
	(0.047)	(0.117)	(0.030)	(0.047)	(0.136)	(0.057)
Period 15 (dummy)	-0.07	-0.10***	-0.21***	-0.07	-0.10***	-0.18***
	(0.049)	(0.029)	(0.030)	(0.049)	(0.032)	(0.036)
Low Bonus (LB)	-0.20***	0.06	0.04	-0.20***	0.06	0.03
	(0.040)	(0.050)	(0.059)	(0.040)	(0.049)	(0.043)
Med Bonus (MB)	-0.26***	0.05	0.01	-0.26***	0.05	0.06
	(0.037)	(0.040)	(0.058)	(0.037)	(0.042)	(0.052)
High Bonus (HB)	-0.18***	0.05	0.11*	-0.18***	0.06	0.15**
	(0.040)	(0.038)	(0.058)	(0.040)	(0.038)	(0.048)
Constant	0.62***	0.59***	0.58***	0.28***	0.26***	0.30***
	(0.039)	(0.054)	(0.052)	(0.039)	(0.056)	(0.055)
Observations	3,033	3,033	2,925	3,033	2,922	3,023
R-squared	0.042	0.008	0.009	0.119	0.011	0.015

Notes: [1] Each column presents a simple OLS regression using as the dependent variable firms' profits. [2] The first three columns include in this calculation Entrant firms' reservation wage, w = 1, in Auctions 1 and 2. The last three columns exclude the reservation wage from profit calculations . [3] Robust standard errors, clustered by session, appear in parentheses. [4] *** p<0.01, ** p<0.05, * p<0.1

Table B5: Entrant firms' profits

Period 2 (dummy)	-0.06
	(0.083)
Period 3 (dummy)	-0.12
	(0.079)
Period 4 (dummy)	-0.04
	(0.073)
Period 5 (dummy)	-0.16
	(0.096)
Period 6 (dummy)	-0.20**
	(0.070)
Period 7 (dummy)	-0.09
	(0.101)
Period 8 (dummy)	-0.21*
	(0.115)
Period 9 (dummy)	-0.17*
	(0.085)
Period 10 (dummy)	-0.15
	(0.113)
Period 11 (dummy)	-0.12
	(0.088)
Period 12 (dummy)	-0.18*
	(0.099)
Period 13 (dummy)	0.07
	(0.135)
Period 14 (dummy)	-0.24*
	(0.129)
Period 15 (dummy)	-0.10
	(0.090)
Low Bonus (LB)	-0.08*
	(0.040)
Med Bonus (MB)	0.09*
	(0.048)
High Bonus (HB)	0.31***
	(0.045)
Constant	1.25***
	(0.085)
Observations	1,011
R-squared	0.094

Notes: [1] Table reports results from a simple OLS regression using as the dependent variable Entrant firms' profits. [2] Robust standard errors, clustered by session, appear in parentheses. [4] *** p<0.01, ** p<0.05, * p<0.1

Section C: Solving the three-period auction model

Before solving the model, we introduce and explain our notation. We have three periods and three firms involved in a three periods first-price auction. We call Firm 1 and 2 the incumbents and Firm 3 the entrant.

As explained in the paper, we introduce reputational incentives through the provision of a bonus for the winning firm. Let B be reputational bonus for incumbents and β the reputational bonus for the entrant.

The incumbent firm that wins the auction (i.e. has offered the lowest price p^*) decides whether delivering the service with high quality or low quality at costs c_H or c_L respectively, with $c_H > c_L$.

The entrant firm has to choose whether to enter or not at the beginning of the third period; if it enters, he loses w and participate in the auction with the incumbent. The entrant is more efficient in the production of the low quality service, that is $c_L{}^e = c_L - k$.

We use subscripts to indicate the firm number (*1, 2* or *3*) and the superscripts to indicate the period (*I, II* or *III*).

We have solved the model for three different values of β, i.e. $\beta = B$, $\beta = 1$ and $\beta = \frac{B+1}{2}$. In each of these scenarios we focus just on the two equilibria mentioned in the paper, i.e. "entry-accommodation" and "entry-deterrence".

