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SURVEY EVIDENCE ON DIFFUSION OF INTEREST AND INFORMATION AMONG INVESTORS*

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Questionnaire surveys of institutional and individual investors were undertaken to learn about patterns of communications. It was found that direct interpersonal communications are very important in investor decisions. Questions elicited what fraction of investors were unsystematic and allowed themselves to be influenced by word-of-mouth communications or other salient stimuli. Randomly sampled investors were studied as well as investors in stocks whose price had recently increased dramatically. Contagion or epidemic models of financial markets are proposed in which interest in individual stocks is spread by word of mouth. The survey evidence is interpreted as supporting such models.

1. Introduction

How do investors develop interest in and receive important information, leading to decisions about investments? Does a chain of communication, from one investor to another, plan an important role? That is, is contagion of interest important in financial markets? Or does their interest and information tend to come directly from stockbrokers or from publications? Are conversations among investors related strongly to news breaks, as is the interest evinced by the news media? Does initial interest that most investors show in individual stocks tend to be systematic or capricious? Most of us have casual impressions as to the answers to these questions, but apparently no thorough study has been undertaken before.

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We have undertaken investor surveys whose purpose is to learn something about this 'information technology' and 'social psychology' in financial markets. In all surveys, investors were questioned about specific stocks that they had purchased. Both institutional and individual investors, and investors in both random samples of stocks and rapid price increase (RPI) stocks were surveyed.

The surveys of investors were motivated by 'epidemic models' of the transmission of interest and information. One simple epidemic model is discussed in section 2 below and will be used in section 4 to scale infection and removal quantities for the time interval over which they were observed. The survey methods are described in section 3. Some general results are described in section 4. In section 5 we conclude.

2. An epidemic model

Contagion or epidemic models, like those used by epidemiologists to study the transmission of disease [e.g., Bailey (1975)] or social psychologists to study rumors or fads [e.g., Bartholomew (1982)] would seem to be naturally of relevance to understanding the spread of investor interest in specific financial assets, and hence to understanding the predictability of returns, volatility of prices or volume of trade in financial markets. Psychologists have shown that direct interpersonal communication among peers is of singular importance in the transmission of attitudes [see for example McGuire (1985)]. Interpersonal communication among peers seems to produce the kind of attention and reassurance that leads to changes in behavior. This fact is well recognized today in marketing: advertisements often try to create the impression of such communication.

The relevance of such contagion models in finance remains today one of conjecture; there is little concrete evidence concerning them.[1] Researchers perhaps despair of studying them, since they feel that they do not know how to disentangle such behavior from behavior that is purposeful and intelligent. It should be noted, though, that the psychological literature does not hypothesize that the above models apply only to the less intelligent individuals. Still, we would expect that the effect of investor epidemics would be attenuated by some 'smart money' that is more systematic in approach to investing, though such smart money need not eliminate an effect on price and certainly would not eliminate an effect on transactions volume. The epidemic model below is meant to apply to ordinary investors. Our survey results will give some indication what fraction of investors might be described in those terms.

The classic general epidemic model of Kermack and McKendrick (1927)

[1]See, however, Alder and Alder (1984).

used to represent the spread of contagious diseases has also been used to represent the time pattern of rumors, attitudes or fads. Their model in its simplest form hypothesizes that the number I_t of infectives (or, in our application, information carriers or interested people) is increased by an amount per unit of time equal to an infection rate b_t times the number of infectives, while b_t is itself proportional to the number S_t of susceptibles. At the same time, infectives cease to carry the disease (in our application, forget or lose interest) and become immune to the disease at a rate per unit of time equal to a constant removal rate g times the number of infectives. The time path of I_t can show a hump shaped pattern through time, rising at first and then declining, or a decaying form in which the epidemic only declines from its initial intensity.

A special case of the general epidemic model that would appear especially relevant for markets for individual stocks occurs when the number of infectives remains a very small proportion of the total population, so that the number of susceptibles is close to the entire population. Then we can regard the infection rate b_t as a constant b. The differential equation for the total amount of interest for a particular stock among all people I_t is then just

$$dI_t/dt = (b-g)I_t + u_t, \tag{1}$$

where the error term u_t is due either to the 'source' of the epidemic or to variations in the process of contagion.[2] We shall adopt eq. (1) as our epidemic model for use in section 4 below.

Supposing that $b<g$ and that the source u_t of the epidemic has an influence only for an instant (as would be the case if, for example, the source was the sales efforts of stockbrokers in an initial public offering or a single widely publicized news story at time 0) then the total interest in the stock would follow an exponential decay pattern. However, hump shaped patterns for total demand for the stock could still be produced by assuming that total demand for the stock is a distributed lag on I_t (if investors take time to invest after their initial interest) or if the 'source' continues to attract interest for a while, as for example if it too had an exponential decay pattern. Again, of course we would not expect to see such a hump pattern conveyed without alteration into price, although such behavior on the part of ordinary investors might be manifested in the 'mean-reverting' phenomenon for price movements observed by Campbell and Shiller (1988a, b), Fama and French (1988), and Poterba and Summers (1987).

