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SUPPLEMENT TO "NONEXCLUSIVE COMPETITION IN THE MARKET FOR LEMONS": THE EXCLUSIVE COMPETITION BENCHMARK

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In this supplement, we provide a detailed analysis of the exclusive competition game for the two-type specification of the model considered in Section 3 of the paper.

AS A CONTRAST to our results, it is useful to characterize the equilibrium outcomes under exclusive competition, that is, when the seller can trade with at most one buyer, as is standardly assumed in models of competition under adverse selection. The timing of the exclusive competition game is similar to that of the nonexclusive competition game, except that the second stage is now defined as follows:

(ii′) After privately learning her type θ, the seller selects one contract (q^i, t^i) from one of the menus C^i offered by the buyers.

Given a menu profile $(C^1, \dots, C^n)$, the seller's profit maximization problem becomes

$$\max\{t^i - \theta q^i : (q^i, t^i) \in C^i \text{ for some } i\}.$$

As in the paper, the equilibrium concept is pure strategy perfect Bayesian equilibrium.

We analyze this game under the parametric restrictions of Section 3. There are two types, $\underline{\theta}$ and $\overline{\theta}$, such that $\overline{\theta} > \underline{\theta} > 0$, $v(\overline{\theta}) > v(\underline{\theta})$, $v(\underline{\theta}) > \underline{\theta}$, and $v(\overline{\theta}) > \overline{\theta}$. To avoid trivial cases, we assume that $\nu \equiv \mathbf{P}[\theta = \overline{\theta}] \in (0, 1)$. The contracts $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$ traded by each type of seller in an equilibrium of the exclusive competition game can then be characterized as follows.

PROPOSITION A.1: *Any equilibrium of the exclusive competition game is separating, with*

$$(\underline{q}^e, \underline{t}^e) = (1, v(\underline{\theta})) \quad \textit{and} \quad (\overline{q}^e, \overline{t}^e) = \frac{v(\underline{\theta}) - \underline{\theta}}{v(\overline{\theta}) - \underline{\theta}}(1, v(\overline{\theta})).$$

Moreover, the exclusive competition game has an equilibrium if and only if $\nu \leq \nu^e$, *where*

$$\nu^e \equiv \frac{\overline{\theta} - \underline{\theta}}{v(\overline{\theta}) - \underline{\theta}}.$$

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This result shows that when the rules of the competition game are such that the seller can trade with at most one buyer, the structure of equilibria is formally analogous to that which obtains in the competitive insurance model of Rothschild and Stiglitz (1976). First, any pure strategy equilibrium is separating, with type $\underline{\theta}$ efficiently selling her whole endowment, $\underline{q}^e = 1$, and type $\overline{\theta}$ only selling a fraction of her endowment, $0 < \overline{q}^e < 1$. The corresponding contracts are traded at unit prices $v(\underline{\theta})$ and $v(\overline{\theta})$, respectively, so that each of them yields a zero profit to the buyers. Second, type $\underline{\theta}$ is indifferent between her equilibrium contract and that of type $\overline{\theta}$, that is, $v(\underline{\theta}) - \underline{\theta} = [v(\overline{\theta}) - \underline{\theta}]\overline{q}^e$, which gives the value of $\overline{q}^e$. Third, the exclusive competition game has an equilibrium only under certain parameter restrictions. Specifically, the equilibrium isoprofit line of type $\overline{\theta}$ must lie above the zero isoprofit line for the buyers with slope $\mathbf{E}[v(\theta)]$; otherwise, there would exist a profitable deviation attracting both types of seller. As a result, an equilibrium exists if and only if the probability that the good is of high quality is low enough, that is, $\nu \leq \nu^e$. The equilibrium is depicted on Figure A.1.[1]

