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Prevailing models of capital markets capture a limited form of social influence and information transmission, in which the beliefs and behavior of an investor affect others only through market price, information transmission and processing is simple (without thoughts and feelings), and there is no localization in the influence of an investor on others. In reality, individuals often process verbal arguments obtained in conversation or from media presentations, and observe the behavior of others. We review here evidence concerning how these activities cause beliefs and behaviors to spread, affect financial decisions, and affect market prices; and theoretical models of social influence and its effects on capital markets. Social influence is central to how information and investor sentiment are transmitted, so thought and behavior contagion should be incorporated into the theory of capital markets.

Key Words: capital markets, thought contagion, behavioral contagion, herd behavior, information cascades, social learning, investor psychology, accounting regulation, disclosure policy, behavioral finance, market efficiency, popular models, memes

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Contents

1 Introduction

The theory of capital market trading and pricing generally incorporates only a limited form of social interaction and information transmission, wherein the beliefs and behavior of an investor affect other investors only through market price. Furthermore, in standard capital markets models, there is no localized contagion in beliefs and trading. Trading behaviors do not move from one investor to other investors who are proximate (geographically, socially, professionally, or attentionally through connectivity in the news media). Even most recent models of herding and information cascades in securities markets involve contagion mediated by market price, so that there are no networks of social interaction.[1] Furthermore, existing behavioral models of capital market equilibrium do not examine how investors form naive popular ideas about how capital markets work and what investors should do, and how such popular viewpoints spread.[2]

The theory of investment has incorporated social interactions somewhat more extensively, both in the analysis of increasing returns and path-dependence (see Arthur (1989)), and in models of social learning about the quality of investment projects (discussed in Subsection 10.1). However, traditional models of corporate investment decisions do not examine the process of contagion among managers of ideas about investment, financing, disclosure, and corporate strategy.

In reality, individuals often observe others' behavior, and obtain information and ideas through conversation and through print and electronic media. Individuals process this information through both reasoning and emotional reactions, rather than performing the simple Bayesian or quasi-Bayesian updating of standard rational or behavioral models. Popular opinions about investment strategies and corporate policies evolve over time, partly in response to improvements in scientific understanding, and partly as a result of psychological biases and other social processes. We are influenced by others in almost every activity, and price is just one channel of influence. Such influence can occur through rational learning (see, e.g., Banerjee (1992), Bikhchandani, Hirshleifer, and Welch (1992)) or through through irrational mechanisms (see Section 5), the latter including the urge to conform (or deviate), and contagious emotional responses to stressful events.

This essay reviews theory and evidence about how beliefs about and behaviors in cap-

[1]However, DeMarzo, Vayanos, and Zwiebel (2001) and Ozsoylev (2005) provide models of asset pricing when there are interactions through social networks (see Section 9, which also discusses learning in standard capital market models in greater depth).

[2]Insightful discussions of 'popular models' in finance are provided by Shiller (1990), Case and Shiller (2003), and Shiller (2007a, 2007b).

ital markets spread. We consider here decisions by investors about whether to participate in the stock market and what stocks to buy; decisions by managers about investment, financing, reporting, and disclosure; and decisions by analysts and media commentators about what stocks to follow, what stocks to recommend, and what forecasts to make. We also consider the effects of contagion on market prices, regulation, and welfare; and policy implications.

We argue that in actual capital markets, in addition to learning from price, a more personal form of learning is also important: from quantities (individual actions), from performance outcomes, and from conversation—which conveys private information, ideas about specific assets, and ideas about how capital markets work. Furthermore, we argue that learning is often local: people learn more from others who are proximate, either geographically or through professional or other social networks. We therefore argue that social influence is central to economics and finance, and that contagion should be incorporated into the theory of capital markets.

Several phenomena are often adduced as evidence of irrational conformism in capital markets, such as anecdotes of market price movements without obvious justifying news; valuations which, with the benefit of hindsight, seem like mistakes (such as the valuations of U.S. internet stocks in the late 1990s, or of mortgage backed securities in recent years); the fact that financial activity such as new issues, IPOs, venture capital financing, and takeovers move in general or sector-specific waves (see, e.g., Ritter and Welch (2002), Rau and Stouraitis (2008), and Goldfarb, Kirsch, and Miller (2007)). Observers are often very quick to denounce alleged market blunders, and conclude that investors or managers have succumbed to contagious folly.

There are two problems with such casual interpretations. First, sudden shifts do not prove that there was a blunder. Large price or quantity movements may be responses to news about important market forces. Second, even rational social processes can lead to dysfunctional social outcomes.

With respect to the first point, market efficiency is entirely compatible with massive ex post errors in analyst forecasts and in market prices, and with waves in corporate transactions actions in response to common shifts in fundamental conditions.

With respect to the second point, the theory of information cascades (defined in Section 2) and rational observational learning shows that some phenomena that seem irrational can actually arise naturally in fully rational settings. Such phenomena include: (1) frequent convergence by individuals or firms upon mistaken actions based upon little investigation and little justifying information; (2) fragility of social outcomes with respect to seemingly small shocks; and (3) the tendency for individuals or firms to delay decision for extended periods of time and then, without substantial external trigger, suddenly to act simultaneously. Furthermore, theoretical work has shown that reputation-building incentives on the part of managers can cause convergent behavior (item (1)), and has also offered explanations for why some managers may deviate from the herd as well.

So care is needed in attributing either corporate event clustering or large asset price fluctuations to contagion of irrational errors.[3] In addition to addressing these issues, we consider a shift in analytical point of view from the individual to the financial idea or meme.

A *meme* is a mental representation (such as an idea, proposition, or catchphrase) that can be passed from person to person. Memes are therefore units of cultural replication, analogous to the gene as a unit of biological heredity. The field of memetics views cultural units as *replicators*, which are selected upon and change in frequency within the population. Just as changes in gene frequency imply evolution within biologically reproducing populations, changes in meme frequency imply cultural evolution. We argue that certain investment theories have properties which make them better at replicating (more contagious, or more persistent), leading to their spread and survival.

Furthermore, we argue that through cumulative evolution, financial memes combine into coadapted assemblies which are more effective at replicating their constituent memes than when the components operate separately. We call these assemblies *financial ideologies*. Memetics offers an intriguing analytical approach to understanding the evolution of capital market (and other) popular beliefs and ideologies.

Only a few finance scholars have emphasized the importance of popular ideas about markets (especially Robert Shiller, as mentioned in footnote 2), and there has been very little formal analysis of the effects and spread of popular financial ideas. We argue here that the analysis of thought contagion, the evolution of financial ideologies, and their effects on markets is a missing chapter in modern finance, including behavioral finance.

Our focus is on contagion of beliefs or behavior, rather than defining contagion as occurring whenever one party' outcomes affect another's.[4] So we do not review systematically the literature on contagion in bankruptcies or international crises in which fundamental shocks and financial constraints cause news about one firm or region to

[3] Recent reviews of theory and evidence of both rational observational learning and other sources of behavioral convergence in finance include Devenow and Welch (1996), Hirshleifer (2001), Bikhchandani and Sharma (2001), and Daniel, Hirshleifer, and Teoh (2002).

[4] If a flat tire in John's car causes it to slam into a wall and then collide with Edna's, the crash is not caused by any transfer of beliefs or behavior from John to Edna. So even though bad new for John has caused bad news for Edna, our focus is not on this sort of interaction per se.

affect the payoffs of another.

Section 2 discusses learning and the general sources of behavioral convergence. Section 3 discusses basic implications of rational learning and information cascades. Section 4 discusses basic principles of rational learning models and alternative scenarios of information transfer by communication or observation. Section 5 examines psychological bias and herding. Section 6 describes agency and reputation-based herding models. Section 7 describes theory and evidence on herding and cascades in security analysis. Section 8 describes herd behavior and cascades in security trading. Section 9 describes the price implications of herding and cascading. Section 10 discusses herd behavior and cascading in firms' investment, financing, and disclosure decisions. Section 11 examines the popular models or memes about financial markets. Section 12 concludes.

2 Sources of Behavioral Convergence

An individual's thoughts, feelings and actions are influenced by other individuals by several means: verbal communication, observation of actions (e.g., quantities such as supplies and demands), and observation of the consequences of actions (such as payoff outcomes or market prices). Our interest is in convergence or divergence brought about by direct or indirect social interactions (herding or dispersing). So we do not count random groupings that arise solely by chance as herding, nor do we count mere clustering, wherein individuals act in a similar way owing to the parallel independent influence of a common external factor.

Following Hirshleifer and Teoh (2003a) we define *herding/dispersing* as any behavior similarity or dissimilarity brought about by the direct or indirect interaction of individuals.[5] Possible sources include: (1) *Payoff externalities* (often called strategic complementarities or network externalities). For example, there is little point to participating in Facebook unless many other individuals do so as well; (2) *Sanctions upon deviants.* For example, critics of a dictatorial regime are often punished; (3) *Preference interactions.* For example, a teenager may want an iPhone mainly because others talk about the product, though a few mavericks may dislike a product for the same reason); (4) *Direct communication.* This is just telling; however, just telling often lacks credibility); and (5) *Observational influence.* This is an informational effect wherein an individual

[5] The interaction required in our definition of herding can be indirect. It includes a situation where the action of an individual affects the world in a way that makes it more advantageous for another individual to take the same action, even if the two individuals have never directly communicated. But mere clustering is ruled out.

observes and draws inferences from the actions of others or the consequences of those actions.

We can distinguish an *informational hierarchy* and a *payoff hierarchy* in sources of convergence or divergence (see also Hirshleifer and Teoh (2003a)). The most inclusive category, *herding/dispersing*, includes both informational and payoff interaction sources of herding as special cases.

Within herding/dispersing, the informational hierarchy is topped by *observational influence*, a dependence of behavior upon the observed behavior of others, or the results of their behavior. This influence may be either rational or irrational. A subcategory is *rational observational learning*, which results from rational Bayesian inference from information reflected in the behavior of others, or the results of their behavior. A further refinement of this subcategory consists of *information cascades*, wherein the observation of others (their actions, payoffs, or statements) is so informative that an individual's action does not depend on his own private signal.[6]

Imitation, broadly construed, includes both information cascades, and sub-rational mechanisms that produce conformity with the behavior of others. A crucial benefit of imitation is the exploitation of information possessed by others. When an insider is buying, it may be profitable to buy even without knowing the detailed reason for the purchase. There is also contagion in the emotions of interacting individuals (see, e.g., Barsade (2002)).

The benefits of imitation are so fundamental that the propensity to follow the behaviors of others has evolved by natural selection. Imitation has been extensively documented in many animal species, both in the wild and experimentally; among beast, fish, and fowl; and in foraging and diet choices, selection of mates, selection of territories, and means of avoiding predators.[7] Indeed, Blackmore (1999) (e.g., pp. 74-81) suggests that in early hominids there was strong selection for the ability to imitate, and that the evolution of large brain size resulted from the need to be able to imitate complex innovative behaviors.

In an information cascade, since an individual's action choice does not depend upon his signal, his action is uninformative to later observers. Thus, cascades are associ-

[6]See Bikhchandani, Hirshleifer, and Welch (1992), Welch (1992); Banerjee (1992) uses a different terminology for this phenomenon.

[7]See, e.g., Gibson and Hoglund (1992), Giraldeau (1997), and Dugatkin (1992) Some authors use highly restrictive definitions of imitation that require substantial understanding on the part of the imitator. Under such definitions imitation is of course rare to non-existent among non-humans. The evolution of mirror neurons in primates and humans (neurons that fire both when an individual takes an action or observes the same action being performed by a different individual) also suggests the importance of imitation.

ated with *information blockages* (Banerjee (1992), Bikhchandani, Hirshleifer, and Welch (1992)), and, as we will see, with *fragility* of decisions (Bikhchandani, Hirshleifer, and Welch (1992)). Information blockages are caused by an informational externality: an individual chooses his actions for private purposes with little regard to the potential information benefit to others.[8]

A *payoff interaction hierarchy* provides a distinct hierarchy of types of herding or dispersing that intersects with the categories in the information hierarchy. The first subcategory of the catch-all herding/dispersing category is *payoff and network externalities.* This consists of behavioral convergence or divergence arising from the effects of an individuals actions on the payoffs to others of taking that action. For example, in the classic analysis of the geometry of the selfish herd (Hamilton (1971)), prey animals form herds as an unintended result of the selfish attempt by each to put others between itself and predators. Direct payoff externalities have been proposed as an explanation for bank runs (Chari and Jagannathan (1988), Diamond and Dybvig (1983)) since a depositor who expects other depositors to withdraw has a stronger incentive to withdraw; and clumping of stock trades by time (Admati and Pfleiderer (1988) and Foster and Viswanathan (1995)) or exchange (Chowdhry and Nanda (1991)), since uninformed investors have an incentive to try to trade with each other instead of with the informed.

In several models, a desire for good reputation causes payoffs to depend on whether individual behaviors converge.[9] Thus, a subcategory of the *payoff and network externalities* category is *reputational herding and dispersion*, wherein behavior converges or diverges owing to the incentive for a manager to maintain a good reputation with some observer. When individuals care about their reputations, reputational herding and information cascades can easily both occur, since an individual who seeks to build a reputation as a good decisionmaker may rely on the information of earlier decisionmakers (Ottaviani and Sorenson (2000)).

[8]Chamley (2004b) and Gale (1996) review models of social learning and herding in general. For presentation of information cascades theory and discussion of applications, tests, and extensions, see Bikhchandani, Hirshleifer, and Welch (1998, 2008a); Bikhchandani, Hirshleifer, and Welch (2008b) provides an annotated bibliography of research relating to cascades.

[9]See Scharfstein and Stein (1990), Rajan (1994), Trueman (1994), Brandenburger and Polak (1996), Zwiebel (1995), and Ottaviani and Sorensen (2006).

3 Rational Learning and Information Cascades: Basic Implications

If many individuals possess conditionally independent signals about which choice alternative is better, their information could be aggregated to determine the right decision with arbitrarily high precision. Information cascades lead to information blockage, which reduces the quality of later decisions. This blockage also has several other implications for the contagion and stability of financial decisions, some of which hold even in rational learning settings in which cascades proper do not occur.

Consider a sequence of individuals who face ex ante identical choices (e.g., investment projects), observe conditionally independent and identically distributed private information signals, and who observe the actions but not the payoffs of predecessors. Suppose that individual i is in a cascade, and that later individuals understand this. Then individual $i+1$, having learned nothing from the choice of i, is in an informationally identical position to that of i. So $i+1$ also makes the same choice regardless of his private signal. By induction, this reasoning extends to all later individuals; the pool of information implicit in the past actions of individuals stops growing when a cascade begins. Indeed, in the simplest possible cascades setting, at this point the quality of decisions never improves again.

When the assumptions are modified slightly, information is not blocked forever. If individuals are not identical ex ante, then the arrival of an individual with deviant information or preferences can dislodge a cascade. For example, an individual with a highly precise signal will act independently, which conveys new information to later individuals. Furthermore, the arrival of public news, either spontaneously and independently of past choices, or as payoff outcomes from past choices, can dislodge a cascade. The more generic implication of the cascades approach is that the quality of decisions improves much more slowly than would be the case under ideal information aggregation. Information blockages can last for substantial periods of time; as we will see, at such times, social outcomes are often fragile.

Information cascades are a special case of *behavioral coarsening*, defined as any situation in which an individual takes the same action for multiple signal values. When there is behavioral coarsening, as in an information cascade an individuals action does not fully convey his information signal to observers. So where a cascade causes (at least temporarily) a complete information blockage, behavioral coarsening leads to partial blockage. A surprising aspect of the theory of information cascades is that in a natural setting the most extreme form of behavioral coarsening occurs.