Other plausible assumptions will produce I_t that closely resembles a random walk. Suppose that g is only a little smaller than b and that the

[2]In the study of the diffusion of news, rumors or ideas the 'source' may be well defined: e.g., a particular advertisement. See Bartholomew (1982).

error term is serially uncorrelated noise (formally we may replace $u_t dt$ with the stochastic differential of a Wiener process). Here, the uncorrelated shocks to demand are cumulated by an (ever changing) pool of interested investors, to produce a level of interest whose change is nearly unforecastable. Such an outcome could be part of the reason for the approximate 'random walk' behavior of stock prices.

Such serially uncorrelated u_t might come about as attention is drawn to the stock by random associations with other events. News stories or commonly noted events may remind people of the stock in capricious ways. Publicity given to success or failure of other stocks that superficially resemble the stock may cause conversations about the stock. Conversely, important news about other stocks may divert attention from the stock. Opportunities to spread interest in a given stock may be influenced by patterns of social interaction that may vary irregularly over time; conversations about the stock may be concentrated in certain subgroups of the population that share irregularly varying activities and diversions. Investment advisory publications whose policy is to single out a few stocks for special consideration may capriciously focus attention on the stock at irregular intervals.

Such a theory of random walk behavior for prices is inherently a rather weak one, in that it relies on serial uncorrelation of shocks that need not be so, and the theory can be only part of the random walk story. 'Smart money' must certainly also play a role in causing prices to behave like a random walk. Evidence from the market for single family homes, where there are barriers to exploitation of profit opportunities by 'smart money', shows that prices are not well approximated by a random walk [Case and Shiller (1989)]. Smart money may be responsible for the low serial correlation of price changes and yet price movements may still be driven primarily by irrational fashions and fads [Shiller (1984)].

3. Survey description[3]

Four samples of investors were collected: 1. a random sample of institutional investors (INST-RAND) 2. a random sample of individual investors (INDIV-RAND), 3. a rapid price increase sample of institutional investors (INST-RPI) and 4. a rapid price increase sample of individual investors (INDIV-RPI).

For our samples of institutional investors, we first sampled stocks and then sought out investors in these stocks. For INST-RAND a sample of 10 stocks was selected at random from the Standard and Poor's Daily Stock Price Records for the New York Stock Exchange, American Stock Exchange and Over the Counter Stocks. For INST-RPI a sample of 10 stocks was selected

[3]See appendix for further details of survey methodology.

Table 1

Comparison of the four samples.[a]

	Random samples (RAND)	Rapid price increase samples (RPI)
A. Institutional investors (INST)		
Price increase End of June 1984 to end of June 1985	9.0%	184.5%
Earnings price ratio June 1985	5.6%	2.5%
B. Individual investors (INDIV)		
Price increase[b]	9.4%	40%[c]
Earnings–price ratio[d]	5.8%	0%[c]

[a]Figures shown are averages (weighted by number of completed questionnaires). E/P ratios and price increase figures exclude Continental Illinois Holding Company. The data on earnings forecast changes exclude Continental Illinois Holding Company (two respondents) in the INST-RAND group of institutional investors and exclude Barris Industries, Chilton Corporation and Safeguard Services (these accounting for a total of three respondents). Data for individual investors in the INST-RAND group are based on only the firms for which the respondent indicated a legible firm for which price and earnings were quoted in Standard and Poor's Daily Stock Price Records.

[b]Price increase for random sample of individual investors is average price increase over the year preceding the date respondents indicated that their holdings of the COMPANY (that they identified) reached maximum. Price increase for the RPI sample of individual investors is price increase for the company in two months following the effective date of the IPO.

[c]Statistics for the single firm used to construct the RPI individual investor sample are rounded to discourage identification of the company.

[d]Earnings–price ratio for INDIV-RAND is the average for the date respondents indicated shares in the COMPANY (that they identified) reached maximum. Earnings are for the preceding 12 months. Earnings–price ratio for INDIV-RPI is for the initial public offering, June, 1985.

from the list of 25 stocks experiencing highest price increases in the preceding year, as reported on the first page of Trendline's Current Market Perspectives, of June, 1985 and the OTC Chart Manual, of May–June 1985. The stocks in the RPI group were further selected to have high price-earnings ratio and other characteristics (see appendix). For each of these samples of stocks, institutional stockholders were then selected from those firms who had reported to the Securities and Exchange Commission that they held one of the stocks on either March 31 or June 30, 1985.

For institutional investors, our questionnaires were sent to senior officers of the institutions asking that the questionnaire be forwarded to the 'decision makers' who were responsible for the institution's holding of the stock in question. We emphasized that only actual decision makers should fill out the questionnaire. Respondents were urged to call us collect if they had any questions (we received about 20 phone calls). We thus compiled a sample for

INST-RAND (30 usable completed questionnaires) and a sample for INST-RPI (41 usable completed questionnaires).

