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Rational herding in financial economics

Andrea Devenow, Ivo Welch *

AGSM at UCLA, 110 Westwood Plaza, Box 951481, Los Angeles, CA 90095-1481, USA

Abstract

This paper briefly describes recent papers on the economics of rational herding in financial markets. Some models can predict perfect herding, in which rational agents all act alike without any countervailing force. Such herding typically arises either from direct payoff externalities (negative externalities in bank runs; positive externalities in the generation of trading liquidity or in information acquisition), principal–agent problems (based on managerial desire to protect or signal reputation), or informational learning (cascades). The paper also provides a few pointers to related literature and suggests issues to be addressed in future research.

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1. Introduction / purpose

Imitation and mimicry are perhaps among our most basic instincts. Herding can be found in fashion and fads, just as in such simple decisions as how to best commute and what research to work on. There is an especially prominent belief, not only among practitioners but also among financial economists (when asked in conversation), that investors are influenced by the decisions of other investors and that this influence is a first-order effect. In the financial realm, herding could potentially be universal.

* Tel: 44-171-262-5050; fax: 44-171-724-3317; e-mail: ivo.welch@anderson.ucla.edu. E-mail Devenow: andrea.devenow@anderson.ucla.edu

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Yet it is difficult to precisely define 'herding'. In its most general form, herding could be defined as behavior patterns that are correlated across individuals. But, if many investors are purchasing 'hot' stocks, it could just be due to correlated information arrival in independently acting investors. The notion of 'herding' we consider instead is one which can lead to systematic erroneous (i.e., sub-optimal relative to the best aggregate choice) decision-making by entire populations. In this sense, herding is closely linked to such distinct phenomena as imperfect expectations, fickle changes without much new information, bubbles, fads, frenzies, and sun-spot equilibria.

Herding does require a coordination mechanism. This mechanism can be either a widely spread rule to coordinate based on some signal (e.g., a price movement), or based on a direct ability to observe other decision-makers (e.g., observing a colleague's investments). There are two polar views of herding, loosely speaking the non-rational and rational views. The non-rational view centers on investor psychology and holds that agents behave like lemmings, following one another blindly and foregoing rational analysis. Less crazy investors are assumed to be able to profit handsomely therefrom. The rational view centers on externalities, optimal decision-making being distorted by information difficulties or incentive issues. The intermediate view holds that decision-makers are near-rational, economizing on information processing or information acquisition costs by using 'heuristics', and that rational activities by third-parties cannot eliminate this influence.

Our goal is to provide the interested reader with pointers to some recent developments in the relevant academic financial literature on rational herding. Because of space constraints, we (mostly) exclude the irrational herding literature; further we exclude papers of semi-strong market efficiency, e.g. Grossman and Stiglitz (1976), Diamond and Verrecchia (1981), where the market price is the only efficient coordination device for investors, each investor's valuation is an interior combination only of private and public information, and local information is quickly [1] dispersed into and dominated by the market price. Instead, we concentrate on models without a strong countervailing force, i.e., in which incentives to follow the herd (weakly) increase in the size of the herd, and if enough agents follow the herd, each additional agent acts purely based on others' actions. (We briefly mention some relevant herding models without this characteristic in II.F.) We shall also not focus on papers on bubbles, fads, noise-trading, sentiment, and trading rules (typically, these do not explicitly consider the herding or contagious aspects). For an overview of bubbles, refer to the Journal of Economic Perspectives (1990) symposium. For an overview of some 'anomalies,' refer to DeBondt and Thaler (1989). For an overview of the noise trading literature, refer to Shleifer and Summers (1990).

[1] Vives (1995b) studies the speed of price adjustment in such a market.