Since information is aggregated poorly in an information cascade, the quality of decisions is reduced. Rational individuals who are in a cascade understand perfectly well that the public pool of information implicit in predecessors' actions is not very precise. As a result, even a rather small nudge, such as a minor public information disclosure, can cause a well-established and thoroughly conventional behavior pattern to switch.

The arrival of a meaningful but inconclusive public information disclosure, paradoxically, can reduce the average quality the individuals' decisions. Other things equal, a given individual is better off receiving the extra information in the disclosure. However, additional information will sometimes cause individuals to cascade earlier, aggregating the information of fewer individuals. On balance, the public signal can induce a less-informative cascade (Bikhchandani, Hirshleifer, and Welch (1992)). Of course, if highly conclusive public information arrives, rational individuals will make very accurate decisions. As Alexander Pope inimitably put it, "A little knowledge is a dangerous thing; drink deep, or touch not the Pierian spring."

The dangers of a little learning are created in other information environments as well. In cascades models, the ability of individuals to observe payoff outcomes in addition to past actions, or to make a noisy observation of past actions more precisely, can reduce the average accuracy of decisions (Cao and Hirshleifer (1997, 2002)). Also, the ability to learn by observing predecessors can make the decisions of followers noisier by reducing their incentives to collect (perhaps more accurate) information themselves (Cao and Hirshleifer (1997)). Another qualification to the benefits of information arrival about payoff outcomes is that even if an unlimited number of signals arrive, the choices that individuals can make may limit the resulting improvement in the information pool. For example, there can be a positive probability that a mistaken cascade lasts forever (Cao and Hirshleifer (2002)).

Often individuals choose not only whether to adopt or reject a project, but *when* to do so. As a result, the timing and order of moves, which are given in the basic cascades model, are endogenously determined. In models of the option to delay investment choices[10], there can be long periods with no investment, followed by sudden spasms in which the adoption of the project by one firm triggers investment by others.

Most of the conclusions described above generalize to other social learning settings in which cascades proper do not occur. Even when information blockage is not complete, information aggregation is limited by the fact that individuals privately optimize rather

[10]See Chamley and Gale (1994); see also Hendricks and Kovenock (1989), Bhattacharya, Chatterjee, and Samuelson (1986), Zhang (1997) and Grenadier (1999), and Chamley (2004a, 2004b).

than taking into account their effects upon the public information pool. In particular, there is a general tendency for information aggregation to be self-limiting. At first, when the public pool of information is very uninformative, actions are highly sensitive to private signals, so actions add a lot of information to the public pool.[11] As the public pool of information grows, individuals' actions become less sensitive to private signals.

In the simplest versions of the cascades model, behavioral coarsening occurs in an all-or-nothing fashion, so that there is either full use of private signals, or no use of private signals (as in Banerjee (1992), and the binary example of Bikhchandani, Hirshleifer, and Welch (1992)). In more general settings, coarsening occurs by degrees, but complete blockage eventually occurs (see the cascades model with multiple signal values of Bikhchandani, Hirshleifer, and Welch (1992)). In some settings, coarsening can gradually proceed without ever reaching a point of complete blockage, though the probability that an individual uses his own signal asymptotes toward zero, a phenomenon called 'limit cascades' (Smith and Sorenson (2000)). Or, if there is observation noise, the public pool of information can grow steadily but more and more slowly (Vives (1993)).

So whether information channels become gradually or quickly clogged, and whether the blockage is partial or complete, depends on the economic setting; but the general conclusion that there can be long periods in which individuals herd upon poor decisions is robust. Also, there tends to be too much copying or behavioral convergence; someone who uses his own private information heavily provides a positive externality to followers, who can draw inferences from his action.

Information cascades result from the individual's private signal being overwhelmed by the growing public pool of information. Such an outcome is impossible in a setting where there is always a chance that an individual will receive a signal that is conclusive or arbitrarily close to conclusive. However, if near-conclusive signals are rare, the public information pool can grow very slowly, in which case 'information cascade' can be a good approximation. Indeed, as the quality of the public information pool improves, the likelihood that an individual will receive a signal powerful enough to oppose it declines.

To summarize, the information cascades model and some related rational learning theories provide a few key general implications. The first, and central implication is *idiosyncrasy*, or poor information aggregation. Cascades tend to emerge rapidly, so that the signals of a relatively small number of early individuals dominates the behavior of numerous followers.

[11] The addition can be directly through observation of past actions, or indirectly through observation of consequences of past actions, as in public payoff information that results from new experimentation on different choice alternatives.

The second is *fragility* (fads). The blockage of information aggregation that is characteristic of cascades makes behavior sensitive to small shocks. We are accustomed to thinking of sensitivity to shocks as a rare circumstance, as when a flipped coin lands on its side. The tendency of cascades to form suggests that real life is somewhat like Hollywood thrillers in which the chase scene inevitably ends with the heros car teetering precariously at the edge of a precipice.

The third is *simultaneity* (delay followed by sudden joint action). Such effects are sometimes referred to as 'chain reactions,' 'stampedes' or 'avalanches'. Endogenous order of moves, heterogeneous preferences and precisions can exacerbate these problems.

The fourth is *paradoxicality* (adverse effects on decision accuracy or welfare of informational improvements), and the fifth is *path dependence* (outcomes depending on the order of moves or signal arrival). This implication is shared with models of payoff interactions (e.g., Arthur (1989)).

4 What is Communicated or Observed?

We now describe in somewhat more detail alternative sets of assumptions in observational influence models and the implications of these differences.

4.1 Observation of Past Actions Only

Here we retain the assumption of the basic cascade model that only past actions are observable, but consider several model variations.

1. Discrete, bounded, or gapped actions versus continuous unbounded actions

If the action space is continuous, unbounded, and without gaps, then an individual's action is always at least slightly sensitive to his private signal. Thus, actions always remain informative, and information cascade never form. So for inefficient information cascades to occur, actions must be discrete, bounded, or gapped. As discrete or bounded action spaces become more extensive, cascades become more informative, approaching full revelation (Lee (1993); see Gul and Lundholm (1995) and Vives (1993) for continuous settings without cascades. Early cascade models were based upon action discreteness (Bikhchandani, Hirshleifer, and Welch (1992), Welch (1992)).

The assumption that actions are discrete is often highly plausible. We vote for one candidate or another, not for a weighted average of the two. A worker is hired or not hired, and fired or not fired. A takeover bidder either does or does not seek control of a target firm. Often alternative investment projects are mutually exclusive. Although the amount invested is often continuous, if there is a fixed cost the option of not investing at all is discretely different from positive investment.

More broadly, one way in which the action set can be bounded is if there is a minimum and maximum feasible project scale. If so, then when the public information pool is sufficiently favorable a cascades at the maximum scale will form, and when the public information pool is sufficiently adverse individuals will cascades upon the minimum scale. Since there is always an option to reject a new project, investment has a natural extreme action of zero. Thus, a lower bound of zero on a continuous investment choice creates cascades of non-investment (Chari and Kehoe (2004)).[12]

Similarly, gaps can create cascades. For example, sometimes either a substantial new investment, no change, or disinvestment is feasible, but fixed costs make a small change clearly unprofitable. If so, then a cascade upon no change is feasible. Similarly, a cascade of securities non-trading can form when there is a fixed cost of taking a long or short position, or when there is a minimum trade size.

Even if the true action space is continuous, ungapped and unbounded, to the extent that observers are unable to perceive or recall small fractional differences, the actions of their predecessors effectively become either noisy or discrete. Where discretizing can cause cascades and complete information blockage, noise slows down learning. In reality there is always some effective discreteness or noise because real observers have finite perceptual and cognitive powers. It is impossible for an observer to perceive arbitrarily small differences in actions. Even if perception were perfect, it would also be impossible, in the absence of infinite time and calculating capacity, to make use of arbitrarily small observed differences in actions. Thus, for fundamental reasons there must be either noise, perceptual/analytic discretizing, or both.[13] However, cascades will tend to be close to efficient unless choice options are sufficiently coarse.

If perceptual discretizing is very fine-graded, the outcome will still be very close to full revelation. However, perception and analysis are coarse; consider, for example, the tendency for people to round off numbers in memory and conversation. There is evidence of clustering for retail deposit interest rates around integers, and that this is caused by

[12]Asymmetry between adoption and rejection of projects is often realistic and has been incorporated in several social learning models of investment to generate interesting effects.

[13]In the absence of discretizing, repeated copying will gradually accumulate noise until the information contained in a distant past action is overwhelmed. This overwhelming of analog signals by noise when there is sequential replication is the reason that information must be digitized in the genetic code of DNA, and in information that is sent (with repeated reamplification of signals) over the internet (Dawkins (1995)).

limited recall of investors (Kahn, Pennacchi, and Sopranzetti (1999)).

2. Observability of predecessors' payoffs or signals

Even if individuals observe a subset of past signals, such as the past k signals, since in general uncertainty remains, inefficient cascades can form. With regard to settings with observation of past payoffs, inefficient cascades can form and with positively probability last forever, because a cascade can lock into an inferior choice before sufficient trials have been performed on the other alternative to persuade later individuals that this alternative is superior (Cao and Hirshleifer (2002)). We discuss research on the effects of observability of past payoffs and signals in more depth in Subsection 4.2.

3. Costless versus costly private information acquisition

Individuals often expend resources to obtain signals, but also often observe private signals costlessly in the ordinary course of life. Most social learning models take the costless route. Costs of obtaining signals can lead to little accumulation of information in the social pool for reasons similar to cascades or herding models with costless information acquisition. Individuals have less incentive to investigate or observe private signals if the primary benefit of using such signals is the information that such use will confer upon later individuals. (Burguet and Vives (2000) examine the conditions under which complete learning occurs in a continuum model with investigation costs.) Indeed, if the basic information cascades setting is modified to require individuals to pay a cost to obtain their private signals, once a cascade is about to start an individual has no reason to investigate. The outcome is identical to the basic cascades model, information blockage. But the individual is acting without regard to his signal in only a degenerate sense: he has not acquired any signal to regard to.

This suggests an extended definition of cascades that can apply to situations where private signals are costly to obtain. Following Hirshleifer and Teoh (2003a), we define an *investigative cascade* as a situation where either:

1. An individual acts without regard to his private signal; or,
2. Chooses not to acquire a costly signal, but he would have acted without regard to that signal had he been forced to acquire it at the same level of precision that he would have voluntarily acquired if he were unable to observe the actions or payoffs of others.

Item 1 implies that all information cascades are also investigative cascades. Item 2 is simplest in the special case of a binary decision of whether or not to acquire an information signal of exogenously given precision. Item 2 then reduces to the statement:

the individual chooses not to acquire the signal, but if he were forced to acquire it he would ignore its realization (because of the information he has already gleaned by observing others).[14]

Investigative cascades may occur in the decisions by individuals to invest in different countries. If investigation of each requires a fixed cost, then with a large number of countries investors may cascade on non-investment (see the related analysis of Calvo and Mendoza (2001)).

4. Observation of all past actions versus a subset or statistical summary of actions

Sometimes people can observe only the recent actions of others, a random sample of actions, or can only observe the behavior of neighbors in some geographic or other network.[15] In such settings mistaken cascades can still form. For example, if only the preceding k actions are observed, then a cascades may form within the first k individuals, and then through chaining can extend indefinitely. Alternatively, individuals may only be able to observe a statistical summary of past actions. Information blockage and cascades are possible in such a setting as well (Bikhchandani, Hirshleifer, and Welch (1992)).[16] A possible application is to the purchase of consumer products. Aggregate sales figures for a product matter to future buyers because it reveals how previous buyers viewed desirability of alternative products (Bikhchandani, Hirshleifer, and Welch (1992), Caminal and Vives (1999)).

5. Observation of past actions accurately or with noise

When past actions are observed with noise, social learning is still imperfect (Vives (1993)), and (depending on the setting) cascades can still form (Cao and Hirshleifer (1997)). In some scenarios a model in which individuals learn from price reduces in effect to a basic social learning model with indirect observation of a noisy statistical summary of the past trades of others.

6. Choice of timing of moves versus exogenous moves

Consider a setting in which individuals (firms) with private signals about project quality have a choice about whether to invest or delay. In other words, firms decide when to exercise their investment option. Then in equilibrium there is delay (Chamley and

[14]Item 2 further allows for the purchase of different possible levels of precision. The definition focuses on the precision that the individual would select under informational autarky. If, under this precision, the individual's action does not depend on the realization, he is in an investigative cascade.

[15]Bala and Goyal (1998, 2001) analyze learning from the actions and payoff experiences of neighbors. They show that this leads to convergence of behavior, and under some conditions efficient outcomes.

[16]With continuous actions and observation noise, as discussed above, the outcome may be slow information aggregation rather than cascade; Vives (1993).

Gale (1994)), because a firm that waits can learn from the actions of others. However, if all were to wait, there would be no advantage to delay. Thus, in equilibrium firms with favorable signals randomize strategies in deciding how long to delay before being the first to invest. If only a few firms invest (by firms that have received favorable signals), other firms infer that the state of the world is bad, and investment activity ends. However, if many firms invest, this conveys favorable information, and a sudden rush to invest by the other firms occurs (even firms with adverse signals). Indeed, in the limit a period of little investment is followed by either a sudden surge in investment or a collapse. Thus, the model illustrates simultaneity. In equilibrium cascades occur and information is aggregated inefficiently.

Allowing for uncertainty about signal precision leads to a surprisingly simple outcome (Zhang (1997)). Suppose that investors know the precisions only of their own signals about project quality. In the unique symmetric equilibrium, those investors whose favorable signals are less precise delay longer than those with more precise favorable signals; noisy information encourages waiting for corroboration. In equilibrium there is delay until the critical investment date of the individual who drew the highest precision is reached. Once he invests, other investors all immediately follow, though investment may be inefficient. This sudden onset of investment illustrates simultaneity in an extreme form.[17]

In settings with social learning, information blockages, delays in investment, periods of sudden shifts in investment, and overshooting can occur, either with (Caplin and Leahy (1994), Grenadier (1999)) or without (Caplin and Leahy (1993), Persons and Warther (1997)) information cascades. These models share the broad intuitions that informational externalities cause socially undesirable choices about whether and when to invest. For example, Caplin and Leahy (1994) analyze information cascades in the cancelation of investment projects when timing is endogenous. Individual cancelations can trigger sudden crashes in the investments of many firms.

A natural application of social learning models is to the adoption of financial innovations such as leveraged buyouts, which often seem to follow a boom and bust pattern. Several authors have explained this pattern as resulting from managers adopting based upon observation of the payoffs resulting from the repeated actions of other firms. In the model of Persons and Warther (1997), there is a tendency for innovations to 'end

[17] Chamley (2004a) finds that when individuals have different prior beliefs, there are multiple equilibria that generate different amounts of public information. Imperfect information aggregation can also occur in a rational expectations (simultaneous trading) modeling approach when information is costly to acquire, asset prices are endogenous, and investment is a discrete decision which leads to price and investment fluctuations (Beaudry and Gonzalez (2003)).

in disappointment' even though all participants are fully rational. Participants expect to gain from extending the boom until disappointing news arrives. Related notions of informational overshooting have been applied to real estate and stock markets (Zeira (1999)).

7. Presence of an evolving publicly observable state variable

In models of cascades in the exercise of investment options, the trigger for exercise of an investment option is often the exogenous continuous evolution of a publicly observable state variable that affects the profitability of investment. In the model of Grenadier (1999), eventually a small move in the state variable triggers a cascade of option exercise.

8. Stable versus stochastic hidden environmental variable

The attractiveness of market conditions for financial transactions such as raising capital vary greatly over time. When the underlying state of the world is stochastic but unobservable, there can be fads wherein the probability that action changes is much higher than the probability of a change in the state of the world (Bikhchandani, Hirshleifer, and Welch (1992)). Moscarini et al (1998) examine how long cascades can last as the environment shifts. Hirshleifer and Welch (2002) consider an individual or firm subject to memory loss about past signals but not actions. They describe the determinants (such as environmental volatility) of whether memory loss causes inertia (a higher probability of continuing past actions than if memory were perfect) or impulsiveness (a lower probability).