For our random sample of individual investors INDIV-RAND, we took a list that was a random high-income sample of 500 individuals from the continental United States, provided for us by Survey Sampling, Inc. The first question on the questionnaire inquired whether they had purchased common stock, and to indicate the name of the stock they purchased most recently. These respondents were told that the company they indicated would be referred to as the COMPANY in following questions on the questionnaire. From these we received 156 usable completed questionnaires from stockholders. Our rapid price increase sample INDIV-RPI of individual investors was produced from a random sample of stockholders in a single company, which had an initial public offering (IPO) a year earlier, followed by a dramatic price increase despite negligible earnings. (The price had declined back to the neighborhood of the offering price by the survey date.) The company agreed to allow us to use a random sample of 204 of their stockholders on the condition that we not disclose the name of the company. We received 134 usable completed questionnaires for our INDIV-RPI sample.

We believe that our random samples of both individual and institutional investors are genuinely random samplings from the entire U.S. population and thus indicative of general investor traits. Of course, since not all members of the sample responded to our questionnaires, there is a possibility of selection bias in those answering questions. However, we took great pains to maintain a high response rate (see appendix for details), and achieved a 59% response rate from institutional investors, a 59% response rate from our INDIV-RAND group of individual investors and a 66% response rate from our INDIV-RPI group of individual investors. These high response rates are our best protection against selection bias.[4]

The composition of our RPI samples could be described in various ways. We emphasize the fact that, since the price increased a lot in these stocks, important information about the stock became public in the recent past. We included the rapid price increase samples in our study because we wanted to study stocks for which interpersonal communications might be intense. The behavior of investors in these stocks are of particular interest, for example, in understanding the alleged phenomena of 'hot markets'. The samples might also be described as samples of successful investors, but this latter interpre-

[4]High response rates are in a sense more important than large sample size, a fact that is overlooked by many surveyors. The uncertainty related to simple sampling error has a known magnitude given by computed standard errors while the magnitude of sample selection bias is not known. The response rates in the text are based on counts of cooperative responses, while not all responses yielded usable questionnaires (for example, some indicated that they were out of frame).

tation is of limited use, since most investors did not buy and sell over the interval we used to define the price increase. A third interpretation of the RPI samples, and the most tenuous of the three suggested here, is that the RPI sample, with high price increases to high price-earnings ratios, might be interpreted as samples of stocks that were overpriced by overly enthusiastic investors. Indeed, the single firm in our RPI individual investor sample had been identified in a prominent article in *Barrons* a few months before the survey as an example of a fad like the computer stock fad a few years earlier.[5] The stock had a good 'story' to go with it, i.e., the company was pursuing a simple new idea in marketing that most investors could appreciate.

In considering the third of the above interpretations, note that DeBondt and Thaler (1985) found that stocks whose price had risen very dramatically tended to have negative abnormal returns in subsequent years. A number of other studies have shown that stocks whose price is high relative to earnings tend to have negative abnormal returns.[6] These studies thus suggest that high price increase and high P/E stocks may be overpriced (perhaps because of a fashion or fad) and thus tend to do poorly subsequently. However, the extent to which these stocks actually tend to do poorly subsequently is not enough to allow us to say that we can identify overpriced stocks with any reliability.

4. Survey results

4.1 Source and nature of initial interest

We asked a series of questions aimed at discovering how investors became interested in and decided to buy stock in a particular company. The results are reported in table 2, parts a and b.[7]

From these results, it would appear that initial interest in individual stocks is usually motivated at least in part by interpersonal communications. Among institutional investors, most in both the INST-RAND and the INST-RPI groups said initial interest was stimulated by another investment

[5]The *Barron's* article pointed out that the firm had never made a profit and was selling at a very high multiple over projected earnings in a business where many active competitors were in the field.

[6]Reinganum (1981) claimed that the effect of the price relative to earnings was really subsumed by a 'size effect', however Reinganum's finding was disputed by Basu (1983) and Peavey and Goodwin (1983).

[7]These questions ask subjects to report on the sources of their own behavior, and thus is of the kind that is widely criticized. However, even critics of such questions will admit that 'Accurate reports will occur when influential stimuli are salient and are plausible causes of the responses they produce'. [Nisbett and Wilson (1977).] We think that careful wording of questions can in the case of investments in particular firms often isolate the initial source of interest. See Katz and Lazarsfeld, 'The Art of Asking Why. (1955).

Table 2a

Questions to institutional investors on sources of interest.[a]

Did any of the following motivate your initial interest in a way that led to your purchase of COMPANY stock?