2. Herding in financial markets

2.1. Herding and the efficient markets hypothesis (EMH)

In one sense, the EMH was so successful because it seemed to dispel the previously dominant notion of an irrational market driven by herds. Keynes (1936) famous adage was that the stock market was mostly a beauty contest in which judges picked who they thought other judges would pick, rather than who they considered to be most beautiful. The perceptions of MacKay (1841), Kindleberger (1989) and Galbraith (1993) were that there was convincing evidence of 'bubbles,' of mass errors caused by the fickle nature of herds. Episodes like the Tulip Mania and the South Sea Bubble are burnt in the minds of many. [2] With our better understanding of the importance of efficient markets, academic research has turned back towards reexamining the remaining empirical puzzles not easily addressed in parsimonious strong-form EM models: First, many financial markets phenomena display either waves and/or a certain fragility. For example, mergers and IPOs come in waves that are seemingly more amplified than possible waves in underlying fundamentals. (From our perspective, such pricing patterns are an indication but not clear evidence that investors herd.) Second, consensus among market participants seems to be low, not based on private information and still localized (e.g., Shiller et al., 1995), indicating that independent decision-making across all market participants is a fiction. Third, in conversations, many influential market participants continuously emphasize that their decisions are highly influenced by other market participants.

To explain these phenomena, a 'rational herding' literature has recently been emerging in financial economics. These models are typically built on one or more of three effects: Payoff externalities models show that the payoffs to an agent adopting an action increases in the number of other agents adopting the same action (example: the convention of driving on the right side of the road). Principal–agent models show that managers, in order to preserve or gain reputation when markets are imperfectly informed, may prefer either to 'hide in the herd' not to be evaluable, or to 'ride the herd' in order to prove quality. Cascades models show that later agents, inferring information from the actions of prior agents, optimally decide to ignore their own information and act alike. [3]

[2] Garber (1990) disputes the notion that the market overall displayed irrational pricing. However, the influence of investors on one another in the price-finding process remains undisputed.

[3] Outside financial markets, herding is also sometimes modelled as arising from direct preference (utility).

2.2. Payoff externalities: Bank runs

There are numerous anecdotes from banking panics, with graphic descriptions of depositors running on banks when they observe other depositors doing so. [4] Modeling this mutual influence of investors in a bank run has had a long tradition in the banking literature. There are two salient features of bank runs modeled in Diamond and Dybvig (1983): First, investors can see (through long lines) when other investors are running the bank. Second, when banks that have invested in long-term projects are forced to liquidate early (because of the run), there is a potential shortfall of funds. Consequently, the last depositors to withdraw can be left empty-handed (first-come, first-served constraint). Diamond and Dybvig show that there are two feasible ('sunspot') equilibria, one equilibrium in which a bank remains solvent to pay off high returns to all participants, and another 'run' equilibrium in which every investor justly believes that other investors' withdrawals are forcing the bank to short-circuit its high-profitability investment. The Diamond and Dybvig model has been extended in Waldo (1985), who considers the role of deposit-currency ratios and interest rates; Gorton (1985), who considers the (rational) informational component in starting bank-runs; Postlewaite and Vives (1987), who show that bank runs might occur in a model with a positive probability in one universal equilibrium; Jacklin and Bhattacharya (1988) and Chen (1995a), who model the bank's ex-ante adverse investment incentives created by the possibility of a bank run; Chari and Jagannathan (1988), who model the informational dynamics of bank-runs more explicitly, allowing for both liquidity and informational withdrawals and not imposing a sequential service constraint; and many others. Relevant empirical evidence includes Gorton (1988) and Donaldson (1992) who disagree on whether bank-run starts have a large unpredictable component (indicating random starts) or are predictable (indicating information-caused starts); Park (1991), who reviews the history of U.S. bank runs and argues that inter-bank contagion of runs were stopped by government and private information release; and Wigmore (1988), who argues that the 1933 bank-run was caused by an earlier run on the dollar.

2.3. Payoff externalities: Liquidity in markets

There were about 250 stock exchanges in the U.S. in the 19th century. Today, there are less than one-tenth this number and payoff externalities may have caused this decline. When there are either economies of scale (fixed costs) or when informed trading imposes an externality on uninformed trading (Admati and Pfleiderer, 1988; Chowdhry and Nanda, 1991), then both informed and unin-

[4] There are anecdotes of intervention by impresarios, such J.P. Morgan's intervention in the 1907 banking crisis, who single-handedly restored confidence and thus stopped the bank-run.

formed investors will benefit from transacting in markets with more depth (liquidity). This pressure eventually forces most investors to transact in only one market.