9. Homogeneous versus heterogeneous payoffs

Individuals have different preferences, though this is probably more important in non-financial settings. Suppose that different individuals value adoption differently. A rather extreme case is opposing preferences or payoffs, so that under full information two individuals would prefer opposite behaviors. If each individual's type is observable, different types may cascades upon opposite actions.

However, if the type of each individual is only privately known, and if preferences are negatively correlated, then learning may be confounded— individuals do not know what to infer from the mix of preceding actions they observe, so they simply follow their own signals (Smith and Sorenson (2000)).

10. Endogenous cost of action: models with markets and endogenous price

We cover this topic separately in Section 9.

11. Single or repeated actions and private information arrival

Most models with private information involve a single irreversible action, and a single arrival of private information. In Chari and Kehoe (2004), in each period one investor receives a private signal, and investors have a timing choice as to when to commit to an irreversible investment. In equilibrium there are inefficient cascades. If individuals take repeated, similar, actions and continue to receive non-negligible additional information, actions will of course become very accurate. However, there can still be short-run inefficiencies (e.g., Hirshleifer and Welch (2002)).

12. Discrete versus continuous signal values

Depending on probability distributions, with continuous signal values limit cascades instead of cascades can occur (Smith and Sorenson (2000)). Of course, signal values are often discrete. For example, the buyer of a consumer product may observe as a signal of quality the number of 'stars' or 'thumbs up' the product has received by a reviewing agency.[18] Furthermore, the empirical and policy significance of the two predictions is much the same. Having information arrives too late to be helpful for most individuals' decisions is similar to one where information is completely blocked for some period (Gale (1996)).

13. Exogenous rules versus endogenous contracts and institutional structure

Institutional rules and compensation contracts can be designed to manage herding and information cascades in project choice (See Prendergast (1993), Khanna (1997), and Khanna and Slezak (2000) (discussed below); see also Ottaviani and Sorenson (2001).)

4.2 Observation of Consequences of Past Actions

If vicarious learning can be used to aggregate the outcomes of many past trials of alternatives, one might expect that society could overcome information blockages to converge upon correct actions. However, as emphasized by Shiller (2000a), imperfect rationality makes conversation a very imperfect aggregator of information. Biases induced by conversation are therefore likely to be important for stock market behavior.

In formal modeling in an imperfectly rational setting (though not one designed specifically to capture Shiller's arguments), Banerjee and Fudenberg (2004) find convergence to efficient outcomes if people sample at least two predecessors. In their model, each period a continuum of individuals try choice alternatives. Since each individual observes

[18] In practice, signal discreteness is rampant. Often the signal is information about whether something does or does not fall into some discrete category. In voting for a U.S. presidential candidate, an individual may take into account whether the individual currently is or is not Vice President. In deciding whether or not to bet on a horse, a gambler may use as a signal whether or not it won the last race; he may not know its exact time. When people obtain advice about a course of action, the advisor often recommends an alternative with little elaboration.

only a sample from past history, the shadow of history is not overwhelming. Particular individuals fall into cascades, but different individuals make different choices. With a continuum of individuals, society cannot get unanimously stuck on a bad choice. Information about the payoffs from all possible options is continually regenerated, creating a rich inventory of information to draw from.

A setting that is closer to the basic cascades model allows for observation of payoff outcomes without assuming the infinitely rich inventory of past information. In Cao and Hirshleifer (2002), there are two alternative project choices, each of which has an unknown value-state. Payoffs are in general stochastic each period conditional on the value-state. Rational individuals receive private signals and act in sequence, and individuals can observe all past actions and project payoffs. Nevertheless, idiosyncratic cascades still form. For example, a sequence of early individuals may cascade upon project A, and its payoffs may become visible to all, perhaps revealing the value-state perfectly. But since the payoffs of alternative B are still hidden, B may be the superior project. Indeed, the ability to observe past payoffs can sometimes trigger cascades even more quickly, reducing average decision quality and welfare—i.e., there is paradoxicality.

Intuitively, comparing the different settings, when only a sample of past actions and outcomes is observed, decisions are improved, because the shadow of the past becomes less overwhelming. When individuals are discrete, a sampling scenario makes it less likely that society will unanimously fix upon a bad behavior, because there is more opportunity for a few individuals who observe an unusual historical sample to choose deviant actions that generate new corrective information. Bad cascades become less frequent. In a sampling setting, having a greater number of individuals also reduces the likelihood of chance unanimous fixation on a bad action. At the extreme of an infinite number of individuals (as with a continuum), the risk of unanimous bad cascades can be eliminated.

Potential industry entrants can learn indirectly about the actions of previous entrants by observing market price, since this is affected by previous decisions. In the model of Caplin and Leahy (1993), entrants do not possess any private information prior to entry. Information problems slow the adjustment of investment to sectoral economic shocks.

4.3 Conversation, Media, and Advertising

A growing recent literature provides evidence suggesting that conversation in social networks conveys valuable information for financial decisions, and spreads corporate and individual behaviors. Analysts who have old school ties to corporate managers at a company make better stock recommendations about the company (Cohen, Frazzini, and Malloy (2008a)), mutual fund managers who have old school ties to corporate directors are more willing to take a large position in the firm, and achieve better return performance on their holdings (Cohen, Frazzini, and Malloy (2008b)); and investors who have stronger social interaction based on several measures (old college ties, sharing the same profession, and geographical proximity) make more similar portfolio choices (Massa and Simonov (2005)). Bizjak, Lemmon, and Whitby (2007) (discussed later) provide evidence that option backdating spreads through board interlocks. Gupta-Mukherjee (2007) finds that information relevant for achieving investment performance is transmitted between fund managers (along fund-fund networks), and between fund managers and companies in which they invest (along fund-company networks), where network linkage is identified by geographical proximity.

Biases in conversation contribute to the spread of mistaken beliefs. Contributing to this problem is a tendency for people to take statements that they hear from acquaintances and the news media at face value, rather than rationally discounting for cheap talk. It is suggestive that discussion on stock message boards predict returns (Wysocki (1998)), and that e-mail spam campaigns affect trading volume and price (Böhme and Holz (2006), Frieder and Zittrain (2007)).

News media activity can provide a measure of the extent to which information is being conveyed to investors. Veldkamp (2006) provides a model of 'frenzies' in emerging equity markets in which media coverage rises, investors become better-informed about asset payoffs and therefore face less risk, so that asset prices rise. She provides supporting evidence.

Some individuals are more central than others in the social network that disseminates financial ideas and information. The news media creates nodes of high influence. Recent research has confirmed that the political opinions disseminated by media outlets affect those of viewers (DellaVigna and Kaplan (2007)). There is every reason to believe that media dissemination affects the financial ideologies of receivers as well.

Part of the effect of the media results from the sheer existence of high-influence nodes in the social network, especially since media commentators may have different beliefs from the public at large. Other effects arise from the self-interest of journalists and media firms, which can also influence the viewpoints expressed or the stories selected for reporting. This could bias stories because of journalists have a direct financial interest in the firm they are reporting on, or could come from the benefits of reporting a story that will grab the attention of the public (possibly at the expense of reporting more important stories).

Financial firms influence investors both by disclosures to the media, and through advertising. Mullainathan and Shleifer (2005a, 2005b) argue that audiences like to see news that matches their beliefs, and are more likely to be persuaded by advertising messages that fit their predispositions. Mullainathan and Shleifer provide evidence over the course of the Internet bubble that in good times (after high market returns) financial firms emphasize in their advertisements how their products create opportunity for investors, whereas in bad times advertisements emphasize how their products provide safety.

5 Psychological Bias

Conformism allows individuals to obtain the benefit of the valuable ideas of others. Several researchers have modeled the circumstances under which a propensity toward conformism is favored by natural selection, and how conformism maintains cultural differences between groups (Henrich and Boyd (1998), Boyd and Richerson (2005); see also the discussion of Blackmore (1999)). Kuran (1987, 1989) analyzes the effects of external pressures for and preferences for conformity; Bernheim (1994) analyzes the consequences of a preference for conformity.

Even without a direct preference for conformity, psychological bias can promote herding and cascades. Several models of herding or cascades assume either mechanistic or imperfectly rational decisionmakers include Ellison and Fudenberg (1993, 1995) (rules of thumb), Hirshleifer, Subrahmanyam, and Titman (1994) ('hubris' about the ability to obtain information quickly), Bernardo and Welch (2001) (overconfidence about the quality of information signals), Hirshleifer and Noah (1999) (misfits of several sorts), and Hirshleifer and Welch (2002) (memory loss about past signals).

A reasonable imitation strategy for individuals is to base choices on the payoffs that past adopters have received, and on the market shares of the choice alternatives, as in the model of Smallwood and Conlisk (1979); see also Henrich and Boyd (2001). An individual may observe a past sample of individuals, and take an action based upon the actions and payoffs within this sample (Ellison and Fudenberg (1993, 1995)).

If individuals use a diversity of decision rules (whether rational, quasi-rational, or simple rules of thumb), then there will be greater diversity of action choices after rational individuals fall into a cascade. This action diversity can be informative, and can break mistaken cascades (Bernardo and Welch (2001), Hirshleifer and Noah (1999)). Consistent with Bernardo and Welch (2001), experiments show that individuals often overweight private signals, breaking cascades (Goeree, Palfrey, Rogers, and McKelvey

(2007)).

There are other possible directions to take imperfect rationality and social learning. Evidence of emotional contagion within groups suggests that there may be merit to popular views that there are contagious manias or fads in speculative markets (see also Shiller (2000b), Lynch (2000), and Lux (1995)). However, there are rational models of bubbles and crashes that do not involve herding (see, e.g., the agency/intermediation model of Allen and Gale (2000a), and the review of Brunnermeier (2001)).

In security market settings, the assumption that the variance of aggregate noise trading is large enough to influence prices non-negligibly (as in the seminal paper of DeLong, Shleifer, Summers, and Waldmann (1990) and subsequent models of exogenous noise) implicitly reflects an assumption that individuals are irrationally correlated in their trades. This could be a result of herding (social interaction), or merely a common irrational influence of some noisy variable on individuals' trades. Park and Sgroi (2008) find evidence of irrational herding in an experimental security market.

We and others have argued that limits to investor attention are important for financial disclosure, financial reporting, and capital markets.[19] Such limits to attention may pressure individuals to herd or cascade despite the availability of a rich set of public and private information signals (beyond past actions of other individuals). A related issue is whether the tendency to herd or cascade greater when the private information that individuals receive is hard to process (cognitive constraints and the use of heuristics for hard decision problems were emphasized by Simon (1955); in the context of social influence, see Conlisk (1996)). In this regard, there is evidence that apparent herd behavior by analysts is greater for diversified firms, for which the task that analysts face is more difficult (Kim and Pantzalis (2000)).[20]

6 Reputation, Contracts, and Herding

The seminal paper on reputation and herd behavior, Scharfstein and Stein (1990) captures the insight of John Maynard Keynes that "it is better to fail conventionally than to succeed unconventionally." Consider two managers who face identical binary investment choices. Managers may have high or low ability, but neither they nor outside observers know which. Observers infer the ability of managers from whether their investment

[19] See the review of Daniel, Hirshleifer, and Teoh (2002), and the models of Hirshleifer and Teoh (2003b, 2004), Peng and Xiong (2006), and Dellavigna and Pollet (2006, 2007).

[20] There are also models with mechanistic agents and the relation of herd behavior to price distributions (see, e.g., Cont and Bouchaud (2000)).

choices are identical or opposite, and then update based upon observing investment payoffs. Managers are paid according to observers' assessment of their abilities. It is assumed that high ability managers will observe identical signals about the investment project, whereas low ability managers observe independent noise.

There is a herding equilibrium in which the first manager makes the choice that his signal indicates, whereas the second manager always imitates this action regardless of his own signal. If the second manager were to follow his own signal, observers would correctly infer that his signal differed from the first manager, and as a result they would infer that both managers are probably of low quality. In contrast, if he takes the same choice as the first manager, even if the outcome is poor, observers conclude that there is a fairly good chance that both managers are high quality and that the bad outcome occurred by chance.

During bad times, the necessity for even a good firm to take actions indicative of poor performance can create an opening for a firm that has a choice to take such actions without severe reputational penalty. Rajan (1994) considers the incentive for banks with private information about borrowers to manage earnings upward by relaxing their credit standards for loans, and by refraining from setting aside loan-loss reserves. In a bad aggregate state, even the loans of high ability managers do poorly, so observers are more tolerant of a banker that sets aside loan-loss reserves. Thus, a set-aside of reserves triggers by a bank triggers set-asides by other banks. This simultaneity in the actions of banks is somewhat analogous to the delay and sudden onset of information cascades in the models Zhang (1997) and Chamley and Gale (1994).

Furthermore, Rajan shows that banks tighten credit in response to declines in the quality of the borrower pool. Thus banks amplify shocks to fundamentals. Rajan provides evidence from New England banks in the 1990s of such delay in increasing loan loss reserves, followed by sudden simultaneous action.

It is often argued that stock market analysts have a reputational incentive to herd in their forecasts of future earnings. The classic model along these lines is Trueman (1994), which we cover in the next section. One of his findings is that analysts have an incentive to make forecasts biased toward the market's prior expectation. Brandenburger and Polak (1996) show that a firm or set of firms with superior information can have a reputational incentive to make investment decisions consistent with the prior belief that observers have about which project choice is more profitable—a sort of herding of managers upon outsiders rather than each other. There can also be an incentive for subordinate managers to make recommendations consistent with the prior beliefs of their superiors (Prendergast (1993)).

In contrast with the model of Scharfstein and Stein, in which it is better to fail as part of the herd than to succeed as a deviant, in Zwiebel (1995) it is always best to succeed. Herding (and anti-herding) is caused by the fact that a manager's success is measured relative to others sometimes causes herding. The first premise of the model is that there are common components of uncertainty about managerial ability. As a result, observers exploit relative performance of managers to draw inferences about differences in ability. The second premise is that managers are averse to the risk of being exposed as having low ability (perhaps because the risk of firing is nonlinear). For a manager who follows the standard behavior, the industry benchmark can quite accurately filter out the common uncertainty. This makes following the industry benchmark more attractive for a fairly good manager than a poor one, even if the innovative project stochastically dominates the standard project. The alternative of choosing a deviant or innovative project is highly risky in the sense that it creates a possibility that the manager will do very poorly relative to the benchmark.[21]

However, in Zwiebel's model a very good manager can be highly confident of beating the industry benchmark even if he chooses a risky, innovative project. If this project is superior, it pays for him to deviate. Thus, intermediate quality managers herd, whereas very good or very poor managers deviate. Zwiebel's approach suggests that under some circumstances portfolio managers may herd by reducing the risk of their portfolios relative to a stock market or other index benchmark, but under others may intentionally deviate from the benchmark. Several papers pursue these and related issues, such as optimal contracting, in detail (see, e.g., Maug and Naik (1996), Gumbel (1998), Huddart (1999), and Hvide (2001)). Sciubba (2000) provides a model of herding by portfolio managers in relation to past performance.

Institutions and/or compensation schemes can be designed to address or exploit managerial incentives to engage in information cascades or making choices to match an observer's priors (Prendergast (1993) [discussed above], Khanna (1997), Khanna and Slezak (2000)).[22] Khanna (1997) examines the optimal compensation scheme when managers have incentives to cascade in their investment decisions. In his model, a manager who investigates potentially has an incentive to cascade upon the action of an earlier manager. Furthermore, a manager may delay investigation about the profitability

[21] Relative wealth concerns can also induce investment herding (DeMarzo, Kaniel, and Kremer (2007)). Alternative explanations for corporate conservatism include the reputational models of Hirshleifer and Thakor (1992) and Prendergast and Stole (1996), and the memory-loss approach of Hirshleifer and Welch (2002).

