Herding over the career

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Abstract

We develop a model of decision-making when managers have private information about their abilities. With no private information about ability, managers ‘herd’. However, with sufficient private information, managers inefficiently ‘anti-herd’. The model potentially illuminates recent empirical work on career concerns. © 1999 Published by Elsevier Science S.A. All rights reserved.

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1. Introduction

We develop a model of managerial decision-making when managers have private information about their abilities. This model potentially illuminates the growing empirical literature examining changes in herding behavior over the course of the career (see, for example, Lamont (1995), Hong et al. (1998), and Chevalier and Ellison (1998)). These papers are surprisingly consistent in their findings; younger decision-makers ‘herd’ more than their older counterparts. However, these results are difficult to interpret because existing theoretical models do not make predictions about whether herding should increase or decrease over the career.

A manager’s incentives to herd evolve through her career in response to her information relative to that of the market. Early in her career, a manager may have no private information about her ability. Scharfstein and Stein (1990) consider a situation in which managers have no private information about their abilities and provide sufficient conditions such that such managers will have an incentive to inefficiently ‘herd’. In their sequential decision model, the second manager will copy the action of the first, regardless of her private signal.

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Scharfstein and Stein (1990) do not consider the fact that a herding manager obtains private information about her ability over time. Each period, she observes whether her private signal was accurate, although this is not revealed to the market. As we will show, a signaling (contrarian) equilibrium replaces the Scharfstein and Stein herding outcome when the manager builds up sufficient private information about her ability. In this equilibrium, managers with positive information about their abilities attempt to demonstrate their self-confidence by going against market trends. Moreover, managers with negative information about their abilities also choose to ‘anti-herd’, lest they be recognized for having no independent information. This suggests that managers may herd early in their careers and diverge in their actions later, which is consistent with the empirical literature.

Our setup follows Scharfstein and Stein. In a different framework, Prendergast and Stole (1996) show that agents may undertake bold actions in order to signal possession of precise information. In our model, ‘anti-herding’ occurs when a trigger amount of private information is added to the Scharfstein and Stein herding model. Private information should arrive endogenously to herding managers as the career progresses.

2. The model

Two managers consider separate investment decisions in sequence. The payoff from investing is the same for both managers and is equally likely to be H (‘high’) or L (‘low’). We assume that \( L = -H \) so the expected value of investing and not investing are equal. Managers are smart and dumb in the proportions \( \Theta_h \) and \( 1 - \Theta \). Both types of managers receive a binary signal about the likely outcome of the investment, with possible values G (‘good’) and B (‘bad’). For smart managers, \( P(G|H) = P(B|L) = p \), where \( p > 1/2 \). If both managers are smart, they receive the same signal. For dumb managers, \( P(G|H) = P(B|L) = 1/2 \); the dumb managers’ signals are uncorrelated noise. Each manager receives a fixed first period wage and subsequently, a wage equal to her expected ability. Thus, each manager maximizes the market’s assessment of her ability.

Crucially, Scharfstein and Stein assume that managers have no private information about their ability. In our model, a proportion \( \gamma \) of managers have ‘promising’ private information about their ability; they are smart with probability \( \Theta_h \geq \Theta \). A proportion \( 1 - \gamma \) of managers have ‘unpromising’ private information about their abilities; they are smart with probability \( \Theta_h \leq \Theta \). Assuming Bayesian updating, \( \gamma \Theta_h + (1 - \gamma) \Theta_L = \Theta \). We assume that \( \gamma < \Theta \) so that it is possible to take a limit as \( \Theta_h \) approaches 1. We provide comparative statics results based on adjustments to \( \Theta_h \) and (corresponding adjustments to) \( \Theta_L \) while holding other parameters constant.

We focus on three possible outcomes. In an efficient outcome, manager 1 invests if and only if his signal is positive. Suppose that manager 1 does not invest. If manager 2 has a negative signal, it is unambiguously desirable for her not to invest. If, however, manager 2 has a positive signal, then her efficient action depends on her information about her ability. If she is promising, then her signal is

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1 Setting \( P(H) = P(L) = 1/2 \) eliminates any incentive for manager 1 to signal his ability by deviating from the efficient outcome.

