Information revelation in markets with pairwise meetings : complete information revelation in dynamic analysis

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Information revelation in markets with pairwise meetings: complete information revelation in dynamic analysis

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Abstract

We study information revelation in markets with pairwise meetings. We focus on the one-sided case and perform a dynamic analysis of a constant entry flow model. The same question has been studied in an identical framework in Serrano and Yosha (1993) but they limit their analysis to the stationary steady states. Blouin and Serrano (2001) study information revelation in a one-time entry model and obtain results different than Serrano and Yosha (1993). We establish that the main difference is not due to the steady state analysis but is due to the differences concerning the entry assumption.

Keywords: information revelation, asymmetric information, decentralized trade.

JEL Classification: D49, D82, D83

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Introduction

We can illustrate the general issue of information revelation in market with pairwise meetings by a parallelism with what we can observe on all the places of interest in Egypt. On all these places, one observes bargaining between Egyptians and Tourists. The Egyptians try to sell a guided tour of the place. The Tourists are the potential buyers. There is neither a central institution nor a unique public price. The phase of bargaining happens after a matching between one seller and one buyer. When an Egyptian reaches an agreement with a Tourist, the two quit the market to effectuate the tour. In case of disagreement, the two separate and are matched anew with an agent of the opposite type.

The asymmetric information concerns the interest of the place. It is not obvious, for a Tourist, if the place has a long history, if there is a lot of anecdotes about the site. Some Tourists can be uninformed about the interest while some other ones are informed, for instance, because they know some friends who previously visited the same place. Of course, all the Egyptians know the exact interest of the place.

The interest of the place has an influence on the value and the cost of the guided tour. It is more interesting to have a guide when there is a lot of things to say about the site. At the same time, it is more costly for an Egyptian to guide when the place is interesting, at least because it takes more time.

We can expect that the *good* price is higher when the place is of high interest. It is also natural that the uninformed Tourists try to extract information from their matches with different partners. This learning is expensive because there is a waste of time. Naturally, sellers try to exploit their information's advantage by misrepresenting. By misrepresenting, sellers incur also a cost for the same reason, i.e. the waste of time.

The main issue will be to determine if the trading process will imply an information revelation. Especially when the agents become infinitely patient, i.e. the market becomes approximately frictionless.

In market with pairwise meetings, the information revelation literature began with the seminal paper Wolinsky (1990) [1]. The model studied in this paper is more general than ours because there are also some uninformed

[1] Concerning the market with pairwise meetings with perfect information, there is a significant literature studying following the seminal works of Gale, Rubinstein and Wolinsky. For a review, see Osborne and Rubinstein (2000).

sellers. In our egyptian story, it would mean that some Egyptians are not aware of the place's interest. The main result of Wolinsky (1990) is that some trades occur at a wrong price according to the state even when market becomes approximately frictionless.

Gale (1989) conjectures the great importance of the assumption that uninformed agents are present in the two sides of the market because a noise is created if the cost of learning decreases. Indeed, the decreasing of the cost causes the probability - of an uninformed agent to meet another uninformed agent - to increase. This requires, however, the information power of meeting to decrease when the cost of learning declines.

Serrano and Yosha (1993) show that Gale's conjecture is correct. They use the same model than Wolinsky (1990), but they assume that all sellers are informed. The noise force disappears, since uninformed buyers always meet informed sellers. Finally, Serrano and Yosha (1993) establish that all transactions occur at the right price whenever the market becomes approximately frictionless.

Wolinsky (1990) and Serrano and Yosha (1993) use a constant flow entry model. At each period, a certain number of new agents enter the market. To simplify the analysis, these papers consider only the stationary steady states. In other words, they consider the situations where the number of agreements is exactly equal to the entry flow. Blouin and Serrano (2001) study the same question of information revelation but in a one-time entry model[2]. At the first period, all the agents are present and nobody enters the market in the following periods. They obtain a dramatically different result in the one sided case. They conclude, in this case, that some transactions occur at wrong prices even when the market is frictionless. The two sided analysis provides results similar to Wolinsky (1990).