[22] Grant, King, and Polak (1996) review the effects of informational externalities in firms when managers have share price incentives.

of investment in the expectation of gleaning information more cheaply by observing the behavior of the competitor. Khanna describes optimal contracts that address the incentives to investigate and to cascade, and the implications for compensation and investments across different industries.

Within the firm, the incentive to cascade upon the recommendations of other managers makes it hard to motivate managers to make meaningful recommendations. In the model of Khanna and Slezak (2000), cascading among managers reduces the quality of project recommendations and choices. This is a drawback of a regime of 'team decisions,' in which managers make decisions sequentially and observe each others' recommendations. Incentive contracts that eliminate cascades may be too costly to be desirable for the shareholders. A hub-and-spokes hierarchical structure where managers independently report recommendations to a superior eliminates cascades, but requires superiors to incur costs of monitoring subordinates to prevent communication. Thus, under different conditions the optimal organizational form can be either teams or hierarchy.

7 Security Analysis

7.1 Investigative Herding

Most of the literature on information cascades in securities markets has focused on direct cascades in trading (Section 8), and elucidates the conditions under which such cascades can or cannot form. However, even in those scenarios in which direct cascades in trading cannot form, cascades of investigation can form before any trading has occurred. Such cascades still affect trading behavior.

Consider a sequence of individuals deciding whether to access a costly source of private information, such as an investment newsletter. If individuals can observe the decisions of predecessors (directly, through conversation, or through circulation data), then an information cascade can form of acquisition of this information. The cascade may eventually be broken owing to a negative externality: when more investors have access to an information signal, its value goes down.

Such cascades are one case of what we call *investigative herding*. Positive payoff externalities can also create investigative herding (though information still plays an important role). The analysis of Brennan (1990) was seminal in illustrating a source of positive payoff externalities in the analysis of securities, and how this can create investigative herding. He provides an overlapping generations model in which private information about a security is not necessarily reflected in market price the next period. This occurs in a given period only if a pre-specified number of individuals had acquired the signal. Thus, the benefit to an investor of acquiring information about an asset can be low if no other investor acquires the information. However, if a group of investors tacitly coordinate on acquiring information, then the investors who obtain information first do well.

This insight raises the question of whether investigative herding can occur in settings with greater resemblance to standard models of security trading and price determination. In the model of Froot, Scharfstein, and Stein (1992), investors with exogenous short horizons find it profitable to herd by investigating the same stock. In so doing they are, indirectly able to effect what amounts to a tacit manipulation strategy. When they buy together the price is driven up, and then they sell together at the high price. Thus, herding even on 'noise' (a spurious uninformative signal) is profitable.

However, even in the absence of opportunities for herding there is a potential incentive for individuals, acting on their own, to effect such manipulation strategies. If individuals are allowed to trade to 'arbitrage' such manipulation opportunities, it is not clear that such opportunities can in equilibrium persist. This raises the question of whether there are incentives for herding per se rather than for herding as an indirect means of manipulation.[23]

Hirshleifer, Subrahmanyam, and Titman (1994) examine the security analysis and trading decisions of risk averse individuals, where investigation of a security leads some individuals to receive information before others. They find a tendency toward herding. The presence of investigators who receive information late confers an obvious benefit upon those who receive information early- the late informed drive the price in a direction favorable to the early-informed. But by the same token, the early-informed push the price in a direction unfavorable to the late-informed.

The key to the herding result is that the presence of the late-informed allows the early-informed to unwind their positions sooner. This allows the early-informed to reduce the extraneous risk they would have to bear if, in order to profit on their information, they had to hold their positions for longer. This risk-reduction that the late-informed confer upon the early informed is a genuine ex ante net benefit—it is not purely at the expense of the late informed.[24] Overconfidence about the ability to become informed

[23]Since holding a speculative position a long time is risky, something akin to short horizons can arise endogenously. Thus, prices reflect private long-term information very imperfectly (Dow and Gorton (1994)).

[24]Related tradeoffs can also cause herding in the choice of whether to study short-term or long-term information about a stock (Holden and Subrahmanyam (1996)). A different approach to strategic

early further encourages herding in this model; each investor expects to come out the winner in the competition to study the 'hot' stocks.

7.2 Herd Behavior by Stock Analysts and other Forecasters

We expect rational forecasts to glean information from the forecasts of others, causing herding. A further question is whether, owing to reputational effects or irrationality, herding causes biased forecasts or recommendations.

Several studies provide evidence of herding in various kinds of forecasts, such as forecasts of the Japanese macro-economy (Ashiya and Doi (2001)). If herding occurs for reputational reasons, other things equal we would expect forecasters to tilt their forecasts toward the most accurate among other forecasters. Ehrbeck and Waldmann (1996) show that the pattern of repeated forecasts over time made by accurate (low mean-squared-error) forecasters tend to differ (e.g., smaller forecast revisions) from that of less accurate forecasters. Inconsistent with a rational reputational approach, in their tests economic forecasters bias their forecasts in directions characteristic of *less* accurate forecasters. Nevertheless, most analytical literature on stock market analysts has focused on rational reputational reasons for bias.

Analyst earnings forecasts are biased (see Givoly and Lakonishok (1984), Brown, Foster, and Noreen (1985)). Forecasts are generally optimistic in the U.S. and other countries, especially at horizons longer than one year (see, e.g. Capstaff, Paudyal, and Rees (1998)). More recent evidence indicates that analysts' forecasts have become pessimistic at horizons of 3 months or less before the earnings announcement (see, e.g., Richardson, Teoh, and Wysocki (2004)).

A concern for reputation can pressure analysts to herd. The compensation received by analysts is related to its ranking in a poll by *Institutional Investor* about the best analysts (Stickel (1992)). Furthermore, analysts whose forecasts are less accurate than peers are more likely to experience job turnover (Mikhail, Walther, and Willis (1999)).[25] These findings suggests that analysts may have an incentive to adjust their forecasts to maintain good reputations for high accuracy. Less experienced analysts are more likely to be terminated for 'bold' (deviant) forecasts that deviate from the consensus forecast than are experienced ones. This seems to place a higher pressure to herd on those analysts for whom uncertainty about ability is greater (Hong, Kubik, and Solomon

complementarity in information acquisition with short-term trading is provided by Chamley (2007).

[25]The importance of relative evaluation supports the premise of reputational models of herding. However, Mikhail et al find no relation between either absolute or relative profitability of an analyst's *recommendations* and probability of turnover.

(2000)). Clement and Tse (2005) finds that analysts with greater prior accuracy and experience are more likely to make 'bold' (deviant) forecasts (see Trueman (1994) below), and that herding forecast revisions tend to be less accurate than bold forecast revisions.

True herding (issuing forecasts that are biased toward those announced by previous analysts—a form of social interaction between analysts) should be distinguished from issuing forecasts that are biased toward prior earnings expectations. In the reputation model of Trueman (1994), both occur. In his analysis, an analyst has a greater tendency to herd if he is less skillful at predicting earnings—it is less costly to sacrifice a poor signal than a good one.

When analysts herd, a shift in forecast by one analyst stimulates response by others. A challenge for testing this prediction and for evaluating whether the response is appropriate, is that it is hard to show causality. Changes in consensus analyst forecasts are indeed positively related to subsequent revisions in analysts' forecasts (Stickel (1990)), which is potentially consistent with herd behavior. This relationship is weaker for the high-precision analysts who are ranked in an elite category by *Institutional Investor* magazine than for analysts who are not. Thus, it appears that analysts ranked as elite are less prone to herding than those that are not, consistent with the prediction of the Trueman model.

Experimental evidence involving experienced professional stock analysts has also supported the model (Cote and Sanders (1997)). Cote and Sanders report that these forecasters exhibited herding behavior. Furthermore, the amount of herding was related to the forecasters' perception of their own abilities and their motivation to preserve or create their reputations.

Two papers that provide methodologies for estimating the degree of herding versus exaggeration of differences (dispersing, the opposite of herding) by analysts in the field (Zitzewitz (2001), Bernhardt, Campello, and Kutsoati (2006)) find dispersing. These studies indicate that analysts on average *exaggerate* their differences. Zitzewitz also finds that analysts under-update their forecasts in response to public information, indicating an overweighting of prior private information. This evidence is supportive of overconfidence by analysts in their own private signals, or with reputational models in which some individuals intentionally diverge (e.g., Prendergast and Stole (1996) and Ottaviani and Sorensen (2006)).

It is also often alleged that analysts herd in their choice of what stocks to follow. There is high variation in analyst coverage of different firms (Bhushan (1989)); this does not prove that herding is the source of this variation. Rao, Greve, and Davis (2001) provide evidence that analysts tend to follow each other in initiating coverage on a stock, and provide a cascades interpretation.

There are also allegations that analysts herd inappropriately in their stock recommendations. The evidence of Welch (2000) indicates that revisions in the buy and sell stock recommendations of a security analyst are positively related to revisions in the buy and sell recommendations of the next two analysts. Welch traces this influence to short-term information, identified by estimating the ability of the revision to predict subsequent returns.[26]

Welch also finds that analysts' choices are correlated with the prevailing consensus forecast. The 'influence' of the consensus on later analysts is not stronger when it is a better predictor of subsequent stock returns. In other words, the evidence is consistent with analysts herding even upon consensus forecasts that aggregate information poorly. This is consistent with either agency effects such as reputational herding, or imperfect rationality on the part of analysts. Finally, Welch finds an asymmetry, that the tendency to herd is stronger when recent returns have been positive ('good times') and when the consensus is optimistic. He speculates that this could lead to greater fragility during stock market booms, and the occurrence of crashes.

A different way to test for the effects of herding in recommendations is to examine the stock price reactions to new recommendations that are close to versus farther from the consensus forecast (Jegadeesh and Kim (2007)). Such tests indicate that stock price reactions are stronger when the new recommendation deviates farther from the consensus. Assuming that the market is efficient, this suggests that analysts herd (and that investors appropriately adjust for this fact in setting price).

There is mixed evidence of herding in recommendations of investment newsletters. Jaffe and Mahoney (1999) report only weak evidence of herding by newsletters in their recommendations over 1980-96. However, Graham (1999) develops and tests an explicit reputation-based model of the recommendations of investment news letters, in the spirit of Scharfstein and Stein (1990). He finds that analysts with better private information are less likely to herd on the market leader, Value Line investment survey. This finding is consistent with both the reputational herding and information cascades approaches.

8 Herd Behavior and Cascades in Security Trading

Some sociologists have emphasized that the 'weak ties' of liaison individuals, who connect partly-separated social networks, are important for spreading behaviors across networks

[26] This could reflect cascading, or could be a clustering effect wherein the analysts commonly respond to a common information signal.

(Granovetter (1973)). A recent literature in economics has examined the strength of peer-group effects in a number of different contexts (see, e.g., Weinberg, Reagan, and Yankow (2004), and the review of Glaeser and Scheinkman (2000)).

Questionnaire/survey evidence indicates that word-of-mouth communications are important for the trading decisions of both individual and institutional investors (Shiller and Pound (1989)). Employees are influenced by the choices of coworkers in their decisions of whether to participate in different employer-sponsored retirement plans (Duflo and Saez (2002, 2003), Madrian and Shea (2000)). Furthermore, there is both modern and historical evidence suggesting that social interactions between individuals affects decisions about equity participation and other financial decisions.[27] There is also evidence of clustering in the trading of institutional managers. Mutual fund managers located in a given city tend to be more correlated in their purchases or sales of stocks than managers located in different cities (Hong, Kubik, and Stein (2005)), possibly owing to access to similar information sources.

8.1 Evidence on Herding in Securities Trades

8.1.1 Herding on Endorsements

According to the information cascades theory, endorsements can be extremely influential if the endorser has a reputation for accuracy, and if the endorsement involves an actual informative action by the expert. This could take the form of knowing that the expert took a similar action (buying a stock), but could also involve the expert investing his reputation in the stock by recommending it.

Empirically, the choice by a big-five auditor, top-rank investment bank, or venture capitalist to invest its reputation in certifying a firm influences investor favorably toward the firm.[28] Just as shopping mall developers use 'anchor' stores to attract other stores, according to McGee (1997) some investment banks have been using the names of well-known investors as 'anchors' to attract other investors. There are many examples of influential investors, some more benign than others. Some investors are influenced in cold-calls by brokers by statements that famous investors such as Warren Buffett are holding a stock (see Lohse (1998)). The publication of news that Buffett has purchased a stock is associated with a positive stock price reaction which is on average greater

[27] See Kelly and O'Grada (2000), Hong, Kubik, and Stein (2004), Ivkovich and Weisbenner (2007), Shive (2008), and Brown, Ivkovich, Smith, and Weisbenner (2008).

[28] See the model of Titman and Trueman (1986), and the evidence of Beatty and Ritter (1986), Beatty (1989), Simunic (1991), and Michaely and Shaw (1995).

than 4% (Martin and Puthenpurackal (2008)).[29] Stock prices react to the news of the trades of insiders (e.g., Givoly and Palmaon (1985)). Such trades provide information, and this price evidences indicates that observers use it to adjust their demand for stock.

Investing in human capital is a form of endorsement; the signing of a famous name to a management team affects how a startup is perceived by investors. Investors are sometimes irrationally influenced by famous but incompetent analysts—stock market 'gurus'. This may involve a limited attention/availability effect wherein investors use an analyst's visibility as an indicator of ability. A would-be guru can exploit the flaws of this heuristic by using even outlandish publicity stunts to gain notoriety; see, e.g., the description of Joseph Granville's career in Shiller (2000b).

As discussed earlier, investors are also influenced by private conversations with peers. There is also evidence that investors are influenced by implicit endorsements, as with default settings for contributions in 401(k) plans; see Samuelson and Zeckhauser (1988) and Madrian and Shea (2000).

8.1.2 Herding on Trades

A key challenge for empirical tests for herding is to show that there is actual social interaction or strategic complementarity, rather than clustering based solely on some external causal factor (Manski (1993)). If an external factor shifts the cost or benefit of some action (such as buying a stock) for a group of investors, then their trades will shift together even if there is no social interaction.

Several lines of attack have been used to identify herding in financial markets. One approach is to control carefully for variables that jointly affect the behavior of different individuals (see, e.g., Grinblatt, Keloharju, and Ikaheimo (2008) on demand for cars; for a general analysis of econometric issues in measuring social interaction, see Brock and Durlauf (2000)). Using an instrumental variable approach to identify a causal relation between the decisions of neighbors to participate in the stock market, Brown, Ivkovich, Smith, and Weisbenner (2008) show that the effect is stronger in communities with stronger social interactions. To identify the effects of local peers on an individuals' stock ownership (as distinguished from the effects of other factors that may affect all local individuals), Brown et al focus on the effects of stock ownership by the *non-local parents* of the local peers. Ivkovich and Weisbenner (2007) provide evidence that investors are

[29] After news that Warren Buffett had bought approximately 20% of the 1997 world silver output, according to *The Economist* (1998), silver prices were "soaring." When Buffett's filings reporting his increased shareholding in American Express and in PNC Bank became public, these shares rose by 4.3% and 3.6% respectively (Obrien and Murray (1995)).

influenced in their stock trading behavior by the behavior of neighbors. Ng and Wu (2006) provide relatively direct evidence of social influence in trades through word-of-mouth communication in trading rooms in China.

If higher population density encourages social interaction, then density should affect volume of trading (see the tests of Eleswarapu (2004)). Survey evidence indicates that households that are more social or attend church participate more in the stock market (Hong, Kubik, and Stein (2004)), suggesting that participation is contagious. Shive (2008) measures the opportunity for investors who own a stock to 'infect' non-holders in a municipality by the product of the number of owners and the number of non-owners of the stock. This measure is motivated by models from epidemiology which contain such product terms. Using data from the Finland stock market on investor trading of the 20 most actively traded stocks, she finds that this product term is a predictor of trading in the stock, consistent with social interactions affecting trading.

