Discussion Paper No. 479

HERD BEHAVIOR OF JAPANESE ECONOMISTS

Masahiro Ashiya
and
Takero Doi

May 1999

The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

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Masahiro ASHIYA* and Takero DOI**

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Suppose competent economists obtain common information on business forecasts, and incompetent economists obtain independent information. If no one knows who is able, young economists mimic others because a forecast different from others indicates inability when it proves wrong. An older economist, however, can infer his ability from past information. Those who got useful information stop herding to signal their ability when economists are heterogeneous. All economists herd together when economists are homogenous and the merit from signaling is small. The empirical result suggests that Japanese economists are more homogenous than American.

Keywords: Signaling; Herd behavior; Reputation; Forecast.

JEL Classification Codes: D82

* Institute of Social and Economic Research, Osaka University, 9-8-611, Korigaoka, Hirakata, Osaka, Japan 573-0084, email: ashiya@iser.osaka-u.ac.jp

** Faculty of Economics, Keio University, 4-36-21-A-210 Ooka, Minami-ku, Yokohama, Kanagawa, Japan 232-0061, email: tdoi@econ.keio.ac.jp

1. Introduction

People point out 'herd behavior' as a notable feature of Japanese workers. They say that Japanese workers lack originality and always mimic colleagues or workers of other firms. This paper analyzes whether Japanese workers really herd together using macroeconomic forecast data of Japanese economists. It is the first empirical study on herd behavior in Japan.

Scharfstein and Stein (1990) suggest that an economist may herd to keep his reputation.[1] Suppose economists with high ability obtain common information on business forecasts, and economists with low ability obtain independent information. [2] If no one knows who is able, economists are evaluated by their forecasts. Then they have an incentive to imitate each other since a forecast different from others indicates inability when it proves wrong.

This argument fits well with a young economist since he has no way to prove his ability. An old economist, however, may stop herding when forecasts are made repeatedly. Since an economist gradually understands the value of his information, he has an incentive to make forecasts based on his information only if it was valuable in the past. Therefore an older economist can signal his ability by following his own information.

When economists are heterogeneous, the benefit from signaling is large. Accordingly, there exists a separating equilibrium in which only those who got useful information in the past stop herding. Then forecasts tend to be more dispersed as economists grow older. [3] When economists are homogeneous, on the other hand, old economists continue herding since the merit from signaling is small.

The latter half of this paper investigates the relation between economists' age and degree of herding. It uses the forecast data of Japanese economists on Japanese real growth rate in "Monthly Statistics (Tokei Geppo)". The dependent variable is the degree of herding, which is defined as the distance between a forecast of an economist and the forecast average excluding him. The independent variables are 'age' of the economist (the years while he starts forecasting), individual dummies, and the average distance between him and the forecast average excluding him (This variable is added to eliminate specific factors of each year). Then the coefficient of 'age' is found to be small and statistically insignificant. It suggests that Japanese economists continue herding as they grow older.

Lamont (1995) makes the same regression using American data, and obtains the result that older economists stop herding. [4] Compared with the implication of our model, these results suggest that Japanese economists are more homogenous than American.

This paper is organized as follows. Section 2 provides the model in which two economists forecast business fluctuation across two periods. Section 3 analyzes the equilibrium. Section 4 explains data and reports the estimated result. Section 5 concludes this paper. All proofs of propositions are summarized in the Appendix.

2. The Model

We modify the model of Scharfstein and Stein (1990). The structure of this model is common knowledge to all players. There are two risk-neutral economists, A and B, who predict the trend of the economy through two periods. In each period, they collect information independently and report whether the economy will have an upward tendency (u) or it will take a downward turn (d). The prior probability of boom is assumed to be 0.5 in each period, and there is no correlation between business conditions of period 1 and 2. Each of A and B may or may not be a good forecaster, but no one (including himself) knows who is a good forecaster. The market revises the evaluation of each economist based on fitness of his forecast, and each economist tries to obtain a higher evaluation.

At the beginning of period 1, the ability of A and B are independently determined. The prior probability that economist i is able is θ (the probability that he is not able is $1-\theta$). No one knows who is able.

At date 1 in period 1, A and B receives a signal $s_1^i \in S_1 \equiv \{u_1, d_1\}$ ($i = A, B$). No one except i can observe s_1^i. If economist i is able and receives u_1 (d_1), a boom occurs with the probability p ($-p$) and a recession occurs with the probability $-p$ (p). If economist i is not able, a boom occurs with probability 0.5 regardless of his signal. If both are able, they always receive the same signal. Otherwise s_1^A and s_1^B are independent. The conclusion does not change if we suppose competent economists receive correlated signals. [5]

At date 2 in period 1, A reports his forecast $R_1^A = r_1^A(s_1^A) \in S_1$. At date 3, B observes R_1^A and reports $R_1^B = r_1^B(R_1^A, s_1^B) \in S_1$. [6] Let $r_1 \equiv (r_1^A, r_1^B)$. Define I_t^i as

$$I_t^i(s_t^i) = s_t^i \text{ for any } s_t^i$$

and let $I_t \equiv (I_t^A, I_t^B)$. I_t^i is the strategy to follow its own information. Also define m_t^B, mimicking strategy, as

$$m_t^B(R_t^A) = R_t^A \text{ for any } R_t^A.$$

At the last day of period 1, the true state of the economy, $o_1 \in S_1$, is revealed. Define $h_1 \equiv (R_1^A, R_1^B, o_1)$. Let $\theta_1^i = \theta_1^i(s_1^A, s_1^B, o_1)$ be the *objective* probability at the last day of period 1 that economist i is able. Let $\hat{\theta}_1^i$ be the *subjective* evaluation of the market at the last day of period 1 that economist i is able. Then, since the forecast of other economist is useful in evaluation,

$$\hat{\theta}_1^i = \hat{\theta}_1^i(h_1, r_1) \text{ if } \Pr(h_1 | r_1) > 0,$$

$$= \hat{\theta}_1^i(h_1, I_1) \text{ if } \Pr(R_1^A | r_1^A) = 0, \text{ and}$$

$$= \hat{\theta}_1^i(h_1, (r_1^A, I_1^B)) \text{ if } \Pr(R_1^A | r_1^A) > 0 \text{ and } \Pr(h_1 | r_1) = 0.$$

Each economist obtains utility from higher evaluation. For simplicity, the utility of economist i in period 1, V_1^i, is assumed to be

$$V_1^i = \hat{\theta}_1^i.$$ [7]

At date 1 in period 2, each economist receives a signal $s_2^i \in S_2 = \{u_2, d_2\}$. At date 2, A reports $R_2^A = r_2^A(h_1, s_1^A, s_2^A) \in S_2$. At date 3, B observes R_2^A and reports $R_2^B = r_2^B(h_1, R_2^A, s_1^B, s_2^B) \in S_2$. We make the same assumptions about the signals as that in period 1. Define $r_2 \equiv (r_2^A, r_2^B)$. Then the updated evaluation of the market, $\hat{\theta}_{12}^i$, is

$$\hat{\theta}_{12}^A = \hat{\theta}_{12}^A(h_1, R_2^A, r_1, r_2^A) \text{ if } \Pr(h_1 | r_1)\Pr(R_2^A | r_2^A) > 0,$$

$$= \hat{\theta}_{12}^A(h_1, R_2^A, r_1^A, I_1^B, r_2^A) \text{ if } \Pr(R_1^A | r_1^A)\Pr(R_2^A | r_2^A) > 0 \text{ and } \Pr(h_1 | r_1) = 0,$$

$$= \hat{\theta}_1^A \text{ otherwise;}$$

$$\hat{\theta}_{12}^B = \hat{\theta}_{12}^B(h_1, R_2^A, R_2^B, r_1, r_2) \text{ if } \Pr(h_1 | r_1)\Pr(R_2^A, R_2^B | r_2) > 0,$$

$$= \hat{\theta}_1^B \text{ otherwise.}$$

At the last day of period 2, the true state of the economy, $o_2 \in S_2$, is revealed. Define $h_2 \equiv (h_1, R_2^A, R_2^B, o_2)$. Then the market evaluation of i becomes

$$\hat{\theta}_2^i = \hat{\theta}_2^i(h_2, r_1, r_2) \text{ if } \Pr(h_1 | r_1)\Pr(h_2 | r_2) > 0,$$

$= \hat{\theta}_2^i(h_2, I_1, I_2)$ if $\Pr(R_1^A | r_1^A) = 0$,

$= \hat{\theta}_2^i(h_2, r_1, I_2)$ if $\Pr(h_1 | r_1) > 0$ and $\Pr(R_2^A | r_2^A) = 0$,

$= \hat{\theta}_2^i(h_2, (r_1^A, I_1^B), (r_2^A, m_2^B))$ if $\Pr(R_1^A | r_1^A)\Pr(R_2^A | r_2^A) > 0$, $\Pr(h_1 | r_1) = 0$, and $R_2^A = R_2^B$,

$= \hat{\theta}_2^i(h_2, (r_1^A, I_1^B), (r_2^A, I_2^B))$ if $\Pr(R_1^A | r_1^A)\Pr(R_2^A | r_2^A) > 0$, $\Pr(h_1 | r_1) = 0$, and $R_2^A \neq R_2^B$,

$= \hat{\theta}_2^i(h_2, (r_1^A, I_1^B), I_2)$ if $\Pr(R_1^A | r_1^A) > 0$, $\Pr(h_1 | r_1) = 0$, and $\Pr(R_2^A | r_2^A) = 0$,

$= \hat{\theta}_2^i(h_2, r_1, (r_2^A, m_2^B))$ if $\Pr(h_1 | r_1)\Pr(R_2^A | r_2^A) > 0$, $\Pr(h_2 | r_2) = 0$, and $R_2^A = R_2^B$,

$= \hat{\theta}_2^i(h_2, r_1, (r_2^A, I_2^B))$ if $\Pr(h_1 | r_1)\Pr(R_2^A | r_2^A) > 0$, $\Pr(h_2 | r_2) = 0$, and $R_2^A \neq R_2^B$

from sequential rationality. The utility of economist *i* in period 2 is $V_2^i = \hat{\theta}_2^i$. Let

$$\begin{aligned} \theta_2^i &= \theta_2^i\left(s_1^A, s_1^B, o_1, s_2^A, s_2^B, o_2\right) \\ &= \theta_2^i\left(s_2^A, s_2^B, o_2 \middle| \theta_1^A, \theta_1^B\right) \end{aligned}$$

be the objective probability at the last day of period 2 that economist *i* is able.