The question is to know whether the differences of results are due to the difference of hypothesis or to the restriction of the analysis to the steady states in the case of a constant entry flow model. In the case of a constant flow entry, we can imagine that there is a kind of externality between the different generations of agents, which implies the difference of the results. Concerning the restriction to the steady states, it is not unreasonable to believe that some dynamics are ignored which could explain why full revelation is obtained in Serrano and Yosha (1993) while not in Serrano and

[2]For a discussion of these two hypothesis (constant entry flow and one time entry) in the perfect information case see Gale (1987). Generally, the implicit economy in the constant entry flow model is not well defined. Nevertheless, the constant entry flow model remains interesting at least because they may correspond better to some real markets.

Blouin (2001).

This paper studies the same model than Serrano and Yosha (1993) but assumes an initial period. The model thereby has a starting point outside a steady-state. As usual in the literature, this paper studies markets which become approximately frictionless.

A first intuition could be that a transition phase will be observed before the steady-states. The first proposition states that such a transition phase does not exist for the steady-state that implies a complete information revelation. So, the differences of result between Serrano and Yosha (1993) and Blouin and Serrano (2001) can not be completely explained by the restricted analysis used by Serrano and Yosha (1993).

This kind of model often presents a multiplicity of equilibria. One could then suspect that a steady-state analysis is unable to find all these equilibria. Among these ignored equilibria, one can expect to find some equilibria without complete information revelation. The second proposition shows that this is not the case, at least if uninformed buyers are sufficiently suspicious. In our egyptian story, sufficiently suspicious would mean that the probability that the place is interesting is not considered very high by uninformed Tourists. Then, the equilibrium about the first proposition is the unique one.

Let's note that surprisingly the dynamic analysis reduces the number of equilibria rather than adds some new ones. Some of the steady-state cannot be reached from our starting point.

To sum up, we proved the existence and the uniqueness of an equilibrium. This equilibrium implies a complete information revelation. So, the difference between Serrano and Yosha (1993) and Blouin and Serrano (2001) is due to the difference of modeling and not to the restriction of the analysis to the steady-states in Serrano and Yosha (1993).

In the first section, we present the model. The second section delineates some characterizations of the equilibria that are useful in the next sections. The third section introduces the first proposition. The second proposition is presented and proved in the last section.

1 The model

We consider the model of Serrano and Yosha (1993) without modifying it but we study the outcomes without assuming an *a priori* stationarity of the equilibrium.

Times runs discretely from 0 to ∞[3]. Each period is identical. On one side, there are sellers who have one unit of indivisible good to sell. On the other side, there are buyers who want to buy one unit of this good. In each period, a continuum of measure M of new sellers and the same quantity of buyers enter on the market. The sellers' number which arrive on the market is equal to the buyers' one. The agents quit the market when they have traded. Hence, the number of sellers is always equal to the number of buyers.

There exist two possible states of the world which influence on the payoff of the agents. If the state is low (L), the cost of production (c_L) for the sellers but also the utility (u_L) of the buyers are low. If the state is high (H), the corresponding parameters (c_H and u_H) are high. The state remains identical during all the periods.

All sellers know the state of the world, whereas not all buyers are perfectly informed about the state of the world. Among the new comers, there is a part x_B of buyers which is perfectly informed. The remaining buyers are uninformed and possess a common prior belief $\alpha_H \in [0,1]$ that the state is H and $(1-\alpha_H)$ that the state is L.

At each period, all the agents are randomly matched with an agent of the other type. At each meeting, the agents can announce one of two prices : p^H and p^L. If both agents announce same price, trade occurs at this price. If a seller announces a lower price, trade occur at an intermediate price p^M. If a seller announces a higher price, trade does not occur. The different parameters are assumed to be ordered such that :

$$c_L < p^L < u_L < p^M < c_H < p^H < u_H \tag{1}$$

Staying on the market implies a zero payoff. The instantaneous payoff when a trade occurs is the price minus the cost for a seller and the utility minus the price for a buyer. All agents discount the future by a constant factor δ.