A few studies examine natural or artificial experiments which rule out the possibility of an omitted influence. There is evidence of the peer effect of roommates on grade point average and on decisions to join fraternities even when roommates are assigned randomly (Sacerdote (2001)), which avoids the possible bias. Also, a growing literature starting with Anderson and Holt (1996) has confirmed learning by observing actions, and the existence of information cascades in the experimental laboratory.[30] Consistent with cascades, female guppies tend to reverse their mate choices in experiments where they observe other females choosing different males (Dugatkin and Godin (1992)).

The causation issue is especially tricky in financial market trading tests because of the market clearing condition as mediated by price. Correlation in trades within a group of investors (conditioned upon past price movements in some tests) may merely reflect herding (or other reasons for correlated trading) by some other investor group of investors. For example, individual investors buying and selling in tandem could result from some other group of investors such as mutual funds buying and selling in tandem, influencing prices. If individual investors supply liquidity to institutions by trading as contrarians in response to price movements (as found by Kaniel, Saar, and Titman (2008)), they will tend to trade together.

If there are only two groups of traders, then by market clearing, herding by one group of traders automatically implies correlation in the trades of the other group, even if there be no interactions and no strategic complementarities between members of this other group. Thus, to verify that a group is truly herding, it is crucial either to control for

[30]See also Hung and Plott (2001), Anderson (2001), Sgroi (2003) and Celen and Kariv (2004, 2005).

price, or else to find some other way to verify the causality of the behavioral convergence.

A number of alternative measures of herding in trading behavior have been developed in papers on the behavior of institutional investors.[31] Bikhchandani and Sharma (2001) critically review alternative empirical measures of herding. Griffiths et al (1998) find increased similarity of behavior in successive trades for securities that are traded in an open outcry market rather than a system trading market on the Toronto stock exchange, consistent with the possibility of imitation-trading raised by the evidence of Biais, Hillion, and Spatt (1995). Grinblatt and Keloharju (2000) provide evidence consistent with herding by individuals and institutions.

Institutional investors constitute a large fraction of all investors. By market-clearing it is impossible for all investors to be buyers or sellers. So although testing for herding by such a large group is not unreasonable, it is helpful to examine finer subdivisions of investors. Earlier evidence consistent with mutual fund herding was provided by Friend, Blume, and Crockett (1970), who found, during a quarter in 1968, that funds tended to follow the investment decisions made in the previous quarter by successful funds. However, in a sample of mutual funds and bank trusts from 1968-9, Kraus and Stoll (1972) attribute the trade imbalances they find in stocks to chance rather than correlated trading.

More recent studies find evidence of correlated trading by different categories of institutional investors, especially involving small firms. Whether this reflects actual herding by (interaction among) institutions, common responses to common information signals, or correlated trading in response to herding by individual or other institutional investors is unclear. There is evidence that the trades of individual investors as a group are correlated (Kumar and Lee (2006)), and evidence from trading in China of stronger correlation in trades among individual investors who are geographically close (Feng and Seasholes (2004)).[32]

Fund managers who are doing well tend to lock in their gains toward end of the year by indexing the market, whereas funds that are doing poorly deviate from the benchmark in order to try to overtake it (Brown, Harlow, and Starks (1996) and Chevalier and Ellison (1997)). Chevalier and Ellison (1999) identify possible compensation incentives

[31] See, e.g., Lakonishok, Shleifer, and Vishny (1992), Grinblatt, Titman, and Wermers (1995), and Wermers (1999).

[32] Several papers on trading by institutional investors provides evidence of correlation in trades (referred to as 'herding' in this literature with no clear implication of interaction between traders), and provide many interesting stylized facts (Lakonishok, Shleifer, and Vishny (1992), Grinblatt, Titman, and Wermers (1995), Kodres and Pritsker (1997), Wermers (1999), Nofsinger and Sias (1999), and Sias (2004)).

for younger managers to herd by investing in popular sectors, and find empirically that younger managers choose portfolios that are more 'conventional' and which have lower non-systematic risk.

There is evidence suggesting that mutual fund herding affects prices (Brown, Wei, and Wermers (2008)). Mutual funds tend to buy stocks that have experienced consensus analyst upgrades and to sell stocks with consensus downgrades. Brown, Wei and Wermers find that the upgraded stocks at first achieve superior return performance, but subsequently underperform, suggestive of either reputational or imperfectly rational herding.

8.2 Financial Market Runs and Contagion

There is a problem with provision of public goods because the contributions of one party confer positive externalities upon others. When there are strategic complementarities in contributions, there is the possibility of a 'run,' possibly triggered by information disclosure, in which contributions suddenly shrink to zero or some other low level. As a result, unbiased disclosure can reduce welfare (Teoh (1997)).

The most familiar form of financial market run is the bank run. There is a negative payoff externality in which withdrawal by one depositor, or the refusal of a creditor to renegotiate a loan, reduces the expected payoffs of others. Bernardo and Welch (2004) model how financial market runs can arise endogenously among investors in a stock because of illiquidity.

A traditional view is that bank runs are due to 'mob psychology' or 'mass hysteria' (see the references discussed in Gorton (1988)). At some point economists may revisit the role of emotions in causing bank runs or 'panics,' and more generally causing multiple creditors to refuse to finance distressed firms. Such an analysis will require attending to evidence from psychology about how emotions affect judgments and behavior.

The main existing models of bank runs and of financial distress are based upon full rationality (for reviews of models and evidence about bank runs, see, e.g., Calomiris and Gorton (1991) and Bhattacharya and Thakor (1993) Section 5.2). The externality in withdrawals can lead to multiple equilibria involving runs on the bank or firm, or to bank runs triggered by random shocks to withdrawals (see, e.g., Diamond and Dybvig (1983)). This of course does not preclude the possibility that there is also an informational externality.

The informational hypothesis (e.g., Gorton (1985, 1988)) holds that bank runs result from information that depositors receive about the condition of banks' assets. When a distressed firm seeks to renegotiate its debt, the refusal of one creditor may make others more skeptical. Similarly, if some bank depositors withdraw their funds from a troubled bank, others may infer that those who withdrew had adverse information about the value of the bank's illiquid assets, leading to a bank run (see, e.g., Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988)).

Since the decision to withdraw is bounded (an investor can only withdraw up to the amount of his deposit), bank runs can be modeled as information cascades. There is a payoff interaction as well. However, at the start of the run, when only a few creditors have withdrawn, the main effect may be the information conveyed by the withdrawals rather than the reduction in the bank's liquidity. Furthermore, if asset values are imperfectly correlated, cascades can pass contagiously between banks and cause mistaken runs even in banks that could have remained sound; (on information and contagious bank runs, see Gorton (1988), Chen (1999), and Allen and Gale (2000b)).

There is evidence of geographical contagion between bank failures or loan-loss reserve announcements and the returns on other banks (Aharony and Swary (1996) and Docking, Hirschey, and Jones (1997)). This suggests that bank runs could be triggered by information rather than being a purely non-informational (multiple equilibria, or effects of random withdrawal) phenomenon.[33] There is also evidence of contagion effects in a sample of U.S. bank failures during the period 1930-32 (Saunders and Wilson (1996)). On the other hand Calomiris and Mason (1997) find that the failure of banks during the Chicago panic of June 1932 was due to common shocks, and Calomiris and Mason (2001) find that banking problems during the Great Depression can be explained based upon either bank-specific variables or publicly observable national and regional variables rather than contagion.

The problem of financial runs can potentially explain regional financial crises as well. Adverse information can cause lenders to be reluctant to extend credit, and owing to the externality in providing capital, this can potentially lead to a collapse. Chari and Kehoe (2003) model international financial crises as informational runs. The model of Teoh (1997) suggests that intransparency can in principle have the desirable effect of preventing crises.

[33] There is also evidence of contagion in speculative attacks on national currencies (Eichengreen, Rose, and Wyplosz (1996)).

8.3 Exploiting Herding and Cascades

Firms often market experience goods by offering low introductory prices. In cascades theory, the low price induces early adoptions, which helps start a positive cascade. Welch (1992) developed this idea to explain why initial public offerings of equity are on average severely underpriced by issuing firms. The pricing decision for the Microsoft IPO seems to have reflected this consideration (Uttal (1986) (p. 32)), and later authors have provided supporting evidence (Amihud, Hauser, and Kirsh (2003)).

The advantages of inducing information cascades may apply to auctions of other goods. In the model of Neeman and Orosel (1999), there is a potential winner's curse, and a seller (such as a firm selling assets) can gain from approaching potential buyers sequentially and inducing information cascades, rather than conducting an English auction.

9 Markets, Equilibrium Prices, and Bubbles

In classical models of asset markets such as the CAPM, investors are rational, and markets are perfect and competitive. There is complete agreement about probability distributions of exogenous variables, which are common knowledge. As a result, risk-adjusted returns are unpredictable. Furthermore, in a classical market there is no excess volatility, if by this term we mean some faulty processing of information by the market which creates opportunities for abnormal trading profits. So fully rational and frictionless models of cascades or herding cannot explain anomalous evidence regarding return predictability or excess volatility based upon public information (for recent surveys of theory and evidence on investor psychology in capital markets, see, e.g., Hirshleifer (2001), Daniel, Hirshleifer, and Teoh (2002)). To explain return patterns that are anomalous for classical models, market frictions or imperfect rationality are needed.[34]

However, information blockages and herding can still affect prices. For example, in the model of Abreu and Brunnermeier (2003), the common knowledge assumption is violated, and arbitrageurs who seek to profit from the end of a bubble are not sure when other arbitrageurs will start to sell. Arbitrageurs may use a public news event to synchronize, causing the bubble to burst.

Within a fully rational setting (and with common knowledge about probability distributions), cascades or herding can block information aggregation. Cascades or herding

[34] In rational expectations models of information and securities trading, returns are predictable owing to so-called noise or liquidity trading. But limited amounts of non-contingent liquidity trading will not explain major bubbles and crashes.

can affect how much information gets into that information set in two ways. First, there can be direct cascades in investor trading, causing some information to remain private which otherwise would be reflected in prices. We discuss below some models in which this occurs because of market imperfections. Second, even if markets are perfect, cascades or herding can cause individuals to cascade in their investigation behavior, which affects the amount of private and public information that is generated in the first place. For example, if individuals cascade in subscribing or not subscribing to a stock market newsletter, then the effect of this on the distribution of private information across investors affects trading and prices.

An intuition similar to the intuition of cascades or herding models with exogenous action cost can be extended to the issue of how quickly investors learn in competitive securities markets. In cascades and other learning models, the past history of informative actions creates an information pool that can crowd out the accumulation of new information, because new decisionmakers have insufficient incentive to take informative actions. Even in a market setting without cascades, an informed trader does not internalize the benefit that other traders have from learning his private information as revealed through trading. As more private information is reflected in price, informed traders have diminishing incentive to trade speculatively against the market price (setting aside any change in the riskiness of speculative trading). If informed traders trade less, their trades tend to be lost amidst uninformative trades, reducing the aggregation of their information into market price. Thus, the rate of convergence of price to efficiency can slow down over time (Vives (1995)).[35]

In settings without technological externalities, market interactions typically lead to dispersing (anti-herding), because the attempt to acquire a resource makes it more costly for others to do so.[36] Consider, for example, competition among demanders in the market for bread. If one individual's demand increases and he buys more, that drives up the price, which causes others to reduce their demand quantities. Such pressure against herding supports market clearing. As consumers try to buy more, price rises to constrain purchases to the available supply.

A similar effect operates in the market for a security. The tendency to imitate past

[35] An opposing effect is that as price becomes more efficient, risk is reduced, which encourages informed traders to trade more aggressively. However, when trading occurs through market orders, noise trading creates an irreducible price risk for informed traders. Thus, Vives finds that market learning slows when trading occurs through submission of market orders but not when it occurs through submission of limit orders.

[36] There is a growing literature on externalities as a source of herding, as in work on strategic complementarities (Haltiwanger and Waldman (1989)) and on agglomeration economies (Krugman and Venables (1995, 1996)).

trades is limited by the fact that past trades tend to drive prices to be adverse to further trades in the same direction. Nevertheless, under asymmetric information there are circumstances under which cascades or other forms of herding occur.

In a setting with asymmetric information, social learning, and a perfectly liquid securities market, the basic argument for why cascades of trading will *not* form is still fairly direct. If at a given price an individual were going to buy (for example) regardless of his information signal, a rational seller who understands this would charge a higher price. For this reason, even in a securities market model where the action space is discrete and there there are transactions costs, such as that of Glosten and Milgrom (1985), the argument implies that there will be no information cascades.

To see this in more detail, consider the market clearing condition. If privately informed traders were buying regardless of their signals, then *a fortiori* so would uninformed traders; having no signal encourages buying more than having an adverse signal. But if, foreseeably, both informed and uninformed will try to buy, then (the argument goes) the marketmaker should set prices higher, a contradiction. Indeed, some experimental tests in a simple Glosten/Milgrom setting do not yield cascades.[37]

There are three main snags with the argument against direct cascades in trading decisions. First is that special constraints may prevent prices from adjusting. Second is that the party on the opposite side of the transaction (call it the 'market maker') may not know for sure that the investor is going to buy regardless of his signal. The third is that owing to transactions costs, an individual may *refrain* from trading regardless of his signal, which blocks information aggregation.

With respect to the first snag, there are special circumstances in which non-market-clearing prices are imposed. In the short run, the expectation that NYSE specialists will maintain an 'orderly market' by keeping prices continuous can force temporary deviations of prices from fundamental values, blocking information flow. This suggests that during extreme market periods such as crashes, cascades can form. Sometimes prices are explicitly constrained by price move limits. This permits cascades in which all investors try to buy (or all sell), resulting in non-trading.

The second problem with the argument against direct trading cascades is that the party on the opposite side of the transaction (call it the 'market maker') may not know for sure that the investor is going to buy regardless of his signal. We will first discuss how this can lead to what we will call quasi-cascades. We then discuss how cascades

[37]See Cipriani and Guarino (2005) and Drehmann, Oechssler, and Roider (2005). On the other hand, other experimental evidence suggests that market settings do not solve the problem of inefficient information aggregation (Hey and Morone (2004)).

proper can occur.

It is standard to assume that informed investors know more than the market maker about a single dimension of uncertainty, the expected payoff of the security. Suppose that in addition there is a second type of informational advantage to informed investors over the market maker—knowledge about *whether* informative signals were sent. Then a price rise can encourage an investor with an adverse signal to buy when there is a transaction cost or bid-ask spread (Avery and Zemsky (1998)). The price rise persuades the investor that others possess favorable information, whereas the market maker adjusts prices sluggishly in response to this good news.

This relative sluggishness of the marketmaker arises results from his ignorance over whether an informative signal was sent. Informed traders—even those with adverse signals—at least know that information signals were sent, so that the previous order probably came from a favorably informed trader. In contrast, the market maker places greater weight on the possibility of a liquidity trade.

The behavior described by Avery and Zemsky is very cascade-like, in that the individual trades in opposition to his private signal—a rather extreme behavioral coarsening. However, it is not strictly an information cascade, because when no information signal is received, the investor takes a different action from when information is received. There are really three possible signal realizations—favorable, unfavorable, and 'no signal'. Action does depend on the value of this appropriately redefined signal. Still, the result is a quasi-cascading phenomenon with partial information blockage.[38]

The third snag with the argument against cascades in trading decisions is that transaction costs can easily cause cascades of non-trading. Bid-ask spreads or other transactions costs, by deterring trade, can block information flow. In the model of Cipriani and Guarino (2007), transactions costs cause cascades of non-trading which block information aggregation and cause prices to deviate from full-information fundamental value. Cipriani and Guarino (2007) also provide experimental support for the predictions of their model.