The discount rate is supposed to be unity for simplicity. Since each economist is risk-neutral, he maximizes the expectation of $\Pi^i \equiv \hat{\theta}_1^i + \hat{\theta}_2^i$. He maximizes the probability to be correct in case of a tie. [8] We adopt a pure strategy sequential equilibrium as the equilibrium concept.

3. The equilibrium

There are two equilibria, a pooling equilibrium and a separating one, in this game. In either equilibrium, economist *A* reports what his information suggests in both periods, and economist *B* mimics *A* in period 1. The only difference between the two equilibria is *B*'s strategy in period 2; *B* always mimics *A* in the pooling equilibrium; *B* relies on his information if and only if it was correct in period 1 in the separating equilibrium. There exists a pooling equilibrium when economists are homogeneous (i.e. p is small or θ is large). There exists a separating equilibrium when p and θ take middle values.

3.1 The objective probability that an economist is able

The following argument extends that of Scharfstein and Stein (1990). Let us define $\Pr\left(s_t^A, s_t^B \middle| o_t\right)$ as the conditional probability that the economists obtain $\left(s_t^A, s_t^B\right)$ when o_t is the true state. Suppose the objective probability that economist i is able before he collects information is θ_i. Then

$$\Pr\left(u_t, u_t \middle| u_t\right) = 0.25(1-\theta_A)(1-\theta_B) + 0.5p\theta_A(1-\theta_B) + 0.5p\theta_B(1-\theta_A) + p\theta_A\theta_B$$

$$= 0.25 + 0.5(\theta_A + \theta_B)(p-0.5) + 0.25\theta_A\theta_B = \Pr\left(d_t, d_t \middle| d_t\right),$$

$$\Pr\left(d_t, d_t \middle| u_t\right) = \Pr\left(u_t, u_t \middle| d_t\right) = 0.25 - 0.5(\theta_A + \theta_B)(p-0.5) + 0.25\theta_A\theta_B,$$

$$\Pr\left(u_t, d_t \middle| u_t\right) = \Pr\left(d_t, u_t \middle| d_t\right)$$

$$= 0.25(1-\theta_A)(1-\theta_B) + 0.5p\theta_A(1-\theta_B) + 0.5\theta_B(1-p)(1-\theta_A)$$

$$= 0.25 + 0.5(\theta_A - \theta_B)(p-0.5) - 0.25\theta_A\theta_B, \text{ and}$$

$$\Pr\left(d_t, u_t \middle| u_t\right) = \Pr\left(u_t, d_t \middle| d_t\right) = 0.25 - 0.5(\theta_A - \theta_B)(p-0.5) - 0.25\theta_A\theta_B$$

(Note that $s_t^A = s_t^B$ if both are able). The conditional probability that o_t is realized, $\Pr\left(o_t \middle| s_t^A, s_t^B\right)$, is

$$\Pr\left(u_t \middle| u_t, u_t\right) = \frac{0.5 + (\theta_A + \theta_B)(p-0.5) + 0.5\theta_A\theta_B}{1+\theta_A\theta_B} = \Pr\left(d_t \middle| d_t, d_t\right),$$

$$\Pr\left(d_t \middle| u_t, u_t\right) = \Pr\left(u_t \middle| d_t, d_t\right) = \frac{0.5 - (\theta_A + \theta_B)(p-0.5) + 0.5\theta_A\theta_B}{1+\theta_A\theta_B},$$

$$\Pr\left(u_t \middle| u_t, d_t\right) = \Pr\left(d_t \middle| d_t, u_t\right) = \frac{0.5 + (\theta_A - \theta_B)(p - 0.5) - 0.5\theta_A\theta_B}{1 - \theta_A\theta_B}, \text{ and}$$

$$\Pr\left(u_t \middle| d_t, u_t\right) = \Pr\left(d_t \middle| u_t, d_t\right) = \frac{0.5 - (\theta_A - \theta_B)(p - 0.5) - 0.5\theta_A\theta_B}{1 - \theta_A\theta_B}.$$

Therefore the objective probability in the end of period t that economist i is able is

$$\theta_t^i\left(s_t^A, s_t^B, o_t\right) = \frac{2p\theta_i(1+\theta_j)}{1 + (\theta_i + \theta_j)(2p-1) + \theta_i\theta_j} \text{ if } s_t^i = s_t^j = o_t,$$

$$= \frac{2\theta_i(1+\theta_j)(1-p)}{1 - (\theta_i + \theta_j)(2p-1) + \theta_i\theta_j} \text{ if } s_t^i = s_t^j \neq o_t,$$

$$= \frac{2p\theta_i(1-\theta_j)}{1 + (\theta_i - \theta_j)(2p-1) - \theta_i\theta_j} \text{ if } s_t^i = o_t \neq s_t^j, \text{ and}$$

$$= \frac{2\theta_i(1-\theta_j)(1-p)}{1 - (\theta_i - \theta_j)(2p-1) - \theta_i\theta_j} \text{ if } s_t^i \neq s_t^j = o_t.$$

θ_1^i (θ_2^i) is obtained by substituting θ (θ_1^i and θ_1^j) for θ_i and θ_j. Two remarks are in order. First, at least one of them is incompetent when $s_t^A \neq s_t^B$. Hence

$$\theta_t^i\left(s_t^i = s_t^j = o_t\right) - \theta_t^i\left(s_t^i = o_t \neq s_t^j\right)$$

$$= \frac{8\theta_i\theta_j p(1-p)(1-\theta_i)}{\left[1 + (\theta_i + \theta_j)(2p-1) + \theta_i\theta_j\right]\left[1 + (\theta_i - \theta_j)(2p-1) - \theta_i\theta_j\right]} > 0$$

and $\theta_t^i\left(s_t^i = s_t^j \neq o_t\right) > \theta_t^i\left(s_t^i \neq o_t = s_t^j\right)$.

Secondly, an incorrect forecast implies incompetency. Hence

$\theta_t^i\left(s_t^i = s_t^j = o_t\right) > \theta_t^i\left(s_t^i = s_t^j \neq o_t\right)$ and

$\theta_t^i\left(s_t^i = o_t \neq s_t^j\right) > \theta_t^i\left(s_t^i \neq s_t^j = o_t\right)$.

3.2 B's equilibrium strategy

This subsection assumes that A always reports what he obtains, namely $r_t^A = I_t^A$ for any $t = 1, 2$. The last subsection shows that, given accuracy of the forecast, an economist is favorably evaluated when the other economist makes the same forecast as he. Since accuracy of s_1^A and s_1^B are the same for B in period 1, he does not have an incentive to make a different forecast from A when $s_1^B \neq R_1^A$. Lemma 1 shows that B always mimics A in period 1 if there exists an equilibrium (See the Appendix for the proof).

Lemma 1.

Suppose $r_t^A = I_t^A$ for any $t = 1, 2$. Then B chooses $r_1^B = m_1^B$ in equilibrium.

Next we consider the subgame after $R_1^B = R_1^A$. Proposition 1 shows that, if p is small or θ is large, there exists a pooling equilibrium in which B always mimics A in period 2.

Proposition 1.

Suppose $r_t^A = I_t^A$ for $t = 1, 2$ and $R_1^B = R_1^A$. Suppose also that both of

$$\theta \geq \frac{1}{3} \text{ or } p \leq \frac{(1-\theta)^2}{2(1-2\theta-\theta^2)} \tag{1}$$

$$\text{and } p \leq \frac{-1+\theta-2\theta^2+\sqrt{-8\theta^3+9\theta^2+2\theta+1}}{4\theta(1-\theta)} \tag{2}$$

are satisfied. Then $r_2^B = m_2^B$ is an equilibrium of this subgame.

Figure 1 shows these conditions graphically. The probability that R_2^A proves right is increasing in θ. s_2^B is not accurate enough even if $s_1^B = o_1$ when p is small. Therefore the merit to follow s_2^B is small when θ is large or p is small.

Next we consider whether there is an equilibrium in which B makes his forecast based on his own information. Lemma 2 shows that there is no equilibrium in which B always reports what his information suggests in period 2. The reason is B has an incentive to mimic A in period 2 when his information proves wrong in period 1.

Lemma 2.

Suppose $r_t^A = I_t^A$ for any t. Then $r_2^B = I_2^B$ cannot be part of an equilibrium.

Because of the same reason as Lemma 1, $r_2^B = u_2$ and the reverse of $r_2^B = I_2^B$ cannot be part of an equilibrium. Hence only two behavioral strategies of B in period 2 are candidates for an equilibrium strategy. One strategy corresponds to Proposition 1, in which B continues mimicking A. In the other strategy, B follows his information in period 2 if and only if it was correct in period 1. Proposition 2 shows that this strategy is an equilibrium of the subgame after $R_1^B = R_1^A$ for some (p, θ).

Proposition 2.

Suppose $r_t^A = I_t^A$ for any t and $R_1^B = R_1^A$ in period 1. Then there exists a (p, θ) pair under which $r_2^B = \begin{cases} I_2^B & \text{if } s_1^B = o_1 \\ m_2^B & \text{otherwise} \end{cases}$ is an equilibrium of this subgame.

Figure 2 shows the set of (p, θ) under which the above equilibrium exists. Since B has only two options (reporting the same forecast as A or reporting the opposite of A), this separating equilibrium does not exist if his incentive to follow s_2^B is too small or too large. This is the reason why the set of (p, θ) under which the separating equilibrium exists is very small. [9] Let us investigate how (p, θ) affects B's incentive.

Suppose B mimics A in both periods. Then the market cannot update B's evaluation from θ (the ex ante probability that B is able). If θ is large, B does not dare to stop herding in period 2 because he can earn enough utility by mimicking A and the probability that R_2^A proves right is high. If θ is small, B's utility is low as long as he mimics A. Hence he makes a forecast different from R_2^A in period 2 even if $s_1^B \neq o_1$. Therefore θ must take middle values for the separating equilibrium to exist.

If p is small, s_2^B is not so accurate even if $s_1^B = o_1$. Thus B does not have an incentive to follow it. If p is large, on the other hand, B follows s_2^B even if $s_1^B \neq o_1$ because the merit of being regarded as able is large. Consequently p must also take middle values.

3.3 Two types of equilibria

The argument in the last section assumes that A always follows his information. This section considers A's incentive and shows that he always follows his own information in equilibrium. Hence there are two equilibria in this game. Proposition 3 shows the pooling equilibrium in which B mimics A in both periods. Proposition 4 shows the separating equilibrium in which B follows his information if and only if it proved right in period 1 (Lemma 1 and Lemma 2 shows that there is no other equilibrium). We use Lemma 3 to prove them.

Lemma 3.

Suppose $r_t^A = I_t^A$ for any t and $R_1^B \neq R_1^A$. Then $r_2^B = m_2^B$ is the unique equilibrium of this subgame.