2 Scharfstein and Stein placed no restriction on \( H \) and \( L \). The case \( L = -H \) is a knife-edge; the managers’ signals will determine whether investment is desirable.
more informative on average than manager 1’s signal and she should invest. Conversely, if she is unpromising, she should not invest. In a herding outcome, manager 2 copies manager 1’s action, regardless of her type and private signal. In a signaling outcome, a promising manager 2 deviates from manager 1’s action if her signal disagrees with that action, as in the efficient outcome. However, an unpromising manager 2 also deviates from manager 1’s action with some probability, in contrast to the efficient outcome.

2.1. Equilibrium analysis

The addition of private information about ability introduces the possibility of signaling. The first effect is signaling by choice of action. The natural way for a promising manager 2 to indicate that she is promising is to follow her signal, regardless of the action of manager 1. It may not always be profitable for a promising manager to signal her type when her signal disagrees with the choice of manager 1. A key feature of this model is that all smart managers receive the same private signal; if they receive different signals, at least one of them must be dumb. When a promising manager receives a signal that disagrees with manager 1’s action, she reduces her assessed probability that she herself is smart.

Lemma 1. If manager 2 is promising and her signal disagrees with manager 1’s signal, then the probability that manager 2 is smart is \( \Theta_h(1 - \Theta)/(1 - \Theta + \Theta^2) < \Theta_h \).

Proofs and algebraic derivations are available from the authors.

We begin by considering the possibility of herding. We can apply the logic of the intuitive criterion and forward induction to conclude that a promising manager with a contrary signal has the greatest incentive to deviate from the herding outcome. Therefore, the most ‘intuitive’ out-of-equilibrium belief is that a deviation from herding almost certainly indicates a promising manager with a contrary signal.

Proposition 2. Herding is an equilibrium based on ‘intuitive beliefs’ iff \( \Theta_h < \Theta/(1 - \Theta + \Theta^2) \).

The tradeoff between two effects determines whether herding is an equilibrium. On the one hand, manager 2 can signal confidence in her contrary signal by deviating. On the other hand, by copying manager 1, manager 2 can hide the fact that she received a different signal from manager 1 (and that therefore, one of them must be dumb). When \( \Theta_h \) is sufficiently low, managers have little private information about their abilities, and the second incentive outweighs the first. This is the logic of the original Scharfstein and Stein herding equilibrium.

We now consider the case where \( \Theta_h > \Theta/(1 - \Theta + \Theta^2) \). Under these conditions, it is profitable for manager 2 to deviate from manager 1’s action if that would reveal that she is promising.

Proposition 3. When \( \Theta_h > \Theta/(1 - \Theta + \Theta^2) \), there is always an equilibrium where a promising
manager 2 follows her signal, regardless of manager 1’s action. For $\Theta_H$ sufficiently large, there is a signaling equilibrium, but no herding or efficient equilibrium. In the signaling equilibrium, a promising manager 2 follows her signal, while an unpromising manager 2 follows her signal with some probability (depending on whether her signal is G or B).

The signaling equilibrium is semi-separating because the action of manager 2 only partly reveals her type. Promising managers act efficiently by following their signals. It would be efficient for an unpromising manager 2 to copy manager 1’s action. Thus, there is too little herding in the semi-separating equilibrium.

The logic follows. If manager 1 does not invest, manager 2’s assessed probability of H depends on her type and her signal:

$$P(H|\text{promising, } G) > 1/2 > P(H|\text{unpromising, } G) > P(H|\text{unpromising, } B) > P(H|\text{promising, } B).$$

Beyond the herding case, the outcome of the investment is informative about manager 2’s ability. This implies there are differential costs to signaling by deviating from manager 1’s action, depending on manager 2’s type and private signal; these costs are determined endogenously by equilibrium actions and Bayesian updating by the market. When manager 1 does not invest, the costs of signaling decrease with $P(H|\text{type, signal})$, the probability that it is desirable for manager 2 to invest.

If $\Theta_H$ is barely greater than $\Theta/(1 - \Theta + \Theta^2)$, then it is barely profitable for a promising manager 2 to deviate if her signal disagrees with manager 1’s action. Since it is more costly for an unpromising manager to signal, it is not profitable for unpromising managers to deviate, even though a deviation always indicates a promising manager in equilibrium. Thus, the efficient outcome is an equilibrium when $\Theta_H$ is sufficiently close to $\Theta/(1 - \Theta + \Theta^2)$.

As $\Theta_H$ increases, the potential benefits of signaling increase as well. If $\Theta_H$ is sufficiently greater than $\Theta/(1 - \Theta + \Theta^2)$, then efficient investment is no longer an equilibrium. Instead, unpromising managers will copy the contrarian behavior of promising managers with some positive probability. An equilibrium results because the wages for deviating decline with the probability that an unpromising manager deviates. In equilibrium, unpromising managers with a given signal will invest with a probability such that they are indifferent between investing and not investing. A promising manager with signal G always invests, as her costs of signaling are less than those for unpromising managers.