[38]Private information about the existence or quality of private signals (i.e., multiple dimensions of uncertainty) can also lead to information blockages in which learning about precision stops (Gervais (1996)). In the model of Gervais (1996), owing to uncertainty about investors' information precision, trader private information is not fully incorporated into price. Informed investors know the precision of their private signal, but the market-maker does not. Initially a high bid-ask spread acts as a filter by deterring trade by informed investors unless they have high precision. By observing whether trade occurs, the market-maker updates about signal precision and asset value, and narrows the spread over time. Eventually even investors with imprecise signals trade, and the market-maker stops learning about precision. The independence of the decision to trade of the private information about precision is a behavioral coarsening, and causes some information about the insiders' precision to remain forever private.

Cipriani and Guarino (2003) provide a modified version of Glosten/Milgrom with multiple securities. Starting with a single security intuition, the trading of informed investors causes information to be partly reflected in price. At some point, as price becomes more informative, having one more conditionally independent private signal causes an investor to update expected fundamental value only modestly. So an investor who has a non-speculative reason to purchase the security finds it profitable to buy even if his private information signal is adverse, and similarly an investor who has a non-speculative motive to sell does so regardless of his signal. In other words, he is in a cascade. With all informed investors in a cascade, further aggregation of information is completely blocked. Thus, in contrast to Avery and Zemsky, information cascades proper form. Furthermore, cascades can result from contagion across markets; trading in one asset can trigger a cascade in another market. Furthermore, cascades can occur in both markets at the same time, leading to complete information blockage.

In Lee (1998), quasi-cascades result in temporary information blockage, then information avalanches. This results from transactions costs and discreteness in trades, which can cause informed investors to be sidelined. In sequential trading, hidden information becomes accumulated as the market reaches a point at which, owing to transactions costs, trading temporarily ceases. Eventually a large amount of private information can be revealed by a small triggering event. The triggering event is a rare, low probability adverse signal realization. An individual who draws this signal value sells. Other individuals who observe this sale are drawn into the market, causing a market crash or information avalanche.[39]

A key issue regarding the occurrence of information blockage in these models is the significance of the assumption of discrete actions. Any model that attempts to explain empirical phenomena such as market crashes as (quasi-)cascades must calibrate with respect to the size of minimum trade size or price movements. Such constraints are most likely to be more significant in markets that are less liquid.

Perhaps the more important role of cascades is likely to be in the decision of whether or not to participate at all, rather than in the decision of whether to buy or sell at a particular price. If there is a fixed setup cost (perhaps psychic) of participating, then there can be a substantial discreteness to individual decisions that does not rely upon limiting the size of trades to a single unit. Cascades of participation versus non-participation may have important pricing effects.

[39]Romano (2007) further explores conditions under which transactions costs lead to trading cascades. When investors are risk averse and action choices are discrete, even with endogenous price, cascades proper form (Décamps and Lovo (2006)).

Some of the most important puzzles in finance involve failures of investors to participate in asset classes. For example, there is the puzzle of insufficient participation in equity markets, and the preference for participating in the markets for local and familiar stocks, which includes the home bias.[40] The phenomenon of underpriced neglected stocks (which is exogenous in the model of Merton (1987)) can also be viewed as a puzzle of non-participation.

Cascades within a purely rational setting offer a partial explanation. Suppose that investors are more likely to interact and observe the behavior of other investors in the same income class than those in different income classes. If a group of low income investors do not invest in the stock market (possibly for historical reasons, or because some are deterred by fixed costs of participation), their choices can trigger a cascade of non-participation. Similarly, if investors in a locality observe (or discuss) each other's investment choices, and if some individuals invest locally (for historical or informational reasons), this can trigger a cascade of local investment.

Such arguments may require greater fleshing out to provide a complete explanation for the puzzles, since rationally an investor should draw inferences from what investors in other groups are doing. For example, even if one's peers are not investing in the stock market, there is also information to be gleaned from the fairly obvious fact that someone else is. Of course, an individual may believe that the benefits of stock investing are heterogeneous, and that his own benefits are more similar to those of his peers than the non-peers who are making different choices.

Psychological biases can reinforce the effects of rational social learning, which may help explain cascades of non-participation. For example, suppose that some individuals irrationally fear and avoid unfamiliar stocks. Then other investors who observe low participation in such stocks may draw adverse inferences about the benefits of participation, causing a cascade. This occurs if investors draw such inferences in a quasi-rational fashions that fails to adjust for the irrationality of others. More generally, cascades in market participation offer a rich avenue for theoretical analysis. For example, fragility in cascades of participation may help explain bubbles and crashes in stocks or portfolios.

There is starting to be some exploration of how the decisions of individuals over time

[40] Huberman (2001) provides evidence and insightful discussion indicating that individuals prefer to invest in familiar stocks; Cao, Han, Hirshleifer, and Zhang (2008) model the effects of familiarity on economic decisions and capital markets. There is also evidence of local preferences in investment for both institutional investors (Coval and Moskowitz (1999)), who achieve better performance on local investments (Coval and Moskowitz (2001)); and individual investors (Zhu (2003)), Ivkovich and Weisbenner (2005)) who in some studies do (Ivkovich and Weisbenner (2005)) and in others do not (Zhu (2003), Seasholes and Zhu (2005)). On the home bias puzzle of international finance, see, Tesar and Werner (1995), Lewis (1999)).

as to whether or not to participate in trading causes information blockages to form and clear.[41] In settings with limited participation, large crashes can be triggered by minimal information, and the sidelining and entry of investors can cause skewness and volatility to vary conditional upon past price moves.

The use of the *availability heuristic* (Tversky and Kahneman (1973)) and the *mere exposure effect* (Moreland and Beach (1992)), should also affect participation in markets and the amount of buzz about or neglect of a stock. Using the availability heuristic, people judge how common something is by how easy it is to retrieve or imagine examples of it. Among other things, this causes vivid case examples to be too persuasive of the truth of a proposition. The mere exposure effect is the tendency for people to like things more that they have been exposed to.

In the context of risk regulation, Kuran and Sunstein (1999) develop the notion of *availability cascades*, in which social processes together with availability bias make a belief or behavior self-reinforcing. Kuran and Sunstein (p. 683) define an availability cascade as "a self-reinforcing process of collective belief formation by which an expressed perception triggers a chain reaction that gives the perception increasing plausibility through its rising availability in public discourse." Availability cascades can result either from information cascades, reputational effects, or a combination of the two.

Availability cascades offer a possible explanation for security market bubbles and waves of corporate events. High favorable publicity about a firm or market theory makes supportive positive arguments more salient and 'available' to investors. Furthermore, mere exposure should also make the firm or transaction more familiar and therefore more appealing. Such effects make enthusiasm for investment self-reinforcing. The phenomenon of hot versus cold IPOs, and of sudden excitement at different times about types of transactions (hostile takeovers; LBOs; asset backed securities, and so forth) seem to be availability cascades.

Popular allegations that securities market are irrational often emphasize the contagiousness of emotions such as panic or frenzy. Critics often go on to argue that this causes excess volatility, destabilizes markets, and makes financial system fragile (see, e.g., the critical review of Bikhchandani and Sharma (2001) and references therein). There is indeed evidence that the contagious spread of emotions affects perceptions and behavior (see, e.g., Hatfield, Cacioppo, and Rapson (1993), Barsade (2002)).

Prevailing models of capital market trading and equilibrium are quite limited in the forms of social influence and information transmission that they accommodate. This

[41]See Romer (1993), Lee (1998), Cao, Coval, and Hirshleifer (2002), and Hong and Stein (2003).

applies both to classical models of information and securities markets such as Grossman and Stiglitz (1976), Kyle (1985), and most of the work reviewed here on cascades and herding in capital markets.

The first premise is that the beliefs and behavior of an investor affects others only through market price.[42] This is perhaps most easily seen in the 'rational expectations' approach of Grossman and Stiglitz (1976), wherein uninformed investors observe the market price, draw an inference from that price about the beliefs of informed traders, and trade based upon their resulting belief.

The second premise is there is no localization in the influence of an investor on others. This rules out conversation with neighbors within a social network (which could be organized geographically or in other ways), and in which media may have influential nodes.

The evidence discussed in Section 8 suggests that social interactions between individuals affect financial decisions, which suggests that the social or geographical localization of information may be an important part of the process by which trading behaviors spread. Furthermore, there are often strategic complementarities or threshold effects in social processes, wherein the adoption of a belief or behavior by a critical number of individuals leads to a tipping in favor of one behavior versus another (Granovetter (1978), Schelling (1978), Kuran (1989, 1998)).

Thus, an important direction for further empirical research is to examine how and whether a localized process of contagion of beliefs and attitudes affects stock markets (see, e.g., Shiller (2000a)), and whether securities market price patterns are consistent with rational models of contagion. Shive (2008) finds that 'socially motivated trades'

[42]In the Capital Asset Pricing Model (CAPM) and its generalizations (consumption CAPM, intertemporal CAPM), beliefs are exogenous (specifically, individuals are assumed to assess the probability distribution of variables correctly conditional upon all publicly available information), and investors form demands for securities by individual optimization taking market prices as given. In consequence, an investor's behavior (considering different possible out-of-equilibrium choices) affects other investors only through the effect of that behavior on market price. In other words, just as in the standard economic theory of supply and demand, equilibrium is mediated by market price.

In models of information and securities markets (Grossman and Stiglitz (1976), Glosten and Milgrom (1985), Kyle (1985)), the market clearing mechanisms by which trades are converted into prices are somewhat different, but interactions between investors are still mediated by price.

In Kyle (1985), a competitive market maker quotes a pricing function that fixes the price of the security as a function of aggregate demand. Investors submit demand quantities, and their orders are fulfilled at a price determined by the pricing function. So one investor affects another solely through the effect of his order on price (via the pricing function).

In Glosten and Milgrom (1985), the market maker sets a bid-ask spread, and each investor (who can be either informed or uninformed) submits a buy or sell order which is executed at the pre-specified price. An investor is affected by the previous actions of other investors solely through the effect of those actions on bid-ask prices.

(as measured based on the predictive power of an epidemiological model) predict future returns, and that this effect does not reverse out; this suggests that such trading helps aggregate meaningful information.

An important direction for future theoretical research is to examine the implications for securities market trading, participation, and prices of conversation between individuals; see, e.g., DeMarzo, Vayanos, and Zwiebel (2001) and Ozsoylev (2005). DeMarzo, Vayanos, and Zwiebel (2003) provide a general analysis of the effects of *persuasion bias* in social networks. Individuals do not adjust appropriately for the fact that the information they receive from others may have come from a single common source. Individuals who have more connections in the social network have a stronger influence on beliefs in the network (even if their information is not more accurate).

Ozsoylev (2005) provides a model in which investors learn by observing the signals of other investors to which they are linked within a social network. Investors who belong to a relatively tightly integrated social cluster have relatively high correlation in their investment positions. Furthermore, although investors are rational, those who have many social network connections have a stronger influence on asset prices than those with fewer connections.

Agency-induced herding by investment managers, such as reputational effects, can also create mispricing (Brennan (1993), Dasgupta and Prat (2005)). Brennan (1993) analyzes the asset pricing implications of index-herding behavior. Any price effects of herding caused by agency problems should be driven by the behavior of institutional investors. Dasgupta, Prat, and Verardo (2005) test their model prediction that the reputation return premium increases with the past trades of career-driven traders, and find that buying by such traders predicts return underperformance, and selling predicts overperformance. There is evidence suggesting that institutional investors are a source of positive portfolio return serial correlations (both own-and cross correlations of the securities held by institutions); see Sias and Starks (1997). There is also evidence that the autocorrelation of the returns of emerging stock markets increased sharply at the time that institutional investors were expanding their positions in emerging markets (Aitken (1998)). Aitken argues that this indicates that this reflected the effect of fluctuating sentiment by institutional investors.[43]

There is a substantial literature on contagion between the debt or equity markets of

[43]Christie and Huang (1995) are unable to detect 'herd behavior,' which they define as high cross-sectional standard deviations of security returns at the time of large price movements. This definition differs from ours (social interactions that cause behavior to converge). See also Chang, Cheng, and Khorana (2000) and Richards (1999).

different nations (see, e.g., Bikhchandani and Sharma (2001)). Borensztein and Gelos (2003) report moderate correlation in the trades of emerging market mutual funds during 1996-9; correlation was not stronger during crises than normal times. With regard to price effects of herding, there are some large correlations in returns, but it is hard to measure whether this is an effect of herding, and there is only mixed evidence as to whether correlations are higher during financial crises.[44] Many studies have examined how the occurrence of a crisis in one country affects the probability of crisis in another country (Berg and Pattillo (1999) review this research).

Experimental asset markets have been found to be capable of aggregating a great deal of the private information of participants; however, in complex environments the literature has found that blockages form so that information aggregation is imperfect.[45] Experimental laboratory research (see, e.g., Cipriani and Guarino (2007)) and field experiments (see Alevy, Haigh, and List (2007), who test for cascades among financial market professionals on the Chicago Board of Trade) are promising ways of testing how cascades and herding affect information aggregation in markets, and will offer important directions for improving theories of financial herding.

There is some evidence suggesting that correlated sentiment on the part of investors for certain kinds of real assets moves prices for non-fundamental reasons. Gompers and Lerner (2000) provide evidence of 'money chasing deals' in venture capital. Inflows into venture capital funds are associated with higher valuations of the new investments made by these funds, but not with the ultimate success of the firms. However, Froot, O'Connell, and Seasholes (2001) find that portfolio flows in and out of 44 countries during 1994-98 were *positive* forecasters of future equity returns, with statistical significance in emerging markets.

10 Cascades and Herding in Firm Behavior

It is often alleged in the popular press that managers are foolishly prone to fads in management methods (for examples and formal analysis see Strang and Macy (2001)), investment choices, and disclosure or reporting practices. We first consider investment and financing choices, and then disclosure and reporting.

[44]Choe, Kho, and Stulz (1999) provide strong evidence of trading convergence among foreign investors before the 1996-7 period of economic crisis for Korea, but convergence was actually lower during the crisis period. Furthermore, they do not find any indication that trades by foreign investors had a destabilizing effect on Korea's stock market.

[45]See, e.g., Noeth et al (2002), Bloomfield and Libby (1996), and the surveys of Libby, Bloomfield, and Nelson (2002) and Sunder (1995)).

10.1 Investment and Financing Decisions

Managers learn by observing the actions and performance of other managers, both within and across firms. This suggests that firms will engage in herding and be subject to information cascades, leading to management fads in accounting, financing and investment decisions. We have already discussed models of social learning and investment decisions.[46]

As for stylized facts, the popularity of different investment valuation methods, securities to issue, and so on have certainly waxed and waned. There are booms and quiet periods in new issues of equity that are related to past stock market returns and to the past average initial returns from buying an IPO (see, e.g., Eckbo and Masulis (1995), Lowry and Schwert (2002), Ritter and Welch (2002), and Rau and Stouraitis (2008)). However, it is not easy to test whether fluctuations in investments and strategies are the result of irrationality, rational but imperfect aggregation of private information signals, or direct responses to fluctuations in public observables.

Takeover markets have been subject to seemingly idiosyncratic booms and busts of enormous scale, such as the wave of conglomerate mergers in the 1960's and 70's, in which firms diversified across different industries, the subsequent refocusing of firms through restructuring and bustup takeovers in the 1980's, followed by the merger boom of the 1990s. Targets of a takeover bid are 'put into play,' and often quickly receive competing offers, despite the negative cost externality of having a competitor. A distinct kind of evidence suggesting that the decision to engage in a takeover is contagious is that within a 1981-90 sample, a firm was more likely to merge if one of its top managers was a director of another firm that had engaged in a merger during the preceding three years (Haunschild (1993)).