2.4. Payoff externalities: Information acquisition

Payoff externalities may also drive the decisions of agents for which stocks they acquire information. Under certain circumstances, agents find it worthwhile to acquire further information only if other agents do. Agents thus herd on information acquisition (or lack thereof).

In Brennan (1990), traders have a limited lifespan in an infinite, overlapping generations model. The true value is sometimes revealed exogenously. Private information is reflected in stock prices one period after it is acquired, but only if a minimum number of investors have acquired it. Consequently, expected gains to purchasing information depend on an assessment of others' expected gains (and the probability of exogenous value revelation), and two equilibria obtain. In one equilibrium, no one purchases information because information is unlikely to be reflected in the stock price.

In Froot et al. (1992), traders have two-period horizons in a three-period world (value is revealed only at the final period; but see also Dow and Gorton (1994) and Vives (1995a)). They are not sure whether placed orders are executed in the first or second period. If a trader decides to acquire information on the same stock on which other traders acquire information, then an order executed in the first period is likely to be followed by a similar order in the intermediate period and the trader benefits from the information. Yet, if a trader is alone in acquiring information about another 'unherded' stock instead, no other buy orders are likely to arrive in the intermediate period.

Similarly, Hirshleifer et al. (1994) show that risk-averse long-lived traders can prefer to acquire information in the same stock as other investors when investors discover the same information at different times. The first investors to discover the information can profit from the information with a minimum of fundamental risk if it is likely that other investors will soon discover the same signal. Thus, the expected utility from gathering information can increase in the number of other investors who gather the same information.

2.5. Reputation / principal–agent models: Investment decisions

Rational herding can also be caused by principal–agent concerns. Managerial performance evaluation is often based on relative not absolute performance. (Morck et al. (1989) document that top management firings are associated with poor performance of a firm relative to its industry, rather than with industry failures.) Typically, these herding models show that each manager prefers to

mimic the actions of other managers, completely ignoring private information, to avoid being revealed to be of low-ability. Keynes' observation in the General Theory that "it is better for reputation to fail conventionally than to succeed unconventionally" motivates Scharfstein and Stein (1990) and Rajan (1994). Relative performance evaluation also motivates Zwiebel (1995).

In Scharfstein and Stein (1990), informative (true) signals received by better managers are correlated, whereas uninformative signals (noise) received by worse managers are not. Consequently, when a manager invests in an ex-post bad product, it reveals his poor quality only if the other managers did not invest in the same product (which could then be attributed to an ex-post poor investment climate torpedoing an ex-ante good investment decision). As a result, even better-than-average managers prefer to follow the crowd (and worse managers also make better decisions). If enough bad managers herd on a poor decision, even the better managers may herd instead of taking the risk with an ex-ante better project being the only manager investing into what might turn out to be an ex-post bad decision. Graham (1994) extends the model and produces relevant evidence for investment newsletters. Defining 'herding' as following the leader, *Value Line*, he finds that newsletters with high reputation but low ability are more likely to follow *Value Line*. Similarly, herding on *Value Line* is also more pronounced when newsletters also herd on one another, and when a statistical model predicts more investment success.

In Rajan (1994), low-ability managers can trade off long-term for short-term earnings by making bad loans. In a bad state, all bankers perform poorly. When enough bankers publicly write down their loans, low-quality bankers can follow the herd and write down their ex-ante poor loans without being detected. Consequently, once the first bank sets aside loan-loss reserves, a multitude of banks previously persistently reluctant to recognize bad loans may follow. A major difference between Scharfstein and Stein and Rajan is that following the herd is beneficial for the firm in the former and harmful in the latter. Rajan provides empirical evidence [5] for New England banks: [1] that there are local information spill-over effects into other banks' loan portfolios when the Bank of New England increased its loan loss reserves; [2] that New England banks did not increase their loan loss reserves for many quarters despite mounting losses-until the first bank did after which almost every other bank followed immediately.

Zwiebel (1995) models corporate conservatism [6] in which managers are evaluated relative to one another, and benchmark evaluation is more accurate when more managers use the same technology. If enough managers have adopted a

[5] Jain and Gupta (1987) on the other hand find only weak evidence of herding in LDC loans. However, their test may be weak due to data constraints (both in cross-section and in frequency).

