Rational herding

- It is often that we observe traders acting similarly, even if there seems to be no justification in doing so, at least retrospectively. It is also often that no information can be identified at the time that would suggest traders taking similar actions; indeed often information held by individual traders suggests a much more heterogenous range of trading decisions.
- If many traders act in the same way, without this being based on information, this is commonly referred to as 'herding'.
- We will investigate such herding behaviour and why it can be rational for traders to ignore their own information and act like other traders.

The existence of herding

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→ Herding is a common observation in financial markets, but also in other areas of decision-making.

- Traders should acquire information and use this information to generate profits. Assuming that information costs are not too high, this should be more profitable than remaining uninformed or not using the information that has been acquired.
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  - However, there is widespread evidence of traders ignoring their own information and even going against the action suggested by the information they have obtained.
  - While many explanations from behavioral finance can be given for specific decisions, there is strong evidence that the actual behaviour is herding and we suggest here that this might be not only be rational for traders but also profitable.
- Those traders engaged in herding do not make use of their information and hence in the presence of other informed traders using their information, they should make a loss.

→ However, herding can nevertheless be profitable, even in the presence of informed investors as we will argue now.

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Revealing asset values

Revealing asset values

→ We will now develop a simple model of trading in which herding will emerge, and such herding will be more profitable than relying on information. The model is presented intuitively, but can also be more formalised.

- We assume that the value of an asset is not known to uninformed traders, but that its value will might be revealed either after two rounds of trading, or it will only be revealed in the more distant future. Thus information might be revealed sooner or later, but traders do not know when such disclosures will happen.
- If the value of the asset is revealed early, then the asset will trade at its true value from then onwards.
- If the value of the asset is revealed late, we assume that all informed trade is concluded after two trades and from then onwards the price is not expected to change.
- When the information is revealed, if it is revealed late, is irrelevant as we assume that the time horizon of traders is short, only the two trading rounds. This might be due to high discounting of future profits or because traders need to close any position by this time.

→ We can now investigate how informed and uninformed traders behave in such an environment.

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- If a trader becomes informed, he learns the true value of the asset.
- We assume that uninformed traders have no information about the value of the asset.
  - However, they follow a signal (some piece of information) that is common to all uninformed traders.
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- Let us finally assume that once a trader becomes informed, he loses the ability to know the common signal that uninformed traders follow. This might be a reasonable assumption if we assume that being informed will not allow a trader to neglect his information and follow any spurious trend; knowledge makes such behaviour not sustainable. Hence, informed traders will follow the information about the true value of the asset which they have obtained.

→ We can now see how trades are occurring and what the implications are.

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Processing information and signals

→ We will now look at how traders are submitting their orders to the market.

- We assume that we have two trading rounds that fall within the time horizon of traders.
  - Which of these trading rounds a trader chooses will be random.
- This might be the result of how quickly a trader makes decisions or it might be the result of when information is received, but could also be the result of other exogenous factors on the ability to trade.
- However, traders commit in the first round of trading to actually trade, it is merely the timing of the order that is random due to the speed of submitting such an order. It is thus not possible to observe trading in the first round of trading and then decide how to trade in the second round.

⇒ Therefore the orders submitted in each round are identical as the trader does not know into which round his order will be assigned.

→ With the orders being submitted, the price needs now to be determined.

Processing information and signals

- Trading happens in two rounds

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$\Rightarrow$ The orders submitted in round 1 and round 2 are identical

Processing information and signals

→ We will now look at how traders are submitting their orders to the market.

- We assume that we have two trading rounds that fall within the time horizon of traders.
  - Which of these trading rounds a trader chooses will be random.
- This might be the result of how quickly a trader makes decisions or it might be the result of when information is received, but could also be the result of other exogenous factors on the ability to trade.
- However, traders commit in the first round of trading to actually trade, it is merely the timing of the order that is random due to the speed of submitting such an order. It is thus not possible to observe trading in the first round of trading and then decide how to trade in the second round.

⇒ Therefore the orders submitted in each round are identical as the trader does not know into which round his order will be assigned.

→ With the orders being submitted, the price needs now to be determined.

Processing information and signals

- Trading happens in two rounds and which round a trader chooses is random
- Traders might submit orders at different speeds given their other duties
- The commitment to trade is made in the first round of trading

$\Rightarrow$ The orders submitted in round 1 and round 2 are identical

Processing information and signals

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Price setting

Price setting

→ We now proceed to assess how the price is set in such a market.

- The price setter is uninformed and doe snot know the value of the asset; thus the price set will only be a reaction to the demand for the asset by traders.
-
  - If there are more buy orders than sell orders, the price is increased.
  - If there are more sell orders than buy orders, the price is reduced.
- The larger the demand (positive or negative), the more the price is adjusted.
- If the net demand is driven by uninformed traders, a small number of informed traders will not affect the price much as their influence will be limited, assuming they have limited resources and do not submit excessively large orders.
- However, if the number of informed traders is large, their net demand will cause the price to move as implied by their demand, thus increase if the true value of the asset is high and decrease if the true value of the asset is low.

→ We can now look at the implications of such price developments for the profits of traders.

