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First-mover disadvantage

Tymofiy Mylovanov*

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*Tymofiy Mylovanov, Department of Economics, University of Bonn, Adenauerallee 24-42, 53113 Bonn.
mylovanov@uni-bonn.de

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Speaker: Prof. Konrad Stahl, Ph.D. · Department of Economics · University of Mannheim · D-68131 Mannheim,
Phone: +49(0621)1812786 · Fax: +49(0621)1812785

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Tymofiy Mylovanov †

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Abstract

This note considers a bargaining environment with two-sided asymmetric information and quasilinear preferences in which parties select bargaining mechanism after learning their valuations. I demonstrate that sometimes the buyer achieves a higher ex-ante payoff if the bargaining mechanism is selected by her opponent rather than by herself. In the model, the buyer has limited wealth and in addition to acquiring one good from the seller can purchase a different good from a competitive market. The positive relation between the values of these goods is what delivers our result.

JEL Codes: C72, C78, D82.

This note presents a simple bargaining model with two-sided asymmetric information and quasilinear preferences, in which the buyer selects a bargaining mechanism after learning her valuation.[1] I demonstrate that there exist circumstances such that the buyer achieves a higher ex-ante payoff if the mechanism is selected by her opponent rather than by herself.

In my model, in addition to acquiring one good from the seller, the buyer can also acquire some other good, whose value is positively related to the (relative) value of the first good. Because the buyer has limited wealth and uses the monetary rents remaining after bargaining with the seller to purchase the other good, her ex-ante payoff is maximized in a mechanism that generates relatively high monetary rents for the types with high valuations and zero payoffs for the types with low valuations.

However, if the buyer selects a mechanism after learning her valuation, the types with low valuations can always achieve some positive payoff by offering an ultimatum bargaining game; this makes impossible for the buyer to implement an ex-ante optimal

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†Department of Economics, University of Bonn, Adenauerallee 24-42, 53113 Bonn. Email:mylovanov@uni-bonn.de

[1]That is, the buyer is an informed principal. Myerson [10] and Maskin and Tirole [8] and [9] are the main references in this field.

mechanism. Results in Yilankaya [18] imply that in this environment all types of the buyer will always implement an allocation that is equivalent to the equilibrium allocation of the ultimatum bargaining game conditional on their type.[2] (A symmetric result holds if the seller selects a mechanism.)

Now imagine that instead of the buyer, the mechanism is chosen by the seller. The seller will select an ultimatum bargaining game, in which she makes a take-it-or-leave-it price offer. The seller will extract almost all valuation from medium valuation types, exclude from trade low valuation types, and leave some rent to the high valuation types of the buyer. Importantly, the expected rents for the high types of the buyer could be quite large resulting in a bigger ex-ante payoff in this game than in the ultimatum game in which the buyer makes an offer herself.

The fact that because of the conflict of preferences among different types of a player, the allocation implemented by her types does not maximize her ex-ante payoff is not specific to my model. (Mylovanov [13] demonstrates that for generic prior beliefs and concave payoffs a player who is privately informed will fail to implement ex-ante optimal allocation.) This note shows that this conflict could be so destructive that the implemented allocation is ex-ante inferior to the allocation that maximizes the (ex-ante and interim) payoff of the opponent and ignores the payoff of the player.[3]

Environment. There is a buyer who can purchase two goods A and B. Good A can only be acquired from a seller, who has *one unit* of this good. The seller's cost c of good A is her private information. Good B can be acquired from a competitive market with *unlimited supply* at the unit price normalized to one. The buyer's has total wealth of $W > 1$ (With unlimited wealth, the buyer in my model would acquire infinite amount of good B).

The marginal values of the goods A and B for the buyer are correspondingly v_A and v_B.[4] In order to make purchase of good B always desirable, it is assumed that $v_B \geq 1$. Let $v = v_A/v_B$ be the relative value of good A. I assume that v uniquely determines values v_A and v_B and, in particular, that $v_B = g(v)$, where $g(\cdot)$ is a weakly increasing function. This relative value v is (one-dimensional) private information of the buyer. The seller's and the buyer's private information (types), c and v, are distributed according to $F_c(\cdot)$ and $F_v(\cdot)$ with continuous differentiable bounded and everywhere strictly positive densities $f_c(\cdot)$ and $f_v(\cdot)$ and support on $[0, 1]$.