[6] Corporate conservatism is closely related to corporate inertia, modeled in Hirshleifer and Welch (1995).

certain technology, subsequent managers prefer to adopt this technology (in order to signal their skills) instead of a possibly superior but proprietary technology.

In a sense, these models can justify the known fact that investment managers are compensated relative to benchmarks, typically the S&P500, rather than an absolute performance relative to the efficient frontier. [7] Roll (1992) derive the portfolio choices of such an investment manager and Brennan (1993) produces an asset-pricing model in which this benchmark-relative performance causes an extra factor. He finds some mildly favorable empirical evidence.

2.6. *Informational externalities: Cascades*

The most general explanation of herding right now may be cascades, introduced in Bikhchandani et al. (1992) and Welch (1992). [8] The basic cascade model applies when *actions* rather than *private information* are publicly visible, and when there are finite limits to agent's private information and possible actions. The idea is that agents gain useful information from observing previous agents' decisions, to the point where they optimally and rationally completely ignore their own private information. For example, an investor with the most negative private information may be swayed to purchase anyway if he sees that three investors previously purchased (the information in three buys may outweigh the private negative information). But then, all subsequent investors will have no more positive information, either, and will act alike, even though everyone is aware that this (or subsequent) purchase decisions conveyed no information. The model can explain universal herding (clumping) on an incorrect decision, low consensus (when polled) and fragility (in which a little bit of public information can reverse long-standing cascades, because cascades can arise after only very little information has been publicly aggregated), and strong dependence on initial conditions (the first few investors' purchase decisions). [9, 10] Cascades may explain or at least help explain such empirical phenomena as:

- The decisions of banks to write down certain assets (Rajan, 1994).
- The decisions of IPO investors to ask for share allocations (Welch, 1992). Offering prices are fixed by regulation in the U.S.

[7] Maug and Naik (1995) argue that herding caused by relative benchmarking can be in the interest of a principal.

[8] A tutorial introduction can be found in Hirshleifer (1995).

[9] There have been a number of extensions to the model. One extension is noteworthy because it answers the common question whether exogenous ordering of agents (assumed in BHW) is important: In Zhang (1993), agents can choose when to act. He shows that the investor with the most precise information moves first and a cascade ensues immediately.

[10] Shiller (1995) argues that multiple equilibria can arise from conversation patterns and initial informational conditions.

- The decisions of managers to assume debt or to pay dividends. (Without a good model of why firms pay dividends, managers may infer the best choice from peer companies.)
- The decisions of depositors to infer a banking panic and withdraw their deposits. Models combining cascades and bank-run effects appear in Corb (1993) and Chen (1995b). [11]
- The decisions of insurers to underwrite certain types of risks (D'Arcy and Oh, 1996).
- The decisions of IPO firms in certain industries to approach the public market for funding ('hot-issue markets').
- The decisions of firms to invest in R&D in a particular area.
- The decisions of firms to merge with others – and the form by which such mergers are accomplished (conglomerization, hostile takeovers, tender offers, etc.). [12]
- The decisions of analysts to recommend a stock.

The basic cascades model applies only in fixed-price situations. For example, if prices moved perfectly smoothly and instantaneously, the fact that the first investor bought at \$100 does not carry much information to the second investor who would then face a price of \$101. The market price would have adjusted to reflect the information in the first investor's purchase decision. Although we are aware of only two such models (Lee, 1992; Avery and Zemsky, 1995), cascades could apply to asset-pricing markets if prices do not move instantaneously and smoothly. For example, if the market-maker is not aware that an order is due to private information (or if the order is not big enough to bridge the tick [13]), then those investors who observe the order (and know its information content) may copy it. Similarly, if it is possible to front-run an order, as it may have been during a crash, cascades may explain how investors might have followed the divesting herd without regard to their own, possibly favorable information. Perhaps consistent with a scenario in which funds obtain information from previous purchases by other funds, Wermers (1994) examines the trading patterns of 274 mutual fund investors from 1975–1984, and finds both significant simultaneous purchases and sequential purchases of the same stocks after having controlled for funds' investment objectives.

[11] Chen models inter-bank panics, while Corb concentrates on intra-bank panics.

