Behavioural explanations for under and overreaction

Although underreaction and overreaction are fairly well documented, it still difficult to say why this occurs. One set of explanations relate to the way investors are assumed to make decisions, according to psychological evidence. Underreaction is perhaps similar to the phenomenon of conservatism in which individuals are slow to change their beliefs. Although they adjust their views in the light of new evidence, the adjustment is too small. Overreaction is perhaps related to optimism and the representativeness heuristic, in which individuals see upward patterns of behaviour where there are none.

However, a serious problem with psychological explanations is that they are frequently inconsistent with each other. And more importantly they are *ex post*. When the market underreacts this is said to be caused by conservatism; when there is overreaction, this is said to be caused by optimism. But we need to know the circumstances for conservatism and the circumstances for optimism. That is, if psychology is to be a useful explanation of market behaviour, it should identify the situation in which there is likely to be under or over reaction.

We consider two recent papers which have tried to move forward our understanding about how psychological explanations of individual behaviour can be used to explain underreaction and overreaction.

Barberis, Shleifer and Vishny, A model of investor sentiment, Journal of Financial Economics, 1998, 3077-343

The approach of Barberis et. al. is motivated by the recent paper,

Griffin & Tversky, "The weighing of evidence and the determinants of confidence", Cognitive Psychology, 1992

in which the authors try to link together the ideas of conservatism and optimism. This is based on the strength and weight of evidence. A signal has both strength and weight. Strength relates to the size of the signal, whereas weight relates to how much importance should be placed on it. G&T use a recommendation letter to explain the concepts; strength relates to how favourable is the referee's report, whereas weight relates to the reputation of the referee and how much importance should be placed on the referee's recommendation. Translating these ideas to earnings: the strength of an earnings signal is probably its size; the weight of an earnings signal is probably its implications for forecasting next period's earnings.

The driver of both under and overreaction is that investors focus too much on strength and too little on the weight. Therefore:

underreaction will tend to occur in signals of **low** strength and **high** weight;
overreaction will tend to occur in signals of **high** strength and **low** weight.

There are a number of papers which suggest that the investors do not give enough emphasis to the weight of a signal. A recent example is Sloan, "Do stock prices fully reflect information in accruals and cash flows about future earnings?", Accounting Review, July 1996. He finds that the cash flow component of earnings is more stable, and therefore has more predictive power than the accruals component in predicting next period's earnings. However, the market appears to ignore this in its reactions to earnings numbers. Investors do not distinguish between earnings with a high cash flow component and earnings with a low cash flow component.

1. Weight and the earnings process

The weight of an earnings announcement depends on the time series properties of the process.

I - RANDOM WALK EARNINGS

For example, if earnings X_t were a random walk

$$X_t = X_{t-1} + u_t,$$

then,

the forecast of X_{t+1} (for given information at t, ϕ_t) is X_t.

Since

$$X_{t+1} = X_t + u_{t+1}$$

it follows that

$$E[X_{t+1} \mid \phi_t] = X_t + E[u_{t+1} \mid \phi_t]$$

$$= X_t + 0$$

X_t is also the best forecast of X_{t+2} at time t. This means that when earnings are announced at time t, they should affect all future predictions of earnings.

II - MEAN REVERSION OF EARNINGS

In contrast, earnings might be thought to be mean reverting

$$X_t = \mu + u_t$$

In this case, the value of the disclosure is very small. The disclosure of X_t just gives more observations from which to estimate the mean of the process, μ. Any difference between Xt and the estimated value of μ is random and will not be maintained in the future.

2. Under and overreaction

I - UNDERREACTION

Underreaction occurs during the period in which the signal is announced. In the following period(s), between 1 -12 months, this is corrected and positive autocorrelations in returns are found.

If earnings are thought to be mean reverting when in fact they are random walk, then insufficient weight will be placed on a particular earnings disclosure and underreaction will result. More generally, underreaction will take place if the market believes that earnings are more stationary than they really are. For example, in Bernard & Thomas (1990) investors believe that earnings are a random walk rather than a seasonal series.

Therefore underreaction is most likely to be found when events are low in strength but high in

weight and this high weight is not appreciated by the market.

II - OVERREACTION

Overreaction occurs when the investor responds to (what appears to be) a consistent pattern of news pointing in the same direction. The investor falsely believes that the pattern of news points to a trend, when in fact the pattern is random. Consequently, the securities become overpriced during a period of 3-5 years and then have low returns afterwards. Overreaction is driven by a tendency to see a rising (or falling) pattern where none exists, which is called the representativeness heuristic.

Overreaction is therefore most likely to occur when the pattern of events are high in strength but low in weight. That is a signal which generates a number of positive shocks, which the investors falsely views as following a trend. But the events have low weight (ie do not indicate a trend).

3. The model

The model which Barberis et. al. use to generate under and overreaction from these psychological features is given below.

Earnings follow a random walk

$N_t = N_{t-1} + y_t,$

where

N_t = earnings

and

y_t = a positive shock term, which can take two values +y and -y

However, investors believe there are two possible states of nature, mean reversion (model 1) and trending (model 2).

Mean reversion (Model 1)	Pr (y_{t+1} = y)	Pr (y_{t+1} = -y)	Trending (Model 2)	Pr (y_{t+1} = y)	Pr (y_{t+1} = -y)
y_t = y	π_L	1 - π_L	y_t = y	π_H	1 - π_H
y_t = -y	1 - π_L	π_L	y_t = -y	1 - π_H	π_H

In the mean reversion case, a positive shock in period t has a small (π_L) chance of being maintained in the next period t+1. In the trending case, a positive shock in period t has a large (π_H) chance of being maintained in the next period t+1.

The transition from one regime to the other is a Markov process. That is, the state today depends only on the state in the previous period. The transition probabilities from one regime to the other are fixed in the investor's mind, as follows.

	state at t +1 = model 1	state at t +1 = model 2
state at t = model 1	$1 - \lambda_1$	λ_1
state at t = model 2	λ_2	$1 - \lambda_2$

Transitions from one state to another are small, that is both λ_1 and λ_2 are small. In addition, the investor believes that mean reversion is more common than the trend; that is, the chances of switching out of model 1 in to model 2 (λ_1) are smaller than of switching out of model 2 in to model 1(λ_2).

In this world, both underreaction and overreaction can be observed.

Underreaction occurs after one signal when the investor assumes that model 1 is the state. The investor believes that the signal is of low weight, and does not appreciate that the signal has a higher weight (since the signal follows a random walk)

Overreaction occurs after a series of signals in the same direction, leading the investor to believe that model 2 is the state. The investor believes that the signal has higher weight than it really does.

The paper then simulates stock returns using plausible values of λ_1, λ_2, π_L and π_H and generates results very similar to underreaction studies.

Daniel, Hirshleifer & Subrahmanyam, "Investor psychology and security market under-and overreactions, Journal of Finance, December, 1998, 1839-1885

1. Background

This is another paper which attempts to integrate underreaction and overreaction using psychological evidence about individual behaviour. It is based on two ideas:

firstly, the robust finding in psychology that individuals are overconfident; and

secondly, on the idea of biased self attribution.

Overconfidence is said to be more severe for diffuse tasks (those requiring judgement) and for those with delayed feedback. Also experts tend to be more overconfident than the inexperienced.

Biased self attribution concerns how investors adjust their beliefs when public information is disclosed. When the public information is in agreement with their prior private beliefs then their confidence grows. However, it does not fall commensurately when the public information contradicts private prior beliefs. When public information does not confirm their private information, they tend to interpret the result to bad luck rather than to their ability.

2. The basic idea in DHS

The basic idea is that when private information is collected investors tend to overreact to it. This gives rise to a short term price overreaction. When the private information contains good news, then the share price will rise too high; similarly, if the private information contains bad news, then the share price will fall too much. If subsequent public disclosure confirms the private information, then a further overreaction is stimulated.

However, when subsequent public disclosures eventually indicate that the share price is too high (or too low), then there will be a price adjustment in the right direction. But the adjustment to the rational price will be much slower than previous overreaction. This gives rise to the long term reversals found, for example, by Lakonishok, Shleifer and Vishny, "Contrarian investment, extrapolation and risk", Journal of Finance, December 1994.

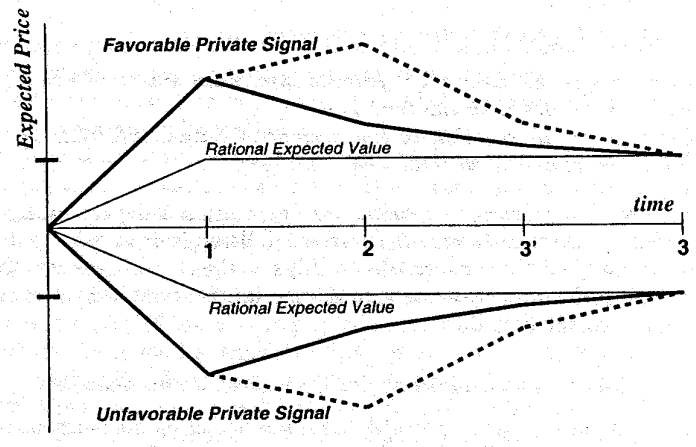

Figure 1. Average price as a function of time with overconfident investors. This figure shows price as a function of time for the dynamic model of Section III with (dashed line) and without (solid line) self-attribution bias.

The main idea in DHS is given in their figure 1, reproduced above. There are informed individuals (I) and uninformed (U), who trade with each other. The thick solid line specifies what happens to share price, and the thin solid line gives the path of the rational price[1]. Let's concentrate on the good news case. At date 1, individual I receives a noisy private signal, which is misinterpreted and therefore the price rises above its rational value. At date 2 a noisy public signal arrives which partly and slowly dampens down the optimism; at date 3, an unambiguous public signal arrives, which then reduces the price to its rational level.

This setting gives rise to times when price rises above its rational level and then subsequently reverses. This behaviour is clearly related to the long term reversals in price documented above. However, what is not clear is what part of the anomalies literature is being described by the initial overreaction; furthermore, how does the behaviour in figure 1 account for observed post earnings announcement drift (PEAD)?

[1] We shall consider the dotted line later.

PEAD documents that price changes following an announcement are (on average) of the same sign as at the time of the announcement. It is as if the market is underreacting to the earnings announcement. Where does this fit in to the DHS story?

In the basic model we have a situation in which prior overreaction, to a private signal, is gradually reversed first by a noisy public signal and then by an unambiguous public signal. But how does the noisy public signal arise?

DHS speculate that just before the noisy public signal, company managers or analysts receive a second private signal and then take action on the basis of it. The action then starts off the long term adjustment to the initial overreaction. This views PEAD not as an underreaction to new information but rather a gradual adjustment to previous mispricing. Let's take some examples.

Suppose that investors initially receive bad (private) news about the company and then overreact to this. Managers of the company then receive private information that the company is now seriously undervalued, because for example they have analysed their situation against their competitors. In order to convince the market they should have a higher value (perhaps in order to obtain their company bonuses) , they disclose a high value for earnings (through accruals choices and accounting policy choices). This public signal then slowly starts the market to adjusting towards the rational price.

Similarly, managers of overvalued companies may adjust earnings downwards for fear of intervention by government regulators. The market will adjust downwards in response to the earnings announcement, but the continued adjustment downwards is a response to the initial overvaluation rather than an underreaction to the earnings announcement.

This way of viewing PEAD means that there will not be underreaction for every public announcement; but only for those which are trying to rectify previous mispricing. DHS call these selective public events because they are related to the mispricing; they also claim that there is some evidence for this.

The DHS idea also relates to the literature on initial public offerings (IPOs). When a particular industrial sector is overvalued, managers of an unquoted company may take advantage of this by making an IPO. The well documented decline in returns following an IPO arises because the IPO was made at too high a price. The issue of an IPO is a selective event which is correlated with the market's initial excessive optimism, and the decline in returns following the IPO is the market adjustment to the earlier optimism.

3. Outcome dependent confidence

So far the model has used the idea that investors overreact to their private information, and they adjust only slowly when the public signal contradicts it. There is not much made of one aspect of biased self attribution theory, which is that when the public signal reinforces private beliefs, confidence increases further. Evidence from the psychological literature suggests that this confidence boosting takes place in situations where feedback is slow or inconclusive and also where significant judgement is involved. If this is the case, then it is likely to be observed in stocks with high P/E ratios for example.

This situation is illustrated by the dotted line in figure 1. If the noisy public signal confirms the

private beliefs, then the overreaction will continue further, and the price will be further out of line with the rational value. In this setting, post earnings announcement drift can be seen as:

either

the **continued overreaction** which takes place after the noisy public signal;

or

the **subsequent reversal** (as in the previous section, through public disclosures) of the earlier mispricing.