	[CIRCLE ONE NUMBER FOR EACH] Yes	No
a. An investment professional.	1 [53%, 75%] (9%, 7%) *n*:30, 40	2 [47%, 25%] (9%, 7%)
b. A person who is not an investment professional.	1 [10%, 30%] (5%, 7%) *n*:30, 40	2 [90%, 70%] (5%, 7%)
c. A newspaper, magazine, television or radio show.	1 [0%, 15%] (−, 6%) *n*:30, 40	2 [100%, 85%] (−, 6%)

If YES, name of periodical or show: _____

d. An investment advisory newsletter or brokerage house recommendation.	1 [30%, 52%] (8%, 8%) *n*:30, 40	2 [70%, 48%] (8%, 8%)

If YES, name of newsletter or brokerage house: _____

e. My initial interest was the result of my, or someone else's, systematic search over a large number of stocks (using a computerized or other similar search procedure) for a stock with certain characteristics.	1 [67%, 25%] (9%, 7%) *n*:30, 40	2 [33%, 75%] (9%, 7%)

[a]In the square brackets beneath each answer are the percent of the random sample of institutional investors (INST-RAND) followed by the percent of rapid price increase sample of institutional investors (INST-RPI) who chose that answer. Beneath (in parentheses) are the standard errors for the percents, and the number *n* who chose to answer that question.

Table 2b

Questions to individual investors on sources of interest.[a]

a. What first drew your attention to the COMPANY?
(open ended question, our coding of their answers:) n:131, 124

1. Friend or relative	[13%, 31%]	(3%, 4%)
2. Worked for company	[21%, 0%]	(1%, –)
3. Someone involved with co.	[3%, 7%]	(1%, 2%)
4. Broker	[33%, 24%]	(4%, 4%)
5. Spinoff of successful co.	[2%, 0%]	(1%, –)
6. IPO – publicity	[2%, 6%]	(1%, 2%)
7. Periodicals – newspapers	[6%, 7%]	(2%, 2%)
8. Customer of co.	[2%, 3%]	(1%, 2%)
9. Inherited or gift	[2%, 3%]	(1%, 2%)
10. Performance of similar co.	[0%, 27%]	(1%, 4%)

b. Was a stockbroker influential in getting you to buy stock in the COMPANY?

Yes	No
[37%, 33%]	[63%, 67%]
(4%, 4%)	(4%, 4%)

n:153, 122

c. Was another person you spoke to, besides a stockbroker (for example, a friend or business associate), influential in getting you to buy stock in the COMPANY?

Yes	No
[33%, 50%]	[67%, 50%]
(4%, 4%)	(4%, 4%)

n:152, 122

d. Was the fact that someone (whom you know or know of) bought stock in the COMPANY influential in getting you to buy the stock?

Yes	No
[28%, 44%]	[72%, 56%]
(4%, 4%)	(4%, 4%)

n:153, 121

e. Was your decision to invest in the COMPANY the result of your, or someone else's. systematic search over a large number of stocks for a stock with certain characteristics?

Yes	No
[38%, –]	[62%, –]
(4%, –)	(4%, –)

n:145, 0

f. When you made the decision to purchase the COMPANY stock, had you recently conducted your own analysis of the company and its likely stock performance? This might involve using Value Line, other reports, computerized databases, etc.

Yes	No
[23%, 16%]	[77%, 84%]
(4%, 4%)	(4%, 4%)

n:147, 119

[a]In the square brackets by each answer are the percent of the random sample of individual investors (INDIV-RAND) followed by the percent of rapid price increase sample of individual investors (INDIV-RPI) who gave that answer. In parentheses are the standard errors for the percents. Also given are the number n who chose to answer that question, first for the INDIV-RAND group and second for the INDIV-RPI group.

professional, and some percent were also motivated by a person who was not an investment professional. Among individual investors, about a third in both groups were motivated by stockbrokers and another third in the INDIV-RAND group (and half in the INDIV-RPI group) were motivated by another person, not a stockbroker.[8]

It is a very strong result here that both individual and institutional investors generally do not get interested in individual stocks by reading about them alone. There is a strong interpersonal component to investing, as hypothesized in epidemic models. This confirms for investors the 'two step flow of communication' from media to influentials to others shown first by Lazarsfeld and Katz (1955) in other contexts.

Among individual investors, a substantial part of this interpersonal communication takes the form of communications with stockbrokers. However, since only about a third of individual investors say their initial interest came from stockbrokers, stockbrokers themselves are apparently not the direct cause of most investor interest. Moreover, there is other information in the results that suggest the importance of a chain of infection among investors themselves. Note that 28% in the INDIV-RAND group and 44% in the INDIV-RPI group said that they were influenced by the fact that someone they knew or knew of bought stock in the company. We shall see in the section below on infection rates that, even though many people claim not to have become interested via interpersonal communications, a substantial number of investors claim to have interested many others.

The most striking bit of evidence that some sort of diffusion of information model has some truth to it is in answers to the questions e in the two parts of table 2. Most individual investors and most of the institutional investors in the RPI group denied that they were systematic in their decision to buy the stock, that is, they answered no to part e. Most of the INST-RAND investors answered yes to part e, claiming that they were systematic, yet even in the INST-RAND a third said that they were not systematic.