Let x be the exchanged amount of good A and p be the price paid by the buyer to the seller. Then, the payoff of the seller is $u_s(c, x, p) = p - xc$ and the payoff of the buyer is $u_b(v, x, p) = xv_A + v_B(W - p) = v_B(x\frac{v_A}{v_B} + W - p) = g(v)(xv + W - p)$. Notice that the buyer's interim preferences can be represented by a function which

[2] In this note, equivalence is meant in terms of the parties' expected payoffs conditional on their private information. Yilankaya [18] has proven the result that the informed seller will implement an allocation equivalent to the equilibrium allocation of the ultimatum bargaining game. It is immediate to modify his arguments to establish the result for the buyer.

[3] Unlike the buyer, the seller in my model would implement the same allocation regardless of whether she selects a mechanism ex-ante or after learning her type.

[4] An alternative interpretation is to think of goods A and B as intermediate goods in production of a final good Y whose value is 1 and whose production technology is given by $Y = v_A x_A + v_B x_B$, where x_A, x_B, and Y are the corresponding amounts of the goods.

measures the monetary surplus from trade in good A, $\tilde{u}_b(v,x,p) = xv - p$.[5] Hence, after the parties' private information has been realized, this environment becomes equivalent to the bargaining setting with two-sided incomplete information in Myerson and Satterthwaite [11].

Bargaining. When the buyer selects a mechanism, the timing of the game is as follows: First, the parties simultaneously and privately observe their own types. Then, the buyer offers a mechanism. If the seller accepts, the mechanism is played and the buyer pays the price and obtains the amount of good A prescribed by the mechanism. After that, the buyer acquires good B from the market.[6] The game ends. When the seller selects a mechanism, the roles are reversed: the seller makes a mechanism offer and the buyer decides whether to accept it. The rest of the game is the same as before. The solution concept for these games is Perfect Bayesian equilibrium.[7]

Mechanism selection. Because at the moment of mechanism selection, the preferences of the players can be described by $u_s(c,x,p) = p - xc$ and $\tilde{u}_b(v,x,p) = xv - p$, the results in Yilankaya [18] are valid for my setting. Yilankaya shows that the seller who has private information about her valuation at the moment of selecting a mechanism will implement an allocation equivalent to the allocation resulting from the ultimatum bargaining game.[8] Similar results are straightforward to obtain for the buyer.

Result. Notice that the ex-ante payoff of the buyer can be written as $\int_0^1 g(v)(\tilde{U}(v) + W)f_v(v)dv$, where $\tilde{U}(v) = \mathbb{E}\tilde{u}_b(v,x,p)$. Let us denote by $\tilde{U}^S(v)$ and $\tilde{U}^B(v)$ the buyer's expected payoff conditional on her type in the mechanism selected by the seller and the mechanism selected by the buyer correspondingly. If $g(v)$ is relatively high for large v and for the high types of the buyer $\tilde{U}^S(v) > \tilde{U}^B(v)$, the buyer's ex-ante payoff is higher in the game where she receives an ultimatum offer:

Proposition 1. *If there is some $v' < 1$ such that $\tilde{U}^S(v) > \tilde{U}^B(v)$ for all $v > v'$, then there exists $g(\cdot)$ for which the ex-ante expected payoff of the buyer is strictly higher if the mechanism is selected by her opponent rather than by herself.*

Proof. The difference between the ex-ante expected payoffs in the game where the

[5] After the private information of the buyer is realized, she treats $g(v)$ as a constant. Then, one can divide $u_b(v,x,p)$ by $g(v)$ and subtract W to obtain $\tilde{u}_b(v,x,p)$.

[6] In the model, there are three endogenously determined variables: the payment for good A and the amounts of goods A and B acquired by the buyer. It is assumed that the parties can contract only on the first two.

[7] For a precise description of mechanism selection game, including the set of allowed mechanisms and details of the solution concept see Maskin and Tirole [9] and Mylovanov [12].