Several studies test for herd behavior in corporate investment decisions. This raises the question of whether there is a general tendency toward strategic imitation.[47] Survey evidence on Japanese firms indicates that a factor that encourages firms to engage in direct investment in an emerging economy in Asia is whether other firms are investing in that country. This is consistent with possible cascading based upon a manager's

[46]In addition, a growing literature analyzes how rates of learning vary during macroeconomic fluctuations and how the learning process causes booms and crashes in levels of investment (see, e.g., Gonzalez (1997), Chalkley and Lee (1998), Chamley (1999), Veldkamp (2000)).

[47]Jain and Gupta (1987) report only weak evidence of herding in loans to LDC's by US banks. D'Arcy and Oh (1997) study cascades in the decisions of insurers to underwrite risks and the pricing of insurance. Foresi, Hamao, and Mei (1998) provide evidence consistent with imitation in the investment decisions of Japanese firms. Greve (1998) provide evidence of firm imitation in the choice of new radio formats in the U.S.. Kedia and Rajgopal (2006) find geographical clustering in the decision by firms to use option compensation for rank and file workers.

perception that rival firms possess useful private information about the desirability of such investment (Kinoshita and Mody (2001)). Gilbert and Lieberman (1987) examined the relation amongst the investments of 24 chemical products over two decades. They found that larger firms in an industry tend to invest when their rivals do not. In contrast, smaller firms tend to be followers in investment. This behavior is consistent with the 'fashion leader' version of the cascades model (Bikhchandani, Hirshleifer, and Welch (1992)) in which the less precise free-ride informationally on the more precise (if large firms have greater absolute benefit from acquiring precise information, or if there are scale economies in information acquisition).

A natural way of identifying possible herding, in the spirit of the animal behavior that gave herding its name, is to test for geographical clustering. Chaudhuri, Chang, and Jayaratne (1997) provide evidence of spatial clustering of bank branches in cities. They find that a bank's decision to open a new branch in a census tract of New York City during 1990-95 was increasing in the number of existing branches in that tract after controlling for profitability proxies.

Analogous to the endorsement effect in individual investor trading are endorsement effects in real investments. There are certainly examples in which investors act soon after others make their decisions. However, especially since there are likely to be payoff externalities, it is important to examine case examples carefully to evaluate whether investors are really imitating each other. Real estate investment is a natural field of application for cascades/endorsement effects, because the investment decisions are discrete and conspicuous (Caplin and Leahy (1998) analyze real estate herding/cascading).

Economists have long studied agglomeration economies as an explanation for geographical concentration of investment and economic activity (e.g., Marshall (1920), Krugman and Venables (1995, 1996)). Such effects are surely important. However, as pointed out by DeCoster and Strange (1993), geographical concentration can occur without agglomeration economies owing to learning by observation of others: 'spurious agglomeration.' Empirically, some papers use previous investment by other firms in a location as a proxy for agglomeration economies in predicting investment by other firms (e.g., Head, Ries and Swenson (1995, 2000)). Barry, Görg, and Strobl (2004) test between agglomeration economies and what they call 'demonstration effects,' whereby a firm locates in a host country because the presence of other firms there provides information about the attractiveness of the host country. They conclude that both effects are important.

10.2 Disclosure and Reporting Decisions

Since investors make comparisons in evaluating firms, the disclosure and reporting practices of one firm impose externalities upon others. This point is reinforced by the likelihood that the voluntary disclosure/reporting practices chosen by firms help establish informal standards for other firms (though such practices are also, of course, subject to regulation).

Disclosure and reporting practices vary over time. For example, in recent years it has been popular for U.S. firms to disclose *pro forma* earnings in ways that differ from the GAAP-permitted definitions on firms' financial reports. Regulators have expressed concern about this practice, but firms argue that this allows them to reflect better long-term profitability by adjusting for non-recurring items. It is also possible that firms are just herding, or exploiting herd behavior by investors.

Surprisingly, Pincus and Wasley (1994) report that voluntary accounting changes by firms do not appear to be clustered in time and industry, suggesting no herding behavior in accounting changes. This result further suggests that firms do not switch accounting methods in response to changes in macro-economic investment conditions that are experienced at about the same time by similar firms within an industry. Rather, the voluntary accounting changes would appear to be made in response to firm-specific needs, such as a firm-specific need to manage earnings.

However, it is not obvious why firms would manage earnings in response to firm-specific but not common factor shocks. One speculative possibility is that there is a concern for relative performance, as reflected in the model of Zwiebel (1995), combined with some deviation from perfect rationality that causes investors to adjust imperfectly for accounting method in evaluating firms' earnings.[48] The concern for relative performance may create a stronger incentive for managers to manage earnings upward when the firm is doing poorly relative to peers than when the entire industry is doing poorly.[49]

Geographical proximity does affect reporting practices. Kedia and Rajgopal (2008) find that the accounting practices of neighboring firms are correlated with the likelihood that a firm misreports accounting items resulting in accounting restatements. Presum-

[48]For example, Daniel, Hirshleifer, and Teoh (2002) suggest that owing to limited attention, investors are too credulous in the sense of failing to adjust for the interested motives of firms, and that this explains actions such as issuing equity or of failing to disclose information. Hirshleifer, Lim, and Teoh (2004) provide a model of how informed parties adjust their disclosure decisions to exploit the limited attention of observers.

[49]Consistent with this idea, Morck, Shleifer, and Vishny (1989) provide evidence that the likelihood of hostile takeover forcing managerial turnover was high for firms underperforming their industry, but was not high when the industry as a whole was underperforming.

ably this is because managers of firms in close proximity presumably interact and share information about their accounting practices. One would expect such an effect to be strongly in gray areas that could result in eventual restatement.

Furthermore, Kedia and Rajgopal (2008) find that counties that are farther from SEC regional offices have a higher frequency of income-decreasing restatements, and Defond, Francis, and Hu (2008) find that distance from SEC regional offices affect the likelihood of severe problems, SEC enforcement actions, and consequently the quality of the auditor and the financial statements. To the extent that word-of-mouth communication among auditors, managers, and regulators is localized, we expect a greater chance that parties to potential misreporting leak information about questionable practices leaks to regulators when enforcement offices are close.

Option backdating affects the way that compensation levels are reported to investors. Bizjak, Lemmon, and Whitby (2007) find that option backdating seems to spread contagiously through interlocked boards of directors, auditor links, and are also affected by geographical proximity. This suggests that word-of-mouth discussion between managers and directors spreads corporate behaviors.

11 Contagion of Financial Memes

Standard rational and behavioral models of information in capital markets usually focus on simple signals and signal processing (often using univariate signals with normal or binary distributions, and Bayesian or quasi-Bayesian updating). Such modeling does not capture the way that people accept or rule out arguments based upon chains of reasoning, triggered associations, and emotional reactions. So most existing information models say little about how thoughts and beliefs about firms or capital markets spread from person to person.

In reality, investors use verbal 'reasons' to decide how to trade, and these reasons are often not cogent. Barber, Heath, and Odean (2003) find that individual investors and their investment clubs tend to buy stocks for which plausible reasons are available (such as a firm being on a media list of most admired companies). This is despite the fact that the reasons examined do not predict superior trading performance. These reasons seem to be spread by social interaction; stock clubs favor such stocks more strongly than individuals.

Reasons, or financial *memes* (units of cultural replication, as defined in the introduction) can be simple ('buy on the dips'), or can be elaborate structures of analysis, examples, terminology, catchphrases, and modeling (e.g., portfolio theory). The contagion of such memes, their effects on markets, and (more ambitiously) how combinations of memes evolve as they move from person to person, are the subjects of a missing chapter in financial theory.

Leading the charge, Robert Shiller and coauthors have discussed and provided survey evidence about 'popular models' during bubbles in securities and real estate markets (see footnote 2).[50] We use the terms 'popular idea' or meme to refer to thoughts where there is no presumption as to whether carriers hold the thoughts because of some supporting theory or analysis.

For example, Shiller, Kon-Ya, and Tsutsui (1996) find during the late 1980's to early 1990's that U.S. investors were much more prone to viewing the Japanese stock market as overpriced than did Japanese investors, and that the popularity of this meme among Japanese investors followed market movements. They also report that a substantial fraction of investors viewed the market as overpriced but recommended staying in the market because it was going to go up before it falls—a viewpoint which lends itself to the formation of bubbles. There is need for much more theoretical and empirical research about what affects the popularity of the 'The market is overpriced (underpriced)' and the 'The market is rising (falling)' memes.

Case and Shiller (1989, 2003) find that real estate investors in 'glamour cities' have unrealistic beliefs about the risk and expected appreciation of residential housing, and that these beliefs seem to come from 'simplistic theories' that are more prevalent in glamour cities than in a non-glamour city (Milwaukee). One such meme is the idea that more desirable real estate tends to appreciate more rapidly. Case and Shiller (2003, p. 325) propose that this is because people 'confuse the level of prices with the rate of change.' Evidently people do not understand the efficient markets notion that prices ad-

[50]See also Lynch (2000) for intriguing discussion. The phrase 'popular model,' implicitly connotes some metaphor, analysis or theory of mechanism on the part of investors (even if a superficial or erroneous one). Certainly the appeal of some popular ideas comes from a justifying mechanism or story. For example, the idea, "No one ever became a billionaire holding a diversified portfolio," contains both investment advice and a simple justifying explanation. However, ideas can become popular even when the carriers lack any clear conception of mechanism at all. Such ideas are popular because of some inherent attractiveness of the idea (or some expression of it), or simply because the high prevalence of the idea makes it psychologically available and self-sustaining (just as a celebrity can be 'famous for being famous').

For example, the popular idea that during a stock market boom, investors become greedy does not seem to be based on any explanation for why greed shifts (we are not aware of any general folk psychology view that when people receive good news they become greedier). The popularity of the idea probably comes from observation of seemingly overaggressive behavior by speculators during a boom period. Rather than thinking through some model of social dynamics during a boom, it is cognitively easier to simply attribute the change in investors' behavior to a change in their internal mental state (greater greed). (Over-attribution of behaviors to personal dispositions is known as the *fundamental attribution error*; Jones and Harris (1967), Nisbett and Ross (1980).)

just immediately to reflect differences in attractiveness. Their survey evidence supports this. Another fallacy is the idea that when housing is scarce, price becomes irrelevant.

Shiller (2007b) suggests that the 1970s boom in U.S. farmland prices may have been due to the 'great population scare,' of the 1970s, which was associated with widespread media attention devoted to forecasts of mass starvation and global exhaustion of resources. This meme seems to have been reinforced by the popular idea that since the amount land is finite, as population rises and people use space to live, inevitably land will be permanently lost for cultivation, driving up prices.

Apart from Shiller's discussions and pioneering surveys, behavioral economics and finance has focused mainly on the effects of individual psychological biases, and how individuals interact through buying and selling as mediated by price. The memetic approach focuses specifically on the social transmission mechanism (e.g., conversation, or news media communication); a meme can replicate only through information that is conveyed from one person to another. Furthermore, memetics focuses on the idea's ability to hijack the psychological mechanisms of its carriers, much like the way a virus hijacks cellular mechanisms within the bodies of carriers to replicate itself.

Thus, the memetic approach is not primarily about importing ideas from social psychology into behavioral finance. It is about how memes exploit the process by which ideas are stored and replicated. This suggests a different kind of question from those typically asked in behavioral economics or in social psychology. A standard question would be, "What are the kinds of biases that individuals are prone to?" Somewhat closer to memetics is the question, "How do individual biases affect whether people will be tempted to succumb to some exogenously specified popular idea about financial markets?" Some less conventional questions are, "What are the characteristics of an *idea* (meme) in relation to its environment that help it replicate and predominate within the population of ideas?"[51], and "How do financial ideologies evolve?" Thus, the memetic perspective suggests different hypotheses, approaches to modeling, and tests.[52]

[51] There is a population of people and a population of ideas that people hold. If an idea spreads from one person to another, it has reproduced, and its frequency within the population of ideas has risen. Of course, individual psychology (and the answers to the first two questions) are still crucial for answering memetic questions.

[52] Of course, a correct memetic understanding must be consistent with a correct psychological understanding, just as correct biochemistry must be consistent with correct genetics or physics. But the memetic stance suggests different insights and research questions.

Biological evolution can be viewed as a process that leads to well-adapted genes and organisms (survival of the fittest), or as a process in which certain forces push gene frequencies in certain directions. The first stance, the Darwinian or adaptationist one, suggests that evolution can be understood as an as-if optimization over the possible characteristics a gene or organism might 'choose' to have. The alternative stance focuses on the mechanics and accounting of gene frequencies. Biologists use both

Several objections have been raised about the memetic approach to cultural evolution. This is not the place to review these issues, but we will mention that even some authors who deemphasize the need for replicators (Henrich and Boyd (2002)) still champion the propositions that natural selection operates on cultural variants, and that this results in cumulative evolution of culture. The distinction between discrete variants that are precisely copied, and continuous variants that are approximately copied, seems to be more technical than substantive. Memetic arguments still work qualitatively with only trivial rephrasing—there is still adaptiveness and as-if optimization. We replace the 'selfish meme' with the 'selfish cultural variant' that behaves almost like a meme.[53]

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types of reasoning, and done correctly the two must be consistent.

Similarly, the memetic (i.e., adaptationist) stance focuses on how selection results in the evolution of well-adapted cultural variants. This puts the spotlight on the meme metaphorically striving to be fit. A mechanical stance puts the spotlight on forces that push meme frequencies up or down. So long as it makes sense to think about adaptiveness, as in the paragraph above, these perspectives are two sides of the same coin, and must be consistent.

There is also subtle discussion among scientists and philosophers as to how to define 'replicator.' Some leading exponents of applying natural selection arguments to cultural evolution argue that some cultural representations are not replicators (memes). The problem is that cultural variants may sometimes be arrayed upon a continuum instead of coming in discrete alternatives, and if there is noise in transmission, no variant will ever be copied exactly. Boyd and Richerson (2000) accept the existence of memes, use memetic arguments and develop memetic models. However, they generally use the term 'cultural variants' in order to accommodate both memes and cultural representations that are not replicators. (A memetic argument suggests to us that this 6-syllable term has little hope of replacing 'meme'.)

[53]Henrich and Boyd (2002) provide summary of and reference to some objections to the idea that natural selection on cultural variants produces cumulative evolution. One is that socially transmitted representations are sometimes continuous and copied with noise. Another is that mental representations are transmitted between individuals in a biased fashion. According to this argument, predispositions of the human mind cause certain mental representations to be strong 'attractors,' so that in equilibrium a few popular ideas become dominant.

Henrich and Boyd (2002) give the concrete example of a continuum of possible beliefs between the belief, 'the moon is just a rock,' and 'the moon is a god'. Suppose that these two extremes are attractors; it is easier to think that the moon is a god than to think that it has 2/3 chance of being a god, and easier to think that it is just a rock than that it has 2/3 chance of being just a rock. So an individual who is exposed to the idea that the moon is probably just a rock tends to represent the moon as a rock even more strongly, and if exposed to the idea that the moon probably a god, he tends to believe this even more strongly. The critics of memetics (and of cultural natural selection) therefore argue that a few representations (e.g., either the moon as a god, or the moon as a rock) will soon dominate the population even though cultural variants fall on a continuum, that this dominance is not driven by natural selection on representations, and that selection does not create cumulative evolution.

A problem with this objection is that having strong attractors effectively discretizes the set of cultural variants. As shown in the first model of Henrich and Boyd (2002), with strong attractors, the subset of individuals who start out tending toward a given extreme quickly approach it very closely. Once the population is polarized, selection *between* the two extremes becomes important; whichever is favored by selection dominates in the long run. Boyd and Richerson conclude that even in a scenario without discrete replicators, cultural selection is important. But this scenario also illustrates that evolution through selection on discrete memes can be an arbitrarily good approximation of a continuous setting. Henrich and Boyd (2002) also develop models in which cumulative cultural adaptation occurs when either discrete or continuous memes are copied inaccurately.

In terms of modeling, a memetic approach considers shifts in population frequencies, as in population genetics models and models of disease contagion. The memetic stance further suggests developing models in which the meme is the (as-if) optimizer, selecting characteristics that will promote its own reproduction. This is analogous to models of adaptiveness in evolutionary biology in which genes that have maximal reproductive success. As discussed earlier, Shive (2008) models and tests the contagion of investment behaviors through a population, analogous to the spread of a disease. Similarly, Shiller (2000b) chapter 8 likens the spread of ideas about the stock market to a contagion spread through conversation. Epidemiological models have also been applied to the spread of ideas (see Bartholomew (1982)), an approach that could easily be applied to the spread of an investment idea (e.g., 'Sell your losers, ride your winners') as an infection.

Similarly, the rate at which financial ideas replicate in population can be measured. For example, Shiller (2007a) (discussed further below) measures the rise and fall in popularity of the concept of the real rate of interest. Natural further memetic questions are, in what ways are this meme adaptive to its environment? How well does it exploit the transmission mechanisms that copy ideas from person to person? The answer to this will depend on the characteristics of this meme and its environment (most notably the existing population of memes, and the population of people who carry those memes). For example, the meme is not instantly understandable, which hinders its spread. In an environment of low and stable inflation, the real/nominal distinction becomes less useful in daily life, which hinders the meme's spread. In general, the answers to these questions explains the evolution of the meme's frequency.[54]

Some characteristics that help a meme reproduce include logical cogency, ease of cognitive processing (portfolio theory would be more popular if it were easy to learn), and emotional vividness (hence, the popularity of dysfunctional investment memes that promise ways to 'get rich quick'). The characteristics of the environment that matter include the effectiveness of unrelated memes that struggle for attention in people's minds, and the cogency or vividness of directly competing memes that oppose the given meme. For example, the meme, 'Sell your losers, ride your winners,' is opposed by the meme, 'Buy or sell based on expectations, not history.'

A great puzzle in finance is why individual investors trade actively or place money with actively trading money managers. This effort to beat the market leads to wasted transactions cost and (if correlated investor sentiment affects price) to subnormal gross

[54]Berger and Heath (2005) perform several field and experimental laboratory tests of the effects of 'idea habitat,' the range of situations in which people have the opportunity to use a meme, on its success in reproduction.

returns. Information cascades and memetics can potentially help explain the attractiveness of active investing by non-experts. If friends and acquaintances are investing in an active mutual fund, an individual who learns this but does not observe their return performance can be in a cascade, and imitate.

Furthermore, a conversational bias helps the meme that 'Active trading is the road to exceptional profits,' survive, despite the damage done to its carriers. People like to talk about their trading gains more than their losses. This means that in conversation with acquaintances people hear more about the upside to active trading than the downside. If listeners do not discount for this bias, they will overestimate the benefits to active trading. Such effects should be exacerbated when an individual spends more time discussing investments, as occurs when an individual participates in an investments chat room, message board, or investment club.

Biological evolution has led to the development of coadapted teams of genes that produce organisms. Distin (2004) calls coadapted sets of memes *assemblies*. Dawkins (1976) gives the examples of religions, scientific theories, and philosophies. For our purposes we will refer to *financial ideologies*, with no intended implication that such ideologies are either good or bad. For example, the meme 'dead cat bounce' is too simple and disjoint from other financial memes to be an ideology or part of an ideology. In contrast, the efficient markets hypothesis is a highly elaborated financial ideology (which happens to have a great deal of validity) supported by arguments, formal models, statistical evidence, vivid examples, and prestigious proponents.

It is intuitive that *valid* financial ideologies would develop through cumulative evolution and prosper, but invalid ideologies also do so. Although the surveys of Shiller and his coauthors do not focus on distinguishing simple financial memes from assemblies, their research is a first step toward identifying financial ideologies and devising theories of how they develop.

To give some hints of the memetic approach, we discuss some speculative examples of how popular financial ideologies seem to be adaptive (good at spreading themselves). Shiller (2000b) provides insightful historical review of popular ideologies that developed and prospered during past market booms. Similar ideas recur over the decades, as with what Shiller calls 'New Eras Theories' of the stock market. It seems that periods of rising stock prices, which investors observe and seek to explain, provide a salubrious habitat for the 'New Era' ideology which seems to evolve repeatedly and independently.[55]

[55] In his chapter 5, entitled 'New Era Economic Thinking,' Shiller discusses remarkable parallels between the turn of the century optimism of 1901, the 1920s optimism, the new era thinking of the 1950s and 1960s, and new era thinking in the 1990s.

Such repeated evolution of similar ideologies is reminiscent of the repeated independent biological evolution of behaviors (flight) or organs (the eye). It raises the hope that the adaptiveness concept (for memes, not people) can help explain cumulative memetic evolution, just as adaptiveness helps explain genetic evolution.

Memetics is complementary to the notion of availability cascades (see Section 9). When an environmental shift creates an exceptional opportunity for a meme to spread, often an availability cascade is triggered. The availability cascade concept focuses on spasms of activity in public discourse. An area of possible financial application is to bubbles and crashes); and to the psychological effects of availability. The field of memetics concerns all aspects of the evolution of populations of ideas, including both stable evolutionary equilibria and periods of dynamic shifts; and including all psychological forces that affect the reproduction memes.

The marketing of an IPO can be viewed as a way of trying to trigger an availability cascade wherein the idea that the company is a good investment suddenly becomes popular.[56] In the dot-com period an availability cascade supported the meme that the Internet was a uniquely spectacular investment opportunity. This meme was mutually reinforcing with more specific memes (and availability cascades) about particular dot-com startups, such as Netscape.

As discussed in Subsection 4.3, in bad times people crave safety, and in good times opportunity (Mullainathan and Shleifer (2005b)). Mullainathan and Shleifer find that advertisers adjust their persuasion activities accordingly. More generally, even apart from the exploitive efforts of sellers, during downturns we expect memes about danger versus safety to spread in popular discussions, and during upturns memes about opportunity. The memes that investment clubs or day-trading are ways for individual investors to achieve exceptional performance became popular during the 1990s, a period of rising stock prices. This was probably due in part to a self-feeding effect in which individuals learned from advertising, the media, and word of mouth that many others were engaged in these activities, and supposedly profiting thereby. The rise and fall of these practices therefore seem to be availability cascades.

These examples are a kind of micro-evolution of memes in response to changing market conditions. Perhaps the most basic micro-evolution in financial markets is the perpetual seesawing contest between bullish and bearish memes. These fluctuate in response to fundamental news, the rise through mutation of salient new memes ('The Internet changes everything'), and emotional factors that influence the public mood.

[56]Pollock, Rindova, and Maggitti (2008) discuss information cascades and availability cascades in IPOs.

Another example of such microevolution is provided by the wide swings in popularity of the value ideology versus the growth ideology, the tech boom and bust being the most spectacular recent example. In good times, it is the most speculative stocks (growth options) that tend to do the best, which seems to provide evidence in favor of the growth investing approach. Furthermore, emotionally there is a mood of optimism, which encourages the pursuit of opportunity. During times of opportunity people want to feel that they are 'with it,' that they 'get it,' and are not 'old fogies' (a somewhat old-fogeyish expression).

In contrast, in bad times the evidence from recent returns seems to lend support to the value ideology. Emotionally, investors seek greater safety. Furthermore, the pessimism of such times places a higher premium on the virtue of frugality. The emphasis of the value investing approach on measures of 'cheapness' of stocks plays to this. Indeed, the value ideology provides an emotionally catchy and ego-boosting narrative of folly (by others, the greedy speculators) and wisdom (by the self, the wise and prudent value investor). Proponents of value investing often condemn the irresponsible behavior of previous 'go-go years.' The moralistic tone of value investing expositions in the popular media is striking. This reveals a successful strategy used by the value meme assembly.

Although the value and growth ideologies are subject to microevolution, they also contain deep wells of appeal which allow them to successfully ride out good times and bad. It is easy to see how frequency-dependent natural selection might lead to a long-term equilibrium in which these conflicting ideologies coexist. When there are many growth investors, growth stocks become overvalued, increasing the subsequent profits of value investors; greater profits generate more favorable stories which can be passed on, spreading the ideology. The reverse occurs when there are few growth investors. A similar reasoning suggests that bullish versus bearish ideologies are self-limiting. In the language of genetics, we expect a balanced polymorphism. To develop a memetic understanding of the micro- and macroevolution of these ideologies, research is needed to understand how they exploit investors' psychological needs.

Shiller (2007a) emphasizes that changes in popular economic models should be viewed as central to understanding periods of asset overvaluation. Following Modigliani and Cohn (1979), he argues that as a result of money illusion on the part of investors, low nominal interest rates lead to higher valuations of assets. In particular, investors are currently unaware of the real versus nominal interest rate distinction, and discount at nominal rates without adjusting forecasts of future dividends for forecasts of inflation. He documents the historical rise in public references to 'real interest rates,' and finds that recently the use of the phrase has dropped precipitously. He also documents the recent rise in popularity of the meme that global markets are 'awash with liquidity,' by performing Lexis-Nexis search of this phrase.

There are also managerial fads, and stable popular theories about management methods (such as EVA), capital budgeting techniques (e.g., payback versus NPV), and other aspects of corporate investment and financing policy. As discussed in Subsection 4.3, there is evidence that some corporate behaviors spread across firms through the interlocking social networks of managers and boards. Goldfarb, Kirsch, and Miller (2007) model the influence of the 'get big fast' ideology about the best strategy for Dot Com startups to achieve success, and provide evidence suggesting that it resulted in overinvestment by existing firms and too little entry. (This ideology was motivated in large part by the economic theory literature on network externalities and increasing returns.) They model the adoption of this meme as an information cascade.

The payback criterion is invalid, but decades of explaining its inferiority to NPV to MBAs have not yet completely stamped it out. As an illustration of the memetic approach, consider the following speculative explanation. The extreme simplicity of payback makes it easy to absorb and apply. Furthermore, the ability to use it for quick back-of-the-envelope calculations has the effect of spreading it. Young managers who see senior managers using it infer that it is an acceptable (perhaps even preferable) approach. Valid or not, this simple story illustrates how information cascades and psychological bias can complement the memetic approach.

Financial ideologies also influence public policy. Hirshleifer (2008) discusses the self-promoting characteristics of what he calls the *ideology of anti-short-termism*. He argues that this is meme assembly combines a number of ideas that are conceptually unrelated but emotionally linked, and that it is an important driver of financial and accounting regulation.

12 Conclusion

Observers have long wondered whether sudden large shifts in prices, actions, and resource allocation in capital markets are caused by social contagion. Such phenomena include asset and security market booms and crashes; real investment booms and busts; takeover and financing waves (including boom/bust patterns in the design of securities, such as asset backed securities); shifts in disclosure practices (such as the use of pro forma earnings disclosures; and financial market runs. Often the behaviors of relevant participants converge despite negative payoff externalities, suggesting that such patterns may be caused by contagious effects of psychological bias, or by the failure of rational social learning to aggregate information efficiently.

We review here the causes and effects of contagion of thoughts and behaviors in capital markets among participants such as investors, managers, security analysts, advisors, and media commentators. We examine theory and evidence about how rational observational learning, agency problems, and psychological forces affect contagion in firms' investment, financing, and disclosure choices and in investors' trading decisions; and the consequences of contagion for the pricing of real assets and securities. In addition to herding by managers or other agents, we consider how such agents exploit the readiness of investors to herd.

An externality problem is central to the theory of rational observational learning. Each individual maximizes his own payoff without regard to the effect of his choice on the information obtained by later decisionmakers by observing the individual's action choice and/or the payoff consequences of that choice. Over time, individuals act mainly based upon the accumulated inventory of public information (perhaps including payoff information) generated by past actions. This delays or blocks the generation and revelation of further information.

Thus, in a range of economic settings, even if payoffs are independent and people are rational, decisions tend to converge quickly upon mistaken action choices. In other words, the resulting cascade or herd is idiosyncratic. Owing to idiosyncrasy, rational individuals place only modest faith in the conventional action; the cascade or herd is easily dislodged (fragility). Furthermore, under rational observational learning tends to cause simultaneity (delay followed by a sudden spasm of joint action), paradoxicality (increasing the availability of public information by various means can decrease welfare and decision accuracy), and path dependence (chance early events have big effects on ultimate outcomes).

Depending on the exact assumptions, information may be completely suppressed for a period (until a cascade is dislodged). Under other assumptions, no cascades form, and asymptotically all uncertainty is resolved, but too slowly (relative to full aggregation of private signals). Information cascades require discrete, bounded, or gapped action space (or cognitive constraints); these conditions are highly plausible in many investment settings. Even when these conditions fail, owing to noise, the growth in accuracy of the public information pool tends to be self-limiting, because an individual who places heavy weight on the information derived from past actions puts little weight on his own signal, making his own action less informative to those who follow.

Markets have been praised as marvels of spontaneous information aggregation (Hayek (1945)). Indeed, we see that rational price-setting in perfect markets encourages investors to use their private signals rather than imitating the trades of others, discouraging direct information cascades of trading. However, in settings with multiple dimensions of uncertainty, quasi-cascading behavior can occur in which individuals trade in opposition to their information signals.

Furthermore, transaction costs, minimum trade sizes, or psychological biases can prevent price from fully aggregating information. As a result, trading cascades proper can form, including cascades in participation versus non-participation in markets. Even without frictions or biases, information cascades (and other sources of herd behavior) in investigation indirectly affect trading and the amount of information aggregated into market price. So despite some arguments to the contrary, in several economic settings information cascades affect securities trading and prices.

Although inefficient behaviors can be locked in by non-informational factors (such as positive payoff externalities), the theory of rational observational learning, and especially the information cascades theory, differ in their implication of fragility. So payoff externality models are helpful in explaining herds that seem stable and robust.[57] Reputational models, for example, generate stable patterns of herding or dispersing through endogenously generated payoff externalities. Reputational models help explain when herding versus dispersing will occur, and offer implications about the effect on the pressure to herd of the career statuses of managers.

We need new models of price setting in financial markets in which beliefs are not transmitted solely through price, in which ideas spread between neighbors in a social network, and by means of electronic media. Furthermore, we need analysis that reflects the fact that the information that is conveyed is not necessarily a simple normally distributed signal, processed in some rational or quasi-rational fashion. Often what are conveyed are investment ideas, or memes, and we need to understand how both isolated financial memes (e.g., 'This stock is going to rise') and full-fledged financial ideologies (such as 'New Era' theories, and the value and growth ideologies) spread from person to person as a sort of social epidemic. Empirical testing will of course be crucial for a research program based on thought contagion to succeed.

Such a program involves understanding the spread of particular financial memes viewed as an epidemic, studying what characteristics of financial memes tend to promote their own replication, and what characteristics of the environment favor different kinds of memes. In other words, it involves studying what makes some financial memes more better-adapted than others. Even more ambitiously, it is important to understand why

[57] However, informational effects including cascades can still occur in settings with payoff externalities, leading to idiosyncratic (though not fragile) outcomes.

certain financial memes complement each other, and how this leads to the cumulative evolution of financial ideologies that are well-adapted in the sense that they are good at spreading themselves.

We have suggested that many of the puzzles and anomalies of capital markets can be understood by going beyond a focus on individual psychological biases and how biased individuals interact through trading and market price. Instead, as Robert Shiller has proposed, we need to understand the social processes that lead to the spread of popular ideas. For dynamic phenomena such as bubbles and crashes, the concept of availability cascades is especially promising. We have offered some tentative speculative memetic explanations for such phenomena as the survival of invalid capital budgeting methods and money-losing active trading strategies, bubbles, hot IPOs, short-run fluctuations in the profitability of value versus growth strategies and frequencies of the value and growth ideologies, and long-run coexistence of these ideologies.

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