INFORMATION CASCADES

There is now substantial evidence that financial markets do not react to information exactly as suggested by the efficient market hypothesis. Consequently, a number of papers have asked the question "how can this be explained?" Initially, one of the main explanations was that exogenous institutional imperfections, such as transactions costs, are the cause. This type of explanation is now being replaced by behavioural ones, which focus on exactly how agents process information.

The idea in this paper is that agents respond not only to their own private information, but also to the information which they infer other agents have. The inference is made on the basis of the actions which other agents are seen to take.

Bikhchandani, Hirshleifer & Welch, "A theory of fads, fashion custom and cultural change as informational cascades", Journal of Political Economy, 1992, 992-1026.

1. The basic idea

One of the ideas behind market efficiency is that agents have private information which influences their trading. By trading their information is impounded in price; for example, good news will push prices up because traders wish to purchase shares.

The basic idea behind the BHW paper is that investors have

- their own private information, and
- they also observe what others **do** (that is, the trading actions of others are used to infer what private information they have).

Their decision is a combination of these two factors. The paper shows that when investors make sequential decisions, they will tend to ignore their own information and be guided by the actions of others. What subsequent investors then observe are the uninformed choices of the previous investors, which then reinforces the original choice.

For example, we know that driving in fog is dangerous. Suppose that we join a motorway during fog and see other drivers speeding. We are likely to discard our private information about the danger and speed as well. This then in turn affects the choices of drivers who join the motorway subsequently. BHW have a more quantitative example to illustrate the information cascade.

2. The mechanics of the BHW example

The decision faced by an individual is whether (i) to adopt or (ii) to reject some particular behaviour, for example buying a share.

The cost of adopting is ½ (like a transaction cost).
The gain to adopting is V which is 0 or 1 with an equal prior probability.

Each investor takes a decision sequentially, and this order is determined exogenously.
Each individual receives a private independent signal about the gain, V. The signal is H (high) or L (low). The probability or receiving a H signal is p, if V=1 and 1-p if V=0; $p > ½$.

The probabilities can be set out:

C=½
Pr(V=1) = ½
Pr(V=0) = ½

Pr(H|V=1) = p Pr(H|V=0) = 1-p
Pr(L|V=1) = 1-p Pr(L|V=0) = p

I - CONSIDER THE FIRST INDIVIDUAL

If H is received, then the posterior probability that V=1 is

$$\Pr(V = 1|H) = \frac{\Pr(V = 1) . \Pr(H|V = 1)}{\Pr(H)} \qquad \text{(Bayes rule)}$$

$$\Pr(V = 1|H) = \frac{0.5 \;.\; p}{0.5} = p$$

The expected payoff is then

= 1.p + 0.(1-p) = p.

Since p > ½, therefore p > C. Therefore the decision will be "adopt"

II - CONSIDER THE SECOND INDIVIDUAL

C If H is received, the decision will be to adopt for much the same (but not exactly the same) reason as the first.

C The interesting case is if L is received. Since the 2nd will know the action of the 1st, then s/he will know that 1st received an H signal. If the 2nd receives L, then the two signals will conflict and the 2nd will be in the same position as having received no signal; that is, the probability of V=1 after the two signals is equal to the prior probability of V=1 is ½. Since the cost is ½ then adoption and rejection will take place with a probability of ½.

III - CONSIDER THE THIRD INDIVIDUAL

The 3rd individual is faced with one of three situations:

C Both predecessors have adopted; in this case, the 3rd will adopt even if L is received because two H signals will be inferred to have been received by 1st and 2nd.

Notice that this can happen even if the 2nd has received L; if 1st receives H, and the 2nd receives L, there is still 50% chance of 2nd adopting. If this happens, all 3 will adopt, despite the fact that 1H and 2L signals have been received.

C Both predecessors have rejected; in this case, the 3rd will reject even if H is received because two L signals will be inferred to have been received by 1st and 2nd.

C One predecessor has rejected and the other has adopted. This puts the 3rd individual in the same position as the first; the actions of previous individuals do not contain any information for the present decision.

3. How can cascades arise ?

Given that we now understand the mechanics of the model, what are the chances of individuals taking the correct decisions? Suppose we know that V=1, that is, investors should adopt; what are the chances of (i) an adopt cascade, (ii) a reject cascade after 2 individuals?

The possible events are:

Individual	**1**	**2**
(a)		
Signal received	H	H
Decision	adopt	adopt
(b)		
Signal received	L	L
Decision	reject	reject
(c)		
Signal received	H	L
Decision	adopt	reject with Pr=½ adopt with Pr=½
(d)		
Signal received	L	H
Decision	reject	reject with Pr=½ adopt with Pr=½

I - Consider the correct adopt cascade first, with both individuals adopting.

This can happen if either:

Event A = both receive H
or
Event B = 1st receives H, *and* 2nd receives L but decides to adopt.

