Online Appendix to Communication, Feedbacks and Repeated Moral Hazard with Short-lived Buyers

Bruno Jullien
Toulouse School of Economics
CNRS, Toulouse

In-Uck Park
University of Bristol
Sungkyunkwan University

April 5, 2020

We assumed in the main paper that the seller's item is sold at a price equal to its expected quality, which occurs if the good is sold through first or second price auction to homogenous buyers.[1] Auctioning goods is common in online markets but one may still wonder about the implications of alternative selling mechanisms. In particular, the seller may post a price instead of auctioning the good. We now discuss how this may affect our analysis.

The difference with a posted-price setting is that interim information can be transmitted directly through the choice of prices, without the use of explicit messages. In this setting, we interpret equilibria without communication as those in which prices convey no information on the quality of the good—which are equilibria of the game where the seller observes no signal about quality—and equilibria with communication as those in which prices convey some information about the seller's private signal.

It is easy to see that all equilibria analyzed in the paper (with or without pre-trade communication) remain as equilibria in the game where the seller posts a price. Indeed, the same equilibria can be replicated by specifying that the seller posts a price equal to the expected value of the item, contingent on the history and equilibrium message,[2] followed by the same continuation values. Incentive compatibility is satisfied by assuming that posting any price that is not on the equilibrium path would trigger the lowest belief about effort and signal along with the minimum continuation payoff. In other words, in a posted-price setting price signalling may substitute for messages in transmitting information.

The question remains as to whether new equilibria exist with posted prices that generate higher or lower payoffs than in the model analyzed in the paper. The answer to this

[1] The analysis would not be affected by allowing the seller to choose a reserve price.

[2] The seller may also send a message but this is redundant as different messages are associated with different prices.

question depends on the precise setup.

In particular, posting a price does not change the final price if buyers can "bribe" the seller by offering to buy the good at a higher price than the posted price, e.g., as in real estate markets or through renegotiation in online markets. That is, posting a price below the item's value would imply excess demand and rationing, which may trigger renegotiation and result in an eventual trade at a price equal to the expected value. In this case, posting a price or auctioning the good would induce the same equilibrium outcomes.

Therefore, posted prices would expand the set of equilibrium payoffs only if the seller is committed to a posted price through a take-it-or-leave-it offer (and rationing the good if there is excess demand). Below we discuss two reasons why the set of equilibrium payoffs may change if the seller is committed to a posted price as such.

The first reason relates to the minimum equilibrium payoff. If the seller has no private information on quality beyond knowledge of her effort, the minimum equilibrium payoff is the same regardless of whether the good is auctioned or sold at a posted price. This is because with short-lived buyers, an uninformed seller can always sell at price ℓ.[3] But when the seller has private information, the minimum payoff of the seller is lower when prices are posted. To see this, consider the following punishment phase: in every period the seller exerts low effort and posts a price $p_t = \pi'_{\mathbb{b}}$, and any other price is interpreted by buyers as signalling low effort and bad signal (i.e., $e = 0$ and $s = \mathbb{b}$). This punishment phase generates the lowest continuation equilibrium payoff $\pi'_{\mathbb{b}} < \ell = \underline{v}$. This in turn implies that a higher maximum SGV can be generated.

The second reason why the equilibrium set may expand is that inducing an inefficient level of effort is not necessary to punish the seller because she can be incentivized to set a low price by a reputation mechanism. This holds irrespectively of whether or not the seller has information on quality beyond knowledge of her effort. To see this, consider the highest SGV v^* in the baseline model with no information on the realized quality and modify the first period t of a punishment phase by stipulating that the seller exerts high effort and posts a price $p_t < h$. At the end of the period either the best equilibrium follows, with a higher probability when the delivered quality is good than when it is bad, or else the trivial equilibrium is triggered. If the seller deviated by not choosing the required price, the maximal punishment starts with value ℓ in the next period. The price p_t and continuation probabilities in the punishment phase can be chosen in such a way that the seller's payoff remains at ℓ and the stipulated strategy is incentive compatible. This generates a continuation equilibrium with the same value ℓ for the seller but a higher value for the buyers because the price is below the expected quality.

We note, however, that if the seller does not have interim information on the realized

[3]In particular as the value v^* is the same with posted prices and the value $\bar{v}$ is at least as high as when the good is sold through an auction, the conditions we identified for communication to improve the seller's payoff remain as sufficient conditions when prices are posted.

quality, using posted prices cannot increase the seller's payoff above v^* because the maximal punishment payoff remains equal to ℓ, given that the seller can always sell at price ℓ.

Hence, our analysis continues to be relevant in posted-price settings but it pertains to the seller's payoff only. Two new features are that i) communication (through messages or prices) makes it possible to strengthen incentives to exert effort by reducing the seller's punishment payoff, and ii) posted prices allow raising the buyers surplus by substituting an effort reduction in punishment phase with a price reduction.

We conjecture that in a posted price setting, it is still the case that seller information may raise the maximal payoff of the seller only if it is precise enough. The reason is that with low precision, the lowest prices $\pi'_{\mathbb{b}}$ is close to ℓ, so that information of poor precision does not help reducing the punishment payoff which is necessary to raise the maximum payoff of the seller.