Proposition 3.

Suppose (p, θ) satisfies (1) and (2). Then the following strategy is an equilibrium;

A: $r_t^A = I_t^A$ for any $t = 1, 2$;

B: $r_t^B = m_t^B$ for any $t = 1, 2$.

Proposition 4.

There exists a (p, θ) pair under which the following is an equilibrium;

A: $r_t^A = I_t^A$ for any $t = 1, 2$;

B: $r_1^B = m_1^A$ and $r_2^B = \begin{cases} I_2^B & \text{if } \mathrm{s}_1^{\mathrm{B}} = o_1 \\ m_2^B & \text{otherwise} \end{cases}$.

There exists the separating equilibrium identified in Proposition 4 if (p, θ) lies in the shaded area of Figure 2. These propositions demonstrate that there are two equilibria in this game depending on the value of p (the probability that an able economist obtains correct information) and θ (ex ante probability that an economist is able). B makes the same forecast as A in period 1 in either equilibrium. The reason is that the accuracy of R_1^A and s_1^B is the same for B in period 1 when $s_1^B \neq R_1^A$ and that he obtains higher utility when both economists make the same forecast given the fitness of his forecast.

Proposition 3 shows that B always makes the same forecast as A in period 2 when economists are homogeneous, i.e. when p is small or θ is large. Proposition 4 shows that B follows his information in period 2 if and only if $s_1^B = o_1$ when p and θ take moderate values. Theorem 1 summarizes these results.

Theorem 1.

B continues herding in both periods if the economists are homogeneous. B stops herding in period 2 if $s_1^B = o_1$ and the economists are heterogeneous.

4. Data and results

Toyo Keizai Inc. publishes forecasts of about 70 Japanese economists in the January or February issue of "Monthly Statistics (Tokei Geppo)" every year from 1987. We use the forecasts of the Japanese real GDP growth rate for the next fiscal year from 1987 to 1998. [10] Since we exclude all economists who participate in less than five surveys, the sample contains 69 economists. Total number of forecasts is 623, and the average number of observations per economist is 9.03 (Table 1 shows summary statistics).

Let f_i^t be the forecast of individual i in year t, and $\bar{f}_{-i}^t$ be the forecast average excluding individual i (Figure 3 shows the distribution of f_i^t). Then $y_i^t \equiv \left| f_i^t - \bar{f}_{-i}^t \right|$, the forecast deviation, indicates the degree of i's herding in year t. [11] For instance, smaller y_i^t implies that individual i makes a forecast similar to others in year t. We use y_i^t as the dependent variable of our regression. Its average is 0.4601% points, and its standard deviation is 0.4235% points (Figure 4 shows its distribution).

Let us define age_i^t as the years at t while individual i participates in the survey.

We use age_i^t as an independent variable to investigate the effect of aging on herd behavior. We add $\bar{y}_{-i}^t$, the average of y_i^t excluding economist *i*, as an independent variable to eliminate specific factors in each year. Since larger $\bar{y}_{-i}^t$ means that forecasts of other economists are more dispersed in year *t*, we expect that the coefficient of $\bar{y}_{-i}^t$ is positive. [12] We also add individual dummies d_i to eliminate individual factors.

The regression is as follows; [13]

$$y_i^t = \beta_a age_i^t + \beta_y \bar{y}_{-i}^t + \sum_j \beta_j d_j \,. \qquad (3)$$

The positive coefficient β_a indicates that economists stop herding as they grow older. Insignificant β_a, on the other hand, indicates that old economists do not change their behavior. According to the analysis of Section 3, β_a is positive if the probability that an able economist obtains accurate information is high or the share of able economists is small. β_a is insignificant if economists are homogeneous.

The result of the regression (3) is summarized in Table 2 (the coefficients of individual dummies are not reported). The parentheses indicate the t-values using the consistent covariance of White (1980). The left and the middle columns in Table 2 show our estimates of the fixed effect model (3) and the random effect model. Since we obtain almost the same estimates in both models, we concentrate on the fixed effect model. The coefficient of age_i^t, β_a, is 0.00658. It suggests that aging ten years widens the distance between his forecast and the market's average by 0.0658%pts. The coefficient is much smaller than the average of y_i^t (0.46%pts), and its t-value is not significant. This demonstrates that Japanese economists continue herding as they become older.

The right column in Table 2 shows the estimation of (3) in Lamont (1995). It uses the data of American economists in “Business Week” from 1971 to 1992. The coefficient of age_i^t (0.018) is about three times that of Japanese, and t-value is significant. Namely, an old economist in America makes a more independent forecast than that of a young economist. Table 2 indicates that Japanese economists are more homogenous than American.

Next we change the independent variable from age_i^t to $time_i^t$, which is the cumulative number of forecasts economist i reports up to year t. Table 3 shows the result, which is almost the same as Table 2. We obtain the same result when we use $y_i^t - \bar{y}_{-i}^t$ as the dependent variable and when we use logarithm of y_i^t and $\bar{y}_{-i}^t$. We also run the regression using the forecast data on the ongoing fiscal years, but the result does not change (Table 4).

5. Concluding Remarks

Suppose economists collect information and report forecasts independently. No one knows the ability of each economist, but competent economists obtain common information. Then an economist has an incentive to mimic others because competent economists report the same forecast based on common information. This incentive leads a young economist to herd since he knows nothing about his ability.

An old economist, however, obtains private information about his ability by making forecasts repeatedly. This causes him to signal his ability by following his own information when the merit from it is large, namely when there are few competent economists or when the difference of forecasting ability between the competent economist and the incompetent one is large. On the other hand, an old economist continues herding when the merit from signaling is small, namely when economists are homogeneous.

We analyze Japanese data based on this argument, and obtain the result that Japanese economists continue mimicking others as they grow older. This result presents a striking contrasts to the American result, in which an old economist stops herding. Our argument suggests that Japanese economists are more homogenous than American economists.

Notes

1. Trueman (1994), Zwiebel (1995), and Prendergast and Stole (1996) also point out this possibility. Banerjee (1992) and Bikhchandani, Hirshleifer, and Welch (1992) argue that herding occurs as a result when people use the information obtained from the decisions of others.
2. This assumption implies that competent economists pay attention to similar data such as unemployment rate, but that incompetent economists uses uninformative data such as N. Y. Yankees' percentage of victories.
3. No pure strategy equilibrium exists if the degree of heterogeneity of economists is too large. The reason is those who got uninformative data have an incentive to conduct themselves as if they got informative data.
4. Laster, Bennett, and Geoum (1999) analyze the relation between forecasts and the market evaluation. They obtain the result that the economists whose wages are closely tied to publicity produce independent forecasts. Kraus and Stoll (1972), Lakonishok, Schleifer, and Vishny (1992), and Ehrbeck and Waldman (1996) empirically study herd behavior in financial markets. Zarnowitz and Braun (1992) examine accuracy of forecasts.
5. According to Scharfstein and Stein (1990), this amounts to assume that "there are systematically unpredictable factors affecting the future state that nobody can know anything about" (p.468). See also note 2.
6. Chamley and Gale (1994), Gul and Lundholm (1995), and Zhang (1997) endogenize the order of players' action.
7. Suppose that an employer gains $F+B$ if the forecast of his employee is correct and that he gains F if it is incorrect. Then an economist whose evaluation is $\hat{\theta}$ earns $W(\hat{\theta}) = F + B(0.5 + \hat{\theta}(p-0.5))$ on condition that the labor market is

competitive. Since an economist is risk neutral, his utility is a linear function of wage. Namely, the utility is a linear function of $\hat{\theta}$.

8. Without this assumption, there are many perverse equilibria. For example, the reverse of an equilibrium strategy is also an equilibrium strategy.
9. If B's strategy space is richer than that in our model, he can make a sufficiently different forecast from A's one when $s_1^B = o_1$. Thus there exists a separating equilibrium in a broader range of parameters.
10. "Monthly Statistics" also contains forecasts for the ongoing fiscal year from 1987 to 1998. Using this data does not change the result (See Table 4).
11. We regard the mean forecast as R_t^A since an economist refers to the market consensus for making his forecast.
12. We cannot use year dummies because age_i^t increases every year by one.
13. This is a fixed effect model. We obtain almost the same estimates in a random effect model (See Table 2 and Table 3).

Appendix

Proof of Lemma 1.

There are six behavioral strategies for *B* in period 1; $r_1^B = u_1$, $r_1^B = I_1^B$, $r_1^B = m_1^B$, and their reverses (report d_1 instead of u_1, and vise versa). We prove that no strategy other than $r_1^B = m_1^B$ can be an equilibrium behavioral strategy for *B*.

First we show that $r_1^B = u_1$ is not an equilibrium. If this is an equilibrium and *B* reports $R_1^B = u_1$, $\hat{\theta}_1^B = \theta$ because the market cannot infer s_1^B. We show that *B* has an incentive to deviate regardless of the market's out-of-equilibrium belief. Suppose $\hat{\theta}_1^B\left(\left(R_1^A, d_1, o_1\right), r_1\right) = \theta_1^B\left(R_1^A, d_1, o_1\right)$. Then *B* reports $R_1^B = d_1$ when $R_1^A = s_1^B = d_1$, because his expected utility is

$$E\hat{\theta}_1^B = \Pr\left(u_1 \middle| d_1, d_1\right)\theta_1^B\left(d_1, d_1, u_1\right) + \Pr\left(d_1 \middle| d_1, d_1\right)\theta_1^B\left(d_1, d_1, d_1\right)$$
$$= \frac{\theta(1+\theta)}{1+\theta^2} > \theta .$$

Secondly, suppose $\hat{\theta}_1^B\left(\left(R_1^A, d_1, o_1\right), r_1\right) = \theta_1^B\left(R_1^A, u_1, o_1\right)$. Then *B* reports $R_1^B = d_1$ when $R_1^A = s_1^B = u_1$ for the same reason. Thirdly, suppose that $\hat{\theta}_1^B\left(\left(R_1^A, d_1, o_1\right), r_1\right) = \theta$. Then *B* reports $R_1^B = d_1$ when $R_1^A = s_1^B = d_1$ because $\Pr\left(d_1 \middle| d_1, d_1\right) > \Pr\left(u_1 \middle| d_1, d_1\right)$ (Remember that we assume an economist reports the forecast of the higher possibility to be correct when the expected utilities of two forecasts are the same). The same argument shows that $r_1^B = d_1$ is not an equilibrium.