In state H, we call p^H the *good* price because trade at other prices implies a loss for the sellers. Similarly, the price p^L is the *good* price in state

[3]Serrano and Yosha 1993 consider that times runs from $-\infty$ to ∞. To make the steady state analysis, it is sufficient to assume that the initial conditions are the values of the steady state. This approach is totally equivalent to the approach of Serrano and Yosha 1993.

L because trade at other prices involves loss for the buyers.

After each meeting with a seller who announces p^H, a buyer will actualise his belief α_H according to Bayes'rule. If an uniformed buyer meets a seller who announces p^L, he knows that state is L but it does not really matter since this buyer will trade and leave the market.

It is convenient to say that a seller (resp. a buyer) plays *soft* when he announces p^L (resp. p^H) and *tough* when he announces the p^H (resp. p^L). When an agent plays *soft*, he is ensured to trade and to quit the market. So, to describe completely the strategy of an agent, it is sufficient to give the number of periods in which he plays *tough*. The strategy of an agent might depend on the time of entry on the market. We note $n_{SH}(t)$ the number of periods during which a seller plays *tough* when he enters in time t on a market which is in state H. Similarly, we define $n_{SL}(t)$, $n_{BH}(t)$, $n_{BL}(t)$ and $n_B(t)$. Naturally, the strategy of an uninformed buyer $n_B(t)$ is independent of the state of the world.

We define now the proportions of agents who play *tough* when state is L. The proportion of the total number of buyers in the market who at period t announce p^L is called $B(t)$[4]. Similarly, $S(t)$[5] is the proportion of sellers who at period t announce p^H. These values are known to all agents.

An equilibrium is a profile of strategies where each agent is maximizing his expected payoff, given the strategies of the other agents. All parameters $(p^H, p^M, p^L, c_H, c_L, u_H, u_L, x_B, \delta, \alpha_H)$ are common knowledge.

2 Preliminary results

In this section, some definitions and preliminary results are introduced. Those results will be useful in order to prove the two main propositions.

2.1 Trivial strategies

In the following claim, we characterize the equilibrium strategies of sellers in state H and of informed buyers.

Claim 1 *In any equilibrium* $n_{SH}(t) = \infty$, $n_{BL}(t) = \infty$ *and* $n_{BH}(t) = 0$ $\forall t$.

[4] In Serrano and Yosha (1993), this proportion is noted B_L^l.

[5] This proportion is equivalent to S_L^h in Serrano and Yosha (1993)

Proof An informed seller in state H knows that his payoff will be negative if he trades at an other price than p^H. Since the payoff of perpetual disagreement is 0, he will always prefer to play *tough* even if it implies a long delay before trading. The reasoning is identical for an informed buyer in state L. An informed buyer in state H will understand that $n_{SH}(t) = \infty$ and thus he will never trade while he plays *tough*. Playing *tough* only delays the payoff. So, it is better for this kind of buyer to play immediately *soft*.

2.2 Strategy of uninformed buyers

We define $\Delta V_B(t)$ which is the difference of gain between playing *soft* tomorrow and playing *soft* today for an uninformed buyer which enter the market in period t.

$$\begin{aligned}
\Delta V_B(t) &= \Delta V_B(S(t), S(t+1)) \\
&= \alpha_H(u_H - p^H)\delta \\
&+ (1-\alpha_H)(1-S(t))(u_L - p^L) \\
&+ (1-\alpha_H)\delta S(t)[(u_L - p^M) + S(t+1)(p^M - p^H)] \\
&- [\alpha_H(u_H - p^H) + (1-\alpha_H)[(u_L - p^M) + S(t)(p^M - p^H)]] \quad (2)
\end{aligned}$$

The last line corresponds to the payoff involved by playing *soft* today. [6] The first lines correspond to playing today *tough* and tomorrow *soft*[7].

If the difference of gain between playing *soft* tomorrow and playing *soft* today is positive, it is clear that an uninformed buyer will not play *soft* today. So, we can state :

Claim 2 *Optimal strategies are such that*

$$\Delta V_B(t) > 0 \Longrightarrow n_B(t) \geq 1 \qquad (3)$$

[6] The payoff in state H which is equal to $(u_H - p^H)$ is multiplied by the probability that the state is H. The term in brackets, which is multiplied by the probability that the state is L, is naturally the payoff in state L. This payoff can be written $(1 - S(t))(u_L - p^M)$ (i.e. the probability to meet a *soft* seller times the payoff involved by this meeting) plus $S(t)(u_L - p^H)$ (i.e. the probability to meet a *tough* seller times the payoff involved).