For individual investors, it is also the case that most do no analysis of the company themselves. The results to question f in table 2b show that less than a quarter of individual investors do any analysis.

The differences between the random samples and the rapid price increase samples are important. Institutional investors in the rapid price increase group are less systematic and more influenced by interpersonal communications than are random institutional investors. Individual investors in rapid price increase stocks are also more likely to be influenced by interpersonal communications than are random investors. This might mean that it is

[8]Lease, Lewellen and Schlarbaum (1976) found that older investors relied less on stockbroker advice. In their five 'clusters' of investors, the percent reporting relying on brokers' advice ranged from 14% to 34%. They also found (1974) that only 7% of investors 'rely primarily on paid investment newsletters or investment counsellors advice'.

difficult to be systematic about stocks undergoing rapid information flow, and an epidemic flow of information might therefore come about. Or, it might mean that the price increase itself is the result of a social movement among a class of investors who are vulnerable to fads or fashions in markets.

We asked respondents to try to recall their expectations, on the date when their shares held reached their maximum, for the percentage increase in price per share in the succeeding year. We found remarkably high expected increases: an average increase expected of 33% for the INST-RAND group, 54% for the INST-RPI group, 38% for the INDIV-RAND group, and 30% for the INDIV-RPI group.

We also asked institutional investors whether the respondent was 'sufficiently enthused about your purchase of COMPANY that you thought about it during your leisure hours'. Of the INST-RAND group, 37% said yes, of the INST-RPI group, 63% said yes.[9] We asked of individual investors 'Were you enthusiastic and excited about the company *before your recent purchase*?' Among INDIV-RAND, 60% said yes, among INDIV-RPI, 63% said yes.

With such unsystematic and interpersonal behavior, such high expectations for profit and enthusiasm, contagion of interest seems plausible.

4.2 Timing of discussions

All respondents were asked the date when they first became interested in the stock and when their holdings of the stock reached maximum. We will refer to the time between the two dates as t_2 and the time between the latter date and the questionnaire date as t_1 (both measured in years). Their sum, the total time since the individual became interested in the stock, will be denoted as $T = t_1 + t_2$.

An important question for our purposes is whether communications with others proceeds smoothly from person to person, as in epidemic models, or whether they tend to bunch around dates of news events. We asked the institutional investors: 'When were you most active in discussing COMPANY stock with others?'[10] Spaces were provided to enter the month and year. There was little apparent bunching of dates. For each of two firms[11] there was one date given twice. For one firm, one date was given by three respondents. But there was no other such coincidence of dates.[12] For the random sample of institutional investors, active discussion came on average

[9] We did not ask institutional respondents to recall their level of enthusiasm before they purchased, so the difference between groups on this question may be due only to the success of the RPI group.

[10] The actual questionnaire had in place of the word COMPANY the name of the company for the institutional samples and the RPI individual samples.

[11] Zenith Labs and Stocker and Yale.

[12] Limited, Inc.

3.2 months (s. e. 1.7) before the date t_2 when holdings reached maximum, for the RPI institutional group, 1.6 months (s. e. 1.4). Note that for institutional investors purchases are rarely on a one-shot basis. We found in an earlier paper (1987) that for most institutional investors, if quarterly holdings are plotted against time, a 'hump-shaped' or other smooth pattern tends to emerge. Thus, the time of maximum conversations for institutional investors tends to come after some purchases are made but while they are still purchasing. We also asked of our two individual investor samples: 'Did the most important discussions you had with others about the COMPANY tend to come right after and in response to some important news break that was related to the COMPANY?' With INDIV-RAND 63% said no, while with INDIV-RPI 76% said no.

We interpret these results as favorable to the notion that the timing of information spread is determined to a substantial extent by patterns of interpersonal communications.

4.3 Self-reported removal and infection rates

Table 3 reports questions asking respondents to report, in effect, their own removal rates and infection rates, as described in the epidemic model above. Such self-reporting is likely to be unreliable, but may give some rough indication.

We see from the answers to table 3, questions a and b, that, as one might expect, attention to the company declines with time after the stock is purchased. Since the time interval since the purchase varies across respondents, it is important to standardize this decline in terms of the time since purchase. This can be done by, in effect, estimating the removal rate g in the model, eq. (1) above. Let us call the answers to table 3 question a as $y1$ (the percentage of time they spent thinking about, analyzing and discussing the company around the date of their purchase of the company) and the answer to table 3 question b as $y2$ (the percentage of time they now spend thinking about, analyzing and discussing the company) respectively. For each respondent we took an estimate of g as $g=\ln(y1/y2)/t_1$, and the 'half life' corresponding to this g, $\ln 2/g$, was also computed. The median g for INST-RAND was 1.84 ($n=37$, half life 0.38 years), for INST-RPI, it was 1.39 ($n=25$, half life 0.50 years). The median g for INDIV-RAND was 3.72 ($n=78$, half life 0.19 years) and for INDIV-RPI, 1.73 ($n=62$, half life $=0.40$ years).[13] One survey [McGuire (1985)] on estimates in the psychology literature of removal rates from memory after persuasive communications

[13]The distribution of g across respondents showed a severe outlier problem, since some individuals claimed that they spent no time currently thinking about the company, yielding infinity for their b, and some report essentially no time. Se we report the sample median instead of the sample mean.