REMARK: Under our parameter restrictions, the threshold $\nu^e = (\overline{\theta} - \underline{\theta})/[v(\overline{\theta}) - \underline{\theta}]$ for ν below which the exclusive competition game has an equilibrium is strictly greater than the threshold $\nu^{ne} \equiv \{[\overline{\theta} - v(\underline{\theta})]/[v(\overline{\theta}) - v(\underline{\theta})]\} \vee 0$ for ν below which all equilibria of the nonexclusive competition game are separating. Thus, if one assumes that $\nu \leq \nu^e$, so that equilibria exist under both exclusivity and nonexclusivity, two situations can arise. When $0 < \nu < \nu^{ne}$, the equilibrium is separating under both exclusivity and nonexclusivity; less trade takes place in the latter case, since type $\overline{\theta}$ does not trade at all. By contrast, when $\nu^{ne} < \nu \leq \nu^e$, the equilibrium is separating under exclusivity and pooling under nonexclusivity; more trade takes place in the latter case, since the seller trades her whole endowment no matter her type. Since $v(\underline{\theta}) > \underline{\theta}$ and $v(\overline{\theta}) > \overline{\theta}$ under our parameter restrictions, there are gains from trade regardless of the quality of the good. Therefore, from an ex ante viewpoint, exclusive competition in this example leads to a more efficient outcome under severe adverse selection, while nonexclusive competition leads to a more efficient outcome under mild adverse selection.

PROOF OF PROPOSITION A.1: The proof follows more or less standard lines (see, for instance, Mas-Colell, Whinston, and Green (1995, Chapter 13, Section D)) and goes through a series of steps.

[1]Points A and B correspond to the equilibrium contracts of types $\overline{\theta}$ and $\underline{\theta}$. The solid lines passing through A and B are the equilibrium isoprofit lines of types $\overline{\theta}$ and $\underline{\theta}$. The dotted lines passing through the origin O are zero isoprofit lines for the buyers, with slopes $v(\underline{\theta})$, $\mathbf{E}[v(\theta)]$, and $v(\overline{\theta})$.

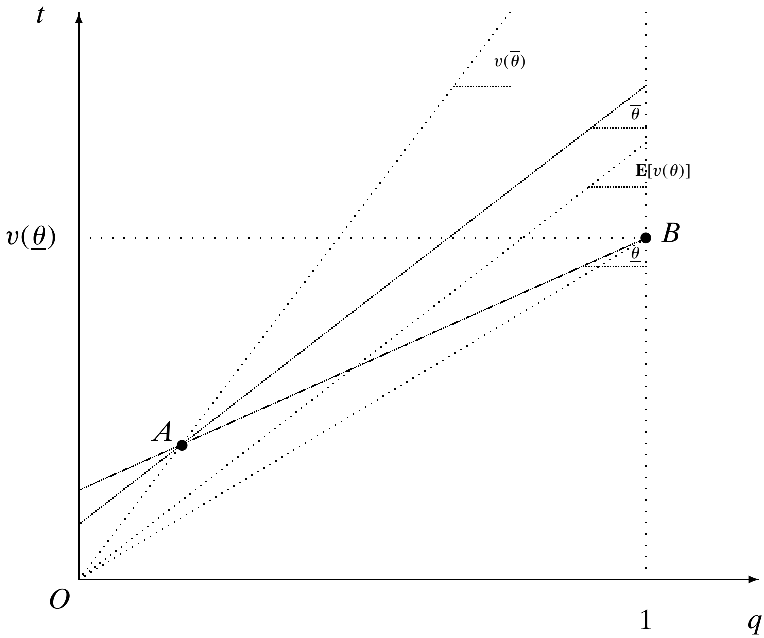

FIGURE A.1.—Equilibrium contracts under exclusive competition when $\nu \leq \nu^e$.