In what follows, we present equilibrium characterizations and their necessary conditions just for the cases mainly discussed an tested in the paper, i.e a) entrant with reputational bonus $\beta = B$ and "entry-accommodation"; b) entrant with reputational bonus $\beta = 1$ and "entry-deterrence"; c) entrant with reputational bonus $\beta = \frac{B+1}{2}$ and indifference between the "entry-deterrence" and "entry-accommodation" equilibria.

a) Entrant with $\beta = B$ and Entry-Accommodation equilibrium

In period 3 we can have two scenarios, i) one incumbent has reputation (hereon, Firm 1), that is he won the previous period auction and produced high quality services, or ii) no incumbent has reputation, that is the winning incumbent in the previous period has delivered an high-quality service.

In case i), In period 3 no firm has incentive to produce the high quality service. If Firm 3 enters it prices incumbents out of the market by charging a price that makes the firm with reputation (Firm 1) indifferent. Now, suppose Firm 3 decides to enter. Then the firms' profits conditions can be written as:

- $PC_1^{III}: Bp_1^{III} - c_L \geq 0;$
- $PC_2^{III}: p_2^{III} - c_L \geq 0;$
- $PC_3^{III}: \beta p_3^{III} - c_L^e \geq 0.$

In equilibrium, the bids are

- $p_1^{III^*} = \frac{c_L}{B} + \epsilon;$
- $p_2^{III^*} = c_L + \epsilon;$
- $p_3^{III^*} = \frac{c_L}{B},$

with $\epsilon > 0$.

Firm 3 prices incumbents out of the market by charging a price that makes Firm 1 indifferent. He wins and gets profits $\pi_3^{III} = \beta \frac{c_L}{B} - c_L^e = k$. Under such conditions, Firm 3 weakly prefers to enter period 3 auction iff $k \geq w$; in its stronger formulation this condition leads to $(condition\ 2)$ in the paper.

Similarly, in case ii), suppose Firm 3 decides to enter. Then the firms' profit conditions can be written as:

- $PC_1^{III} = PC_2^{III}$: $p_{1,2}^{III} - c_L \geq 0$;
- PC_3^{III}: $\beta p_3^{III} - c_L^e \geq 0$.

In equilibrium, the bids are

- $p_1^{III^*} = p_2^{III^*} = c_L + \epsilon$;
- $p_3^{III^*} = c_L$.

Firm 3 bids the price at which the incumbents make zero profits, wins the auction and gets $\pi_3^{III} = \beta c_L - c_L^e = k$. Hence, in this case Firm 3 enters the auction if $B \geq \frac{w + c_L - k}{c_L}$.

In Period 2 and case i), Firm 1 exploits the reputational bonus acquired in Period 1 producing low quality; in this way he enters the next period without reputation so to accommodate Firm 3's entry. Hence Period 2 becomes for Firm 1 as the last period of a two-period auction game. The profits conditions can be written as:

- PC_1^{II}: $Bp_1^{II} - c_L \geq 0$;
- PC_2^{II}: $p_2^{II} - c_L \geq 0$;

In equilibrium, Firm 1 bids the price at which Firm 2 makes zero profits and wins with certainty. The bids are:

- $p_1^{II^*} = c_L$;
- $p_2^{II^*} = c_L + \epsilon$.

This equilibrium is sustained by the following conditions:

- $\pi_1^{II} = Bp_1^{II^*} - c_L \geq 0$, which ensures Firm 1 is making non negative profits by bidding $p_1^{II^*}$. This condition is satisfied if $B \geq 1$;
- $(p_2^{II} - \epsilon) - c_L < 0$, which ensures Firm 2 would negative profits if he offered a price ϵ-lower then $p_1^{II^*}$. This condition is always satisfied (in our model $\epsilon > 0$);
- $Bp_1^{II^*} - c_L \geq Bp_1^{II^*} - c_H$, which guarantees Firm 1 has incentives to produce low-quality and exploit the reputational bonus in this period (recall Period 2 becomes here as the last period of a two periods game). This condition is always satisfied ($c_H > c_L$).

The Period 2 under case ii) is a standard Bertrand 2-firms game that results in an equilibrium characterized by a winning bid $p_1^{II^*} = p_2^{II^*} = {p_{1,2}^{II}}^* = c_L$, zero expected profits and no high-quality (i.e. no investment in reputation). Importantly, as will be clear in what follows, we rule out this case by maintaining a constraint on B such that firms find it optimal to deliver high quality in Period 1 and enter Period 2 with the reputational bonus.

Finally, Period 1 becomes the second period of a two periods auction game since in Period 2 incumbents exploit reputation and deliver a low-quality service. Hence, the profit condition can be written as $PC_{1,2}^I$: $p_{1,2}^I - c_H + B{p_{1,2}^{II}}^* - c_L \geq 0$.