Next we show that $r_1^B = I_1^B$ is not an equilibrium. If this is an equilibrium, $\hat{\theta}_1^B\left(h_1, r_1\right) = \theta_1^B\left(R_1^A, R_1^B, o_1\right)$. We show that *B* has an incentive to deviate when $s_1^B \neq R_1^A$. Suppose $s_1^B = d_1 \neq R_1^A = u_1$. Then $o_1 = u_1$ with probability 0.5. If *B* reports $R_1^B = d_1$,

$$\hat{\theta}_1^B = \theta_1^B(u_1, d_1, u_1) = \frac{2\theta(1-p)}{1+\theta}$$

when $o_1 = u_1$ (with probability 0.5) and

$$\hat{\theta}_1^B = \theta_1^B(u_1, d_1, d_1) = \frac{2\theta p}{1+\theta}$$

when $o_1 = d_1$ (with probability 0.5). If B reports $R_1^B = u_1$,

$$\hat{\theta}_1^B = \theta_1^B(u_1, u_1, u_1) = \frac{p\theta(1+\theta)}{0.5 + 2\theta(p-0.5) + 0.5\theta^2} > \theta_1^B(u_1, d_1, d_1)$$

when $o_1 = u_1$ (with probability 0.5) and

$$\hat{\theta}_1^B = \theta_1^B(u_1, u_1, d_1) = \frac{\theta(1+\theta)(1-p)}{0.5 - 2\theta(p-0.5) + 0.5\theta^2} > \theta_1^B(u_1, d_1, u_1)$$

when $o_1 = d_1$ (with probability 0.5). Since $\hat{\theta}_2^B$ is increasing in $\hat{\theta}_1^B$, B's expected total utility ($\hat{\theta}_1^B + \hat{\theta}_2^1$) increases by deviation.

Finally, reporting the reverse of s_1^B (R_1^A) cannot be an equilibrium because this is less likely to be correct than $r_1^B = I_1^B$ ($r_1^B = m_1^B$). Q.E.D.

Proof of Proposition 1.

Let us assume $R_t^A = u_t$ for $t = 1,2$ without loss of generality. B chooses R_2^B that maximizes $\hat{\theta}_2^B$. Define $E\hat{\theta}_2^B(R_2^A, s_2^B, R_2^B)$ as the expectation of $\hat{\theta}_2^B$ when A reports R_2^A, B observes s_2^B, and he reports R_2^B. If B sticks to the equilibrium strategy and make the same report as A,

$$E\hat{\theta}_2^B(u_2, u_2, u_2) = E\hat{\theta}_2^B(u_2, d_2, u_2) = \theta$$

because the market cannot infer s_2^B. We show that B does not have an incentive to deviate even if the market believes that deviation implies $s_1^B = o_1$, i.e.

$$\hat{\theta}_{12}^B(h_1, R_2^A, R_2^B, r_1, r_2) = \theta_1^B(R_1^A, o_1, o_1) \text{ for } R_2^B \neq R_2^A.$$

Define $\overline{\theta}_i \equiv \theta_1^i\left(R_1^A, o_1, o_1\right)$ and $\overline{\theta} \equiv \left(\overline{\theta}_A, \overline{\theta}_B\right)$. Then

$$E\hat{\theta}_2^B(u_2, u_2, d_2) = \theta_2^B\left(u_2, d_2, u_2 \middle| \overline{\theta}\right)\Pr\left(u_2 \middle| u_2, u_2\right) + \theta_2^B\left(u_2, d_2, d_2 \middle| \overline{\theta}\right)\Pr\left(d_2 \middle| u_2, u_2\right), \text{ and}$$

$$E\hat{\theta}_2^B(u_2, d_2, d_2) = \theta_2^B\left(u_2, d_2, u_2 \middle| \overline{\theta}\right)\Pr\left(u_2 \middle| u_2, d_2\right) + \theta_2^B\left(u_2, d_2, d_2 \middle| \overline{\theta}\right)\Pr\left(d_2 \middle| u_2, d_2\right).$$

Since $\theta_2^B\left(u_2, d_2, u_2 \middle| \overline{\theta}\right) < \theta_2^B\left(u_2, d_2, d_2 \middle| \overline{\theta}\right)$ and $\Pr\left(u_2 \middle| u_2, u_2\right) > \Pr\left(u_2 \middle| u_2, d_2\right)$,

$$E\hat{\theta}_2^B(u_2, u_2, d_2) < E\hat{\theta}_2^B(u_2, d_2, d_2)$$

is always satisfied. Furthermore, $E\hat{\theta}_2^B(u_2, d_2, d_2)$ is increasing in $\Pr\left(d_2 \middle| u_2, d_2\right)$, which is increasing in θ_1^B. Thus the necessary and sufficient condition for B not to deviate is $E\hat{\theta}_2^B(u_2, d_2, d_2) < \theta$ when $s_1^B = o_1$. If $R_1^A = o_1$,

$$E\hat{\theta}_2^B(u_2, d_2, d_2) = \frac{2p\theta(1+\theta)}{1 + 6p\theta - 2\theta + \theta^2 + 2p\theta^2}$$

and the condition turns out to be

$$\theta \geq \frac{1}{3} \text{ or } p \leq \frac{(1-\theta)^2}{2\left(1 - 2\theta - \theta^2\right)}.$$

If $R_1^A \neq o_1$,

$$E\hat{\theta}_2^B(u_2, d_2, d_2) = \frac{2p\theta(1+\theta) - 4\theta^2 p(1-p)}{(1+\theta)^2 - 4\theta^2 p(1-p)}$$

and the condition is

$$p \leq \frac{-1 + \theta - 2\theta^2 + \sqrt{-8\theta^3 + 9\theta^2 + 2\theta + 1}}{4\theta(1-\theta)}. \text{ Q.E.D.}$$

Proof of Lemma 2.

The necessary and sufficient condition for B not to deviate is

$E\hat{\theta}_2^B(u_2, d_2, d_2) > E\hat{\theta}_2^B(u_2, d_2, u_2)$ for any s_1^B and o_1.

We show that the above condition is not satisfied when $s_1^B \neq o_1$. If $r_2^B = I_2^B$ is an equilibrium, we can write $\hat{\theta}_2^B = \theta_2^B(R_2^A, R_2^B, o_2)$ for given (h_1, r_1, r_2). Then, since

$E\hat{\theta}_2^B(u_2, d_2, d_2) = \theta_2^B(u_2, d_2, u_2)\Pr(u_2|u_2, d_2) + \theta_2^B(u_2, d_2, d_2)\Pr(d_2|u_2, d_2)$ and

$E\hat{\theta}_2^B(u_2, d_2, u_2) = \theta_2^B(u_2, u_2, u_2)\Pr(u_2|u_2, d_2) + \theta_2^B(u_2, u_2, d_2)\Pr(d_2|u_2, d_2)$,

$$
\begin{aligned}
& E\hat{\theta}_2^B(u_2, d_2, d_2) - E\hat{\theta}_2^B(u_2, d_2, u_2) \\
&= \{\theta_2^B(u_2, d_2, u_2) - \theta_2^B(u_2, u_2, d_2)\}\Pr(d_2|u_2, d_2) \\
&+ \{\theta_2^B(u_2, d_2, d_2) - \theta_2^B(u_2, u_2, u_2)\}\Pr(d_2|u_2, d_2) \\
&+ \{\theta_2^B(u_2, d_2, u_2) - \theta_2^B(u_2, u_2, u_2)\}\{\Pr(u_2|u_2, d_2) - \Pr(d_2|u_2, d_2)\}.
\end{aligned}
$$

This equation is always negative for $s_1^B \neq o_1$, because

$\Pr(u_2|u_2, d_2) \geq \Pr(d_2|u_2, d_2)$ (from $\theta_A^1 \geq \theta_B^1$),

$\theta_2^B(u_2, d_2, u_2) < \theta_2^B(u_2, u_2, d_2) < \theta_2^B(u_2, u_2, u_2)$,

and $\theta_2^B(u_2, d_2, d_2) < \theta_2^B(u_2, u_2, u_2)$. Q.E.D.

Proof of Proposition 2.

We show B has no incentive to deviate from the equilibrium. We assume $R_t^A = u_t$ for $t = 1, 2$ without loss of generality.

Case (a): $R_1^A = o_1 = u_1$.

$E\hat{\theta}_2^B(u_2, u_2, u_2) = E\hat{\theta}_2^B(u_2, d_2, u_2)$

$$= \frac{\Pr(u_1, d_1 | u_1)\theta_1^B(u_1, d_1, u_1) + \Pr(u_1, u_1 | u_1)\Pr(u_2, u_2)\theta_1^B(u_1, u_1, u_1)}{\Pr(u_1, d_1 | u_1) + \Pr(u_1, u_1 | u_1)\Pr(u_2, u_2)}$$

$$= \frac{4\theta(1-\theta)(1-p)\alpha^2 + 2p\theta(1+\theta)\alpha^2 + 8p^3\theta^3(1+\theta)^3}{2(1-\theta)(1+\theta)\alpha^2 + \alpha^3 + 4p^2\theta^2(1+\theta)^2\alpha},$$

where $\alpha \equiv 1 + 2\theta(2p-1) + \theta^2$.

As we show in the proof of Proposition 1, $E\hat{\theta}_2^B(u_2, d_2, d_2) > E\hat{\theta}_2^B(u_2, u_2, d_2)$.

$$E\hat{\theta}_2^B(u_2, d_2, d_2) = \theta_2^B(u_2, d_2, u_2 | \overline{\theta})\Pr(u_2 | u_2, d_2) + \theta_2^B(u_2, d_2, d_2 | \overline{\theta})\Pr(d_2 | u_2, d_2)$$

$$= \frac{\hat{\theta}_1^B(1-\hat{\theta}_1^A)(1-p)}{1 + (\hat{\theta}_1^A - \hat{\theta}_1^B)(2p-1) - \hat{\theta}_1^A\hat{\theta}_1^B} \frac{1 + (\theta_A - \theta_B)(2p-1) - \theta_A\theta_B}{1 - \theta_A\theta_B}$$

$$+ \frac{p\hat{\theta}_1^B(1-\hat{\theta}_1^A)}{1 - (\hat{\theta}_1^A - \hat{\theta}_1^B)(2p-1) - \hat{\theta}_1^A\hat{\theta}_1^B} \frac{1 - (\theta_A - \theta_B)(2p-1) - \theta_A\theta_B}{1 - \theta_A\theta_B},$$

where $\hat{\theta}_1^A = \hat{\theta}_1^B = \theta_1^A(u_1, u_1, u_1) = \frac{2p\theta(1+\theta)}{1 + 2\theta(2p-1) + \theta^2}$.

Case (a1): $R_1^A = o_1 = u_1 \neq s_1^B$ and $s_2^B = d_2$.