Step 1. Denote by $(\underline{q}, \underline{t})$ and $(\overline{q}, \overline{t})$ the contracts traded by the two types of seller in equilibrium. These contracts must satisfy the incentive constraints

$$\underline{t} - \underline{\theta}\underline{q} \geq \overline{t} - \underline{\theta}\overline{q},$$
$$\overline{t} - \overline{\theta}\overline{q} \geq \underline{t} - \overline{\theta}\underline{q}.$$

Since the buyers always have the option not to trade, each of them must earn at least zero profit in equilibrium. Suppose that some buyer actually makes profits in equilibrium. Then the buyers' aggregate equilibrium profit is strictly positive,

$$\nu[v(\overline{\theta})\overline{q} - \overline{t}] + (1 - \nu)[v(\underline{\theta})\underline{q} - \underline{t}] > 0.$$

Any buyer i earning no more than half of this amount in equilibrium can deviate by offering a menu consisting of the no-trade contract and of two new contracts. The first one is

$$\underline{c}^i(\underline{\varepsilon}) \equiv (\underline{q}, \underline{t} + \underline{\varepsilon})$$

for some strictly positive number $\underline{\varepsilon}$, and is designed to attract type $\underline{\theta}$. The second contract is

$$\overline{c}^i(\overline{\varepsilon}) \equiv (\overline{q}, \overline{t} + \overline{\varepsilon})$$

for some strictly positive number $\overline{\varepsilon}$, and is designed to attract type $\underline{\theta}$. To ensure that type $\underline{\theta}$ trades $\underline{c}^i(\underline{\varepsilon})$ and type $\overline{\theta}$ trades $\overline{c}^i(\overline{\varepsilon})$ with him, buyer i can choose $\underline{\varepsilon}$ to be equal to $\overline{\varepsilon}$ when both types' equilibrium incentive constraints are simultaneously binding or slack, and choose $\underline{\varepsilon}$ and $\overline{\varepsilon}$ to be different but close enough to each other when one of these constraints is binding and the other is slack. The change in buyer i's profit induced by this deviation is at least

$$\frac{1}{2}\left\{\nu[v(\overline{\theta})\overline{q} - \overline{t}] + (1-\nu)[v(\underline{\theta})\underline{q} - \underline{t}]\right\} - \nu\overline{\varepsilon} - (1-\nu)\underline{\varepsilon},$$

which is strictly positive for $\underline{\varepsilon}$ and $\overline{\varepsilon}$ close enough to zero. Thus, buyers earn zero profit in equilibrium.

Step 2. Suppose that there exists a pooling equilibrium with both types of seller trading the same contract (q^p, t^p). It follows from Step 1 that $t^p = \mathbf{E}[v(\theta)]q^p$ and that both types of seller must trade with the same buyer j. Any buyer $i \neq j$ can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\overline{c}^i(\varepsilon) \equiv (q^p - \varepsilon, t^p - \underline{\theta}\varepsilon(1+\varepsilon))$$

for some strictly positive number ε. Trading $\overline{c}^i(\varepsilon)$ decreases type $\underline{\theta}$'s profit by $\underline{\theta}\varepsilon^2$ compared to what she earns by trading (q^p, t^p) with buyer j. Hence, type $\underline{\theta}$ does not trade $\overline{c}^i(\varepsilon)$ following buyer i's deviation. By contrast, if $\varepsilon < \overline{\theta}/\underline{\theta} - 1$, trading $\overline{c}^i(\varepsilon)$ allows type $\overline{\theta}$ to increase her profit by $[\overline{\theta} - (1+\varepsilon)\underline{\theta}]\varepsilon$ compared to what she earns by trading (q^p, t^p) with buyer j. Hence, type $\overline{\theta}$ trades $\overline{c}^i(\varepsilon)$ following buyer i's deviation. The profit for buyer i induced by this deviation is

$$\nu\left\{v(\overline{\theta})q^p - t^p - [v(\overline{\theta}) - \underline{\theta}(1+\varepsilon)]\varepsilon\right\},$$

which is strictly positive for ε close enough to zero since $t^p = \mathbf{E}[v(\theta)]q^p$ and $v(\overline{\theta}) > \mathbf{E}[v(\theta)]$. This, however, is impossible by Step 1. Thus, any equilibrium must be separating, with the two types of seller trading different contracts.