Pr(Event A|V=1) = p . p

Pr(Event B|V=1) = probability of receiving H . probability of receiving L and then adopting
= p .(1-p) . ½

Prob(A or B) = p.p + p.(1-p).½ = p(p + 1). ½

II - Consider the incorrect reject cascade (IRC) with both individuals rejecting.

This can happen if either:

Event A = both receive L
or
Event B = 1st receives L, *and* 2nd receives H but decides to reject.

Pr(Event A|V=1)	=	(1 - p) . (1 - p)
Pr(Event B|V=1)	=	probability of receiving L . probability of receiving H and then rejecting
	=	(1 - p) . p . ½

Prob(A or B) = (1 - p).(1 - p) + (1-p).p.½ = (p - 2).(p - 1). ½

This can be extended (see equation 3, p 998) to an even number of n individuals

$$\frac{(p-2).(p-1).[1-(p-p^2)^{\frac{n}{2}}]}{2(1-p+p^2)}$$

We can examine how the Pr(IRC) varies with p and n, based on the above formulae.

Probability of an incorrect reject cascade (IRC) for varying p and n

Prob	**p**	**n**	**Prob**	**p**	**n**
0.00	1	50	0.00	1	5
0.06	0.9	50	0.06	0.9	5
0.14	0.8	50	0.14	0.8	5
0.25	0.7	50	0.24	0.7	5
0.37	0.6	50	0.36	0.6	5
0.50	0.5	50	0.48	0.5	5
0.63	0.4	50	0.61	0.4	5
0.75	0.3	50	0.74	0.3	5
0.86	0.2	50	0.85	0.2	5
0.94	0.1	50	0.94	0.1	5
1.00	0	50	1.00	0	5

Notice that the Pr(IRC) varies inversely with p. That is, the poorer the signal, the more likely IRC is. However, the number of players does not make much difference. This arises because as soon as IRC has started, then the individual having the correct signal will ignore it and follow the implied signals received by the previous players.

4. The implications for finance

This is all very interesting, but the key question is how relevant and realistic is the model? We now review some of the more important issues raised by the model.

I - When different individuals have different signals

We have assumed that all individuals receive the signal H or L. We have found that when the signal is poor, then an incorrect cascade may begin. However, some investors may have very good private information relative to others. An important issue is then the order in which the investors decide. If the more informed go first, then a correct cascade is more likely.

Why should the more informed go first? This may happen because the less informed will wait to see what others are doing.

Why might the less informed go first? This may happen because the more informed wait until the market is really out of line with their private information. Then they can trade and make the most from their position.

II - The role of public information

In their paper BHW suggest that incorrect cascades are fragile (will be reversed) because public information can override the beliefs that individuals have about others' private information. This may be so in some situations. For example, the public release of information about smoking has drastically affected the preferences of individuals (even if not their habits because of the addiction problem).

However, financial markets are not like this. Even if certain traders have certain knowledge about an aspect of company activity (eg that the chief executive is going to resign), then there will still be some uncertainty about how this will affect the **future** cash flows of the company. The value of financial instruments depends on expectations about the future; these are, by definition, uncertain. Nobody has really good information about this. This brings us to another issue.

III - The precision of the H/L signal.

The results show that IRC has little chance of occurring when the signal contains little noise. Perhaps there are pure signals in some areas, for example scientific evidence about the spherical shape of the earth, but are there any accounting signals with such little noise? Apart from the forward looking nature of financial markets, performance indicators which are based on accounting numbers are often a noisy reflection of the economic activity of the company.

For example, earnings may be a poor measure of sustainable cash flows from existing assets. Current levels of investment and rates of return may be poor predictors of future success from investment activity.

The same economic events may be accounted for in different ways by companies. For example, companies may have different depreciation rates for the same asset.

All this leads to the idea that signals in financial markets are noisy.

IV - The rationality assumption

The model assumes that individuals give more weight to the actions of others than to their own private information. This seems odd, because the individuals know that they have discarded their own private information. But they assume that other individuals do not. This seems to imply some form of irrationality. There are a number of ways out of this.

C One technical point is that individuals do not know for sure how others behave, and therefore perhaps the model is coherent.

C Rationality is not in doubt when some individuals are more informed than others and the more informed individuals trade first. Then it makes sense for individuals to discard their own information. That is, the individual who trade subsequently, do not assume that previous investors have discarded their information.

C They may believe that others, although having inferior information, make up the majority of agents. Individuals may rationally discard their information, not because they don't believe it, but because their success will depend on predicting the actions of others (see for example, the “Presidential address: latent assets” paper by Brennan in J of Finance, 1990, July 709-730.

5. Overall.

I think that cascading in financial markets with respect to accounting information makes a lot of sense. The signal is very noisy about the future performance of the company. A mistake made early on by major market participants (market leaders) is not easily corrected by others. These others, whilst on an individual basis are (by definition) less informed than the leaders, may be collectively more informed. However, their contradictory information stands little chance of being reflected in prices. This also would explain a number of instances in which financial disclosure seems to be ignored by the market.