Since $\theta_A = \theta_1^A(u_1, d_1, u_1) = \frac{2\theta p}{1+\theta}$ and $\theta_B = \theta_1^B(u_1, d_1, u_1) = \frac{2\theta(1-p)}{1+\theta}$,

$$E\hat{\theta}_2^B(u_2, d_2, d_2) = \frac{2p\theta(1+\theta)}{\alpha + 2p\theta(1+\theta)} \frac{(1+\theta)^2 - 4\theta^2 p(1-p) - 2\theta(1+\theta)(2p-1)^3}{(1+\theta)^2 - 4\theta^2 p(1-p)}.$$

B chooses the equilibrium strategy if

$$E\hat{\theta}_2^B(u_2, d_2, d_2) < E\hat{\theta}_2^B(u_2, d_2, u_2). \qquad \text{(a1)}$$

Case (a2): $R_1^A = o_1 = u_1 = s_1^B$.

Since $\theta_A = \theta_B = \theta_1^i(u_1, u_1, u_1) = \frac{2p\theta(1+\theta)}{1 + 2\theta(2p-1) + \theta^2}$,

$$E\hat{\theta}_2^B(u_2, u_2, d_2) = \frac{2p\theta(1+\theta)}{\alpha + 2p\theta(1+\theta)} \frac{\alpha^2 + 4\theta^2 p^2(1+\theta)^2 - 4p\theta(1+\theta)(2p-1)^2\alpha}{\alpha^2 + 4\theta^2 p^2(1+\theta)^2}$$

and $E\hat{\theta}_2^B(u_2,d_2,d_2)=\dfrac{2p\theta(1+\theta)}{\alpha+2p\theta(1+\theta)}$.

B chooses the equilibrium strategy if

$$E\hat{\theta}_2^B(u_2,u_2,d_2)<E\hat{\theta}_2^B(u_2,u_2,u_2) \qquad \text{(a2)}$$

and $E\hat{\theta}_2^B(u_2,d_2,d_2)>E\hat{\theta}_2^B(u_2,d_2,u_2)$. (a3)

Case (b): $R_1^A\neq o_1=d_1$.

$$E\hat{\theta}_2^B(u_2,u_2,u_2)=E\hat{\theta}_2^B(u_2,d_2,u_2)$$

$$=\frac{\Pr(u_1,u_1|d_1)\theta_1^B(u_1,u_1,d_1)+\Pr(u_1,d_1|d_1)\Pr(u_2,u_2)\theta_1^B(u_1,d_1,d_1)}{\Pr(u_1,u_1|d_1)+\Pr(u_1,d_1|d_1)\Pr(u_2,u_2)}$$

$$=\frac{4\theta(1+\theta)^3(1-p)+2p\theta(1-\theta)(1+\theta)^2+8p^2\theta^3(1-p)(1-\theta)}{2(1+\theta)^2\beta+(1-\theta)(1+\theta)^3+4p\theta^2(1-p)(1-\theta)(1+\theta)}$$

where $\beta\equiv 1-2\theta(2p-1)+\theta^2$,

$$E\hat{\theta}_2^B(u_2,d_2,d_2)=\frac{\hat{\theta}_1^B(1-\hat{\theta}_1^A)(1-p)}{1+(\hat{\theta}_1^A-\hat{\theta}_1^B)(2p-1)-\hat{\theta}_1^A\hat{\theta}_1^B}\ \frac{1+(\theta_A-\theta_B)(2p-1)-\theta_A\theta_B}{1-\theta_A\theta_B}$$

$$+\frac{p\hat{\theta}_1^B(1-\hat{\theta}_1^A)}{1-(\hat{\theta}_1^A-\hat{\theta}_1^B)(2p-1)-\hat{\theta}_1^A\hat{\theta}_1^B}\ \frac{1-(\theta_A-\theta_B)(2p-1)-\theta_A\theta_B}{1-\theta_A\theta_B}$$

where $\hat{\theta}_1^A=\theta_1^A(u_1,d_1,d_1)=\dfrac{2\theta(1-p)}{1+\theta}$, and

$\hat{\theta}_1^B=\theta_1^B(u_1,d_1,d_1)=\dfrac{2p\theta}{1+\theta}$.

Case (b1): $R_1^A=s_1^B\neq o_1=d_1$ and $s_2^B=d_2$.

Since $\theta_A=\theta_B=\theta_1^i(u_1,u_1,d_1)=\dfrac{2\theta(1+\theta)(1-p)}{1-2\theta(2p-1)+\theta^2}$,

$$E\hat{\theta}_2^B(u_2,d_2,d_2)=\frac{2p\theta(1-\theta+2p\theta)\left[(1+\theta)^2-2\theta(1+\theta)(2p-1)^3-4\theta^2p(1-p)\right]}{(1+\theta)^4-8\theta^2p(1+\theta)^2(1-p)+16\theta^4p^2(1-p)^2-4\theta^2(1+\theta)^2(2p-1)^4}.$$

B chooses the equilibrium strategy if

$$E\hat{\theta}_2^B(u_2,d_2,d_2) < E\hat{\theta}_2^B(u_2,d_2,u_2). \qquad \text{(b1)}$$

Case (b2): $R_1^A \neq o_1 = d_1 = s_1^B$.

Since $\theta_A = \theta_1^A(u_1,d_1,d_1) = \dfrac{2\theta(1-p)}{1+\theta}$ and $\theta_B = \theta_1^B(u_1,d_1,d_1) = \dfrac{2p\theta}{1+\theta}$,

$$E\hat{\theta}_2^B(u_2,u_2,d_2) = \frac{2p\theta(1-\theta+2p\theta)}{(1+\theta)^2+4\theta^2 p(1-p)}$$

$$\times \frac{(1+\theta)^4 - 4\theta(1+\theta)^2(2p-1)^2(p+\theta-p\theta)+16\theta^3 p(1-p)^2\left[(1+\theta)(2p-1)^2 - p\theta\right]}{(1+\theta)^4 - 8\theta^2 p(1-p)(1+\theta)^2 + 16\theta^4 p^2(1-p)^2 - 4\theta^2(1+\theta)^2(2p-1)^4}$$

and $E\hat{\theta}_2^B(u_2,d_2,d_2) = \dfrac{2p\theta(1+\theta)-4\theta^2 p(1-p)}{(1+\theta)^2-4\theta^2 p(1-p)}$.

B chooses the equilibrium strategy if

$$E\hat{\theta}_2^B(u_2,u_2,d_2) < E\hat{\theta}_2^B(u_2,u_2,u_2) \qquad \text{(b2)}$$

and $E\hat{\theta}_2^B(u_2,d_2,d_2) > E\hat{\theta}_2^B(u_2,d_2,u_2)$. (b3)

B follows the equilibrium strategy if (p,θ) satisfies all of (a1), (a2), (a3), (b1), (b2), and (b3). $(p,\theta)=(0.75, 0.36)$ is one example. Q.E.D.

Proof of Lemma 3.

We assume $R_t^A = u_t$ for $t=1,2$ without loss of generality. Since

$$E\hat{\theta}_2^B(u_2,u_2,u_2) = E\hat{\theta}_2^B(u_2,d_2,u_2) = \hat{\theta}_1^B,$$

$$E\hat{\theta}_2^B(u_2,d_2,d_2) = \frac{\hat{\theta}_1^B(1-\hat{\theta}_1^A)(1-p)}{1+(\hat{\theta}_1^A-\hat{\theta}_1^B)(2p-1)-\hat{\theta}_1^A\hat{\theta}_1^B}\,\frac{1+(\theta_A-\theta_B)(2p-1)-\theta_A\theta_B}{1-\theta_A\theta_B}$$

$$+\frac{p\hat{\theta}_1^B(1-\hat{\theta}_1^A)}{1-(\hat{\theta}_1^A-\hat{\theta}_1^B)(2p-1)-\hat{\theta}_1^A\hat{\theta}_1^B}\,\frac{1-(\theta_A-\theta_B)(2p-1)-\theta_A\theta_B}{1-\theta_A\theta_B},$$

and $E\hat{\theta}_2^B(u_2,u_2,d_2) < E\hat{\theta}_2^B(u_2,d_2,d_2)$, all we have to show is

$$\hat{\theta}_1^B > E\hat{\theta}_2^B(u_2, d_2, d_2) \quad \forall (s_1^B, o_1), \ \ \forall p \in (0.5, 1), \text{ and } \ \forall \theta \in (0,1).$$

Case 1: $s_1^B = u_1 = o_1$.

Since $\theta_A = \theta_B = \theta_1^i(u_1, u_1, u_1) = \dfrac{2p\theta(1+\theta)}{1+2\theta(2p-1)+\theta^2}$,

$\hat{\theta}_1^A = \theta_1^A(u_1, d_1, u_1) = \dfrac{2p\theta}{1+\theta}$,

and $\hat{\theta}_1^B = \hat{\theta}_1^B(u_1, d_1, u_1) = \dfrac{2\theta(1-p)}{1+\theta}$

in this case, the condition turns out to be

$$Z \equiv (1-\theta)(1+\theta)^2 + 2p(1+\theta)^2(-2+3\theta) + 8p^3\theta(2+4\theta+\theta^2) + 4p^2(2-7\theta^2-3\theta^3) > 0.$$

This is always satisfied because $\dfrac{\partial^2 Z}{\partial p^2} > 0$, $\dfrac{\partial Z}{\partial p} > 0$ at $p = 0.5$, and $Z > 0$ at $p = 0.5$.

Case 2: $s_1^B = u_1 \neq o_1$.

Since $\theta_A = \theta_B = \theta_1^i(u_1, u_1, d_1) = \dfrac{2\theta(1+\theta)(1-p)}{1-2\theta(2p-1)+\theta^2}$,

$\hat{\theta}_1^A = \theta_1^A(u_1, d_1, d_1) = \dfrac{2\theta(1-p)}{1+\theta}$,

and $\hat{\theta}_1^B = \hat{\theta}_1^B(u_1, d_1, d_1) = \dfrac{2p\theta}{1+\theta}$

in this case, the condition turns out to be

$$Y \equiv 5 - 12p + 8p^2 + (15 - 46p + 48p^2 - 16p^3)\theta + (11 - 48p + 68p^2 - 32p^3)\theta^2 + (1 - 6p + 12p^2 - 8p^3)\theta^3 > 0.$$

This is always satisfied because $\dfrac{\partial^2 Y}{\partial \theta^2} < 0$ and $\dfrac{\partial Y}{\partial \theta} > 0$ at $\theta \in \{0,1\}$.

Case 3: $s_1^B = d_1$.