[8] Yilankaya invokes the characterization of an ex-ante optimal allocation in Williams [17], which requires additional assumptions on distribution functions, e.g., monotonicity of the hazard rate of the buyer's distribution. Proposition 2 in Mylovanov [12] extends Yilankaya's result to non-monotonic case.

seller sets the price and the buyer sets the price is

$$\Delta = \int_0^1 g(v)\left(\tilde{U}^S(v) - \tilde{U}^B(v)\right) f_v(v)dv =$$
$$\int_0^{v'} g(v)\left(\tilde{U}^S(v) - \tilde{U}^B(v)\right) f_v(v)dv +$$
$$\int_{v'}^1 g(v)\left(\tilde{U}^S(v) - \tilde{U}^B(v)\right) f_v(v)dv.$$

It is immediate that there exist $g(\cdot)$ increasing on $[v', 1]$ such that the second term in the above expression is large enough to ensure $\Delta > 0$. □

Example. Let $F_c(c) = c$ and $F_v(v) = 1-(1-v)^4$. Then, it is direct to demonstrate that there exists $v' \approx 0.544$ such that $\tilde{U}^S(v) \geq \tilde{U}^B(v)$ if $v \geq v'$ and $\tilde{U}^S(v) < \tilde{U}^B(v)$ otherwise. If $g(v) = 1 + 3v$, the buyer's ex-ante payoff is higher in the game where her opponent selects the mechanism.

First-mover disadvantage. The result in Proposition 1 can be equivalently stated as that the buyer may have first-mover disadvantage in the ultimatum bargaining game: she obtains a higher ex-ante payoff in the game in which she moves second receiving an ultimatum price offer than in the game in which she moves first making such an offer herself.[9] This is in accordance with some of the business bargaining literature which recommends to wait for an offer rather than to make one.[10]

Li and Tan [6] make a similar observation in the context of a choice between hidden and announced reserve price in auctions with risk-averse bidders and continuous types. In one-bidder environment announcing the reservation price is equivalent to making a take-it-or-leave-it price offer, whereas hiding the reservation price is equivalent to receiving such an offer. Li and Tan show that a sufficiently risk-averse bidder will make offers which are very close to her true valuation and therefore receiving an offer generates a higher ex-ante payoff for the seller than making an offer. My model differs in two important respects. First, it is currently not known which mechanism will be selected by the informed seller in the environment in Li and Tan. However, the results in Quesada [15] suggest that the seller will offer a mechanism that is different from and achieves a higher expected payoff than in the ultimatum bargaining game.[11] Furthermore, in my model there is no risk-aversion.

[9] First-mover disadvantage is often present in Bertrand duopoly games due to ability to undercut the first mover and in Cournot duopoly games with incomplete information due to the distortion in the equilibrium action caused by signalling effects (Dowrick [3], Gal-Or [4], Amir and Stepanova [1], Mailath [7], Normann [14]). In the models of research and development and adoption of new technology, a second-mover advantage may appear because of informational spillovers or technological advances Reinganum [16] and Hoppe and Lehmann-Grube [5].

[10] See, for instance "The Sourcing Solution: A Step-By-Step Guide to Creating a Successful Purchasing Program," by Larry Paquette, p. 147, "Flipping Properties: Generate Instant Cash Profits in Real Estate," by William Bronchick and Robert Dahlstrom, p. 66, "On-Scene Guide for Crisis Negotiators," by Frederick J. Lanceley, p. 90, "Energy Economics and International Energy Markets," by Carol A Dahl, p. 245, "From the Complete Idiot's Guy to Getting Along with Difficult People," by Brandon Toropov, p. 191.

[11] Quesada considers a setting with discrete types and one risk-averse agent. It is simple to show

Finally, Cornet [2] presents a bargaining model in which there is a seller and two buyers, who can resell the good to each other. The possibility of resale increases competition among the buyers and may lead to a higher ex-ante payoff for the seller in the game where she receives the buyers' offers than in the game where she makes an offer herself.

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that in her environment the equilibrium allocation in the ultimatum bargaining game is independent of the risk attitude of the agent. On the other hand, Quesada shows that the allocation implemented by the informed seller depends on the risk attitudes of the agent and hence is different. Because the seller can always implement the allocation of the ultimatum bargaining game, in the equilibrium all her types must be achieving a higher payoff.

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