Step 3. Suppose that $v(\underline{\theta})\underline{q} > \underline{t}$, so that the contract $(\underline{q}, \underline{t})$ yields the buyer who trades it with type $\underline{\theta}$ a strictly positive profit. Any buyer i can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\underline{c}^i(\varepsilon) \equiv (\underline{q}, \underline{t} + \varepsilon)$$

for some strictly positive number ε. Type $\underline{\theta}$ trades $\underline{c}^i(\varepsilon)$ following buyer i's deviation, and type $\overline{\theta}$ also possibly trades. The profit for buyer i induced by this deviation is thus at least

$$(1-\nu)[v(\underline{\theta})\underline{q}-\underline{t}-\varepsilon],$$

which is strictly positive for ε close enough to zero if $v(\underline{\theta})\underline{q} > \underline{t}$. Since this, by Step 1, is impossible, it must be that $\underline{t} \geq v(\underline{\theta})\underline{q}$. Suppose next that $v(\overline{\theta})\overline{q} > \overline{t}$, so that the contract $(\overline{q}, \overline{t})$ yields the buyer j who trades it with type $\overline{\theta}$ a strictly positive profit. Any buyer $i \neq j$ can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\overline{c}^i(\varepsilon) \equiv (\overline{q}-\varepsilon, \overline{t}-\underline{\theta}\varepsilon(1+\varepsilon))$$

for some strictly positive number ε. As in Step 2, it is easy to check that type $\underline{\theta}$ does not trade $\overline{c}^i(\varepsilon)$ following buyer i's deviation, while type $\overline{\theta}$ does so provided that $\varepsilon < \overline{\theta}/\underline{\theta} - 1$. The profit for buyer i induced by this deviation is

$$\nu\big\{v(\overline{\theta})\overline{q}-\overline{t}-[v(\overline{\theta})-\underline{\theta}(1+\varepsilon)]\varepsilon\big\},$$

which is strictly positive for ε close enough to zero if $v(\overline{\theta})\overline{q} > \overline{t}$. Since this, by Step 1, is impossible, it must be that $\overline{t} \geq v(\overline{\theta})\overline{q}$. Along with the facts that $\underline{t} \geq v(\underline{\theta})\underline{q}$ and that each buyer earns zero profit in equilibrium, this in turn implies that $\underline{t} = v(\underline{\theta})\underline{q}$ and $\overline{t} = v(\overline{\theta})\overline{q}$. Thus, the contracts $(\underline{q}, \underline{t})$ and $(\overline{q}, \overline{t})$ are traded at unit prices $v(\underline{\theta})$ and $v(\overline{\theta})$, and cross-subsidies cannot arise in equilibrium.

Step 4. Suppose that type $\underline{\theta}$ sells a quantity $\underline{q} < 1$ in equilibrium. Any buyer i can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\underline{c}^i(\varepsilon) \equiv \big(1, \underline{t}+[v(\underline{\theta})-\varepsilon](1-\underline{q})\big)$$

for some strictly positive number ε. As long as $\varepsilon < v(\underline{\theta})-\underline{\theta}$, trading $\underline{c}^i(\varepsilon)$ allows type $\underline{\theta}$ to increase her profit by $[v(\underline{\theta})-\underline{\theta}-\varepsilon](1-\underline{q})$ compared to what she earns by trading $(\underline{q}, \underline{t})$. Hence, type $\underline{\theta}$ trades $\underline{c}^i(\varepsilon)$ following buyer i's deviation, and type $\overline{\theta}$ also possibly trades. The profit for buyer i induced by this deviation is thus at least

$$(1-\nu)\big\{v(\underline{\theta})-\underline{t}-[v(\underline{\theta})-\varepsilon](1-\underline{q})\big\} = (1-\nu)(1-\underline{q})\varepsilon,$$

where we used the fact that, by Step 3, $\underline{t} = v(\underline{\theta})\underline{q}$. Since $\varepsilon > 0$, this profit is strictly positive, which, by Step 1, is impossible. Thus, type $\underline{\theta}$ sells her whole endowment in any equilibrium and, by Step 3 again, $(\underline{q}, \underline{t}) = (\underline{q}^e, \underline{t}^e)$.