Since $\theta_i = \hat{\theta}_1^i$, $E\hat{\theta}_2^B(u_2, d_2, d_2) = \dfrac{\hat{\theta}_1^B(1-\hat{\theta}_1^A)}{1-\hat{\theta}_1^A\hat{\theta}_1^B} < \hat{\theta}_1^B$.

The above argument shows that B always mimics A in period 2. Q.E.D.

Proof of Proposition 3.

We assume $s_t^A = u_t$ for $t = 1, 2$ without loss of generality. Define $E\Pi_i \equiv E\hat{\theta}_i^1 + E\hat{\theta}_i^2$ as the sum of expected utility economist i earns in two periods.

We show first that B has no incentive to deviate when A follows the equilibrium strategy. Since Proposition 1 shows that B never deviates in period 2 when (1) and (2) are satisfied, we have only to prove that B never deviates in period 1. If B follows the equilibrium strategy, $E\Pi_B = 2\theta$. If B deviates in period 1, Lemma 3 shows that he always mimics A in period 2 and thus $\hat{\theta}_2^B = \hat{\theta}_1^B$. Therefore, if he deviates in period 1,

$$E\Pi_B = 2\theta_1^B(u_1, d_1, u_1)\Pr(u_1|u_1, d_1) + 2\theta_1^B(u_1, d_1, d_1)\Pr(d_1|u_1, d_1)$$
$$= \frac{2\theta}{1+\theta} < 2\theta$$

when $s_1^B = d_1$, and

$$E\Pi_B = 2\theta_1^B(u_1, d_1, u_1)\Pr(u_1|u_1, u_1) + 2\theta_1^B(u_1, d_1, d_1)\Pr(d_1|u_1, u_1)$$
$$< 2\theta_1^B(u_1, d_1, u_1)\Pr(u_1|u_1, d_1) + 2\theta_1^B(u_1, d_1, d_1)\Pr(d_1|u_1, d_1)$$

when $s_1^B = u_1$. Consequently B has no incentive to deviate.

Next we show that A has no incentive to deviate when B follows the equilibrium strategy. Since the conditional probability that u_t occurs when $s_t^A = u_t$ is

$$\Pr(u_t|u_t) = 0.5 + \theta_A(p - 0.5) > 0.5,$$

the market evaluation of A when B always mimics A, $\hat{\theta}_1^A(R_1^A, o_1)$, is

$$\hat{\theta}_1^A(u_1, u_1) = \hat{\theta}_1^A(d_1, d_1) = \frac{2p\theta}{1+\theta(2p-1)} \text{ and}$$

$$\hat{\theta}_1^A(u_1, d_1) = \hat{\theta}_1^A(d_1, u_1) = \frac{2\theta(1-p)}{1+\theta(2p-1)}.$$

Similarly we obtain $\hat{\theta}_2^A(R_2^A, o_2)$ by substituting $\hat{\theta}_1^A$ for θ in the above equations. Suppose $s_2^A = u_2$. If A reports $R_2^A = u_2$, the expectation of $\hat{\theta}_2^A$ is

$$\hat{\theta}_2^A(u_2, u_2)\Pr(u_2|u_2) + \hat{\theta}_2^A(u_2, d_2)\Pr(d_2|u_2).$$

If A reports $R_2^A = d_2$, the expectation of $\hat{\theta}_2^A$ decreases to

$$\hat{\theta}_2^A(d_2, u_2)\Pr(u_2|u_2) + \hat{\theta}_2^A(d_2, d_2)\Pr(d_2|u_2).$$

Therefore A does not deviate from the equilibrium in period 2. Since the same argument applies to period 1 and $\hat{\theta}_2^A$ is increasing in $\hat{\theta}_1^A$, A does not deviate in period 1. Q.E.D.

Proof of Proposition 4.

Assume $s_t^A = u_t$ for $t = 1, 2$. We show first that B has no incentive to deviate. Proposition 2 shows that B never deviates in period 2 if (p, θ) lies in the shaded area in Figure 2. If B deviates in period 1, the argument in the proof of Proposition 3 shows that $E\Pi_B = \frac{2\theta}{1+\theta}$ at most. If B follows the equilibrium strategy, $\hat{\theta}_1^B = \theta$ and the expectation of $\hat{\theta}_2^B$ is as follows (See the proof of Proposition 2).

$$E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A = o_1\right) = \frac{4\theta(1-\theta)(1-p)\alpha^2 + 2p\theta(1+\theta)\alpha^2 + 8p^3\theta^3(1+\theta)^3}{2(1-\theta)(1+\theta)\alpha^2 + \alpha^3 + 4p^2\theta^2(1+\theta)^2\alpha}$$

where $\alpha \equiv 1 + 2\theta(2p-1) + \theta^2$,

$$E\hat{\theta}_2^B\left(R_2^B \neq R_2^A \middle| R_1^A = o_1\right) = \frac{2p\theta(1+\theta)}{\alpha + 2p\theta(1+\theta)},$$

$$E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A \neq o_1\right) = \frac{4\theta(1+\theta)^3(1-p) + 2p\theta(1-\theta)(1+\theta)^2 + 8p^2\theta^3(1-p)(1-\theta)}{2(1+\theta)^2\beta + (1-\theta)(1+\theta)^3 + 4p\theta^2(1-p)(1-\theta)(1+\theta)}$$

where $\beta \equiv 1 - 2\theta(2p-1) + \theta^2$, and

$$E\hat{\theta}_2^B\left(R_2^B \neq R_2^A \middle| R_1^A \neq o_1\right) = \frac{2p\theta(1+\theta) - 4\theta^2 p(1-p)}{(1+\theta)^2 - 4\theta^2 p(1-p)}.$$

When $s_1^B = u_1 \left(= s_1^A\right)$,

$$E\Pi_B = \theta + \Pr(d_1|u_1, u_1)\, E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A \neq o_1\right)$$

$$+ \Pr(u_1|u_1, u_1)\Pr(u_2, u_2) E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A = o_1\right)$$

$$+ \Pr(u_1|u_1, u_1)\Pr(u_2, d_2) E\hat{\theta}_2^B\left(R_2^B \neq R_2^A \middle| R_1^A = o_1\right)$$

where $\Pr(u_2, u_2) = \frac{1}{2} + \frac{2p^2\theta^2(1+\theta)^2}{\alpha^2}$.

When $s_1^B = d_1 \left(\neq s_1^A\right)$,

$$E\Pi_B = \theta + \Pr(u_1|u_1, d_1)\, E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A = o_1\right)$$

$$+ \Pr(d_1|u_1, d_1)\Pr(u_2, u_2) E\hat{\theta}_2^B\left(R_2^B = R_2^A \middle| R_1^A \neq o_1\right)$$

$$+ \Pr(d_1|u_1, d_1)\Pr(u_2, d_2) E\hat{\theta}_2^B\left(R_2^B \neq R_2^A \middle| R_1^A \neq o_1\right)$$

where $\Pr(u_2, u_2) = \frac{1}{2} + \frac{2p\theta^2(1-p)}{(1+\theta)^2}$.

Since calculation shows that both are larger than $\frac{2\theta}{1+\theta}$, B has no incentive to deviate in period 1.

Next we show that A never deviates from the equilibrium. Since B always mimics A in period 1, the market evaluation of A in period 1, $\hat{\theta}_1^A\left(R_1^A, o_1\right)$, is

$$\hat{\theta}_1^A(u_1, u_1) = \hat{\theta}_1^A(d_1, d_1) = \frac{2p\theta}{1 + \theta(2p-1)}$$

$$\hat{\theta}_1^A(u_1,d_1)=\hat{\theta}_1^A(d_1,u_1)=\frac{2\theta(1-p)}{1+\theta(2p-1)}.$$

The market evaluation in period 2 when $R_2^A=R_2^B$ is as follows.

$$\hat{\theta}_2^A(R_1^A=o_1,R_2^A=o_2)=\frac{p_1\theta_1+p_2\theta_2+p_3\theta_3}{p_1+p_2+p_3}$$

where $p_1\equiv\Pr(u_1,u_1)\Pr(u_2,u_2)\Pr(u_2|u_2,u_2)$

$$=\frac{(1+\theta^2)}{8}\left[1+\frac{4p\theta(1+\theta)(2p-1)}{\alpha}+\frac{4p^2\theta^2(1+\theta)^2}{\alpha^2}\right],$$

$p_2\equiv\Pr(u_1,d_1)\Pr(u_2,u_2)\Pr(u_2|u_2,u_2)$

$$=\frac{(1-\theta)(1+\theta)}{8}\left[1+\frac{2\theta(2p-1)}{1+\theta}+\frac{4\theta^2p(1-p)}{(1+\theta)^2}\right],$$

$p_3\equiv\Pr(u_1,d_1)\Pr(u_2,d_2)\Pr(u_2|u_2,d_2)$

$$=\frac{(1-\theta)(1+\theta)}{8}\left[1+\frac{2\theta(2p-1)^2}{1+\theta}-\frac{4\theta^2p(1-p)}{(1+\theta)^2}\right],$$

$p_1\theta_1=0.5\alpha^{-2}p^2\theta(1+\theta)(1+\theta^2)[\alpha+2p\theta(1+\theta)]$,

$p_2\theta_2=0.5(1+\theta)^{-1}p^2\theta(1-\theta)(1+3\theta-2p\theta)$, and

$p_3\theta_3=0.5(1+\theta)^{-1}p^2\theta(1-\theta)(1-\theta+2p\theta)$.

$$\hat{\theta}_2^A(R_1^A=o_1,R_2^A\neq o_2)=\frac{p_4\theta_4+p_5\theta_5+p_6\theta_6}{p_4+p_5+p_6}$$

where $p_4\equiv\Pr(u_1,u_1)\Pr(u_2,u_2)\Pr(d_2|u_2,u_2)$

$$=\frac{(1+\theta^2)}{8}\left[1-\frac{4p\theta(1+\theta)(2p-1)}{\alpha}+\frac{4p^2\theta^2(1+\theta)^2}{\alpha^2}\right],$$

