Title: Cost-reduction innovation under mixed economy

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Thank you for your useful comments. We would improve the manuscript accordingly. The followings are our replies and ways to reflect your comments.

1. This paper studies the cost-reduction innovation behaviour of a duopoly market where a private firm faces competition from a firm which has some degree of public ownership/control. The publicly owned firm's objective is (assumed) to maximise weighted sum of the firm's profit and consumer surplus. Importantly, the rival firm's profit does not enter its objective function. That is, public ownership does not lead to care about all components of social welfare – it is biased against the rival firm. This objective function makes the publicly owned firm a more aggressive competitor of the rival firm than a counterpart private competitor. This is the key difference between a mixed duopoly and an ordinary duopoly.

It is well known and understood that firms with market power (e.g., ordinary duopolists) do not internalise some of the externalities in their profit maximising behaviour. The externalities include the deadweight loss and benefits of innovation accrued to the consumer. So it is not too surprising that the publicly owned firm (in theory) should innovate and produce more relative to the private rival, or a private counterpart. Indeed these are among the results (or their implications) reported in Propositions 1 and 4 of the paper. What is somewhat surprising is that higher degree of public ownership also makes the rival firm (as well as the publicly owned one) to innovate and produce more in equilibrium, as is claimed in Propositions 2 and 3. It seems that cost-reduction appears to be strategic complements: the best response to rival's more innovation is more innovation. The robustness of these results is worth further investigation. They are interesting.

Reply: As presented in Proposition 2 and 3 in the paper, the equilibrium output and innovation of both firms increase with the degree of public ownership. The findings

imply that cost-reduction appears to be strategic complements. Interestingly, several possible reasons arise for explanation. First, regardless of the degree of the public ownership, both firms aim to reduce their marginal production costs. More outputs and innovation investment do help to achieve this objective, while the former one brings about scale economics and the latter one improves productivity. Especially, as the (semi-) public firm becomes more aggressive with an increase of τ, the private one has to invest more in innovation to enhance its productivity and reduce its production costs. Otherwise, it may quit production under the pressure of competition. As a result, the best response to rival's more innovation is more innovation. Second, the chosen objective of the (semi-) public firm is comprised of two parts, namely its profits and consumer surplus. Obvious, more total outputs and innovation investment of both firms bring about more consumer surplus. Therefore, as the (semi-) public firm concerns more about consumer surplus when τ increases, it is willing to enhance the total production and investment of the market but not only itself. That is, with a larger τ, producing more and investing more are beneficial to both firms. Third, in some industries depending on basic research heavily, like telecommunication and semiconductor, most private firms prefer to invest in application research but not basic research because of low expected return. In contrast, (semi-) public firms are willing to carry out basic R&D activities since their objective is to maximize integrated profits and social welfare. In these industries, basic research implemented by (semi-) public firms is also beneficial to private firms because of technology spillover effect. Hence, both the outputs and the investment of both firms increase with τ.

2. Some minor comments:

• Expressions (5) and (6) give the appearance that innovation and quantity decisions are simultaneously made while in fact they are sequentially made.

• A typo in expression (5): Should the consumer surplus part not be $\frac{\tau}{2}(q_A^2 + q_B^2 + 2\gamma q_A q_B)$?

Reply: As presented in the settings in Section 2, it is a two-stage model. At the first stage, two firms simultaneously choose innovation investment. At the second stage, they compete in quantity. Therefore, innovation and quantity decisions are sequentially made by the two competitors. To simplify the expressions for calculation, we neglect the two differentiated stages in expressions (5) and (6) by a combination of them. That is why innovation and quantity decisions seem to be simultaneously made while in fact they are sequentially made in the two expressions. In addition, we confirm that the consumer surplus part in expression (5) is correct.