Step 5. The contract $(\overline{q}^e, \overline{t}^e)$ is characterized by two properties: it has unit price $v(\overline{\theta})$, and type $\underline{\theta}$ is indifferent between $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$. One cannot have $\overline{q} > \overline{q}^e$, because, by Step 3, $(\overline{q}, \overline{t})$ is traded at unit price $v(\overline{\theta})$ and any contract in which a quantity strictly higher than $\overline{q}^e$ is traded at unit price $v(\overline{\theta})$ is strictly preferred by type $\underline{\theta}$ to $(\underline{q}^e, \underline{t}^e)$. Now suppose that type $\underline{\theta}$ trades $(\underline{q}^e, \underline{t}^e)$ with buyer j in equilibrium and that $\overline{q} < \overline{q}^e$. Then type $\underline{\theta}$ strictly prefers $(\underline{q}^e, \underline{t}^e)$ to $(\overline{q}, \overline{t})$, that is, $\underline{t}^e - \underline{\theta}\underline{q}^e > \overline{t} - \underline{\theta}\overline{q}$. Any buyer $i \neq j$ can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\overline{c}^i(\varepsilon) \equiv (\overline{q} + \varepsilon, \overline{t} + \overline{\theta}\varepsilon(1+\varepsilon))$$

for some strictly positive number ε. Trading $\overline{c}^i(\varepsilon)$ decreases type $\underline{\theta}$'s profit by

$$\underline{t}^e - \underline{\theta}\underline{q}^e - \overline{t} + \underline{\theta}\overline{q} - [\overline{\theta}(1+\varepsilon) - \underline{\theta}]\varepsilon$$

compared to what she earns from trading $(\underline{q}^e, \underline{t}^e)$ with buyer j. Since $\underline{t}^e - \underline{\theta}\underline{q}^e > \overline{t} - \underline{\theta}\overline{q}$, type $\underline{\theta}$ does not trade $\overline{c}^i(\varepsilon)$ following buyer i's deviation if ε is close enough to zero. By contrast, trading $\overline{c}^i(\varepsilon)$ allows type $\overline{\theta}$ to increase her profit by $\overline{\theta}\varepsilon^2$ compared to what she earns in equilibrium. Hence, type $\overline{\theta}$ trades $\overline{c}^i(\varepsilon)$ following buyer i's deviation. The profit for buyer i induced by this deviation is

$$\nu[v(\overline{\theta})(\overline{q} + \varepsilon) - \overline{t} - \overline{\theta}\varepsilon(1+\varepsilon)] = \nu[v(\overline{\theta}) - \overline{\theta}(1+\varepsilon)],$$

where we used the fact that, by Step 3, $\overline{t} = v(\overline{\theta})\overline{q}$. When $\varepsilon < v(\overline{\theta})/\overline{\theta} - 1$, this profit is strictly positive, which, by Step 1, is impossible. Thus, type $\overline{\theta}$ sells a fraction $\overline{q}^e$ of her endowment in any equilibrium and, by Step 3 again, $(\overline{q}, \overline{t}) = (\overline{q}^e, \overline{t}^e)$.