Firm 1 and Firm 2 compete in a Bertrand auction game; eventually, the equilibrium bid is ${p_{1,2}^{I}}^* = c_H - c_L(B-1)$. At this price, one of them wins with 1/2 probability and makes zero profits. This equilibrium requires the following conditions to hold:

- $\pi_{1,2}^{I} = {p_{1,2}^{I}}^* - c_H + B{p_{1,2}^{II}}^* - c_L \geq 0$, which ensures the winning firm is making non negative profits by bidding ${p_{1,2}^{I}}^*$. This condition is satisfied by construction;
- $(p_{1,2}^{I} - \epsilon) - c_H + B{p_{1,2}^{II}}^* - c_L < 0$, which eliminates weakly profitable deviations by offering a price ϵ-lower then ${p_{1,2}^{I}}^*$. This condition is always satisfied (in our model $\epsilon > 0$);
- ${p_{1,2}^{I}}^* - c_H + B{p_1^{II}}^* - c_L \geq {p_{1,2}^{I}}^* - c_L$, which guarantees the winning firm (suppose Firm 1) has incentives to produce with high-quality so to enjoy the reputational bonus in Period 2. This condition is satisfied if $B \geq \frac{c_H}{c_L}$.

We conclude the analysis of the "entry accommodation" equilibrium with *β=B* by emphasizing the constraint on B such that firms are incentivized to deliver high quality in Period 1, i.e. $B \geq \frac{c_H}{c_L}$. If the latter holds true, we can skip the equilibrium characterization for cases ii), that is the cases in which firms enter a period without the reputational bonus.

b) Entrant with $\beta = 1$ and Entry-Deterrence equilibrium

The model for the case in which the entrant does not have reputational bonus (*β=1*) is similar to the one presented in the previous section. We omit the equilibrium characterization for the cases in which no incumbent enters a period with reputational bonus. As already discussed in the previous section, provided *B* falls in a certain interval (see below), we restrict our analysis to cases in which incumbents have incentives to invest in reputation.

In period 3 no firm has incentive to produce the high quality service. If Firm 3 enters it prices incumbents out of the market by charging a price that makes the firm with reputation (Firm 1) indifferent. Now, suppose Firm 3 decides to enter. Then the firms' profit conditions can be written as:

- $PC_1^{III}: Bp_1^{III} - c_L \geq 0$;
- $PC_2^{III}: p_2^{III} - c_L \geq 0$;
- $PC_3^{III}: \beta p_3^{III} - c_L^e \geq 0$.

In equilibrium, the bids are

- ${p_1^{III}}^* = \frac{c_L}{B} + \epsilon$;
- ${p_2^{III}}^* = c_L + \epsilon$;
- ${p_3^{III}}^* = \frac{c_L}{B}$.

Firm 3 prices incumbents out of the market by offering a price that makes Firm 1 indifferent. He wins and gets profits $\pi_3^{III} = \frac{c_L}{B} - c_L^e$. Firm 3 does not enter the auction iff $k < w + c_L - \frac{c_L}{B}$; this is $(condition\ 3)$ in the paper.

Under this condition, entry does not occur and incumbents behave as in a 3-periods auction game with no entry. In Period 3 (no entry), the profits conditions can be written as:

- $PC_1^{III}: Bp_1^{III} - c_L \geq 0$;
- $PC_2^{III}: p_2^{III} - c_L \geq 0$;

In equilibrium Firm 1 prices Firm 2 out of the auction by bidding a price that makes Firm 2 indifferent:

- $p_1^{III^*} = c_L$;
- $p_2^{III^*} = c_L + \epsilon$;

Firm 1 wins and gets profits $\pi_1^{III} = Bc_L - c_L$, which is non-negative provided that $B \geq 1$.