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- Prices are set in response to market demand

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- If on aggregate traders buy the price increase

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Losses when revealing asset value

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→ Let us first assume that after the two trading rounds, the value of the asset is revealed.

- If the true value of the asset is revealed, the uninformed traders will on average make a loss; this is due to the adverse selection they are exposed to. If the asset value increased and they bought the asset, their profits will be small as the price will have increased, also due to the positive demand of the informed traders, reducing profits as these are shared between informed and uninformed traders. If, on the other hand, the asset value has decreased, they will make a loss, but informed traders will not have bought the asset, making them to shoulder the losses alone, without informed traders sharing these.
- If the asset value is not revealed after trading, then the price will not adjust further and uninformed traders might make a profit or loss, this could be well balanced. There is no adverse selection as the price does not adjust to the true value of the asset; the trader could sell the asset at any time and realise the current price, r4egadless of the true value of the asset.
- Thus, if information is likely to be revealed, adverse selection causes uninformed traders a loss; In this case, there is no reason for uninformed traders to trade.

→ We will now consider the case where information is more long-lived and not revealed quickly.

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- Uninformed traders will on average make losses if the value is revealed due to adverse selection

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Emergence of herding

Emergence of herding

→ If information is not revealed quickly, but only in the distant future, beyond the time horizon of traders, we will now argue that herding can emerge.

- If information is not revealed, uninformed traders might make a profit, this will depend on the price that prevail in the second round of trading. If this price is higher than the price at which the asset was bought, or lower than the price at which it was sold, the trader makes a profit.
- A price increases (decreases) is there are more buy 9sell) orders in the market. Thus if the traders is on the majority side of traders and buys (sells) the asset, then he will make a profit. This will be despite informed traders being in the market; as their information is not revealed, they cannot make any profits off uninformed traders.

⇒ The orders submitted in trading rounds 1 and 2 are similar, thus, if the price increased in trading round 1, then it is likely to increase in trading round 2 as well.

⇒
- Traders buying (selling) in round 1 will pay a lower (higher) price than those in trading round 2.
- As the price remains at the level of trading round 2 afterwards, those trading in round 1 will make a profit. Those trading in round 2 will make no profits, but also no losses as the price remains constant.

- To achieve this outcome, uninformed traders need to act similarly, thus mostly buy or mostly sell. This is where the common signal is important as this is used to coordinate their trading; the fact that it is a signal unrelated to the value of the asset is irrelevant.
- Uninformed traders will all act similarly, but this will not be based on information that is relevant to the value of the asset. Thus we have a situation in which herding emerges.

→ While we have shown that herding can be profitable, we now need to establish under which conditions it is likely to emerge, apart from requiring long-lived information.

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- This will require that their orders dominate the market against informed traders

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- If the information is not revealed, uninformed traders might make a profit
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$\Rightarrow$ As similar orders are submitted in round 2 as in round 1, the price will continue in a trend

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Emergence of herding

→ If information is not revealed quickly, but only in the distant future, beyond the time horizon of traders, we will now argue that herding can emerge.

- If information is not revealed, uninformed traders might make a profit, this will depend on the price that prevail in the second round of trading. If this price is higher than the price at which the asset was bought, or lower than the price at which it was sold, the trader makes a profit.
- A price increases (decreases) is there are more buy 9sell) orders in the market. Thus if the traders is on the majority side of traders and buys (sells) the asset, then he will make a profit. This will be despite informed traders being in the market; as their information is not revealed, they cannot make any profits off uninformed traders.

⇒ The orders submitted in trading rounds 1 and 2 are similar, thus, if the price increased in trading round 1, then it is likely to increase in trading round 2 as well.

⇒
- Traders buying (selling) in round 1 will pay a lower (higher) price than those in trading round 2.
- As the price remains at the level of trading round 2 afterwards, those trading in round 1 will make a profit. Those trading in round 2 will make no profits, but also no losses as the price remains constant.

- To achieve this outcome, uninformed traders need to act similarly, thus mostly buy or mostly sell. This is where the common signal is important as this is used to coordinate their trading; the fact that it is a signal unrelated to the value of the asset is irrelevant.
- Uninformed traders will all act similarly, but this will not be based on information that is relevant to the value of the asset. Thus we have a situation in which herding emerges.

→ While we have shown that herding can be profitable, we now need to establish under which conditions it is likely to emerge, apart from requiring long-lived information.

Emergence of herding

- If the information is not revealed, uninformed traders might make a profit
- This will require that their orders dominate the market against informed traders

$\Rightarrow$ As similar orders are submitted in round 2 as in round 1, the price will continue in a trend

$\Rightarrow$ Traders in round 1 will get a more favourable price and as the price of round 2 remains, can make a profit

- This requires uninformed traders to coordinate their trading on the common signal
- As the signal is not informative, uninformed traders are herding

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High fraction of uninformed traders

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→ We will now look at a situation in which we have a large number of uninformed traders in the market.

- Informed traders have precise information on the value of the asset and will hence submit large order.
- This is because the information they have obtained is reducing the risk they are taking, so they are making larger investments than uninformed traders, who face larger risks.