Step 6. It follows from Steps 4 and 5 that if an equilibrium exists, the contracts that are traded in this equilibrium are $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$. To conclude the proof, we only need to determine under which circumstances it is possible to support this allocation in equilibrium. Suppose first that $\nu > \nu^e$. Any buyer i can deviate by offering a menu consisting of the no-trade contract and of the contract

$$\tilde{c}^i(\varepsilon) \equiv (1, v(\overline{\theta})\overline{q}^e + \overline{\theta}(1 - \overline{q}^e) + \varepsilon)$$

for some strictly positive number ε. Using the fact that type $\underline{\theta}$ is indifferent between $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$, we can check that trading $\tilde{c}^i(\varepsilon)$ allows her to increase her profit by

$$v(\overline{\theta})\overline{q}^e + \overline{\theta}(1 - \overline{q}^e) + \varepsilon - v(\underline{\theta}) = (\overline{\theta} - \underline{\theta})(1 - \overline{q}^e) + \varepsilon$$

compared to what she earns by trading $(\underline{q}^e, \underline{t}^e)$. Hence, type $\underline{\theta}$ trades $\tilde{c}^i(\varepsilon)$ following buyer i's deviation. Similarly, trading $\tilde{c}^i(\varepsilon)$ allows type $\overline{\theta}$ to increase her profit by ε compared to what she earn by trading $(\overline{q}^e, \overline{t}^e)$. Hence, type $\overline{\theta}$ trades $\tilde{c}^i(\varepsilon)$ following buyer i's deviation. Simple computations show that the profit for buyer i induced by this deviation is

$$\mathbf{E}[v(\theta)] - v(\overline{\theta})\overline{q}^e - \overline{\theta}(1 - \overline{q}^e) - \varepsilon = [v(\overline{\theta}) - v(\underline{\theta})](\nu - \nu^e) - \varepsilon,$$

which is strictly positive for ε close enough to zero. Since this, by Step 1, is impossible, it follows that no equilibrium exists when $\nu > \nu^e$. Suppose then that $\nu \leq \nu^e$. Consider a candidate equilibrium in which each buyer proposes a menu consisting of the no-trade contract and of the contracts $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$. Then, on the equilibrium path, it is a best response for type $\underline{\theta}$ to trade $(\underline{q}^e, \underline{t}^e)$ and for type $\underline{\theta}$ to trade $(\overline{q}^e, \overline{t}^e)$. By Step 3, this yields each buyer a zero profit. To verify that this constitutes an equilibrium, we first need to check that no buyer can strictly increase his profit by proposing a single contract in addition to the no-trade contract. By Steps 3, 4, and 5, there is no profitable deviation that would attract only one type of seller. Moreover, a profitable pooling deviation exists if and only if, given the menus offered in equilibrium, both types of seller would have a strict incentive to sell their whole endowment at price $\mathbf{E}[v(\theta)]$. This is the case if and only if $\mathbf{E}[v(\theta)] > v(\overline{\theta})\overline{q}^e + \overline{\theta}(1 - \overline{q}^e)$ or, equivalently, $\nu > \nu^e$. Thus, when $\nu \leq \nu^e$, no menu consisting of a single contract in addition to the no-trade contract can constitute a profitable deviation. To conclude the proof, we only need to check that no buyer can strictly increase his profit by offering two contracts, in addition to the no-trade contract, that each attract one type of seller. The maximum profit that any buyer can achieve in this way is given by

$$\max_{(\underline{q}, \underline{t}, \overline{q}, \overline{t})} \left\{ \nu[v(\overline{\theta})\overline{q} - \overline{t}] + (1 - \nu)[v(\underline{\theta})\underline{q} - \underline{t}] \right\}$$

subject to the incentive and participation constraints

$$\underline{t} - \underline{\theta}\underline{q} \geq \overline{t} - \underline{\theta}\overline{q},$$

$$\overline{t} - \overline{\theta}\overline{q} \geq \underline{t} - \overline{\theta}\underline{q},$$

$$\underline{t} - \underline{\theta}\underline{q} \geq \underline{t}^e - \underline{\theta}\underline{q}^e,$$

$$\overline{t} - \overline{\theta}\overline{q} \geq \overline{t}^e - \overline{\theta}\overline{q}^e.$$

Note from the incentive constraints that $\overline{q} \leq \underline{q}$. It is clear that at least one of the participation constraints must be binding.