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4Note that efficient investment can be an equilibrium even though a contrarian action indicates that a manager is promising. An unpromising manager can be deterred from contrarian action because the outcome of the investment is still informative about the true ability of a (promising) contrarian manager. After a contrarian action, manager 2 receives a higher payoff if that action matches the outcome of the investment. Therefore, a promising manager expects a higher payoff from contrarian action than would an unpromising manager.

5It is possible that it is an equilibrium for unpromising managers to deviate for certain with signal G and never to deviate with signal B. Otherwise, there must be such an indifference point, which may occur either for unpromising managers with signal G (and no unpromising managers investing with signal B) or for unpromising managers with signal B (and all unpromising managers investing with signal G). If all unpromising managers invest, then not investing reveals that the manager is promising; that cannot be an equilibrium because an unpromising manager 2 would gain by choosing not to invest.
3. Summary

When a manager’s private information is sufficiently precise, contrarian behavior is an equilibrium; herding and the efficient outcome are not equilibria. Thus, we might expect to observe herding early in the career when managers have no private information about ability and anti-herding later, once private information becomes precise.

Appendix A. Proof of Lemma 1

Table 1 shows the probabilities of the various combinations of types and signals for a promising manager. Given that the managers have received different signals, the probability that a promising manager is smart is

\[
P(\text{Smart}|\text{Promising, Different Signals}) = (1 - \Theta) \Theta_H / [(1 - \Theta) \Theta_H + \Theta (1 - \Theta_H)] + (1 - \Theta) (1 - \Theta_H)] = (1 - \Theta) \Theta_H / (1 - \Theta \Theta_H) < (1 - \Theta \Theta_H) \Theta_H / (1 - \Theta \Theta_H) = \Theta_H.\]

Proof of Proposition 2

This result follows from Lemma 1. With intuitive beliefs, \( P(\text{Smart}|\text{Promising, Different Signals}) = (1 - \Theta) \Theta_H / (1 - \Theta \Theta_H) \) is the out-of-equilibrium wage for manager 2 whenever she deviates from manager 1’s action. The actual wage for manager 2 in a herding equilibrium is simply \( \Theta_H \), since no new information about manager 2 is revealed by her action. If \( \Theta_H < \Theta / (1 - \Theta + \Theta^2) \), then the wage for deviating is less than the wage for herding, and herding is an equilibrium. Otherwise, herding is not an equilibrium.

Proof of Proposition 3

Using the values in Table 1, we calculate

\[
P(\text{Own Signal Correct}|\text{Promising, Different Signals}) = [\Theta (1 - \Theta_H) (1 - p) + (1 - \Theta) \Theta_H p + (1 - \Theta) (1 - \Theta_H) 1/2] / [\Theta (1 - \Theta_H) + (1 - \Theta) \Theta_H + (1 - \Theta) (1 - \Theta_H)] = [1 + \Theta - \Theta \Theta_H - \Theta_H - p \Theta + \Theta \Theta_H] / (1 - \Theta \Theta_H) = 1/2 + (\Theta_H - \Theta) (p - 1/2)/(1 - \Theta \Theta_H).\]

Similarly,

\[
P(\text{Own Signal Correct}|\text{Unpromising, Different Signals}) = 1/2 + (\Theta_L - \Theta) (p - 1/2)/(1 - \Theta \Theta_L).\]

Since \( \Theta_H > \Theta > \Theta_L \),
Table 1
Probabilities for a promising manager.

| M1 | M2 | Likelihood | P (Same signal) | P (Different signals) | P (M2 Correct|Agree) | P (M2 Correct|Disagree) |
|----|----|------------|----------------|----------------------|----------------|----------------------|
| S  | S  | $\Theta \Theta_H$ | 1               | 0                    | $p$            | NA                   |
| S  | D  | $\Theta(1-\Theta_H)$ | 1/2             | 1/2                  | $p$            | $1-p$               |
| D  | S  | $(1-\Theta)\Theta_H$ | 1/2             | 1/2                  | $p$            | $p$                  |
| D  | D  | $(1-\Theta)(1-\Theta_H)$ | 1/2             | 1/2                  | $1/2$          | $1/2$               |

\[
P(\text{Own Signal Correct} | \text{Promising, Different Signals}) > 1/2 > P(\text{Own Signal Correct} | \text{Unpromising, Different Signals}).
\]