Table 3a

Questions to institutional investors on removal and infection.[a]

a. Approximately what percent of your total time did you spend thinking about, analyzing, and discussing the COMPANY in a typical week near the *date when shares held reached maximum* (question 1, above)?

[4.5%, 9.0%]
(0.89, 1.7)
n:28, 39

b. In a typical week, approximately what percent of your total time do you *currently* spend thinking about, analyzing, and discussing the COMPANY?

[1.5%, 2.3%]
(0.27, 0.40)
n:28, 39

c. Roughly how many people have you personally talked to explicitly about COMPANY stock?

[7.2, 21.0]
(1.4, 6.5)
n:28, 41

d. How many of these people would you guess might have become seriously interested in COMPANY as a result of your discussion with them?

[4.2, 10.0]
(1.2, 4.1)
n:27, 37

e. How many institutional investors in the COMPANY (outside your own firm, if you are affiliated with an institution) have you spoken to about the COMPANY?[b]

[0.8, 2.9]
(0.32, 0.58)
n:29, 39

[a]In the square brackets beneath each answer are the percent of the random sample of institutional investors (INST-RAND) followed by the percent of rapid price increase sample of institutional investors (INST-RPI) who chose that answer. Beneath (in parentheses) are the standard errors for the percents, and the number *n* who chose to answer that question.

[b]Two extreme outlier answers were dropped from the sample. We thought that the question must have been misinterpreted.

concluded that the 'decay parameters differ wildly: some studies report most of the initially induced attitude change persisting for months . . . others report intermediate decay rates suggesting a half-life of about a week'.[14] There is also a literature in marketing which produces estimates of half lives for memory that show a range that includes estimates here, see Bagozzi and Silk (1983). Thus, our estimates of g are consistent with the notion that the decline of interest is due to the same process of forgetting that has been studied by psychologists.

Questions c and d of table 3 suggest an extremely high infection rate: people claim to have spoken to large numbers of people and to have gotten them interested in the stock. The answers to the third question suggest, given the relatively small number of institutional investors in the individual stocks,

[14]McGuire, 'Attitudes and Attitude Change', p. 290.

Table 3b

Questions to individual investors on removal and infection.[a]

a. Approximately what percent of your total time did you spend thinking about, analyzing, and discussing the COMPANY in the few weeks before you made your most recent purchase (question 3 above)?

Percent

[3.03%, 4.07%]
(0.60%, 0.80%)
n:120, 95

b. In a typical week, approximately what percent of your total time do you *currently* spend thinking about, analyzing, and discussing the COMPANY?[b]

Percent

[1.98%, 2.08%]
(0.74%, 0.46)
n:125, 100

c. How many friends, business associates, and other potential investors would you guess you have talked to about the COMPANY since the time you first became interested in the stock?

Number of people

[19.69, 5.10]
(7.34, 0.70)
n:145, 118

d. How many of these people would you guess became very likely to purchase stock in the COMPANY as a result of your conversations?

Number of people very likely to purchase

[3.28, 1.62]
(0.84, 0.24)
n:133, 103

[a]In the square brackets beneath each answer are the percent of the random sample of individual investors (INDIV-RAND) followed by the percent of rapid price increase sample of individual investors (INDIV-RPI) who chose that answer. Beneath (in parentheses) are the standard errors for the percents, and the number n who chose to answer that question.

[b]Three extreme outlier observations were dropped from the sample for question c. We thought the question must have been misinterpreted. Dropping these has no effect on estimate of removal rates as these respondents did not answer question a.

that the set of institutional investors in a particular stock in the RPI group is so interconnected that it might even be regarded as a 'small group' as defined by social psychologists. However, 44% of the respondents in the INST-RPI group answered zero to the third question.

As with the removal rate, we can standardize the self-reported infection rate in terms of the time elapsed since the person first became interested in (and presumably transmitting interest in) the stock.

The total interest engendered by the individual is, by the model,

$$b\int_0^T I(s)\,\mathrm{d}s = (bI_0/g)(1-\mathrm{e}^{-gT}). \tag{2}$$

To convert the total interest engendered to the total number x of people who became interested, we may divide the above expression by I_0. Taking the

removal rates g etimated above, we compute for each individual an estimate $b = xg/(1-e^{-gT})$. This estimate of b was computed for each individual and the sample average taken as an estimate of b. For the INST-RAND the estimated infection rate was 20.66 ($n=36$, s. e. $=8.01$), for INST-RPI it was 7.35 ($n=25$, s. e. $=2.11$), for INDIV-RAND it was 12.74 ($n=99$, s. e. $=3.59$) and for INDIV-RPI it was 3.71 ($n=80$, s. e. $=0.59$). In each sample the distribution of infection rates across individuals is highly skewed to the right with a bunching of zeros at the left. Thus the median infection rates are always substantially less than the mean infection rates : (for INST-RAND 9.29, for INST-RPI 2.02, for INDIV-RAND 0.00, for INDIV-RPI 2.22) Many investors get no one else interested in the stocks; at the other extreme some claim to get dozens interested.[15]

The estimated infection rates are greater than our estimated removal rates this would imply a rapidly exploding interest for both random and rapid price increase groups. We believe that answers to the second question above on which the estimate of the infection rate is based cannot be taken at face value. It will probably be very difficult to pin down the value of the infection rate with any accuracy; suffice it to say only that our results are consistent with the notion that it may be significantly greater than zero.

5. Discussion

We have seen a number of indications that contagion of interest, along lines described in the simple epidemic model presented above, may be important in describing the behavior of investors.

The most direct evidence comes from questions asking investors to assess the importance of contagion. Unfortunately, there is a wide disparity between the reports as to how many others the investor infected from the reports as to how many of the investors were infected by other individuals. The respondents claimed to have gotten a very large number of other people seriously interested in their stock, so that estimated infection rates are enormous, so much greater than removal rates that our simple model would imply rapidly exploding interest in all stocks. But only a third of our individual investors say their initial interest was prompted by persons other than a stockbroker. Because of this disparity, we were not able to use the results to evaluate our model of the random walk behavior of stock prices, which required that infection rates be close to removal rates.

[15] Of course, in a random sample of individual stockholders, we are likely to find some investment professionals, even stockbrokers, who are more likely to infect others with interest. However, this does not account for the high infection rate in our random sample of individual investors. In INDIV-RAND only 8 respondents answered yes to 'Are you currently an investment professional? (for example, stockbroker, investment advisor or investment banker)'. When these were deleted from the sample, the average answer to question d, Table 3b (the average number interested) fell from 3.28 to 3.08.

There is, however, other confirming evidence that contagion of interest is important. A third of our random sample of institutional investors and over 60% of our random sample of individual investors described themselves as unsystematic in their choice of stock. The great majority of the individual investors said they had done no analysis of their own of the stock. Among individual investors, 28% in the random sample and 45% in the rapid price increase sample said that they not only knew of someone else who had bought the stock but were influenced by this fact in their decision to purchase the stock.

As noted before, it is likely that contagion of interest does not proceed evenly for all stocks at all times: only certain stocks are 'interesting'. With rapid price increase stocks such contagion is likely to be important, and we might possibly find aspects of a 'fad' or 'rumor mill' in operation. Among institutional investors, the rapid price increase investors (when compared to the random sample of institutional investors) were much less likely to say that their interest in the stock was due to a systematic search, and more likely to be influenced by other individuals or publications. Among individual investors the rapid price increase investors (when compared to the random sample of individual investors) were more influenced by friends and relatives and less by stockbrokers.

None of the results here constitute strong evidence that markets are not efficient; indeed we did not expect to find such strong evidence from a survey. Even granting our results, it is still possible that some smart money, perhaps missed in or not responding to our survey, offset the behavior of other investors. We think, however, that our results are of relevance in evaluating the efficient markets hypothesis. We have documented that the sort of behavior that underlies contagion models is of substantial importance among investors, even among the professional institutional investors that we might normally call 'smart money'.

Appendix: Survey description

Each of our four samples of investors consists of investors in specific individual stocks.

For institutional investors, it was feasible to select stocks first and then randomly select investors in these stocks. All institutional investment managers exercising discretion over accounts with combined equity assets exceeding $100 million must report their holdings to the S.E.C. on Form 13f. Equity holdings below 10,000 and also below $200,000 in market value need not be reported. We accessed this information using Computer Directions Advisors, Inc., SPECTRUM III: 13f Institutional Stockholders Survey. It was found that a number of institutions were selected twice, as holding more than one of the stocks in our sample. It was considered infeasible to ask

participation regarding more than one stock by a single institution. Thus institutions were dropped from the lists of stocks until each institution appeared only once.

For the random sample of institutional investors (INST-RAND), stocks were first selected at random and institutional investors selected from them, as described in the text. The INST-RAND group stocks for which we have completed questionnaires (number received in parentheses) were Continental Illinois Holding Company (2), NCR Corporation (12), Pittston (5), Service Fracturing (1), Stocker and Yale (2), and Unitrode (8).