[7] The meaning of the first line is obvious. It is just important not to forget the discount factor δ. Indeed, if the state is H, a buyer who announces p^L does not trade. In the case where the state is L, there is a probability $(1 - S(t))$ that a buyer meets a *soft* seller and obtains today $(u_L - p^L)$. If a buyer does not have this luck, which happens with probability $S(t)$, he will have tomorrow an expected payoff equal to the expression in brackets. Once again, we must not forget the discount factor.

2.3 Characterisation of $S(t)$ at equilibrium

We define $\Delta V_{SL}(B(t), B(t+1))$ which is the difference of gain between playing *soft* tomorrow and playing *soft* today for an informed seller in state L. This difference depends on time because $B(t)$ may be non-stationary. Remark that $\Delta V_{SL}(B(t), B(t+1) < 0$ does not imply that the best solution is to stop in t.

$$
\begin{aligned}
\Delta V_{SL}(B(t), B(t+1)) &= (1 - B(t))(p^H - c_L) \\
&+ B(t)\delta[((1 - B(t+1))(p^M - c_L) + B(t+1)(p^L - c_L)] \\
&- [((1 - B(t))(p^M - c_L) + B(t)(p^L - c_L)] \\
&= B(t)\bigg[(-p^H + p^M - p^L + c_L) + \delta(p^M - c_L) \\
&+ \delta B(t+1)(p^L - p^M)\bigg] + (p^H - p^M) \qquad (4)
\end{aligned}
$$

In the first equality, the two first lines correspond to playing *tough* today and *soft* tomorrow while the third one corresponds to playing *soft* today.[8]

Assume that a seller stops today playing *tough*. ΔV_{SL} is a measure of gain for a seller if he decides to play *tough* one period more. The measure of gain for a seller if he decides to play *tough* T periods more is given by the sum of succesive ΔV_{SL} balanced in order to take account of discount factor δ. If there exists a T such that this sum is positive, then playing *tough* T periods more gives a higher expected payoff than playing *soft* today. If this sum is negative for all T, then the maximum expected payoff is reached by playing *soft* today. If the sum is null for a T, then the seller is indifferent between playing *soft* today or playing *tough* T periods more.

[8]If a seller plays *soft* today, he has a probability $(1 - B)$ to meet a *soft* buyer and consequently to obtain a payoff $(p^M - c_L)$, otherwise (i.e. with probability B) he will get $(p^L - c_L)$ due to a meeting with a *tough* buyer. If a seller announces p^H, he will reach an agreement only if he is matched with a *soft* buyer. It occurs with a probability $(1 - B)$ and the payoff is then $(p^H - c_L)$. Otherwise, with a probability B, he will remain in the market. In the next period, if he plays *soft*, he has an expected payoff equal to the expression between brackets which must be multiplied by the discount factor δ because trade occurs one period later.

Claim 3 *Optimal strategies are such that the sequence $S(t) \in [0,1]$ satisfies*

$$S(t) = 1 \implies \exists\, T \; s.t. \sum_{i=0}^{T} \delta^i \Delta V_{SL}(t+i) \geq 0 \quad (5)$$

$$S(t) < 1 \implies \sum_{i=0}^{T} \delta^i \Delta V_{SL}(t+i) \leq 0 \quad \forall\, T \quad (6)$$

$$\exists\, T \; s.t. \sum_{i=0}^{T} \delta^i \Delta V_{SL}(t+i) > 0 \implies S(t) = 1 \quad (7)$$

$$\sum_{i=0}^{T} \delta^i \Delta V_{SL}(t+i) < 0 \quad \forall\, T \implies S(t) = 0 \quad (8)$$

3 Existence

The following proposition establishes the existence of a steady state equilibrium, called E1 in Serrano and Yosha (1993), without convergence phase when δ is high enough. The novelty compared to Serrano and Yosha (1993) is the dynamic context of the proof. In other words, there exists, in a dynamic analysis, an equilibrium with full information revelation[9] when market are sufficiently frictionless.

Proposition 1 *If*

$$\delta \geq 1 - \frac{1-\alpha_H}{\alpha_H} \frac{p^M - p^L}{u_H - p^H} \quad (9)$$

then $n_{SL}(t) = 0$ and $n_B(t) = 1$ $\forall t$ imply an equilibrium.

Proof $n_{SL}(t) = 0$ implies $S = 0$. Since no seller misrepresents, once a buyer has met a seller who announces a state H, he knows that it is useless to play *tough*. So, n_B can not be higher than one. To see that $n_B \neq 0$, it is sufficient to oberve that $\Delta V_B(0,0) > 0$. Hence, $n_B(t) = 1$ is an optimal strategy given $n_{SL}(t) = 0$.

The proposed strategies imply $B = 1$. So, $\Delta V_{SL} < 0$ and the conditions given by claim 3 are fulfilled. Hence, no seller has an incentive to deviate.[10]

[9] All the trades occur at the *good* price.

[10] This result depends crucially on the fact that an individual deviation does not affect the value of S and B because agents are negligeable.

4 Uniqueness

The next proposition states that when uninformed buyers are not too optimistic about the probability that the state of the world is H, then the complete revelation equilibrium is the unique one when the market becomes approximately frictionless.

Proposition 2 *If $\alpha_H < \frac{p^H - u_L}{u_H - u_L}$, there exists a $\bar{\delta}$ such that for all $\delta > \bar{\delta}$ there is an unique equilibrium described by proposition 1.*

It is clear that if $S(t) = 0$ and $n_B(t) \geq 1$ for all the periods, the unique equilibrium is described in proposition 1. The proposition will be proved by successive claims. The whole proof is relatively tedious even if not really difficult. The goal of the first claim is obvious. The reader could be desoriented by the next ones. He might be helped by keeping in mind the final goal is to prove $S(t) = 0 \ \forall t$ under the assumptions of the proposition. Actually, other possibilities for $S(t)$ are excluded step by step.

The following claim ensures that uninformed buyers are suspicious enough and prefer to play *tough* during the first period in the market independently of the strategy of the other agents.

Claim 4 *The following condition is sufficient to ensure $n_B(t) \geq 1 \ \forall t$.*

$$\delta \geq \frac{p^H - p^M - u_L + p^L}{p^H - u_L} = \breve{\delta} \quad \textit{and} \quad \alpha_H < \frac{p^H - u_L}{u_H - u_L} \tag{10}$$

Proof It is obvious that $\Delta V_B \geq \Delta V_B(S, 1)$. Clearly, $\Delta V_B(S, 1)$ is a linear function in S. So, either $\Delta V_B(0, 1)$ or $\Delta V_B(1, 1)$ is the minimum value that ΔV_B can take. The second inequality of (10) is equivalent to $\Delta V_B(1, 1) > 0$. The first inequality of (10) is the condition such that $\Delta V_B(1, 1)$ is the minimal value of ΔV_B.

It is usefull to remember that uninformed buyers don't update their belief α_H when $S = 1$. Indeed, since they have the same probability ($= 1$) to meet a *tough* seller in the two states of the world, meeting a *tough* buyer doesn't carry any information with respect to the prevalent state of the world.

Claim 5 *If the condition of claim 4 is satisfied, $S(t) = 1$ implies $B(t+1) = 1$.*

Proof The condition of claim 4 ensures that all the newcomers in the market play *tough*. Among the buyers present in $t+1$ who were already in the market during the previous period, some are informed and play always *tough*. The uninformed buyers who played *tough* in the previous period have no reason to decide to play *soft* since their belief does not change compared to the previous period. Clearly, the uninformed buyers who played *soft* in the previous period are exited. So, there are only buyers playing *tough* on the market in period $t+1$.

Claim 6 *If the condition of claim 4 is satisfied and* $B(t) = 1$ *then* $S(t) < 1$.

Proof Imagine that $S(t) = 1$. First, one can see that $\Delta V_{SL}(B(t), B(t+1)) < 0$. Indeed, according to claim 5, $B(t+1) = 1$ sothat playing *tough* in period t and *soft* in the following period simply implies to delay the instantaneous payoff $c_L - p^L$, which is expensive due to the discount factor.

$S(t) = 1$ implies that $\exists\, T$ such that $\sum_t^T \Delta V_{SL} \geq 0$.

Let's assume $\exists\, T$ such that $\sum_t^T \Delta V_{SL} > 0$, then $\Delta V_{SL}(B(t), B(t+1)) < 0$ implies $\sum_{t+1}^T \Delta V_{SL} > 0$. Hence $S(t+1) = 1$ by claim 3. Remark that $S(t+1) = 1$ implies $\Delta V_{SL}(B(t+1), B(t+2)) < 0$. So, by recurrence, $S = 1$ for all the periods between t and T. But then $\sum_t^T \Delta V_{SL} < 0$ and we have a contradiction. So, $\nexists\, T$ such that $\sum_t^T \Delta V_{SL} > 0$.

Let's now consider the possibility to have T such that $\sum_t^T \Delta V_{SL} = 0$. We will prove that this situation cannot exist by proving that $\Delta V_{SL}(B(t+1), B(t+2))$ cannot be positive nor negative nor null.

$\Delta V_{SL}(B(t+1), B(t+2)) > 0$ is impossible. Indeed, it would imply $S(t+1) = 1$. But this would imply in turn that $\Delta V_{SL}(B(t+1), B(t+2)) < 0$ as explained above.

$\Delta V_{SL}(B(t+1), B(t+2)) < 0$ is not possible either. $S(t) = 1$ and $S(t+1) > 0$[11] implies $\exists\, T$ such that $\sum_t^T \Delta V_{SL} = \sum_{t+1}^T \Delta V_{SL} = 0$ but this is not possible. Indeed, $\sum_t^T \Delta V_{SL} < \sum_{t+1}^T \Delta V_{SL}$ since $\Delta V_{SL}(B(t), B(t+1)) < 0$.

It remains to consider a situation in which $\Delta V_{SL}(B(t+1), B(t+2)) = 0$. $S(t) = 1$ implies $\exists\, T$ such that $\sum_t^T \Delta V_{SL} = 0$. So, for the same T, we have $\sum_{t+1}^T \Delta V_{SL} > 0$ and then $S(t+1) = 1$. Hence, we have a contradiction since $S(t+1) = 1$ implies $\Delta V_{SL}(B(t+1), B(t+2)) < 0$.

So, $\nexists\, T$ such that $\sum_t^T \Delta V_{SL} = 0$.

[11] It is obvious that $S(t+1) = 0$ does not make sens as equilibrium.

Claim 7 *Consider a situation where the condition of claim 4 is satisfied. If* $0 < S(t) < 1$ *and* $\Delta V_{SL}(B(t), B(t+1)) < 0$ *then* $S(t+1) = 1$ *and* $S(t+2) < 1$*. Moreover*

$$\Delta V_{SL}(B(t), B(t+1)) + \Delta V_{SL}(B(t+1), B(t+2)) = 0 \tag{11}$$

Proof If $S(t) > 0$, $\exists T$ such that $\sum_t^T \Delta V_{SL} = 0$. Since $\Delta V_{SL}(B(t), B(t+1)) < 0$, $\sum_{t+1}^T \Delta V_{SL} > \sum_t^T \Delta V_{SL} = 0$. This means that $S(t+1) = 1$. By claim 5, we know that $B(t+2) = 1$ and subsequently by claim 6 we have $S(t+2) < 1$.

$S(t+2) < 1$ implies $\nexists T$ such that $\sum_{t+2}^T \Delta V_{SL} > 0$. So, if $S(t) > 0$ then equation (11) must be satisfied.

Claim 8 *If* $S(0) = 0$ *then* $S(t) = 0$ $\forall t$*.*

Proof If $S(0) = 0$ then the situation in period 1 is exactly identical to the situation in period 0 so $S(1) = 0$. And so on for the following periods.