We next calculate
\[
P(\text{Own Signal Correct} | \text{Promising, Same Signal}) = \frac{p(2\Theta \Theta_H + \Theta(1-\Theta_H) + (1-\Theta)\Theta_H)}{1/2(1-\Theta)(1-\Theta_H)}
\]
\[
+ \frac{1/2(1-\Theta)(1-\Theta_H)}{2\Theta \Theta_H + \Theta(1-\Theta_H) + (1-\Theta)\Theta_H + (1-\Theta)(1-\Theta_H)}
\]
\[
= \frac{p(\Theta + \Theta_H) + 1/2(1-\Theta)(1-\Theta_H)}{1/2 + (p-1/2)(\Theta + \Theta_H)/(1+\Theta \Theta_H)}.
\]

Similarly,
\[
P(\text{Own Signal Correct} | \text{Promising, Same Signal}) = 1/2 + (p-1/2)(\Theta + \Theta_H)/(1+\Theta \Theta_H).
\]

Since $(\Theta + \Theta_H)/(1+\Theta \Theta_H)$ is increasing in $\Theta_H$, we know that
\[
P(\text{Own Signal Correct} | \text{Promising, Same Signal}) > P(\text{Own Signal Correct} | \text{Unpromising, Same Signal}).
\]

Converting these results into the case described in the text, once manager 1 has not invested (indicating a signal of B), we conclude that
\[
P(H | \text{promising, G}) > 1/2 > P(H | \text{unpromising, G}) > P(H | \text{unpromising, B}) > P(H | \text{promising, B}).
\]

This ordering indicates the ordering of signaling costs when there is a higher payoff for a given action when that action proves to be correct.

Now consider the case where promising managers follow their signals. Then for each action (agree or deviate from manager 1’s action), a promising manager has the greatest probability of being correct. Consequently, the assessed probability that manager 2 is smart given her action is higher when her action is correct than when it is incorrect.

When $\Theta_H > \Theta/(1 - \Theta + \Theta^2)$, a promising manager with a signal that disagrees with manager 1 is more likely to be smart than the average manager. Thus, in the efficient outcome (where only such a promising manager deviates), a promising manager who chooses a contrarian action gets a higher average wage than $\Theta$. The average wage for the remaining managers is then less than $\Theta$; those managers receive higher wages when their action is correct than when it is wrong. Since promising managers with contrary signals assess a lower probability of success by copying manager 1’s action than all other managers, they must get an expected wage less than $\Theta$ by deviating from the efficient
outcome by deviating to copy manager 1’s action when \( \Theta_H > \Theta/(1 - \Theta + \Theta^2) \). Similarly, if promising managers follow their signals and unpromising managers always deviate, then promising managers whose signals agree with manager 1’s action get a higher wage by following that signal than by deviating.

The efficient outcome is an equilibrium when \( \Theta_H > \Theta/(1 - \Theta + \Theta^2) \) if an unpromising manager with a contrary signal prefers copying to deviating (note that such managers have the lowest signaling costs of any of those managers who copy manager 1’s action in the efficient case). Otherwise, some unpromising managers prefer to deviate from the efficient outcome with a contrarian action. If we start with the efficient outcome and then gradually switch unpromising managers to contrarian behavior (beginning with those with contrary signals to manager 1’s action, i.e. those with the lowest costs to deviating), then eventually we must reach a point where additional unpromising managers do not wish to change behavior, or else we must run through all of the unpromising managers. In either case, we have reached an equilibrium. Either some set of unpromising managers is indifferent between deviating and copying while other managers strictly prefer their own actions, or all managers strictly prefer their own actions. In either case, we have identified an equilibrium with promising managers following their own signals.

As \( \Theta_H \) approaches 1, \( P(Smart|Promising, Different Signals) = (1 - \Theta) \Theta_H/(1 - \Theta \Theta_H) \) approaches 1. Further, \( P(Smart|Promising, Different Signals) \) still approaches 1 even if it becomes known that manager 2’s signal was incorrect. Thus, if managers are prescribed to follow efficient behavior as \( \Theta_H \) approaches 1, then the wage for a deviating manager 2 would also be close to 1, regardless of the outcome of that action. As a result, the efficient outcome is not an equilibrium for \( \Theta_H \) sufficiently large. This means that the iterative procedure described above identifies a semi-separating signaling outcome.

References