For the sample of rapid price increase institutional investors (INST-RPI) we first compiled a list of the top 25 performing stocks as described in the text. Each stock in the list of 25 was given a score equal to the average of the standardized values of the stock's price increase over the preceding year, and price/earnings ratio. A news search was done for the stocks, to exclude special events; these were merger and acquisition announcements in which the company was the target. Also excluded were stocks that had higher split-adjusted price in an earlier year than the maximum achieved in the sample year. From the remaining, the stocks with the top 10 scores were selected. The RPI group stocks for which we have completed questionnaires (number in parentheses) were: Barris Industries (1), Chilton Corp (1), Limited, Inc. (11), Marion Labs (3), Mylan Labs (4), Rollins Environmental Services (5), Safecard Services (1), U.S. Health Care Systems (12), and Zenith Labs (3).

Our INST-RPI sample chanced upon a boom in companies related to the movement toward cutting health care costs: there were three generic or consumer drug companies in our RPI group and a manager of health maintenance organizations Labs. Others in the RPI group were diverse: there were a producer of young women's apparel, and a disposer of concentrated industrial waste. Five of the nine firms on which we have responses had doubled their earnings between 1982 and 1984. Four paid no dividends in 1984.

For the random sample of individual investors (INDIV-RAND), we began with a random sample of high income investors in the United States, provided for us by Survey Sampling, Inc. That firm uses census tract data, data on vehicle registrations, and other public data as inputs to a multiple regression that predicts income as reported on a subsample. They provided us with a random sample of individuals in the continental United States whose income predicted by this regression was $70,000 per year or greater. The average income respondents reported to us on our questionnaire was $108,000. These respondents were asked to fill out the questionnaire if they ever bought common stock shares.

For our rapid price increase sample of individual investors (INDIV-RPI) we secured the permission of a single firm to use a sample of their stockholders.

The survey of the decision makers then followed Dillman's (1978) 'total design method' fairly closely. The institutional investor survey was implemented by Donald Deluca at the Roper Center at Yale University.

For institutional samples, separate questionnaires were prepared using a word processor for each of the 20 companies in our sample. The name of the company appeared throughout the questionnaire, to affirm clearly our interest in investor behavior with regard to that stock only. For the INDIV-RPI sample, the name of the company was used throughout the questionnaire, and some questions clearly completely specific to that stock were asked, so that it would be quite clear that the questionnaire pertained only to that stock.

Questionnaires were first mailed September, 1985 for INST-RAND and INST-RPI, in April, 1986 for INDIV-RPI and July, 1986 for INDIV-RAND. Enclosed with the questionnaire was a letter, self-addressed envelope and printed brochure describing the Investor Behavior Project at Yale University. The letter emphasized that the results of the project would serve a useful social purpose, and that results would be made public. It was promised that all respondents would remain anonymous and that they would receive a report giving all of our results. The report to them was offered as an incentive to participate, as well as some assurance that we were not trying to secure private advantage from the information gathered. About a week after the initial mailing a followup letter or postcard was mailed, reminding them of the questionnaire and reasserting its importance for research on financial markets. About three weeks later a letter was sent out to those who had not yet responded, with a duplicate questionnaire (in case the respondent had lost the first) and another letter (noting the lack of response) and self-addressed envelope. About 7 weeks after the initial mailing a final letter was sent to those who still had not responded, certified mail, with another questionnaire and self-addressed envelope. The timetable and letter format conformed closely to those that Dillman found yielded high response rates.

For the institutional investors, initially, 216 questionnaires were sent, 89 to the INST-RAND group and 127 to the INST-RPI group. There were 74 completed questionnaires, although after we classified three questionnaires (based on margin comments) as out of frame the total was reduced to 71, 30 in the INST-RAND group and 41 in the RPI group. We received 54 letters or phone calls that indicated that the respondent was out of frame, so that a total of 57 were out of frame. Of these, 24 said that they never held the stock, and 24 said that they did not decide to buy the stock (that the stock was in a custodial account only, or that it was received as a part of a distribution). We believe that some who said they never held the stock actually held it as part of custodial accounts, which they did not check for us. The remainder of the 57 was accounted for by 6 index funds, 3 institutions that used a rigid formula for their investments, and one options

manager whose holdings were due solely to rising options premiums. We received 14 letters declining to fill out the questionnaire, and 1 letter indicating that the decision maker was deceased. The remaining 73 institutions did not respond in any way to our letters.

We thus received cooperative responses from $(71+57)/216=59\%$ of those in our institutional samples. We are pleased with this response rate. It is lower than those attained by Dillman, but our study suffered the handicap that we had to obtain the cooperation of two persons for each questionnaire, and that the questionnaire asked questions that respondents may feel are sensitive.

In INDIV-RAND, we received 156 completed questionnaires, 128 responses indicating that the respondent had never owned stock, 5 letters indicating that the respondent was deceased, and 17 addressee unknowns. We thus received cooperative responses from $(156+128)/(500-5-17)=59\%$ of those in our sample.

In INDIV-RPI we received 134 completed questionnaires, one letter indicating the subject was decreased, 5 refusals to participate and 3 addressee unknowns from an initial mailing of 204 questionnaires, a response rate of $134/(204-1-3)=67\%$.

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