Claim 9 *If the conditionsof claim 4 is satisfied, we can not have an equilibrium with* $S(0) > 0$ *and* $n_B(0) \geq 2$*.*

Proof Condition of claim 4 ensures $n_B(1) \geq 1$, hence $B(0) = B(1) = 1$. Claim 7 implies $S(1) = 1$. Hence, $B(2) = 1$ by claim 5. According to claim 7, the equation (11) must be satisfied for $t = 0$ but it is not possible with $B(0) = B(1) = B(2) = 1$.

Claim 10 *If the condition of claim 4 is satisfied and* $\delta > \tilde{\delta}$*, we can not have an equilibrium with* $S(0) > 0$ *and* $\Delta V_{SL}(B(0), B(1)) = 0$*. With*

$$\tilde{\delta} = \frac{p^L - c_L}{(p^M - c_L) - (p^M - p^L)x_B} < 1 \tag{12}$$

Proof From claims 9 and 4, we know $n_B(0) = 1$. So,

$$B(0) = 1 \quad \text{and} \quad B(1) = \frac{1 + S(0)x_B}{1 + S(0)} \tag{13}$$

$S(0)$ such that $\Delta V_{SL}(1, \frac{1+S(0)x_B}{1+S(0)}) = 0$ is given by

$$S(0) = \frac{(1-\delta)(p^L - c_L)}{(p^L - c_L) - \delta(p^M - c_L) + \delta(p^M - p^L)x_B} \tag{14}$$

The claim is obtained by noting that this expression is negative if $\delta > \tilde{\delta}$.

Claim 11 *Assume that condition of claim 4 is satisfied, we can not have an equilibrium with* $1 > S(0) > 0$ *and* $n_B(0) = 1$ *when* $\delta > \tilde{\delta}$. $\tilde{\delta}$ *defined as above.*

Proof Since $n_B(0) = 1$, $B(1)$ is given by equation (13). By claim 7, $S(1) = 1$ hence $B(2) = 1$.
$S(0)$ such that $\Delta V_{SL}(1, \frac{1+S(0)x_B}{1+S(0)}) + \Delta V_{SL}(\frac{1+S(0)x_B}{1+S(0)}, 1) = 0$ is equal to

$$\frac{2(1-\delta)(p^L - c_L)}{p^H - p^L - (1-\delta)(p^M - c_L) + [(1-\delta)(p^M - p^L + c_L) - p^H + \delta p^L]x_B} > 0 \quad (15)$$

Clearly, if $\delta > \tilde{\delta}$, this expression is larger than the one given by the equation (14). Observe that $\Delta V_{SL}(1, \frac{1+S(0)x_B}{1+S(0)}) = 0$ is increasing in $S(0)$. Hence, $\Delta V_{SL}(1, \frac{1+S(0)x_B}{1+S(0)})$ with $S(0)$ given by (15) is positive. It is a contradiction with the fact that $S(0) < 1$.

Claim 12 *If the condition of claim claim 4 is satisfied and* $\delta > \tilde{\delta}$ *then* $S(t) = 0\ \forall t$ *at equilibrium.*

Proof Claims 9, 10 and 11 ensure $S(0) = 0$ if $\delta > \tilde{\delta}$. The result for the following periods is obtained by claim 8.

For the proposition, take $\bar{\delta} = \max(\breve{\delta}, \tilde{\delta})$.

References

Blouin M.R. and Serrano R.: A decentralized market with common value uncertainty : non-steady states. Review of Economic Studies, **68**, 323-346 (2001)

Gale D.: Limit theorems for markets with sequential bargaining. Journal of Economic Theory, **43**, 20-54 (1987)

Gale D.: Informational efficiency of search equilibrium, mimeo, University of Pittsburg (1989)

Osborne M.J. and Rubinstein A.: Bargaining and markets. San Diego, Academic Press (2000)

Serrano R. and Yosha O.: Information revelation on a market with pairwise meetings : the onesided case. Economic Theory, **3**, 481-499 (1993)

Wolinsky A.: Information revelation in a market with pairwise meetings. Econometrica, **58**, 1-23 (1990)

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