Suppose first that type $\underline{\theta}$'s participation constraint is binding. If $\underline{q} \leq \overline{q}^e$, then because type $\underline{\theta}$ is indifferent between $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$, the relevant constraint for type $\overline{\theta}$ is her incentive constraint. It is then optimal to let type $\overline{\theta}$ be indifferent between $(\underline{q}, \underline{t})$ and $(\overline{q}, \overline{t})$. Since $v(\underline{\theta}) > \underline{\theta}$, $v(\overline{\theta}) > \overline{\theta}$, and $\underline{q} \leq \overline{q}^e$, the maximum profit that the deviating buyer can achieve in this way is obtained by offering $(\overline{q}, \overline{t}) = (\underline{q}, \underline{t}) = (\overline{q}^e, \overline{t}^e)$ and is therefore strictly negative. If $\underline{q} > \overline{q}^e$, then the relevant constraint for type $\overline{\theta}$ is her participation constraint. It is then optimal to let type $\overline{\theta}$ be indifferent between $(\overline{q}, \overline{t})$ and $(\overline{q}^e, \overline{t}^e)$. We cannot have

$\overline{q} > \overline{q}^e$; otherwise, type $\underline{\theta}$ would strictly prefer $(\overline{q}, \overline{t})$ to $(\underline{q}, \underline{t})$. Since $v(\underline{\theta}) > \underline{\theta}$, $v(\overline{\theta}) > \overline{\theta}$, and $\overline{q} \leq \overline{q}^e$, the maximum profit that the deviating buyer can achieve in this way is obtained by offering the equilibrium contracts $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$.

Suppose next that type $\overline{\theta}$'s participation constraint is binding. If $\overline{q} \leq \overline{q}^e$, then the relevant constraint for type $\underline{\theta}$ is her participation constraint. It is then optimal to let type $\underline{\theta}$ be indifferent between $(\underline{q}, \underline{t})$ and $(\underline{q}^e, \underline{t}^e)$. Again, since $v(\underline{\theta}) > \underline{\theta}$, $v(\overline{\theta}) > \overline{\theta}$, and $\overline{q} \leq \overline{q}^e$, the maximum profit that the deviating buyer can achieve in this way is obtained by offering the equilibrium contracts $(\underline{q}^e, \underline{t}^e)$ and $(\overline{q}^e, \overline{t}^e)$. If $\overline{q} > \overline{q}^e$, then the relevant constraint for type $\underline{\theta}$ is her incentive constraint. It is then optimal to let type $\underline{\theta}$ be indifferent between $(\underline{q}, \underline{t})$ and $(\overline{q}, \overline{t})$, and since $v(\underline{\theta}) > \underline{\theta}$, to set $\underline{q} = 1$ and $\underline{t} = \overline{t} + \underline{\theta}(1 - \overline{q})$. The profit for the deviating buyer can then be rewritten as

$$[\nu v(\overline{\theta}) + (1 - \nu)\underline{\theta}]\overline{q} - \overline{t} + (1 - \nu)[v(\underline{\theta}) - \underline{\theta}].$$

Since $\overline{t} = \overline{t}^e + \overline{\theta}(\overline{q} - \overline{q}^e)$, as the participation constraint of type $\overline{\theta}$ is binding, this in turn is equal to

$$\left\{\nu[v(\overline{\theta}) - \underline{\theta}] - \overline{\theta} + \underline{\theta}\right\}\overline{q} + (1 - \nu)[v(\underline{\theta}) - \underline{\theta}] - \overline{t}^e + \overline{\theta}\overline{q}^e,$$

which, because $\nu \leq \nu^e = (\overline{\theta} - \underline{\theta})/[v(\overline{\theta}) - \underline{\theta}]$ and $\overline{q} > \overline{q}^e$, is at most equal to

$$\nu[v(\overline{\theta})\overline{q}^e - \overline{t}^e] + (1 - \nu)[v(\underline{\theta}) - \overline{t}^e - \underline{\theta}(1 - \overline{q}^e)] = 0.$$

The result follows. *Q.E.D.*

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