In Period 2 (no entry), as explained before, the winning firm from the previous Period (for ex., Firm 1) has delivered high quality; hence he enters Period 2 with the reputational bonus. The profit conditions are:

- $PC_1^{II}: Bp_1^{II} - c_H + Bp_1^{III^*} - c_L \geq 0$
- $PC_2^{II}: p_2^{II} - c_H + Bp_2^{III^*} - c_L \geq 0$

Again, Firm 1 bids a price that makes Firm 2 indifferent and wins the auction:

- $p_1^{III^*} = (1 - B)c_L + c_H$
- $p_2^{III^*} = (1 - B)c_L + c_H + \epsilon$

The necessary equilibrium conditions are:

- $\pi_1^{II} = Bp_1^{II^*} - c_H + Bp_1^{III^*} - c_L \geq 0$, which ensures the winning firm is making non negative profits by bidding $p_1^{II^*}$. This condition is satisfied if $B \in \left[1, \frac{c_H + c_L}{c_L}\right]$;
- $(p_1^{II^*} - \epsilon) - c_H + Bp_1^{III^*} - c_L < 0$, which eliminates Firm 2's profitable deviations by offering a price ϵ-lower then $p_1^{II^*}$. This condition is always satisfied (in our model $\epsilon > 0$);
- $Bp_1^{II^*} - c_H + Bp_1^{III^*} - c_L \geq Bp_1^{II^*} - c_L$, which guarantees the winning firm (continuing with our example, Firm 1) weakly prefers to deliver the high-quality service so to have the reputational bonus in Period 2. This condition is satisfied if $B \geq \frac{c_H}{c_L}$.

From these conditions, it follows that the winning firm is incentivized to deliver high quality in Period 2 if $B \geq \frac{c_H}{c_L}$.

In Period 1 (no entry) firms begin the auction with no reputational bonus. Both of them compete on price and in the end offer the same bid which gives zero profits (as in the standard Bertrand model). Only one of the two firms wins with probability 1/2. The profit conditions are:

- $PC_1^I: p_1^I - c_H + Bp_1^{II} - c_H + Bp_1^{III^*} - c_L \geq 0$
- $PC_2^I: p_2^{II} - c_H + Bp_2^{II} - c_H + Bp_2^{III^*} - c_L \geq 0$

Both firms start bidding until they reach the break-even price level, i.e. ${p_{1,2}^I}^* = 2c_H + c_L + B^2c_L - \mathrm{B}\,(2c_L + c_H)$. Eventually, one of the two (for ex., Firm 1) wins with probability 1/2.

The necessary equilibrium conditions are:

- $\pi_{1,2}^I = {p_{1,2}^I}^* - c_H + Bp_{1,2}^{II} - c_H + Bp_{1,2}^{III^*} - c_L \geq 0$, which ensures the winning firm is making non negative profits by bidding ${p_{1,2}^I}^*$. This condition is satisfied by construction;
- $({p_{1,2}^I}^* - \epsilon) - c_H + Bp_{1,2}^{II} - c_H + Bp_{1,2}^{III^*} - c_L <$, which eliminates profitable deviations by offering a price ϵ-lower then $p_1^{II^*}$. This condition is always satisfied (in our model $\epsilon > 0$);
- ${p_{1,2}^I}^* - c_H + Bp_{1,2}^{II} - c_H + Bp_{1,2}^{III^*} - c_L \geq {p_{1,2}^I}^* - c_L$, which guarantees the winning firm weakly prefers to deliver the high-quality service so to have the reputational bonus in the following periods. This condition is satisfied if $B \in \left[\frac{3c_H - c_L}{2c_L}, \frac{c_H + 3c_L}{2c_L}\right]$ which is $(condition$ 1) in the paper.

c) Entrant with $\beta = \frac{B+1}{2}$ and indifference between entry-deterrence/entry-accommodation.

We present here only the equilibrium characterization for Period 3 and derive the ($condition$ 4) reported in the paper. The analysis of the incumbents' behaviour in the remaining periods either for the entry-deterrence or the entry-accommodation scenarios is already reported in the previous sections.

In period 3, suppose Firm 3 decides to enter. Firms' profits conditions can be written as:

- $PC_1^{III}: Bp_1^{III} - c_L \geq 0$;
- $PC_2^{III}: p_2^{III} - c_L \geq 0$;
- $PC_3^{III}: \beta p_3^{III} - c_L^e \geq 0$.

In equilibrium, the bids are

- $p_1^{III^*} = \frac{c_L}{B} + \epsilon$;
- $p_2^{III^*} = c_L + \epsilon$;
- $p_3^{III^*} = \frac{c_L}{B}$.

Firm 3 bids a price that makes Firm 1 indifferent. He wins and gets profits $\pi_3^{III} = \beta \frac{c_L}{B} - c_L^e$. Firm 3 is indifferent between entering or not iff $k = w + c_L - c_L \frac{\beta}{B}$; this is ($condition$ 4) in the paper. According to Firm 3's decision, incumbents can play the entry-deterrence or entry-accommodation equilibria described above.