[12] Matthew Lindenbaum of Basswood Partners (a New Jersey hedge fund specializing in bank stocks) who feels that acquiring banks are overpaying, states in Barrons (July 17, 1995) "Its a frenzy now, and it shows no signs of abating. Bankers are lemmings. They're going to follow the crowd and do deals".

[13] Avery and Zemsky (1995) show that multiple sources of uncertainty can lead to a different interpretation of price history by the market-maker and mildly informed traders. Then, previous purchase decisions (rising price) can induce traders to cascade, completely ignoring their own information, at least for a number of trading periods.

2.7. Models of strong but imperfect herding (correlated activities)

There are many interesting models in which there is a strong but not dominant influence of early agents on later agents, and which can display strongly correlated agent behavior. We do not have the space to detail these models, so we will just point the reader to some recent papers (and their bibliographies):

Genotte and Leland (1990) and **Jacklin et al. (1992)** argue that recent stock market crashes could have been due to the presence of an expectedly large amount of portfolio insurance (positive feedback trading).

Romer (1993) produces a model in which trading reveals to investors information about the quality of other investors' information. This may lead to crashes.

Bulow and Klemperer (1994) consider strategic interactions among bidders in auctions of multiple goods with fixed supply. Once the first purchaser publicly announces his purchase, other potential purchasers revise their opinion of other reservation prices, leading to a possible buying frenzy.

Trueman (1994) models investment analysts' inference from prior analysts' recommendations. He finds that it is optimal for later analysts to copy earlier analysts, even when both have the same information.

Maug and Naik (1995) derive optimal compensation contracts for portfolio managers, and find that such a contract induces herding.

Persons and Warthers (1995) model how past takeover activity produces public information to potential other raiders. If prior takeovers were successful/unsuccessful, raiding continues/seizes. Once activity seizes, no further information is produced. The result is waves in takeover activity.

2.8. 'Irrational' herding references

This paper has focused on models of rational herding. However, although there are few *models* of 'irrational' or 'near-rational' herding ('investor psychology'), there is a good number of interesting phenomena, especially in asset-pricing (such as localized consensus, odd price patterns [especially for stocks that are typically bought by clienteles], and sentiment measures), that are difficult to explain otherwise. For lack of space, we wish to point the interested reader at Case and Shiller (1989), Ritter (1991), and Shiller (1984, 1989, 1990), Shiller et al. (1995), Shiller and Pound (1989) Lee et al. (1991). Of special interest is the wide use of 'rules of thumb' such as 'positive feedback trading' (Grinblatt et al., 1995) – and it can be argued that the CAPM is such a (broken) heuristic. Another set of papers (e.g., DeLong et al., 1991) argues that 'smart money' may actually amplify rather than attenuate the influence of such 'stupid' money.

3. An opiniated conclusion

We now have a number of interesting models of rational herding, based on simple, straightforward and convincing intuition. So what remains to be done in our opinion? On the financial theory side, more work is needed in modelling dynamically how rational (or near-rational) herding aggregates information into markets with constantly moving prices (à la Avery and Zemsky, 1995). On the empirical side, we must point out that most models so far rely primarily on anecdotal observations. Thus, the foremost challenge to the herding literature may be the current scarcity of rigorous empirical evidence. In fact, empirical financial research has concentrated on price (or investment) patterns only, primarily because this data is easily available. But, instead of concluding that a particular pattern looks too volatile and thus that this is evidence of herding, good tests of herding require data on how investors communicate with one another. Communication channel traffic needs to be directly measured. Naturally, this data is difficult to get, often informal, not logged, confidential, and potentially full of legal liability. The next-best alternative (or perhaps the first step) to such direct empirical evidence are tests that measure how individual decision-makers follow one another in time. If we could control for 'fundamental changes' (leading themselves to correlated but not necessarily interesting herding behavior), it would be interesting to establish empirically who follows who. We might then relate such evidence to anecdotal observations of how this particular subset of agents communicates. First steps in this direction have already been taken (Wermers, 1994; Lakonishok et al., 1992), and we are optimistic that future research will as much aid our understanding of decision-making in the financial world as it will uncover yet new puzzles to be explained.

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