$p_5\equiv\Pr(u_1,d_1)\Pr(u_2,u_2)\Pr(d_2|u_2,u_2)$

$$= \frac{(1-\theta)(1+\theta)}{8}\left[1 - \frac{2\theta(2p-1)}{1+\theta} + \frac{4\theta^2 p(1-p)}{(1+\theta)^2}\right],$$

$$p_6 \equiv \Pr(u_1, d_1)\Pr(u_2, d_2)\Pr(d_2 | u_2, d_2)$$

$$= \frac{(1-\theta)(1+\theta)}{8}\left[1 - \frac{2\theta(2p-1)^2}{1+\theta} - \frac{4\theta^2 p(1-p)}{(1+\theta)^2}\right],$$

$$p_4\theta_4 = 0.5\alpha^{-2} p\theta(1-p)(1+\theta)(1+\theta^2)[\alpha + 2p\theta(1+\theta)],$$

$$p_5\theta_5 = 0.5(1+\theta)^{-1} p\theta(1-p)(1-\theta)(1+3\theta-2p\theta), \text{ and}$$

$$p_6\theta_6 = 0.5(1+\theta)^{-1} p\theta(1-p)(1-\theta)(1-\theta+2p\theta).$$

$$\hat{\theta}_2^A(R_1^A \neq o_1, R_2^A = o_2) = \frac{p_7\theta_7 + p_8\theta_8 + p_9\theta_9}{p_7 + p_8 + p_9}$$

where $p_7 \equiv \Pr(u_1, d_1)\Pr(u_2, u_2)\Pr(u_2 | u_2, u_2)$

$$= \frac{(1-\theta)(1+\theta)}{8}\left[1 + \frac{2\theta(2p-1)}{1+\theta} + \frac{4\theta^2 p(1-p)}{(1+\theta)^2}\right],$$

$$p_8 \equiv \Pr(u_1, u_1)\Pr(u_2, u_2)\Pr(u_2 | u_2, u_2)$$

$$= \frac{(1+\theta^2)}{8}\left[1 + \frac{4\theta(1-p)(1+\theta)(2p-1)}{\beta} + \frac{4\theta^2(1-p)^2(1+\theta)^2}{\beta^2}\right],$$

$$p_9 \equiv \Pr(u_1, u_1)\Pr(u_2, d_2)\Pr(u_2 | u_2, d_2)$$

$$= \frac{(1+\theta^2)}{8}\left[1 - \frac{4\theta^2(1+\theta)^2(1-p)^2}{\beta^2}\right],$$

$$p_7\theta_7 = 0.5(1+\theta)^{-1} p\theta(1-\theta)(1-p)(1+\theta+2p\theta),$$

$$p_8\theta_8 = 0.5\beta^{-2} p\theta(1+\theta)(1+\theta^2)(1-p)[\alpha + 2\theta(1+\theta)(1-p)], \text{ and}$$

$$p_9\theta_9 = 0.5\beta^{-2} p\theta(1+\theta)(1+\theta^2)(1-p)[\alpha - 2\theta(1+\theta)(1-p)].$$

$$\hat{\theta}_2^A\left(R_1^A \neq o_1, R_2^A \neq o_2\right) = \frac{p_{10}\theta_{10} + p_{11}\theta_{11} + p_{12}\theta_{12}}{p_{10} + p_{11} + p_{12}}$$

where $p_{10} \equiv \Pr(u_1, d_1)\Pr(u_2, u_2)\Pr(d_2 | u_2, u_2)$

$$= \frac{(1-\theta)(1+\theta)}{8}\left[1 - \frac{2\theta(2p-1)}{1+\theta} + \frac{4\theta^2 p(1-p)}{(1+\theta)^2}\right],$$

$$p_{11} \equiv \Pr(u_1, u_1)\Pr(u_2, u_2)\Pr(d_2 | u_2, u_2)$$

$$= \frac{(1+\theta^2)}{8}\left[1 - \frac{4\theta(1-p)(1+\theta)(2p-1)}{\beta} + \frac{4\theta^2(1-p)^2(1+\theta)^2}{\beta^2}\right],$$

$$p_{12} \equiv \Pr(u_1, u_1)\Pr(u_2, d_2)\Pr(d_2 | u_2, d_2)$$

$$= \frac{(1+\theta^2)}{8}\left[1 - \frac{4\theta^2(1+\theta)^2(1-p)^2}{\beta^2}\right],$$

$$p_{10}\theta_{10} = 0.5(1+\theta)^{-1}\theta(1-\theta)(1-p)^2(1+\theta+2p\theta),$$

$$p_{11}\theta_{11} = 0.5\beta^{-2}\theta(1+\theta)(1+\theta^2)(1-p)^2[\alpha + 2\theta(1+\theta)(1-p)], \text{ and}$$

$$p_{12}\theta_{12} = 0.5\beta^{-2}\theta(1+\theta)(1+\theta^2)(1-p)^2[\alpha - 2\theta(1+\theta)(1-p)].$$

Define $E\hat{\theta}_2^A\left(R_1^A, o_1, R_2^A\right)$ as the expectation of $\hat{\theta}_2^A$. Since

$$E\hat{\theta}_2^A(u_1, u_1, u_2) = \Pr(u_1, u_1)\Pr(u_2, u_2)\Pr(u_2 | u_2, u_2)\,\theta_A^2\left(R_1^A = o_1, R_2^A = o_2\right)$$

$$+ \Pr(u_1, u_1)\Pr(u_2, u_2)\Pr(d_2 | u_2, u_2)\,\hat{\theta}_A^2\left(R_1^A = o_1, R_2^A \neq o_2\right)$$

$$+ \Pr(u_1, u_1)\Pr(u_2, d_2)\Pr(u_2 | u_2, d_2)\,\theta_A^2(u_1, u_1, u_1, u_2, d_2, u_2)$$

$$+ \Pr(u_1, u_1)\Pr(u_2, d_2)\Pr(d_2 | u_2, d_2)\,\theta_A^2(u_1, u_1, u_1, u_2, d_2, d_2)$$

$$+ \Pr(u_1, d_1)\Pr(u_2, u_2)\Pr(u_2 | u_2, u_2)\,\theta_A^2\left(R_1^A = o_1, R_2^A = o_2\right)$$

$$+\Pr(u_1,d_1)\Pr(u_2,u_2)\Pr(d_2|u_2,u_2)\,\hat{\theta}_A^2\left(R_1^A=o_1,R_2^A\neq o_2\right)$$

$$+\Pr(u_1,d_1)\Pr(u_2,d_2)\Pr(u_2|u_2,d_2)\,\theta_A^2\left(R_1^A=o_1,R_2^A=o_2\right)$$

$$+\Pr(u_1,d_1)\Pr(u_2,d_2)\Pr(d_2|u_2,d_2)\,\theta_A^2\left(R_1^A=o_1,R_2^A\neq o_2\right)$$

$$=p\theta\alpha^{-1}(1+\theta)(1+\theta^2)+p\theta(1-\theta)>E\hat{\theta}_2^A(u_1,u_1,d_2)$$

and similarly

$$E\hat{\theta}_2^A(u_1,d_1,u_2)>E\hat{\theta}_2^A(u_1,d_1,d_2),$$

$$E\hat{\theta}_2^A(d_1,u_1,u_2)>E\hat{\theta}_2^A(d_1,u_1,d_2),\text{ and}$$

$$E\hat{\theta}_2^A(d_1,d_1,u_2)>E\hat{\theta}_2^A(d_1,d_1,d_2),$$

A never deviates in period 2.

Finally we consider period 1. Suppose $s_1^A=u_1$. If $R_1^A=u_1$, the sum of his expected utility in period 1 and 2 is

$$\Pi_A\left(R_1^A=s_1^A\right)=\left[\theta_1^A(u_1,u_1)+E\hat{\theta}_2^A(u_1,u_1,u_2)\right]\Pr(u_1|u_1)$$

$$+\left[\theta_1^A(u_1,d_1)+E\hat{\theta}_2^A(u_1,d_1,u_2)\right]\Pr(d_1|u_1).$$

If he deviates and chooses $R_1^A=d_1$, the sum is

$$\Pi_A\left(R_1^A\neq s_1^A\right)=\left[\theta_1^A(u_1,u_1)+E\hat{\theta}_2^A(d_1,d_1,u_2)\right]\Pr(d_1|u_1)$$

$$+\left[\theta_1^A(u_1,d_1)+E\hat{\theta}_2^A(d_1,u_1,u_2)\right]\Pr(u_1|u_1).$$

Since calculation shows that

$$\Pi_A\left(R_1^A=s_1^A\right)>\Pi_A\left(R_1^A\neq s_1^A\right),$$

A never deviates from the equilibrium in period 1. Q.E.D.

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Figure 1: The conditions in which *B* mimics *A* in period 2.

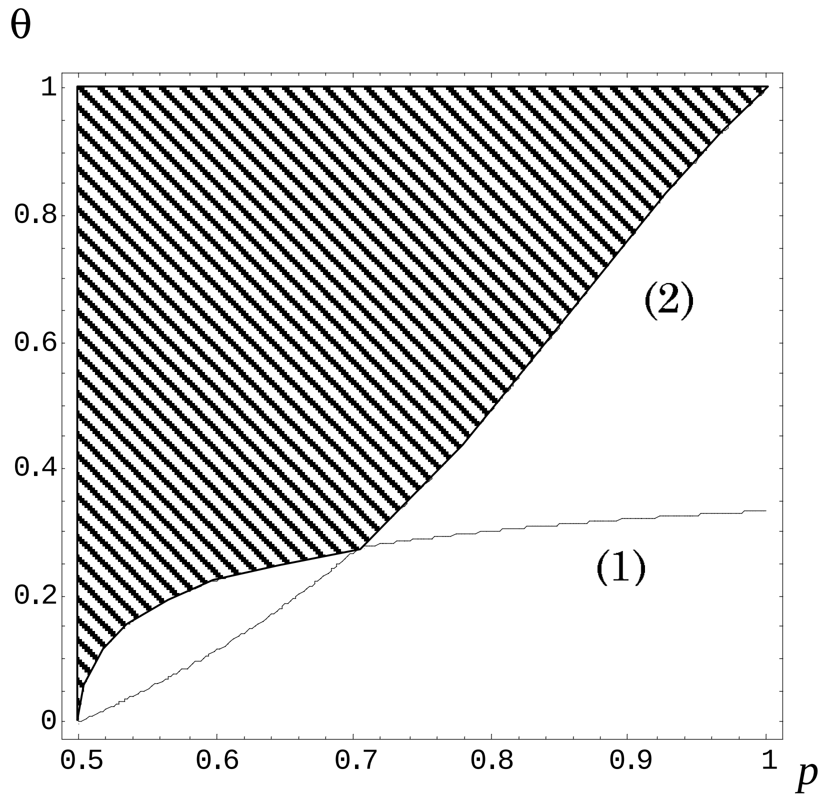


Figure 2: The conditions that *B* follows his own information in period 2 if and only if it was correct in period 1.

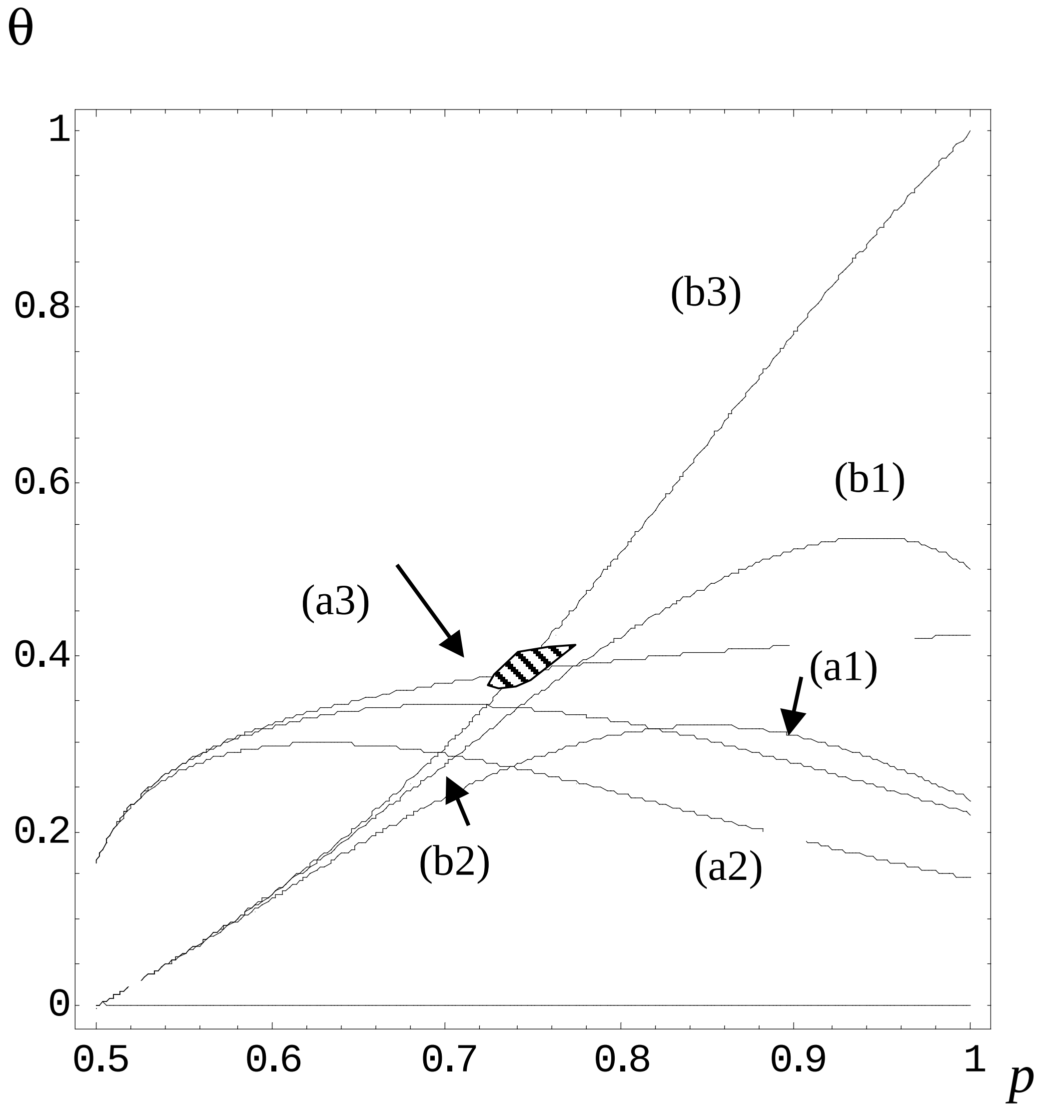
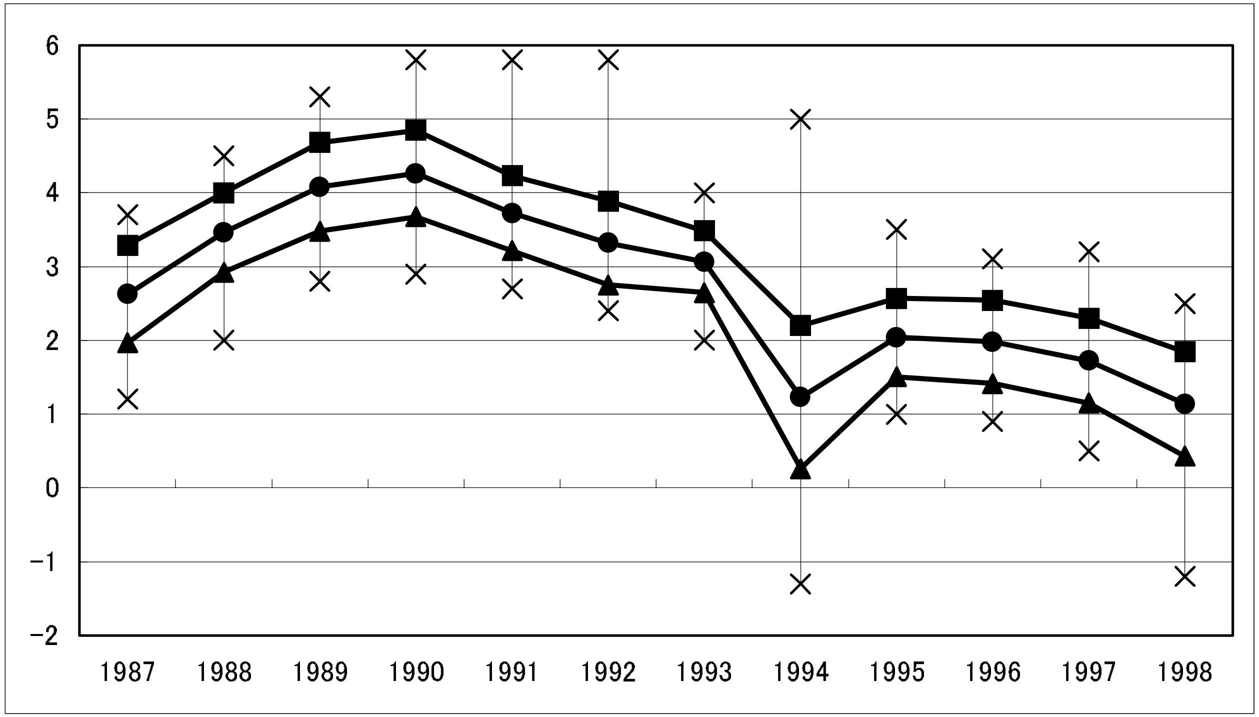
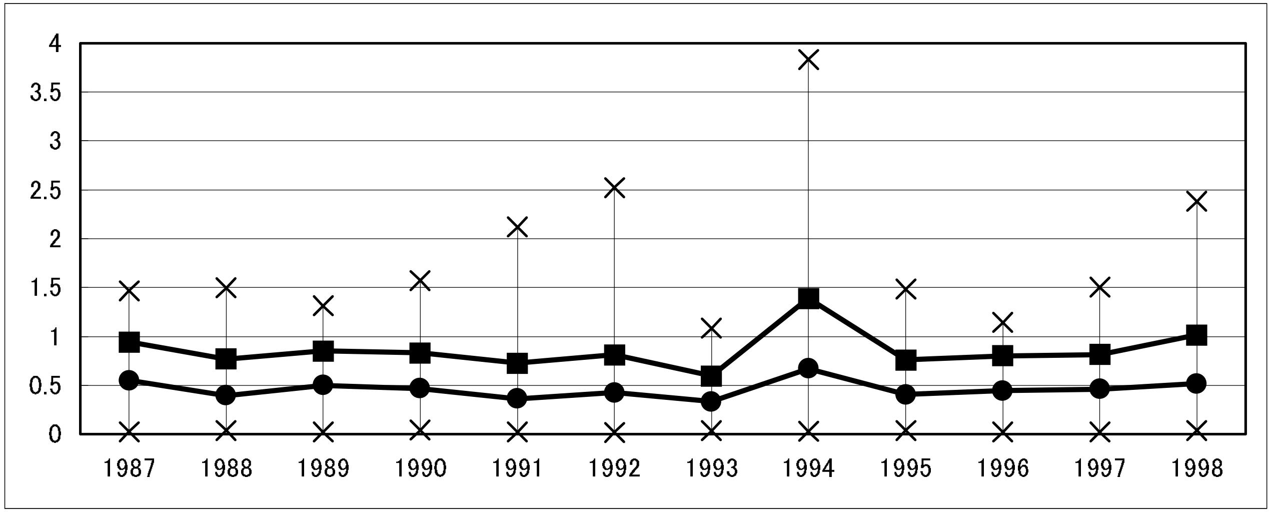


Figure 3: The distribution of Japanese real GDP forecasts.



[Note] Vertical line: Support of the distribution of forecasts
Top line: Mean forecast plus one standard deviation
Middle line: Mean forecast
Bottom line: Mean forecast minus one standard deviation

Figure 4: The distribution of forecast deviations.



[Note] Vertical line: Support of the distribution of forecast deviations
Top line: Mean forecast deviation plus one standard deviation
Bottom line: Mean forecast deviation

Table 1: Summary statistics

No. of forecasters	69
Total number of forecasts	623
Avg. observations per forecaster	9.03
Avg. observations per year	51.9
Avg. of y_i^t	0.4601
Standard deviation of y_i^t	0.4235

Table 2: The effect of aging

Dependent variable: y_i^t (in %)

	fixed effect model	random effect model	Lamont
age	0.00658	0.00679	0.0180
(t-value)	(1.36)	(1.42)	(2.44)
$\bar{y}_{-i}^t$	0.688	0.659	0.77
(t-value)	(4.21)	(4.04)	(7.54)
No. of samples	623	623	728
$\bar{R}^2$	0.256	0.016	0.43
Avg. of y_i^t	0.4601	0.4601	0.7381

Hausman test

H_0: random effect vs. H_1: fixed effect

$\chi^2(2)$	5.5674
P-value	0.062

Table 3: The effect of experience

Dependent variable: y_i^t (in %)

	fixed effect model	random effect model
time	0.00774	0.00796
(t-value)	(1.48)	(1.54)
$\bar{y}_{-i}^t$	0.686	0.657
(t-value)	(4.20)	(4.04)
No. of samples	623	623
$\bar{R}^2$	0.256	0.016

Hausman test

H_0: random effect vs. H_1: fixed effect

$\chi^2(2)$	5.5695
P-value	0.062

Table 4: The estimation using the data for the ongoing year

Dependent variable: y_i^t

	fixed effect model	fixed effect model
age	0.00437	
(t-value)	(0.90)	
time		0.00457
(t-value)		(0.91)
$\bar{y}_{-i}^t$	0.759	0.758
(t-value)	(4.63)	(4.65)
No. of samples	538	538
$\bar{R}^2$	0.214	0.214