- With informed traders submitting larger orders, it will take more uninformed traders to be active in the market such that their coordinated trading decisions can dominate the market. It is only then that uninformed traders can be assured to determine the market trend and not informed traders. If this was not the case, then uninformed traders could only make profits if the trades of the informed traders were by chance similar to their own, thus by coincidence they make the 'right' decision. With sufficient uniformed traders, they are able to 'override' informed traders and the favourable trend emerges if id the decision was 'wrong' from the perspective of informed traders.
- Less informed traders will allow each of them to generate higher profits as there is less competition between them and they will not affect the prices as much, leading to higher profits.
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  - Hence, informed trading can be profitable if their trades are not overwhelmed by the trades of uninformed traders.
  - As being informed can also be profitable, there will be a balance such that both profits are equal. This balance will have some informed and some uniformed traders.

→ Hence even if information is free, not all traders are informed, despite information being profitable. This is because herding can also generate profits to uninformed traders. Too many informed traders will reduce profits due to competition between them and it might be better to remain uninformed and engage in herding.

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- Informed traders will trade more aggressively

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Low probability of information revelation

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→ We can now look at the influence the revelation of information has on herding to emerge.

- If information is not revealed after trading, then uniformed traders will make a profit, provided they have been herding. If the information is revealed they might make a loss if the value has decreased (increased), while herding has increased (decreased) the asset price; if we assume that the probability of either case is equal, they make on profits on average if information is released, but will be subjected to adverse selection.
- Thus if information is revealed rarely, then the profits of herding and thus being uninformed outweigh the profits of becoming informed. If information is revealed early too often, then the losses from adverse selection dominate the decision and traders become more informed.

⇒ Thus we should observe herding as long as information is not revealed too quickly. In this case it is more profitable to be uninformed and 'follow the herd' while becoming informed is unlikely to lead to profits. As informed traders trade on their profits only, they might be overwhelmed by uninformed traders, making them zero expected profits.

→ We thus see that herding is likely to emerge, and traders to remain uninformed, if information is long-lived and not easily revealed.

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Profitable herding

Profitable herding

→ We can now argue that if these conditions are met, herding is profitable, thus rational.

- Herding induces a trend into the market price and those 'jumping on the bandwagon' early, will make a profit, while those who are late to join the herding will not make a loss.
- - Herding can be more profitable than informed trading as competition between traders will move the price towards the true value of the asset, reducing profits. Thus too many informed traders will not make large profits, but with herding no such limit on profits applies as the true value is irrelevant.
  - This is even true in the case that information is free.
- In order to induce herding and make it profitable, we need a large part of the market to follow the common signal, thus we need a large fraction of uninformed traders herding. It is only then that the demand by informed traders will be exceeded and sufficient profits from herding are generated.

→ Thus herding is profitable, in equilibrium it would generate the same profits as being informed. We can therefore conclude that herding is rational.

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- Herding allows uninformed traders to induce a trend into the market that they can benefit from if they enter the market early

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Conditions for herding

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→ We can now summarize the conditions that are required for herding to emerge in markets.

- For herding to be profitable and thus rational, any information in the market must not be revealed too soon, instead information must remain with informed traders only for a prolonged period of time.
- In addition we need the precision of information and other parameters, such as the risk aversion of traders, to be such that we have a sufficiently large number of uninformed traders that coordinate to form a herd.

- The price that emerges will have no relationship to the true value of the asset, it might increase, even though the true value has decreased, or vice versa. It might also move in the same direction as the true value of the asset but less so or more so.
- We have thus seen that there are situations in which it is rational for traders to ignore the ifnormation they have access to, even if free, and engage in herding. The old saying 'the trend is your friend' generates profits for these traders.

→ Herding here is rational as traders do not measure their profits against the value of the asset, but against the price they can obtain after two rounds of trading due to their short time horizon. Thus they seek to exploit price differences over time (from their trading to the price after two trading rounds) and not differences between the price of an asset and its value. Hence, herding can emerge with speculators.

Conditions for herding

- Herding is profitable if information is unlikely to be revealed

Conditions for herding

→ We can now summarize the conditions that are required for herding to emerge in markets.

- For herding to be profitable and thus rational, any information in the market must not be revealed too soon, instead information must remain with informed traders only for a prolonged period of time.
- In addition we need the precision of information and other parameters, such as the risk aversion of traders, to be such that we have a sufficiently large number of uninformed traders that coordinate to form a herd.

- The price that emerges will have no relationship to the true value of the asset, it might increase, even though the true value has decreased, or vice versa. It might also move in the same direction as the true value of the asset but less so or more so.
- We have thus seen that there are situations in which it is rational for traders to ignore the ifnormation they have access to, even if free, and engage in herding. The old saying 'the trend is your friend' generates profits for these traders.

→ Herding here is rational as traders do not measure their profits against the value of the asset, but against the price they can obtain after two rounds of trading due to their short time horizon. Thus they seek to exploit price differences over time (from their trading to the price after two trading rounds) and not differences between the price of an asset and its value. Hence, herding can emerge with speculators.

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Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk