Social Influence in Stock Markets

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"Where all think alike,
no one thinks very much"
Walter Lippmann (1889-1974)

Abstract

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Influences by others when making investments and predictions in stock markets, referred to as herding, is a widely discussed phenomenon in financial economics. This thesis aims to understand herding by applying theories of social influence. In a series of studies employing a multi-trial experimental approach, undergraduates made predictions of stock prices. On each trial they received information about the current price and the predictions made by other fictitious participants, forming a majority or a minority herd. Study I investigated how different rewards altered the level of influence from a herd making random predictions. Experiment 1 (n = 80) demonstrated that the tendency to follow others overrides the effect of a financial reward for individual performance. In Experiment 2 (n = 80) a reward for following a majority herd increased the influence, but a reward for following a minority herd did not. Addressing the importance of consistency for herding, in Study II (n = 96) consistency was varied both as agreement between the others' predictions (correlation) and within the others' predictions (variance). Correlation increased the herd influence, but no effect of variance was observed. Studies I and II suggested that the influence from a consistent random majority herd was associated with the use of a consensus heuristic. Study III further explored the processes mediating majority and minority influences, with the focus on accuracy motives. The results of Experiment 1 (n = 64) showed that the participants followed a majority herd independently of whether its predictions were accurate or random. In Experiment 2 (n = 80) the majority influence was reduced by requesting participants to focus their attention on the accuracy of the others' predictions. It was found in Experiment 3 (n = 60) that a minority herd was influential only when its predictions were accurate and when the participants were requested to focus their attention on the accuracy of the others' predictions. The focus instruction thus seemed to break the tendency to use a consensus heuristic. Study IV (n = 80) examined whether induced expertise and augmenting the validity of price information would have the same effect, showing that the others only influenced participants' predictions when participants were non-experts and the price was invalid. The results of Studies I-IV demonstrate that in prediction tasks based on uncertain information people use heuristic processing more extensively than has been assumed in previous social influence research. A majority herd seems to be influential due to the use of a consensus heuristic. However, no support was found for the proposition that minority influence is associated with systematic processing. Instead, the tendency to follow the price instead of a minority suggests the use of a "minority heuristic". Factors such as focus instructions, high price validity and expertise suppressed heuristic processing.

Keywords: Social influence, Herding, Majority vs. minority influence, Stock markets, Financial incentives, Heuristic vs. systematic processing, Predictions, Behavioural finance.

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Populärvetenskaplig sammanfattning på svenska

På aktiemarknaden finns olika slags information som kan ge vägledning för aktiers framtida avkastning. Problemet är att tillförlitligheten i denna information varierar mycket. Med tilltagande osäkerhet ökar investerares tendens att se hur andra gör. När många investerare fattar liknande beslut uppstår ett ”flockbeteende”. Tidigare forskning bevisar att flockbeteende förekommer på aktiemarknaden. Detta ses som ett hinder för en effektiv aktiemarknad, eftersom flockar av investerare kan luras in i riskfyllda investeringar, vilket i sin tur leder till extrema svängningar i aktiepriser och instabilitet av marknaden. Det är därför viktigt att förstå varför flockbeteende uppkommer.

Den engelska benämningen på flockbeteende (”herding”) liknar investerare vid får eller lämlar som blint följer efter flocken. Denna metafor är en överdrift, men frågan är om det finns någon sanning i påståendet att flockbeteende är oreflekterat? I denna avhandling har jag använt socialpsykologiska teorier för att förstå vilka psykologiska faktorer som orsakar flockbeteende på aktiemarknader.

Information om vad andra tycker och hur de reagerar på denna information är inte bara viktig när det gäller aktiehandel, utan i de flesta sammanhang. Därför är det föga förvånande att socialt inflytande är ett dominerande område i socialpsykologisk forskning sedan 1950-talet. Generellt sett finns det två olika typer av socialt inflytande, normativt och informativt. Normativt socialt inflytande uppstår för att människor vill uppfylla andras positiva förväntningar och motiveras av en önskan att bli accepterad av gruppen. Informativt socialt inflytande uppstår när andras beslut antas vara bevis på vad som är korrekt och motiveras av en vilja att göra bra bedömningar. I situationer då människor fattar sina beslut anonymt minskar betydelsen av önskan att accepteras av gruppen. Istället är en påverkan från andra motiverad av att de antas ha viktig information. Eftersom detta oftast är fallet på aktiemarknaden inriktas avhandlingen mot informativt inflytande.

Hur inflytelserik en ”flock” eller grupp är påverkas av dess storlek. Ett tillförlitligt resultat av forskning om socialt inflytande är att människor påverkas av majoriteter i högre utsträckning än minoriteter. Ju större majoriteten är, desto mer inflytelserik är den vanligtvis. Även minoriteter kan ha inflytande. Enligt den mest betydande teorin om majoritets- och minoritetsinflytande (Moscovicis ”conversion theory”) sker majoritetsinflytande relativt oreflekterat, eftersom de flesta människor önskar tillhöra en majoritet. Inflytandet kan utlösas av att människor använder tumregeln ”en majoritet har alltid rätt” när de fattar beslut. Minoritetsinflytande är däremot associerat med överlagt tänkande, vilket innebär att minoritetens ståndpunkt måste vara övertygande för att få inflytande.

Är det förnuftigt att följa flocken? Det beror på hur bra flocken presterar. Om Moscovicis teori är korrekt och kan tillämpas på aktieinvesteringar, så innebär det en risk att man följer en flock som utgör en majoritet oavsett om den gör rätt eller fel, alltså om den gör kloka aktieinvesteringar eller inte. Det skulle kunna leda till oväntade och förödande konsekvenser på aktiemarknaden.

I denna avhandling presenteras fyra experimentella studier som belyser flockbeteende i en situation som påminner om aktiemarknaden. Det huvudsakliga syftet är fastställa om investerare påverkas av en flock när de fattar investeringsbeslut, och om det i så fall spelar roll om flocken utgör en majoritet eller en minoritet. Hypotesen är att om flocken utgör en majoritet så får den inflytande utan att beslutsfattaren gör ingående övervägande, medan om flocken utgör en minoritet så får den inflytande endast om beslutsfattaren blir övertygad om att den gör rätt.

När en investerare fattar beslut om vilken aktie som ska köpas eller säljas gör de en bedömning av hur aktiens pris kommer att förändras. I likhet med detta var deltagarnas uppgift i avhandlingens samtliga experiment att göra upprepade bedömningar av vad en akties

pris skulle vara kommande dag. Vid varje bedömning fick deltagarna information om dels aktiens nuvarande pris och dels om vilka bedömningar andra deltagare tidigare gjort. De andra deltagarna utgjorde flocken. Flockens relativa storlek varierade så att den antingen utgjorde en majoritet eller en minoritet. Även tillförlitligheten i den tillgängliga informationen varierades. Genom att jämföra deltagarnas bedömningar med flockens bedömningar var det möjligt att fastställa graden av flockbeteende under olika betingelser.

Syftet med den första studien var att undersöka om olika belöningssystem påverkar flockbeteende. För att göra så korrekta bedömningar som möjligt borde deltagarna påverkas av dagens pris, som var tillförlitligt, istället för flocken som gjorde slumpmässiga bedömningar. I ett första experiment fick deltagarna mer betalt ju bättre de presterade, vilket borde minska flockens påverkan. Resultaten visade dock att deltagarna följde flocken trots att de inte tjänade på det. I det andra experimentet fick deltagarna mer betalt om de följde flocken, förutsatt att deras bedömning var korrekt. Det var därför klokt att inte följa efter flocken utan att jämföra dess bedömning med ens egen. Flocken utgjorde antingen en minoritet eller en majoritet. Resultaten visade att deltagarna följde en majoritet mer än en minoritet. Dessa resultat stämmer med hypotesen att majoritetsinflytande sker oreflekterat och att minoritetsinflytande sker först efter kritisk granskning.

För att flockbeteende ska kunna uppstå krävs att flocken är samstämmig. På en aktiemarknad kan graden av samstämmighet definieras på olika sätt. Dels spelar det roll hur överens man är inom flocken, vilket kan uppskattas som sambandet mellan flockens bedömningar, dels hur mycket flockens bedömningar varierar över tid, vilket kan uppskattas genom bedömningarnas variation. I den andra studien undersöktes hur stor påverkan dessa två aspekter av samstämmighet har på flockens påverkan. Resultaten visade att sambandet ökade graden av flockbeteende, medan variationen inte hade någon effekt. Resultaten från både den första och andra studien demonstrerar en stark benägenhet att använda tumregeln ”majoriteten har alltid rätt”.

I den tredje studien undersöktes vilka psykologiska processer som kopplas till majoritets- och minoritetsinflytande. Detta gjordes genom att variera korrektheten i flockens bedömningar, så att de var antingen felaktiga eller korrekta. Flocken utgjorde antingen en majoritet eller en minoritet. I samtliga experiment var priset tillförlitligt. Resultaten från ett första experiment visade att deltagarna följde flocken när den utgjorde en majoritet, oavsett om den gjorde felaktiga eller korrekta bedömningar. Däremot hade flocken inget inflytande när den utgjorde en minoritet. Återigen verkade alltså deltagarna följa en majoritet utan att överväga.

Finns det något sätt att undvika att dras med i flocken? I det andra experimentet fick deltagarna dessutom uppgiften att bedöma hur bra majoritetsflocken presterade. Denna uppgift hade stark effekt. Genom att öka deltagarnas uppmärksamhet på flockens korrekthet minskade flockbeteendet drastiskt. I det tredje experimentet användes samma uppgift med syftet att åstadkomma inflytande från en minoritetsflock. I detta experiment gjorde minoritetsflocken korrekta bedömningar medan priset inte var tillförlitligt. I motsats till hypotesen hade minoriteten dock inget inflytande om inte deltagarna gjordes uppmärksamma på minoritetens korrekta bedömningar.

I de tre första studierna tyder resultaten på att flockbeteende sker relativt oreflekterat, förutsatt att flocken utgör en majoritet. I dessa studier varierade flockens storlek och tillförlitligheten i dess bedömningar. I den fjärde studien varierades istället tillförlitligheten i övrig tillgänglig information för att undersöka om det motverkar flockbeteende. Resultaten visade att hög tillförlitlighet i priset och tydlig information om detta motverkar inflytande från en majoritetsflock.

Sammanfattningsvis visar resultaten av denna avhandling att det på aktiemarknader kan finnas en stark tendens att förlita sig på att majoriteter har rätt och bortse från minoriteter. För att undvika oönskat flockbeteende bör investerare vara uppmärksamma på tillförlitligheten av flockens prestation. Bättre och tydligare information skulle därför sannolikt också öka chansen att investerare bortser från flocken. Att vara medveten om att tillgänglig information på börsen inte är tillförlitlig och att inse att majoriteten inte alltid har rätt är följaktligen en bra utgångspunkt för en lyckad aktiehandel.

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Maria Andersson

Preface

This thesis consists of a summary and the following four studies referred to by roman numerals:

I. Andersson, M., Hedesström, T. M., & Gärling, T. (2009). *Social influence in stock markets: Effects of financial incentives on herding.* Manuscript submitted for publication.

II. Andersson, M., Hedesström, T. M., & Gärling, T. (2009). Social influence on predictions of simulated stock prices. *Journal of Behavioral Decision Making, 22,* 271-279.

III. Andersson, M., Hedesström, T. M., & Gärling, T. (2009). *Processes mediating majority and minority herd influences on predictions of simulated stock prices.* Manuscript submitted for publication.

IV. Andersson, M. (2009). *Social influence in stock markets: Effects of valid price information and expertise.* Manuscript submitted for publication.

Table of Contents

Introduction

A *Homo economicus* can be described as an antisocial species interacting with others only for the benefit of gaining valuable information. This implies that *Homo economicus* is not influenced by others unless it is rational to be so. In contrast, *Homo sapiens* (humans, investors included) are frequently influenced by other humans. This social influence is usually beneficial in the sense that it improves decisions. However, social influence may also be elicited when it is not beneficial. This may for instance occur when making stock market investments. Investors who imitate each other have been described as mindless sheep blindly following the herd, frantic during booms and terrified during market crashes (Shiller, 2000). The aim of the present thesis is to understand why social influences occur in stock markets.

Investors' tendency to behave in similar ways is referred to as herding (Sias, 2004). This tendency may be due to inferences about others' private information that people make by observing their actions. In general, herding is viewed as an impediment in financial markets, because herds are said to be lured into risky ventures without acquiring enough information and appreciating the risk of the investment (Bikchandani & Sharma, 2000). This may induce aggravated volatility, which in turn increases the fragility of financial markets and therefore destabilises the broader market system (Bikchandani & Sharma, 2000; Chari & Koebe, 2004). Furthermore, herding may lead to unbeneficial outcomes for the investor (Celen & Kariv, 2004). Understanding the phenomenon of herding is hence essential.

The tendency to follow others has been observed in many contexts, for example in consumption, in expressing opinions, or even in simple decision making, such as whether or not to cross a street. In social psychology this behaviour is referred to as conformity (Cialdini & Goldstein, 2004) stemming from social influence. A general conclusion in social-influence research is that majorities are more influential than minorities. An ongoing debate concerns whether majority and minority influences are associated with different types of processing. Moscovici (1976, 1980, 1985) argued that majority influence is associated with less cognitive processing effort, and that minority influence is associated with more cognitive processing effort. Minorities may therefore be as influential as majorities. It is here proposed that this theory has bearings on the understanding of herding in financial markets.

As a starting point, the empirical studies presented in this thesis will examine whether consistency within and size of a herd (majority vs. minority) matter for the existence of herding. We then investigate the degree of processing effort associated with majority and minority influences, respectively. Before summarising and discussing the empirical studies, the sections that follow provide an overview of economic and psychological definitions, implications, and empirical evidence of herding. This is followed by a review of research on social influence.

Herding

Introduction

Herding is a widely studied phenomenon in behavioural finance (e.g., Bikchandani & Sharma, 2000; Shiller, 2000; Sias, 2004). The concept is believed to have the potential to explain a number of financial phenomena, such as volatility of, momentum and reversals in stock prices. Although used frequently, herding is a vague term. It refers to investors as animals, like lemmings or sheep, who go browsing passively from one field to another, following others without ever examining whether the grass is greener somewhere else. While this metaphor of course is an exaggeration, does it to some extent represent investor behaviour? If so, what are the investors' reasons for imitating each other? In this section I will

discuss definitions of herding, distinguish a number of proposed causes of herding and selectively review the empirical evidence.

Definitions

"The truth is rarely pure and never simple."
Oscar Wilde (1854 – 1900)

An abundance of research has explored the distinction between rational and irrational herding. According to the research in financial economics, both forms exist. If an investor has limited knowledge and information about which stocks to buy, and an analyst who has been successful in the past and has a good reputation gives a reasonable recommendation, it may be considered rational to follow it. The view of herding as rational centres on optimal decision making altered by information or incentives. However, people may herd for other reasons, such as time constraints, leading to decisions that are conceived of as irrational. The view of herding as irrational centres on investor psychology, stating that investors follow each other without rational analysis. The intermediate view states that investors are boundedly rational, using heuristics that decrease the cost of information processing (Devenow & Welch, 1996). Still, some researchers appear to believe that theories about herding without connection to rational choice are not worth considering (e.g. Bikhchandani & Sharma, 2000; Devenow & Welch, 1996). From a psychological perspective, it is however hard to justify these distinctions based on rationality. For example, if an investor follows the herd because of lack of time to invest in the effort to obtain information or to make further analysis on which to base an investment decision, why should this not be conceived of as rational? The aim of this thesis is to focus on the herding phenomenon, irrespective of whether or not it is rational.

In general, herding is defined as investors' tendency to follow each other into and out of the same stocks (Sias, 2004). A prerequisite for such behaviour is the existence of interaction among investors. One major distinction is the difference between following each other because of *indirect* influences among investors and because of *direct* influences among investors.

Four main causes of indirect influences among investors have been proposed in previous research: common knowledge, fads, common investment strategies and similar compensation schemes. First, common knowledge (also called investigative herding) refers to that investors follow the same or correlated signals, or that the trade information is correlated across sections (Froot, Scharfstein, & Stein, 1992; Grinblatt, Titman, & Wermers, 1995). Second, fads refer to that investors buy the same stocks simply because they become more popular (Sias, 2004). Third, investors may systematically follow certain investment styles (Wermers, 2000) such as momentum trading, which refers to active investment in high past-return stocks (Grinblatt et al., 1995). For example, if investors buy stocks in one industry one quarter, their increased demand will probably result in a higher value of such stocks. Then other investors will buy the same stocks the next quarter due to expected high returns. Fourth, compensation schemes determining how much investors will be paid may reward their performance relative to others' performance, and therefore deviations from the market consensus may cause an undesired cost (Rajan, 1994).

Conversely, herding due to direct influences among investors is said to arise from *information cascades*, where every subsequent actor independently of private information makes the same choice based on the observations of others (e.g. Bikhchandani, Hirshleifer, & Welch, 1992), or *reputational herding*, which refers to that making choices that deviate from the consensus forecast imposes costs for investors in terms of impaired reputation (Scharfstein & Stein, 1990). It is important to note that the causes of herding are not mutually exclusive. Thus, investors may herd for several reasons simultaneously.

The empirical approaches examining herding can be divided into analyses of actual market behaviour and laboratory experiments. The latter mainly investigates information cascades. Studies of market behaviour make no distinction between direct and indirect herding, and in general do not investigate the causes of the phenomenon. Instead, herding is assumed to exist if a number of institutions or individuals buy or sell the same funds at the same time. An obvious problem with this assumption is that since it is unknown on what basis the investors made their decisions, observations of market behaviour do not prove the existence of herding due to direct influence but only that investors make similar decisions. In a real-world setting, it is impossible to assess the investors' private information. In contrast, laboratory environments allow for control of both public and private information, which facilitates explicit tests of causal explanations. In the following I will review previous theoretical and empirical findings, first the results revealed by analyses of market behaviour (which make no explicit distinction between herding due to direct and indirect influences), and then results regarding herding due to direct influences (information cascades and reputational herding).

Analyses of Market Behaviour

Here I will selectively review the main results of financial studies on market behaviour. As already mentioned, a common feature of these studies is that they interpret observed mass behaviour as herding. Therefore, hereafter herding has both direct and indirect influences among investors.

Despite strong theoretical reasons to expect herding, the empirical evidence from analyses of market data points in opposing directions; while some studies confirm the existence of herding in financial markets (e.g. Guedj & Bouchaud, 2005; Sias, 2004), others do not (e.g., Drehmann, Oechssler, & Roider, 2005; Grinblatt et al., 1995; Lakonishok, Shleifer, & Vishny, 1992; Wermers, 1999). The different results can partly be explained by how herding is quantified. One common measure for quantification is the Lakonishok (1992) measure, in which large imbalances between the numbers of buyers and sellers in stocks are assumed to be evidence of herding. More specifically, for the measure assesses cross-sectional temporal dependence by recognising whether investors follow each other into and out of the same stocks over some period of time. Studies applying this measure (e.g., Grinblatt et al., 1995; Wermers, 1999) show a lower level of herding compared to studies applying other measures (e.g., Bennett, Sias, & Starks, 2003; Nofsinger & Sias, 1999; Sias, 2004). A recent study that applied both the Lakonishok (1992) and the Sias (2004) measures to the same data found compelling evidence of herding (Puckett & Yan, 2008).

Herding occurs in different situations, in different firms and at different organisational levels. Empirical evidence of herding has been found in trading of securities (e.g. Hirshleifer, Subrahmanyam, & Titman, 1994; Holden & Subrahmanyam, 1996), as well as in forecasts by stock analysts and other forecasters (e.g. Ashiya & Doi, 2001; Cote & Sanders, 1997; Ehrbeck & Waldmann, 1996).

Several factors are known to impact the level of herding. One factor is the degree of noise in information. In small-capitalisation securities the private information tends to be noisier. Institutional investors therefore place greater weight on the herd's decisions when investing in such securities (Wermers, 1999). Along the same lines, Bennett et al. (2003) concluded that the information advantage is larger in small-capitalisation securities. Related to this is the difference between large and small firms in the tendency to herd. Since large firms may have larger absolute benefits from attaining precise information and lower costs for information acquisition, they tend to be fashion leaders and invest when others do not. Small firms tend to be followers of large firms' investments (Hirshleifer & Teoh, 2003). Another factor is the age of investors; senior investors are less likely to herd. Managers are trained by

studying the decisions and performance of other managers both within and across firms, which implies that they in a sense are trained to take others' opinions into account (Hong, Kubik, & Solomon, 2000).

Overall, the strength of market data analyses is their external validity. Still, if the aim is to find conclusive evidence of the existence and the causes of herding, an experimental approach is preferable.

Information Cascades

The research on information cascades concerns situations where people have uncertain private information and make sequential decisions that are publicly disclosed. In a typical scenario, a respondent reveals his or her decision, and subsequent actors follow this decision even if it contradicts their private information. To illustrate, think of a person who chooses between two unfamiliar, apparently similar restaurants situated on opposite sides of a street. Assume that the person has heard others' mixed opinions about one of the restaurants (A) and only good things about the other (B). When approaching the restaurants, the person notes that restaurant A is more crowded than restaurant B. Many people would probably then choose restaurant A. A restaurant queue, without any proof that the restaurant is better than the other, may thus be enough to attract additional customers, even if they have opposing private information. This is because people base their decisions on choices made by others. In contrast, if they would discuss the decisions and critically assess their first impressions, they might be able to figure out which restaurant is in fact preferable. Information cascades start in a stock market when investors ignore their own information and instead infer information from a herd (Sias, 2004).

Despite essential differences, the terms herding and information cascades are sometimes used interchangeably in research in financial economics. The most important difference concerns the degree of imitation. According to Smith and Sørensen (2000), an information cascade occurs when a sequence of investors ignore their private information when making decisions, and individual behaviour therefore becomes entirely imitative. Herding occurs when an infinite sequence of investors make identical decisions, although their actions may still reflect private information. As a result, an information cascade is stable because additional private information does not cause changes in the behaviour, whereas in herding additional private information may cause dramatic and sudden shifts (Celen & Kariv, 2004). According to these definitions, information cascades are recognised through unobservable beliefs and thus are more difficult to detect than herding.

In a typical experiment on information cascades (e.g. Anderson & Holt, 1997), participants predict which of two events will take place. In each trial, they receive a cue, *a* or *b*, corresponding to the outcomes A and B with a predetermined probability. The cue is private and the prediction is publicly announced, thus participants in each trial receive information about the private cue and the decisions made by preceding participants. An information cascade occurs when a participant observes two consecutive identical decisions (A, A) and, despite contrary private information (b), chooses the same option (A). Anderson and Holt (1997) found that cascades are formed when the decisions made in the initial trials coincide, and they concluded that following the established pattern in such cases is consistent with reasoning according to Bayes' rule, that is to revise one's beliefs by optimally utilising diagnostic information. However, they also found that in about half of the cases when a cascade was observed, the participants' choices were interpreted as an incorrect action.

Hung and Plott (2001) investigated how the tendency to engage in information cascades is altered by different financial rewards. Replicating the results of Anderson and Holt (1997), they showed that when participants were rewarded for making correct decisions, they followed the others preceding them. When rewarded only if the group's answer was

correct, participants instead relied more on private information, which made the group's collective judgment more accurate than that of the cascading groups. It was also found that participants placed even more weight on the decisions made by others when rewarded for making the same decisions as they did.

Information cascades provide a rationale for the imitative behaviour observed among investors. However, the information cascade experiments have recently been subject to criticisms that seem to make them inapplicable to real financial investments. It has been shown that information cascades are inhibited if the dichotomous tasks in information cascade experiments are made continuous (Celen & Kariv, 2004). Information cascades then become less frequent and in almost all cases, participant choices are normatively correct. In information cascade experiments, the cost of taking action is held constant, thus the price of a stock does not change according to supply and demand. If the participants instead choose between assets with market-determined prices, it has been argued that information cascades cannot start (Avery & Zemsky, 1998). In this case, participants trade on the difference between their own information (the history of trades and their private signal) and their common information (the history of trades only). It will then never be the case that they neglect their own information and instead imitate others. For this reason, the price aggregates the information contained in the history of the previous trades correctly. The criticisms have been addressed in a model proposed by Chari and Koehe (2004), who argue that the development of cascades under the defined circumstances depends on the timing of decisions. The criticisms concern experiments with exogenous timing, which means that investors make their decisions in a predetermined order. If timing is instead endogenous, which means that investors make their decisions whenever they want, Chari and Koehe (2004) argue that information cascades reappear, even when signals are continuous or prices are flexible. Sgroi (2003) showed that with exogenous timing, cascades remained ubiquitous.

Further doubts concerning the rationality in information cascades have recently emerged. In a recent study by Spiwoks, Bizer and Hein (2008), only 36% of all decisions were rational, and only a small number of those making a rational decision were able to state a correct reason for why their decision was rational.

Reputational Herding

A prerequisite for reputational herding to occur is, like in information cascades, interdependencies among individual decisions. However, the two forms of herding differ in the underlying motivation; whereas information cascades result from individuals' incomplete information, reputational herding is a result of the motivation to earn social approval or avoid disapproval.

According to Trueman (1994), analysts prefer to release forecasts that are similar to expectations of future earnings, even though a more extreme forecast would be justified by his or her private information. Releasing a forecast similar to expectations of future earnings may positively impact the investors' impression of the analyst's capacity and trustworthiness and thus enable the analysts to charge higher fees for the forecast. A sign of herding is that the probability that an announced forecast is similar to those released by other analysts is larger than would be justified by private information. In reputational herding, acting differently from the herd imposes an additional cost on investors.

An explanation to reputational herding is related to Keynes' (1936) notion that failing conventionally is better for one's reputation than succeeding unconventionally. This is because investors who herd are able to share the blame and hide in the herd when making unfavourable investment decisions (Devenow & Welch, 1996). Along the same lines, Scharfstein and Stein (1990) propose that an unprofitable investment harms a decision maker considerably less when others have made similar investments, which constitutes a reputational

reason for investors to ignore private information in favour of trading with the herd. Parallel to this explanation is Palley's (1995) argument that herding is based on the principle of 'safety in numbers', assuming that managers are individually risk averse, and that their reward is partly based on relative performance.

Empirical results support that reputational concerns may trigger herding. Younger asset managers, whose career concerns are normally stronger than older asset managers since they are facing a longer working life ahead, deviate less from the average market decision (Hong, et al., 2000). This result is related to risk taking; making investments that deviate from the consensus forecast imposes a higher risk of being fired for young and inexperienced managers (Arora & Ou-Yang, 2001; Chevalier & Ellison, 1999). Experiments with professional stock analysts have also demonstrated reputational herding. In a study of continuous choice (Cote & Sanders, 1997), participants predicted earnings in the following year. After a prediction had been made, a consensus of analysts' predictions was shown to the participants, whereafter they had the opportunity to adjust their own predictions. Consistent with reputational herding, the results showed that the consensus had a significant influence on the predictions, and that the level of herding was related to the analysts' perception of their own ability and their motivation to preserve or create a good reputation.

Social Influence

"When people are free to do as they please, they usually imitate each other"
Eric Hoffer (1902-1983)

Empirical Findings

Information about what others think and how people react to this information is abundant in everyday life. Therefore, it is not surprising that social influence has been and continues to be a dominant area of social psychological research (e.g. De Dreu & De Vries, 2001). One of the most prominent theories of social influence is Festinger's (1954) theory of social comparison processes, which suggests that there are incentives to reach consensus within groups. This makes group members dependent on the group in terms of social approval and verification of beliefs. Due to a lack of objective means for verification, others' attitudes and beliefs are used as validation.

Festinger's theory that people seek agreement with the majority has two motives: they wish to be accepted by or belong to the majority (and avoid belonging to the minority), and they believe that the majority is more correct than themselves. Deutsch and Gerard (1955) extended this argument by distinguishing between normative and informational social influence. Normative social influence refers to matching others' positive expectations and is based on the desire to obtain social acceptance. Informational social influence refers to using others' choices as evidence of the truth, motivated by the goal to form an accurate judgment of reality and behave correctly. Normative social influence is expected to induce public compliance without private acceptance, whereas informational social influence is expected to induce both public compliance and private internalisation of others' opinions. In order to capture the distinction between normative and informative social influence in experimental studies, researchers have used different paradigms. Most commonly, variants of the Asch paradigm, in which there is a face-to-face interaction between participants and their confederates, are used to capture normative influence, and variants of the Crutchfield paradigm, in which participants are placed in individual cubicles and receive false feedback of the confederates' responses, are used to capture informative influence (Bond & Smith, 1996). It is however difficult to conclusively distinguish between the two forms of social influence, both theoretically and empirically (David & Turner, 2001).

Altering behaviour to comply with others' responses is referred to as conformity (Cialdini & Goldstein, 2004). A number of factors are known to mediate conformity (Bond & Smith, 1996), such as the relationship between the group and the participants, anonymity in response, stimulus materials and task difficulty. Another important factor is the relationship between group size and social influence. Asch (1956) found that the level of conformity is negligible with only one confederate, increases rapidly when two to four additional confederates' opinions are presented to participants, and is approximately the same with 4-15 confederates. The results of subsequent studies, using variants of the Asch paradigm, have confirmed that the relative magnitude of social influence increases as a function of group size (Latané & Wolf, 1981).

It also matters whether the source of influence constitutes a majority or a minority. The majority-minority distinction refers to the proportion of individuals holding a certain position. The minority must always be numerically smaller than the majority, which most commonly constitutes more than 50% of the group. In a meta-analysis, Bond (2005) concluded that overall the relationship between conformity and the size of the majority is positive and linear. However, according to Bond and Smith (1996), the relationship depends on the paradigm (the Asch paradigm vs. the Crutchfield paradigm) and the response (private vs. public). When responses are private, there is a strong positive relationship in studies using the Crutchfield paradigm and a slightly negative relationship in studies using the Asch paradigm. When responses are public, the relationship is weak and positive in studies regardless of which paradigm is used.

Fewer studies have investigated the relationship between group size and minority influence. Nemeth, Wachtler and Endicott (1977) used a colour perception task to examine the effects of different sizes of minorities, and found that increasing the size of a minority increases its perceived competence. The study was set up so that when the absolute size of the minority increased, the relative difference between the minority and the majority decreased. A strong effect of a minority consisting of more than one person was found, but the effect decreased when the relative difference between the minority and the majority was small.

Consensus information seems to have different effects on majority and minority influence. A study by Martin, Gardikiotis and Hewstone (2002) showed that when participants were presented with information expressed as proportions of others, majorities always had more influence on participants' attitudes than minorities, irrespective of whether the difference between the groups was small or large. The presentation of consensus information also seems to affect social influence (Gardikiotis, Martin, & Hewstone, 2005). When consensus was described in terms of descriptive adjectives (large vs. small), large sources were more influential than small sources, irrespective of whether the source was a majority or a minority. When consensus instead was described in terms of percentages, the majority was more influential than the minority, irrespective of being large or small. Overall, minority influences seem to be more sensitive to both the relative size of the source of influence and how the consensus information is framed.

It is clear that both majorities and minorities may influence people's decisions and attitudes, albeit under different circumstances. Explanations to peoples' reactions to others' beliefs have been proposed for a long time (Cialdini & Goldstein, 2004). The most discussed theoretical approaches and their associated empirical evidence are summarised below.

Theories of Social Influence

Different assumptions have been made regarding cognitive and motivational processes involved in majority and minority influences. Moscovici's (1976, 1980, 1985) conversion theory views majority influence as normative, whereas Mackie's (1987) objective consensus approach views majority influence as informational. Similarities with both approaches are

found in the more recent source-position congruency model (Baker & Petty, 1994) and the cognitive response approach (Eagly & Chaiken, 1993; Petty & Cacioppo, 1986).

Conversion Theory. In Moscovici's (1976, 1980, 1985) conversion theory, all attempts of social influence are expected to create conflict between the source and the target. Two ways of solving such conflicts are proposed: conforming to the majority's view and accepting the minority's view. Majority influence initiates a process of social comparison, where the relationship between the majority group and the target of influence is in focus. Since people generally wish to belong to the majority, they conform to its view without considering its message in detail. In contrast, a distinctive minority may motivate a validation process that leads to careful examination of the minority's arguments in order to understand them and understand why they disagree with the majority. If the target of influence is persuaded by the minority's view, minority influence occurs and the initial conflict is resolved. According to Moscovici, Lage and Naffrechoux (1969), minorities create conflicts with the majority because they offer a new perspective. Since people in general do not wish to publicly agree with the minority, attitude change following minority influence is likely to be only observed on indirect measures (Wood, Lundgren, Ouellette, Busceme, & Blackstone, 1994).

Contrary to single-process models in which majority and minority influences differ primarily in degree (e.g., Latané & Wolf, 1981), conversion theory is a dual-process theory postulating qualitative differences between majority and minority influences. In sum, these differences concern direction of attention, content of thinking, and differential influence (Martin & Hewstone, 2001). Concerning direction of attention, the perception of a majority makes individuals focus on the difference between themselves and the majority members, whereas the perception of a minority makes individuals focus on the content of the minority's message. Concerning content of thinking, minority influences can make individuals reconsider their own beliefs and consider a minority position as a viable alternative, whereas majority influence leads to a superficial examination of the majority arguments. Differences in content of thinking result in differences in message processing. Concerning differential influence, minorities cause more private and indirect influence while the opposite is evident for majorities.

Other approaches to social influence share the dual-process assumption, but make predictions that differ from those of conversion theory.

The Objective Consensus Theory. The major challenge to conversion theory is Mackie's (1987) objective consensus theory, which, in direct contrast to conversion theory, postulates that a majority source rather than a minority source induces message elaboration. This assumption is based on two premises. First, a majority sharing the same opinion indicates that their message is valid and therefore attracts attention. If an individual's view differs from the majority's view, he or she will attempt to understand the discrepancy, which results in considerable analysis of the message. Second, the 'false consensus heuristic' (Martin & Hewstone, 2001) makes people believe they share the same attitudes and norms with people in the majority and thus differ from those in the minority. When one is exposed to a counter-attitudinal majority, the consensus breaks down and people become motivated to analyse the majority's arguments in order to identify the differences in opinion. When one is exposed to a counter-attitudinal minority, it is less likely to motivate analysis of the minority's message. An implication is that individuals are expected to agree with the majority and disagree with the minority, thus majority influences rely on informational aspects rather than normative aspects as in conversion theory. There is relatively little evidence for the main implication of the objective consensus theory. In fact, the meta-analysis by Wood et al. (1994) supports conversion theory.

Recently, there has been a shift in theoretical developments, which has led to the acknowledgement that neither majorities nor minorities are associated exclusively with degree

of analysis of a message (Martin & Hewstone, 2003). Therefore, contingency approaches arguing that the relationship between majority and minority influence and the level of message analysis are contingent on additional factors have gained increasing attention.

The Source/Position Congruency Theory. Baker and Petty's (1994) source/position congruency theory posits that a more thorough message analysis occurs in cases with counter-attitudinal majority or pro-attitudinal minority (unbalanced situations) than in cases with counter-attitudinal minority or pro-attitudinal majority (balanced situations). In pro-attitudinal conditions, where the message from the minority is thoroughly analysed, the conversion theory and the source/position congruency theory make the same predictions, whereas in a counter-attitudinal condition, where the message from the majority is thoroughly analysed, the objective consensus theory and the source/position congruency theory make the same predictions.

In sum, three main predictions concerning which source is associated with a more thorough message analysis can be derived from the theories presented above: the minority (conversion theory, Moscovici, 1976, 1980, 1985), the majority (objective consensus theory, Mackie, 1987), and either the majority or the minority, depending on whether the source and message direction is balanced or unbalanced (source/position congruency theory, Baker & Petty, 1994). Recent research has continued to focus on additional factors that impact majority and minority influence. The cognitive response approach is a way of testing such predictions since it provides a useful technique for determining when a detailed analysis of a message has occurred.

The Cognitive Response Approach. The focal point of the cognitive response approach is how cognition affects how persuasive arguments are processed, which may potentially provide a more detailed understanding of the underlying processes involved in majority and minority influence. The level of message analysis determines how influential the message will be and thus how much it will change a person's attitude. In cases when messages do not generate any supporting or non-supporting thoughts, the message will not affect attitudes.

The cognitive response approach is based on theories of persuasion, that is the Elaboration Likelihood Theory (ELT, Petty & Cacioppo, 1986) and the Heuristic Systematic Theory (HST, Eagly & Chaiken, 1993). Both of these theories distinguish between high elaboration modes (ELT central-route and HST systematic processing) and low elaboration modes (ELT peripheral-route and HST heuristic processing), which demand more and less cognitive effort on behalf of recipients of persuasive communication, respectively.[1] Also, they both predict that an individual needs motivation and ability to pass an elaboration threshold in order to ensure that systematic processing occurs. Systematic processing involves careful evaluation of information. On the other hand, in heuristic processing people are not motivated or able to process the message, and therefore persuasion may occur due to some cue in the source of influence, like status, or the use of a 'consensus implies correctness' heuristic (hereafter referred to as the 'consensus heuristic') implying that 'the majority is always right' (Eagly & Chaiken, 1993).

Integration

The application of concepts and methodologies derived from the cognitive response approach has recently been increasingly involved and used in contemporary research on majority and minority influence. In this vein, Maass and Clark (1983, 1984) equated Moscovici's (1976, 1980, 1985) concepts of comparison and validation with systematic and heuristic processing, a parallel implying that minority influence is associated with systematic

[1] The terminology derived from ELT and HST has been used interchangeably in the literature. Here, we use the terms systematic and heuristic processing.

processing and majority influence with heuristic processing. In contrast, the objective consensus theory would predict that systematic processing occurs in majority influence.

One commonly used method to distinguish between the different modes of processing is to vary the quality of arguments in the message (Petty & Cacioppo, 1986). Strong arguments should have a larger influence than weak arguments if a message is systematically processed, but if it is not, no such difference should be found. Several studies have applied this approach (e.g. Gardikiotis et al., 2005; Martin et al., 2002; Martin & Hewstone, 2003). Most previous research has distinguished between the extremes of the processing continuum, that is that message processing is either heuristic or systematic. Only a few recent studies have paid attention to processing occurring between the extremes, labelled intermediate processing (e.g. Bohner, Dykema-Engblade, Tindale, & Meisenhelder, 2008; Martin, Hewstone, & Martin, 2007).

The fact that both majorities and minorities may be influential is established, but whether the influence is associated with systematic or heuristic processing is still uncertain. Recent studies have investigated specific circumstances in order to determine the relationship between a majority-minority distinction and processing effort. One example is a study investigating how cognitive effort dedicated to the processing of minority and majority communication was related to prior attitudes (Erb, Bohner, Rank, & Einwiller, 2002). The results revealed an interaction between intensity of prior opinions and type of processing. When participants had an opinion that opposed that expressed by a majority or a minority, the message from the minority was systematically processed and the majority message was heuristically processed in line with the predictions from conversion theory (Moscovici, 1976, 1980, 1985). When participants instead held opposing opinions, in line with Mackie's (1987) objective consensus theory, the majority messages were systematically processed.

The results of experiments by Martin, Martin, Smith, and Hewstone (2007) indicated that minority influences instigate systematic processing and thereby generate stronger attitudes, whereas majority influence is based on heuristic processing and generates weaker attitudes. When the topic was of low personal relevance the results were the same, but when the topic was of high personal relevance, systematic processing seemed to occur both in majority and minority influence. Another study (Martin, Hewstone, & Martin, 2008) concluded that minority influence causes attitudes that are more resistant to counter-persuasion than those caused by majority influence. When type of processing was manipulated by requesting participants to recall the message, assumed to increase systematic processing, the attitudes formed following both majority and minority influences resisted a second counter message. Martin, Hewstone et al. (2007) manipulated type of processing by varying either motivational or cognitive factors at three levels. The two types of factors yielded consistent results: When low processing was induced, the majority position was accepted after heuristic processing and no minority influence was found. When intermediate processing was induced, only the information from the minority source was processed systematically. When high processing was induced, both the majority's and minority's messages were processed systematically. When crossing source size (majority vs. minority) with message strength (high vs. ambiguous vs. low) and with framing, Bohner et al. (2008) found that when the source was framed as being similar to participants in terms of knowledge, interests, and educational and demographic backgrounds, systematic processing occurred for arguments stated by a minority but not by a majority, regardless of message quality. When the source was framed as being more knowledgeable, systematic processing occurred in minority conditions when the message quality was high and low, but in majority conditions when the message quality was ambiguous. The results bear similarities to Martin et al.'s (e.g. Martin, Martin et al., 2007) and Moscovici's (1976, 1980, 1985) predictions in that systematic

processing occurred in minority conditions independent of framing, but only in majority conditions under knowledge framing.

Taken together, the results suggest that the question of whether majorities and minorities instigate heuristic or systematic processing can only be answered by taking into account additional factors such as participants' prior attitudes (Erb et al., 2002), personal relevance (Martin, Martin et al., 2007), memory recall (Martin et al., 2008), outcome relevance and orienting tasks (Martin, Hewstone et al., 2007), and framing of the source of influence (Bohner et al., 2008). One conclusion is that majority messages only instigate systematic processing in the presence of additional factors such as instructions that increase processing depth. Thus, whether majorities or minorities induce systematic processing is less of an issue than what one does and what the outcomes are. The empirical studies summarised below address this issue further applied to social influence on predictions of stock prices.

Summary of the Empirical Studies

Overview

The primary aim of the empirical studies is to investigate whether investors are herding when making predictions, and whether the level of herding depends on if the herd constitutes a majority or a minority. A second aim is to investigate whether theories of social influence apply to predictions of stock prices. The general hypothesis is that if the herd is a majority, people use a consensus heuristic and follow the majority, whereas if the herd is a minority, influence occurs only if the minority's predictions are perceived as accurate.

In Study I, participants' predictions of up or down market states were analysed with respect to how different rewards altered the level of herding. In Studies II, III, and IV, participants made predictions of the future price of a given fictitious stock conditional on information about the current price and five fictitious others' predictions. The participants were undergraduates at the University of Gothenburg, Göteborg, Sweden, recruited from a pool of undergraduates enrolled in different educational programmes who had volunteered to take part in experiments.

Study I

The aim of Study I was to analyse how financial incentives impact the level of herding. Experiment 1 investigated the effect of a bonus for individual performance on the tendency to herd with a majority, and Experiment 2 examined whether the effect of a financial reward for following the herd varied for majority and minority herds.

In a review of the effects of financial rewards in experiments, Camerer and Hogarth (1999) concluded that these effects are varied and complex. The presence and level of financial rewards seem to affect performance in judgment tasks, in particular when increased effort would improve performance. Financial rewards for individual performance were expected to increase systematic processing in the same way as increased outcome relevance has been shown to do (Kerr, 2002; Martin, Hewstone et al., 2007). However, since the uncertainty of the information in the applied prediction task was high, heuristic processing was still likely to be elicited, in particular when the herd constitutes a majority. Accordingly, it was proposed that financial rewards for *individual* performance would have no effect on majority influence. In contrast, financially rewarding *group* performance may enhance herding with a majority since it reinforces heuristic processing. However, the presence of a minority herd may elicit critical assessments of its message. In this case, the minority will not be influential despite financial rewards.

A repeated individual decision-making task similar to that devised by Massey and Wu (2004) was employed. Participants made binary predictions of a future 'upmarket' or

‘downmarket’. A ‘signal’ was presented on each trial consisting of a number randomly sampled from either an upmarket or downmarket. In herd conditions additional information was given about predictions made by three fictitious other participants. These predictions were randomly generated so that two of the three others (the majority) always made the same predictions, and one other (the minority) made a deviating prediction.

To consistently follow the signal would result in an average of 75% accurate responses. Hence, participants would be less accurate by following the herd instead of the signal. Performance was assessed by means of measures of outcome accuracy (percentages of correct predictions of upmarket and downmarket) and decision strategy (percentages of following the signal and percentages of following the herd).

In Experiment 1, the participants (n = 80) were randomly assigned to four groups: the individual and the herd conditions with or without bonus. In the bonus conditions, the participants were guaranteed 50 SEK but could receive an additional 0-190 SEK depending on performance. For each correct prediction, they received 4 SEK. In the no-bonus condition, the participants received 150 SEK, which was close to the average payments in the bonus conditions.

In line with expectations, the results showed that the participants’ predictions in the individual conditions followed the signal to a larger extent than did the participants’ predictions in the herd conditions. The participants in the bonus conditions furthermore followed the signal significantly more than did participants in the no-bonus conditions. Thus, the bonus increased participants’ utilisation of the signal and thus the accuracy in their predictions in the individual conditions. No significant difference was observed when the herd conditions were compared in terms of the tendency to follow the herd, implying that participants followed the herd irrespective of the bonus for individual performance. This result is consistent with the hypothesis that an individual bonus had no effect on the level of herding.

Experiment 2 (n = 40) investigated whether the effect of a financial reward for following the herd differed when the herd was a majority or a minority. The materials and procedure were similar to those in Experiment 1, but in addition to the individual bonus (2 SEK) for making accurate predictions, a bonus (4 SEK) was obtained for either being accurate when the majority (majority-bonus condition) or the minority (minority-bonus condition) made accurate predictions.

Consistent with the hypothesis, the results of Experiment 2 indicated that the participants in the majority-bonus condition followed the herd more and thus the signal less than the participants in the minority-bonus condition. Taken together, the results are in line with the hypothesis that the use of a consensus heuristic overrides systematic processing in majority influence, whereas the reverse is true for minority influence.

Study II

The aim of Study II was to explore the importance of consistency among others for herding to occur. Consistency may be defined in different ways. In a stock market it is likely that perceptions of consistency are based on repeated observations over time. Consistency may then be perceived as the agreement across time among investors’ predictions. In addition, consistency may be related to variance over time in each investor’s predictions. Investors who are in agreement with others and do not vary their predictions substantially from time to time would appear more reliable, and they are therefore likely to exert a stronger influence. In Study I, consistency was confounded with the number of others who made the same prediction in each trial. Two of the three others (the majority) were in agreement on each trial, but the majority did not consist of the same others from trial to trial. Therefore, it was not possible to conclude whether the influence was due to the consistency among the others or to

the fact that the others constituted a majority. The setup in Study II therefore captured how consistency may be perceived over time in terms of variance in and correlation between the others' predictions across trials.

In the reported experiment, neither the others' predictions nor the current price were valid cues. When the others' predictions were perceived not to be in agreement and to vary from trial to trial, the participants were expected to judge the current price as a more valid cue than the others' predictions. On the other hand, when the others' predictions were in agreement and did not vary considerably form trial to trial, they were assumed to appear as more valid cues than the current price. It was thus hypothesised that the participants' predictions would correlate with the others' predictions when these were correlated and with the price when the others' predictions were uncorrelated. It was furthermore hypothesised that the correlation with the others' predictions would decrease with their variance.

Participants (n = 96) were asked to make predictions of a stock price in the trial that followed, conditional on information about the current stock price and predictions made by five fictitious other participants who ostensibly had previously participated in the experiment under the same conditions. The same sequence of randomly selected prices of a fictitious stock was presented in all conditions. The others' predictions were generated through random sampling from three normal distributions with the same mean as the price and with low, medium or high variance. In each case, the others' predictions were either highly correlated or uncorrelated with each other but always uncorrelated with the price. The new stock price was presented on the next trial.

As expected, the results showed that the participants relied less on the price and that conformity increased when the others' predictions were correlated compared to when they were uncorrelated. Thus, participants seemed to use a consensus heuristic as a result of heuristic processing. This interpretation is in line with interpretations of most results on majority influence in previous studies.

Variance in others' predictions had no effect on their influence. Still, the answers to post-experiment questions indicated that participants detected the differences in variance. Perhaps these differences were ignored due to that the correlation among the others' predictions is the most important factor for a group to elicit social influence.

To summarise, Study II shows that a group's social influence increases if the predictions made by its members are correlated. However, the variance in their predictions had no effect on the influence. Thus, the tendency to use the consensus heuristic seems to be insensitive to the level of variation in the group's predictions.

Study III

The results of Studies I and II demonstrate influence from a majority despite its predictions being random. This suggests that the participants used the consensus heuristic. Furthermore, in Study I, a financial reward for following a majority or minority herd led to influence from the majority but not from the minority. These results suggest that following a majority is a strong motive. In Study III, this finding was extended by investigating the processes mediating majority and minority influences. The focus was on accuracy motives. In line with Moscovici (1976, 1980, 1985), it was hypothesised that the use of the consensus heuristic accounts for the influence of others' predictions when the herd is a majority. Since a minority was expected to elicit systematic processing, it would need to be accurate in order to have an influence. In contrast, a majority would have an influence regardless of whether it made accurate or random predictions.

In Experiment 1, the participants (n = 64) were informed that they were participating in a multi-trial experiment where each trial represented a trading day. Their task on each trial (day) was to make predictions of the price of a fictitious stock on the next trial (day). The

stock price varied both systematically (referred to as *price trend*) and unsystematically (referred to as *price error*) across trials. On each trial, the participants received information about the current stock price and the predictions made by five other participants who ostensibly had previously taken part in the experiment under identical conditions. In two majority (minority) herd conditions, four (two) of the five others' predictions were correlated across trials. In two (accurate) conditions their predictions were correlated with the price trend, and in two (random) conditions their predictions were uncorrelated with the price trend. The accuracy of the participants' predictions was assessed by correlations with the price trend. Whether the predictions made by the majority and the minority herd had a stronger effect than the current price was assessed by correlations with both the herd's average predictions (after partialling out the price trend when the herd made accurate predictions; referred to as *herd error*) and the current price.

Experiment 1 investigated the influence from a majority herd compared to that from a minority herd when the level of accuracy of the herd's predictions varied. On the three dependent measures (the correlation with price trend, the correlation with price error and the correlation with herd error), significant interactions between herd size and herd accuracy were hypothesised. More specifically, if the majority herd influence was mediated by heuristic processing, then for an accurate majority herd the participants' predictions would correlate with the price trend and the herd error, whereas for a random majority herd their predictions would correlate with the herd error. In contrast, if the minority herd influence was mediated by systematic processing, then for an accurate minority herd the participants' predictions would correlate with the price trend and the herd error, whereas for a random minority herd the participants' predictions would correlate with the price trend and the price error. A pilot study (n = 16) showed that the participants detected the accuracy of and correlations among others' predictions.

The results in Experiment 1 indicated that the majority herd exerted more influence on the participants' predictions than did the minority herd. However, the hypothesised interaction between herd size and herd accuracy was not found for any of the dependent variables, implying that the participants were influenced by a majority herd independently of accuracy in its predictions. Still, the results from the pilot study suggested that the participants were able to detect the differences in accuracy between the conditions. No minority influence was observed. Thus, while majority influence seemed to be mediated by heuristic processing and the use of a consensus heuristic, the results do not support that minority herd influence is associated with systematic processing.

Experiment 2 employed another 80 undergraduates to investigate whether the tendency to rely on a consensus heuristic may be prevented. A condition was introduced where participants were instructed to focus on the accuracy in the herd's predictions. The materials and the procedure were the same as in Experiment 1 except that after 10, 30 and 50 trials the participants were asked to state either how many of the five others made accurate predictions (accuracy focus conditions), or how many of the others were in agreement when making predictions (consistency focus conditions). In all conditions, four others made correlated predictions, thus constituting a majority herd. The accuracy focus instruction was hypothesised to trigger systematic processing, resulting in participants being less influenced by a random herd. Since the influence of the random majority herd was expected to decrease when the participants focused their attention on its accuracy, an interaction between accuracy focus and herd accuracy was expected on the correlation with the herd error. At the same time, the correlation with the price error was expected to increase due to the current price being utilised to a larger degree.

The results showed that the correlation with price error was larger in the accuracy focus conditions than in the consistency focus conditions. The correlation with herd error was

lower for the accuracy focus than for the consistency focus. No significant interaction between focus and herd accuracy was found for any of the dependent variables. The results thus suggested that an accuracy focus was successful in decreasing the tendency to use a consensus heuristic and hence possibly in increasing systematic processing. However, whether the majority herd made random or accurate predictions had no effect on the correlations with price error or herd error.

In Experiment 1, no results support that a minority herd had a stronger influence when its predictions were accurate. A higher level of accuracy thus seemed to be required for this to occur. In Experiment 3, the level of accuracy in the minority herd's predictions was therefore increased. The procedure was the same as in the preceding experiments except that the sequence of events on each trial was changed so that each trial consisted of an *opening price* of the day and the others' predictions shown first, then after having made their prediction of the *closing price* the same day, the participants were shown this closing price. The opening prices and the closing prices were uncorrelated. The predictions made by the two others in the minority herd were uncorrelated with the opening price, and either uncorrelated (random condition) or correlated with the closing price (accurate condition). In the accuracy focus condition, the minority herd made accurate predictions and after trials 10, 30 and 50, the participants were asked to indicate who of the five others had made accurate predictions. The influence of the opening price, the minority herd and accuracy were assessed by the dependent variables correlations with the opening price, the minority herd's average predictions and the closing price, respectively.

Participants' (n = 60) predictions correlated more with the opening price and less with the minority herd's predictions in the condition with a random minority herd than in the condition with an accurate minority herd with accuracy focus. This suggests that the presence of a minority herd does not in itself elicit systematic processing. A minority influence was observed only when the accuracy focus was present and the herd made accurate predictions.

Taken together, the results suggested that majority influence is mediated by heuristic processing. No minority influence was observed irrespective of whether the minority was accurate or random; instead, participants followed the current price (Experiment 1) or the opening price (Experiment 3). When an accuracy focus was introduced, it was successful in breaking heuristic processing. Then, participants were not influenced by a majority, but became influenced by an accurate minority.

Study IV

In line with previous research on social influence, Studies I, II and III showed that following a majority is a strong motive. Since a majority was influential despite its predictions being random, participants seemed to use a consensus heuristic. The results of Study III indicate that the majority influence was possible to break by asking participants to focus on the herd's accuracy. In Study IV, the focus was again on accuracy motives, the aim being to investigate whether salient information about the validity of the opening price can counteract influences from a majority herd's invalid predictions.

The experiment simulated predictions of price movements in a stock market by investors varying in 'expertise', that is knowledge about the validity of the price information. The participants' task was to predict the closing price of a given fictitious stock in 70 trials. On each trial, the participants (n = 80) were first presented the opening price and five others' predictions, then after having made their prediction, the participants were shown the closing price. The predictions made by the others were uncorrelated with both the opening price and the closing price and thus invalid. Four of the five others (the majority) made correlated predictions. The opening price was either correlated or not correlated with the closing price (valid opening price conditions vs. invalid opening price conditions). In two conditions (non-

expert) the others' predictions were disclosed from the first trial, and in two other conditions (expert) only after 30 trials. Thus, expertise was operationalised as exposure to only the price.

Performance was assessed by measures of decision strategy (correlations with the opening price vs. correlations with the others' mean predictions) and outcome accuracy (correlation with the closing price). It was possible for the participants to make accurate predictions by utilising the opening price when it was valid. If so, their predictions correlated with both the opening price *and* the closing price. In contrast, if the participants were influenced by the herd, their predictions correlated only with the herd's mean predictions.

Both validity of the opening price and expertise were expected to increase systematic processing leading to the detection that the majority herd had made invalid predictions. Thus, participants were hypothesised to utilise the opening price when it was valid and to a larger extent in the expert condition. In the conditions with an invalid opening price, the participants were expected to be influenced by the others' predictions, due the use of a consensus heuristic. Since both validity of the opening price and expertise were expected to reduce the majority herd influence, participants' predictions should in these conditions correlate both with the opening price and the closing price. In the conditions with an invalid opening price, participants' predictions should correlate with the herd's mean predictions.

The results from trials 31-70 showed that the participants' predictions correlated more with the opening price than with the closing price in the conditions with a valid opening price than in the conditions with an invalid opening price. Regarding the correlation with the others' mean predictions, an interaction between validity of the opening price and expertise revealed that in the conditions with a valid opening price, no difference between expert and non-expert conditions was observed, while participants in the conditions with an invalid opening price were more influenced by the others' predictions in the non-expert than in the expert condition. Thus, as expected, a valid opening price improved the participants' performance and prevented herding. Furthermore, expertise was also successful in preventing herding when the opening price was invalid. Herding was observed only in the non-expert condition with an invalid opening price. A possible explanation to this finding is that since both validity in the opening price and expertise prevented the use of a consensus heuristic, systematic processing increased.

Discussion and Conclusions

In behavioural finance research, herding is commonly discussed in relation to theories of rational choice (e.g. Devenow & Welch, 1996). This thesis examines the circumstances under which people are influenced by herds regardless of whether or not it is rational. This was accomplished by comparing the influence of herds making valid predictions with that of herds making invalid predictions. Furthermore, rather than discussing the results in relation to theories of rational choice, theories of social influence postulating different types of information processing were drawn on to shed light on the herding phenomenon. Such theories are frequently evoked to explain social influence on attitudes, but have not been explicitly applied with this aim in research on financial decision making. The thesis therefore represents a new direction in research on herding in financial markets.

Interpretations of the Results

An important question in previous social influence research is whether majority influence elicits heuristic processing and minority influence systematic processing. The thesis investigates informative influence in the context of predicting stock prices, and whether the tendency to follow a herd differs when it constitutes a majority or a minority. In line with most theories of social influence (e.g. Martin, Martin et al., 2007; Moscovici, 1976, 1980,

1985), it was hypothesised that there is a strong motive to follow the majority, associated with heuristic processing. This tendency should be even stronger in prediction tasks with uncertain information. The general outcome of the present thesis supports the existence of strong majority herd influence. However, the dual-process theory proposed by Moscovici (1976, 1980, 1985) does not receive unequivocal support: While the results indicate that majority herd influence is indeed primarily associated with heuristic processing, a minority herd did not elicit systematic processing without explicit prompting. In the following an alternative account is proposed, as illustrated in Figure 1.

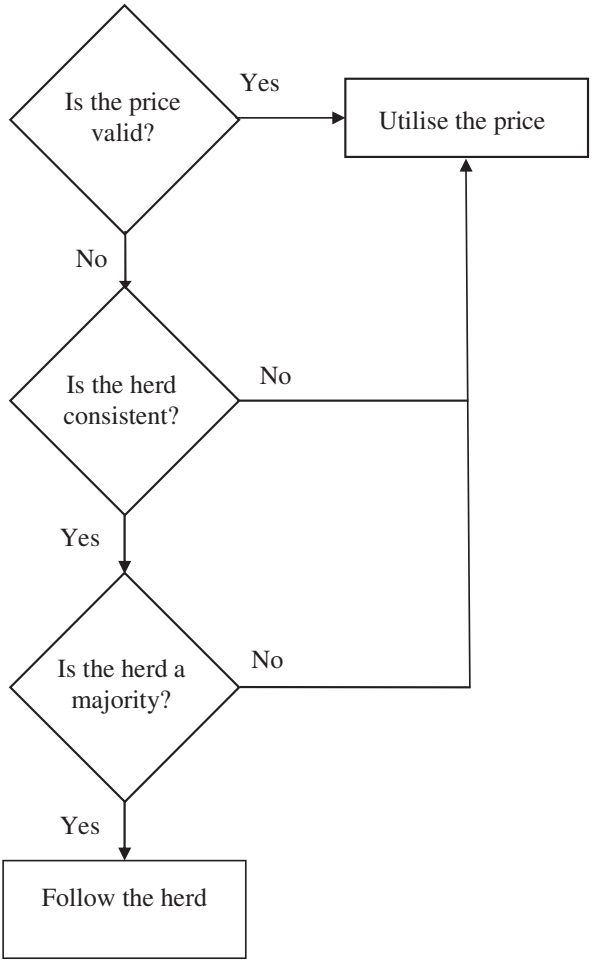

Figure 1. Flow diagram of information processing in predictions of stock prices.

In an uncertain prediction task like the one used, people are likely to search and evaluate the usefulness of various pieces of information or cues (Busemeyer, Byun, Delosh, & McDaniel, 1997). The available price information refers to the signal in Study I, the current price in Study II, the price error (Experiments 1 and 2) and the opening price (Experiment 3) in Study III, and the opening price in Study IV. Henceforth all these measures are referred to as the price. We assume that the participants intuitively judged the available price information as a more useful cue in predicting the future price than the others' predictions. This

assumption was supported by the participants' tendency to attend to the price when a minority of others made consistent predictions (Studies I and III). However, since the price information only had a probabilistic relation to the true price, it is conceivable that the participants preferred to follow others' predictions if the others were a consistent majority, believing that they provided useful information.

It is implied by definition that a prerequisite for herding to occur is that the members of the herd are perceived to be in agreement. In line with this, consistency has in various contexts been shown to be an important factor for a group to be influential, in particular when the group constitutes a minority (for a review, see Wood et al., 1994). In general, consistency implies that a certain number of group members are in agreement (referred to as level of consensus, see Martin et al., 2002) and that each group member holds attitudes, opinions and beliefs and acts in ways that are not contradictory. Since decision making in financial markets is based on repeated observations, consistency may then be perceived as the degree of agreement among investors' predictions over time. Study I employed a majority-minority classification based on the performance of two or three other participants (a majority) or of one other participant (a minority) on each trial. Since the majority-minority did not consist of the same others from trial to trial, consistency was confounded with the majority-minority classification. In Study II, consistency was instead defined as the correlation between and variance within the others' predictions across trials. The results showed that the others' influence increased when their predictions were correlated compared to when they were uncorrelated. In contrast, differences in variance did not affect herd influence. The differences in variance were perhaps ignored if the correlation among the others' predictions was the most important component. Another possibility is that participants interpreted the differences in variance as differences in risk taking and reacted differently to this interpretation. Some of the participants might have preferred to follow those with large variance because they considered them to be risk takers, others those with low variance because they considered them to be risk averse. The net effect would be to counteract any effect of variance. Drawing on the results from Studies I and II, the herd consisted of the same others and the variance in the group members' predictions was held constant across trials in Studies III and IV.

It was assumed that the participants primarily focused their attention on the consistency in the herd's predictions instead of accuracy. This was indicated by the manipulation check in Study III (Experiment 2), showing that participants were more accurate in perceiving the correlations between the others' predictions than they were in inferring whether the others' predictions were accurate or random. Whether they were influenced by the herd depended on the number of others who were in agreement. This was conceptualised as majority herds (Studies I, II, III and IV) and minority herds (Studies I and III).

Overall, the results of the present studies support the existence of strong majority herd influence. Furthermore, the perception of a majority herd appears to be associated with heuristic processing and the use of a consensus heuristic. In Study I, participants were influenced by a majority herd despite the fact that it made random predictions and that the price had higher predictive validity. In a similar vein, the results of Study III (Experiment 1), where the herd's predictions like the price had a probabilistic relation to the future price, indicated that the participants followed a majority herd irrespective of the accuracy in their predictions. However, no minority influence was observed, in spite of a bonus for following the minority (Study I, Experiment 2) and in spite of the minority making accurate predictions (Study III, Experiments 1 and 3). Rather, the participants ignored the minority herd's predictions and instead attended to the price, even when it lacked predictive validity (Study III, Experiment 3). Based on these observations, it is possible that regardless of whether the herd is a majority or a minority, heuristic processing was elicited. Thus, the consensus

heuristic may be accompanied by an 'opposite' heuristic, resulting from the belief that 'a minority is seldom accurate' (henceforth referred to as the 'minority heuristic').

It is possible that this account is incomplete by not considering that an accurate minority herd in Study III (Experiment 3) tended to have a stronger influence than a random minority herd even without the accuracy focus instructions. If in light of this tendency the hypothesis that a minority elicits systematic processing is maintained, it should be proposed that systematic processing varies in degree.

In order to break heuristic processing, both financial motives (Study I) and accuracy motives (Studies III and IV) were employed. The results showed that the focus manipulation in Study III (Experiment 2) and the 'expertise' and validity of available price information in Study IV made participants attend more to the price and less to the herd when making predictions. The focus manipulation in Study III was furthermore required in order to make an accurate minority herd influential. In sum, the manipulations were successful in breaking heuristic processing, but the question of whether they increased systematic processing needs to be discussed further.

It was assumed that if systematic processing is elicited, participants will adopt a decision strategy leading to more accurate predictions. In line with the use of a minority heuristic, the financial reward for following a minority herd making random predictions made participants rely more on the price in the minority-bonus condition in Study I (Experiment 2). Thus, this strategy was more beneficial for participants. However, due to the price being valid, the strategy to follow the price was confounded with the attempt to make accurate predictions. Therefore, it is not possible to disentangle whether a minority heuristic was used or whether the minority-bonus actually induced systematic processing. Studies III and IV are more informative in investigating whether systematic processing occurred. The accuracy focus manipulation in Study III (Experiment 3) and the expertise and validity manipulation in Study IV induced high levels of accuracy, thus the manipulations improved participants' performance. In Study III (Experiment 2), the same focus manipulation made participants attend to the price and decreased the influence of a majority herd irrespective of the accuracy of its predictions.

A prerequisite for systematic processing to improve decisions is that the participants are able to assess accuracy. It is possible though, as supported by the results from the manipulation check in Study III (Experiment 2), that detecting accuracy in the herd's predictions is a difficult task. At the same time, the results from the pilot study implied that the participants were able to distinguish between the differences in accuracy. It should however be noted that the task in the pilot study was to assess accuracy. When the assigned task instead was to make predictions of future stock prices, it would have been harder for participants to assess accuracy. It is also possible that the accuracy focus instructions made the participants more critical towards the others' predictions, and hence more likely to deem them inaccurate. As a consequence, in order to be judged as accurate, the others' predictions should have been more strongly correlated with the price trend than would have been required without the accuracy-focus instructions.

In conclusion, the manipulations were successful in breaking heuristic processing, but more research addressing the issue of accuracy is needed in order to resolve the issue of whether systematic processing was also induced.

Relations to Other Research

The present findings are in some respects an extension of previous findings in research on majority social influence (e.g. Bohner et al., 2008; Bond, 2005, Erb et al., 2002; Martin et al., 2008; Martin, Hewstone et al., 2007; Martin, Martin et al., 2007). The starting point for this thesis was derived from the cognitive response approach regarding which source

(majority vs. minority) is associated with heuristic and systematic processing. According to conversion theory (Moscovici, 1976, 1980, 1985), minority influences should lead to more systematic processing than majority influences. However, a review of the previous research showed that the evidence is inconclusive. This has led to development of alternative theories. Recently, most social influence research has applied the cognitive response approach. A general finding from this research is that the relations between influence source and type of processing will be understood if additional factors are taken into account. Recent studies support the notion that majorities elicit heuristic processing when participants' motivation and/or ability to process the information is low, and systematic processing in the presence of additional factors, such as personal relevance (Martin, Martin et al., 2007) and message recall (Martin et al., 2008), aiming to increase motivation. This conclusion was corroborated by the present results in that participants followed a majority regardless of the accuracy in its predictions. It is important to emphasise that the results were observed in situations with a novel issue of low personal relevance, in the absence of social conflicts, and in a situation where direct interaction between the participant and the others was not possible. Due to the noted similarities with the previous research on majority influence, the present results represent an extension of previous findings, suggesting a possibility to generalise findings from attitude research to prediction tasks. However, since the results indicate that the presence of a minority is also associated with heuristic processing, they are difficult to reconcile with the previous findings regarding minority influence.

A possibility is that this dissimilarity partly depends on the different task devised in the experiments. The bulk of previous social-influence research has employed a paradigm that assesses participants' attitudes after having been exposed to different messages. An initial message is endorsed by a group of others, and then measuring the extent to which attitude certainty is influenced by a subsequent counter-message arguing the opposite position. This task implies that participants are presented with clear information about the group's position. In many other tasks, including predictions of stock prices, people themselves need to infer which others constitute a majority or minority. In addition, in attitude research judgments concern preferences expressed with certainty, whereas in the present research they are predictions that are either correct or incorrect and difficult to judge at the time they are made. A possible conclusion is that when the available information is uncertain, heuristic processing plays a more important role than concluded in previous research.

The heuristic acceptance of the majority's position and the heuristic rejection of the minority's position relate to the phenomenon of the 'wisdom of crowds' (Surowiecki, 2004), referring to the fact that under most circumstances it is reasonable to assume that the aggregate collective judgment provides a more accurate judgment than individual judgment (according to the law of large numbers). The wisdom can be illustrated by an experiment (Treynor, 1987) in which 56 pupils in a class made independent judgments of the number of jelly beans in a jar. The jar held 850 beans, and the aggregate group estimate was 871. Only one of the pupils in the class made a better guess. Thus, the rule is that the combined judgment of a group will outperform the average individual (Larrick & Soll, 2006). In order to characterise a crowd as wise, each person in the crowd must hold private unbiased information (or an interpretation of such information), and each judgment must be made independently of others' judgments (Surowiecki, 2004). If the individual judgments are aggregated so that each judgment receives equal weight, unsystematic errors cancel out. In a similar vein, inductive judgments of investors would yield an asset price similar to its true value. Importantly, the accuracy of a combined judgment increases with group size (although at a decelerating rate). Imagine that the class in the jelly bean experiment consisted of only three pupils. Adding a forth pupil would obviously have a large influence on the group's average judgment. In contrast, adding the judgments made by another pupil would have little

influence on the average judgments made by an already large group. This rule has several implications for informational social influence. Most important for the present thesis is that a combined judgment based on a larger number of individual judgments has superior accuracy, which implies that they should be more influential. It is consequently more sensible to follow a majority than a minority, given the perception that the others' predictions are random. Uncertainty in the available information may therefore increase the justification of using a consensus heuristic.

Furthermore, it may be argued that participants adopted an aggregation strategy, implying that they were influenced by the averages across the five others when making predictions. Without manipulations aiming to increase systematic processing, this would imply that a majority was always and a minority was never influential. However, the present results are different. In Study II, participants were more influenced by the others' predictions when they were correlated compared to when they were uncorrelated, thus showing that a correct aggregation principle was not used. Moreover, participants in minority conditions were influenced by the available price information and thus not by the average of the others' predictions. Previous research has established common misappreciations of the averaging principle. Examples, compatible with the participants' strategies in the present studies, include that consensus opinions are given excessive weight (Harries, Yaniv, & Harvey, 2004) and that the ease of processing increases as a function of the agreement in the information presented to participants (Budescu & Yu, 2006).

In order to benefit from a group's judgments, an individual must first perceive the group and then make correct inferences about its judgments. However, it is known from research on advice taking that people are likely to underestimate the informational advantages of groups. In the review by Bonaccio and Dalal (2006), it is suggested that advisors (which can be compared to the source of influence, the members of the herd in the experiments presented in this thesis) in most cases have less influence than they should given their knowledge. Instead of taking the advisors' recommendations into account as much as they should in order to benefit from them, individuals frequently base their decisions on their own information. This 'egocentric bias' runs counter to Budescu, Rantilla, Yu, and Karelitz (2003), who showed that information has influence in proportion to its reliability. In the present experiments, the fictitious participants who constituted the herd had more influence than they should have, given that they made invalid predictions. Thus, the present results seem to be inconsistent with an egocentric bias as well as with the results of Budescu et al. (2003).

Some previous research indicates that herding may be the result of a conscious strategy. Studies in finance have investigated what information traders use when making investment decisions. An issue is the role of news media and its relationship with market actors. Based on survey data from professional traders, Oberlechner and Hocking (2004) concluded that foreign exchange traders do not consider perceived truth and accuracy to be as important features of news as information speed, expected market impact and anticipated market surprise. It is suggested that investors have limited time to check the accuracy in news releases, and that they anticipate other traders to be equally affected by the news regardless of its accuracy. Thus, making decisions consistent with a herd of investors appears to be a conscious strategy that is more important to use than carefully evaluating the validity of the information. A similar observation was made when following others was not expressed as an explicit strategy (Welch, 2000). In a survey, financial analysts' predictions were shown to be influenced by a consensus forecast regardless of whether or not it was accurate. In a similar vein, the present research shows a strong herd influence, independently of the level of accuracy of the herd's predictions. Thus, the same pattern of findings is demonstrated in our laboratory experiments. In this respect, the meta-cognitive approach has potential relevance.

Meta-cognition refers to people's awareness and thinking about their own thought processes. In Tormala, DeSensi and Petty (2007), people resisted a minority source when they were able to evaluate their processing strategies. Hence, it should be possible to do the same when persuaded by a majority. By applying, for instance, a thought-listing procedure, one may investigate whether the use of the consensus heuristic is due to the use of a conscious strategy or not.

Most experimental research on herding has investigated information cascades. These studies capture people's decisions that are based on imperfect information and are made in a sequence, so that one person first makes a choice that is announced to others who then follow in order. When every person in the sequence has the same probability of making a correct choice, and the preceding individuals have made the same choice, it becomes rational at a certain point to follow the others and disregard the private information. However, as Shiller (2000) argued, in stock markets investors do not usually make decisions in a sequence. In the present experiments, participants were instead informed about the decisions made by five others who had previously participated under identical circumstances as themselves. A difference compared to the information cascade paradigm is that the participants were presented with information about the others' decisions while they also knew their private information. Since in the present studies information about five others was shown on each trial, they are more similar to information cascade experiments with endogenous timing where participants do not make decisions in a predetermined sequential order (Chari & Koehe, 2004; Sgroi, 2003). Furthermore, the participants in the present experiments knew that their predictions would not be disclosed to others. Due to the noted differences, the present results and the findings regarding information cascades are not strictly comparable. Furthermore, instead of focusing on rationality as in information cascades, the present studies examined causes of herding.

Generalisations of the Results

The reader may observe the different nature of the procedures of the present experiments compared to the actual stock markets. I recognise that the experimental setups have limitations in that they do not capture all aspects of stock investments. However, the aim of the studies was to investigate social influences on stock market predictions. The advantage of using an abstract experimental simulation is that it provides the possibility to study a phenomenon while excluding factors that are not the focus of the research even though they influence decision making. For example, when making predictions of actual stock prices, people may be more influenced by others with a good reputation or who are experts. Taking this aspect into account would possibly introduce confounds. Nevertheless, the question regarding the external validity of the present research remains. The tasks devised in the experiments are realistic in that they simulate systematic as well as random movements of stock prices. The systematic movements represent the market trends (bull or bear markets), and the random movements represent deviations from the index, that is the volatility of particular stocks. However, the experiments do not tap knowledge of the stock market, which may be an important factor in actual stock investments. The simulation of investment expertise (Study IV) is likewise limited since it only taps one type of knowledge of the stock market (a stock price's predictive validity). Furthermore, since the present experiments focused primarily on the informational aspects of herding, and not on reputational concerns, no background knowledge of the herd was provided. Another issue is that in an actual stock market it may be difficult to judge which others constitute a herd, and whether the herd constitutes a majority or a minority.

In the present studies professional investors were not used as participants. Although not claiming that the results from such experiments can always be generalised to professional

investors in financial markets, they still make salient the consensus heuristic that investors may rely on in their decision making. Such heuristics are likely to be used particularly when investors are under time pressure or for some other reason are incapable of thoroughly processing the information. Furthermore, Odean (1999) among others has documented the failure of expert decision makers in finance, implying that experts as well as novices are prone to use heuristics, leading to biases. Furthermore, previous research has pointed to the moderating effect that education level has on many anomalies and the response effects manifested in attitude research (e.g. Narayan & Krosnik, 1996), implying that university students may generally be less susceptible to experimental manipulations. Since we recruited university students as participants in the present studies, the demonstrated effects may be less pronounced than if we had used other categories of non-experts. Still, it has been argued that professionals' investment behaviour differs from students' behaviour in the laboratory due to training or regulations, which may affect the development of decision heuristics (Harrison & List, 2004). In a recent information cascade experiment, the performance of market professionals was compared to that of students (Alevy, Haigh, & List, 2007). A key finding was that professionals seem to use a more sophisticated decision process by utilising the private information more frequently and critically assess the public information more than do students. However, whether this applies to other research on herding is unclear.

How serious these limitations are needs to be systematically explored in future research if the goal is to apply the results to actual stock markets. Another avenue to investigate the generalisability of the present findings is to test their invariance across different investment tasks in laboratory experiments.

Future Research

The present theoretical analysis was based on the position that each source of influence (majority-minority) leads to information processing but that the *type* of processing varies, being either heuristic or systematic. Some (e.g. Martin et al., 2008) take a different approach by considering which source leads to *more* processing effort. In the present studies we have interpreted low processing effort as heuristic processing, primarily operationalised as the tendency to follow a random majority herd, and high processing effort as systematic processing, operationalised as the tendency to use a decision strategy improving their performance. Future research needs to disentangle the issue of whether the different types of processing can be equated with different amounts of processing effort. This issue seems particularly interesting with regards to informational social influence. An example is when a person after thorough elaboration evaluates the available information as uncertain, and therefore decides to rely on a consensus heuristic. In this case the decision to use a heuristic, which appears as heuristic processing, is a result of systematic processing.

As mentioned in the introduction, people may herd for different reasons. In the present experiments, participants were informed that the members of the herd had taken part under the same conditions as themselves. In situations where participants make individual decisions knowing that their decisions are not disclosed to others, as in a stock market, the informative influences will dominate. In a recent study, Quiamzade and L'Huillier (2009) showed that people herd with others who have made unexpected investments, believing that the others possessed privileged information. This belief was a more important explanation for herding than information about whether the others held professional investment positions. In line with the results in the present thesis, Quiamzade and L'Huillier (2009) underline the role of heuristic processing for herding by arguing that since attribution of superior information relates to the perception of expertise, people herd due to the use of a 'heuristic about competence'. They also connect informational social influence to reputational concerns, which is more closely related to the normative social influences that also exist in stock

markets (Shiller, 2000). Research on analyses of investor behaviour does not distinguish among different types of social influences. However, such analyses would be suitable for understanding investors' actual investment decisions and possibly the role of indirect influences due to investors' similar education, training and values.

A final remark

The studies presented in this thesis suggest that there is a strong motive to herd with a majority. Our explanation that heuristic processing may evoke reliance on the belief that the majority is always and the minority is seldom correct is in accordance with Kahneman's (2003) notion of System 1 (automatic, intuitive) thinking, which accounts for the use of many heuristics. However, the tendency to use heuristic processing may be constrained if the motivation to critically assess the available information is increased. This is also compatible with Kahneman's and others' (e.g. Gilovich, Griffin, & Kahneman, 2002) framework, postulating that intuitive judgments that are products of System 1 thinking will be overruled if System 2 (systematic, deliberate) thinking identifies it as biased. Herding may thus be considered as part of a broader approach to human behaviour stipulating that people use heuristics rather than calculations in everyday decision making.

References

Alevy, J. E., Haigh, M. S., & List, J. A. (2007). Information cascades: Evidence from a field experiment with financial market professionals. *The Journal of Finance, 62,* 151 – 180.

Anderson, L. R., & Holt, C. (1997). Information cascades in the laboratory. *American Economic Review, 87*, 847-862.

Arora, N., & Ou-Yang, H. (2001). *Explicit and implicit incentives in a delegated portfolio management problem: Theory and evidence*. Unpublished manuscript, University of North Carolina.

Asch, S. E. (1956). Studies of independence and conformity: A minority of one against a unanimous majority. *Psychological Monographs, 70,* (Whole No. 416).

Ashiya, M., & Doi, T. (2001). Herd behavior of Japanese economists. *Journal of Economic Behavior and Organization, 46*, 343-346.

Avery, C. & Zemsky, P. (1998). Multi-dimensional uncertainty and herd behaviour in financial markets. *American Economic Review, 88*, 724-748.

Baker, S. M., & Petty, R. E. (1994). Majority and minority influence: Source-position imbalance as a determinant of message scrutiny. *Journal of Personality and Social Psychology, 67*, 5-19.

Bennett, J., Sias, R., & Starks, L. (2003). Greener pastures and the impact of dynamic institutional preferences. *Review of Financial Studies, 16*, 1203-1238.

Bikhchandani, S., Hirshleifer, D., & Welch, I. (1992). A theory of fads, fashion, custom and cultural change as informational cascades. *Journal of Political Economy, 100*, 992-1026.

Bikchandani, S., & Sharma, S. (2000). Herd behavior in financial markets. *IMF Staff Papers, 47*, 279-310.

Bohner, G., Dykema-Engblade, A., Tindale, R. S., & Meisenhelder, H. (2008). Framing of majority and minority source information in persuasion: When and how "consensus implies correctness". *Social Psychology, 39*, 108-116.

Bonaccio, S., & Dalal, R. S. (2006). Advice taking and decision-making: An integrative literature review, and implications for the organizational sciences. *Organizational Behavior and Human Decision Processes, 101*, 127-151.

Bond, R. (2005). Group size and conformity. *Group Processes & Intergroup Relations*, *8*, 331-354.

Bond, R., & Smith, P. B. (1996). Culture and conformity: A meta-analysis of studies using Asch's (1952, 1956) line judgment task. *Psychological Bulletin, 119*, 111-137.

Budescu, D. V., Rantilla, A. K., Yu, H-T., & Karelitz, T. M. (2003). The effects of asymmetry among advisors on the aggregation of their opinions. *Organizational Behavior and Human Decision Processes, 90,* 178-194.

Budesco, D., & Yu, H. (2006). To Bayes or not to Bayes? A comparison of two classes of models of information aggregation. *Decision Analysis, 3*, 145-162.

Busemeyer, J. R., Byun, E., Delosh, E. L., & McDaniel, M. A. (1997). Learning functional relations based on experience with input-output pairs by humans and artificial neural networks. In K. Lamberts & D. Shanks (Eds.), *Knowledge concepts and categories* (pp.403-437). Cambridge, MA: MIT Press.

Camerer, C. F., & Hogarth, R. M. (1999). The effects of financial incentives in experiments: A review and capital-labor-production framework. *Journal of Risk and Uncertainty, 19*, 7-42.

Celen, B., & Kariv, S. (2004). Distinguishing informational cascades from herd behavior in the laboratory. *American Economic Review, 94*, 484-498.

Chari, V. V., & Koehe, P. J. (2004). Financial crises as herds: Overturning the critiques. *Journal of Economic Theory, 119*, 128-150.

Chevalier, J., & Ellison, G. (1999). Career concerns of mutual fund managers. *Quarterly Journal of Economics, 114*, 382-432.

Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology, 55*, 591-621.

Cote, I., & Sanders, D. (1997). Herding behavior: Explanations and implications. *Behavioral Research and Accounting, 9*, 20-45.

David, B., & Turner, J. C. (2001). Majority and minority influence: a single process self-categorization analysis. In C. K. W. De Dreu, & N. K. De Vries (Eds.), *Group consensus and minority influence: Implications for innovation* (pp. 91-121). Oxford: Blackwell.

De Dreu, C. K. W., & De Vries, N. K. (2001). *Group consensus and minority influence: Implications for innovation.* Oxford: Blackwell.

Deutsch, M., & Gerard, H.G. (1955). A study of normative and informational social influence upon individual judgment. *Journal of Abnormal and Social Psychology, 51*, 629-636.

Devenow, A., & Welch, I. (1996). Rational herding in financial economics. *European Economic Review, 40*, 603-615.

Drehmann, M., Oechssler, J., & Roider, S. (2005). Herding and contrarian behavior in financial markets: An internet experiment. *American Economic Review*, *95*, 1403-1426.

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich.

Ehrbeck, T., & Waldmann, R. (1996). Why are professional forecasters biased? Agency versus behavioral explanations. *Quarterly Journal of Economics, 111*, 21-40.

Erb, H. P., Bohner, G., Rank, S. & Einwiller, S. (2002). Processing majority and minority communications: The role of conflicts with prior attitudes. *Personality and Social Psychology Bulletin, 28*, 1172-82.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*, 117-140.

Froot, K., Scharfstein, D., & Stein, J. C. (1992). Herd on the street: Informational inefficiencies in a market with short-term speculation. *Journal of Finance, 47,* 1461-1484.

Gardikiotis, A., Martin, R., & Hewstone, M. (2005). Group consensus in social influence: Type of consensus information as a moderator of majority and minority influence. *Personality and Social Psychology Bulletin, 31*, 1163-1174.

Gilovich, T., Griffin, D., & Kahneman, D. (2002). *Heuristics and biases*. Cambridge: Cambridge University Press.

Grinblatt, M., Titman, S., & Wermers, R. (1995). Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior. *American Economic Review, 85,* 1088-1105.

Guedj, O., & Bouchaud, J. P. (2005). Experts' earning forecasts: Bias, herding and gossamer information. *International Journal of Theoretical and Applied Finance, 8*, 933-946.

Harries, C., Yaniv, I., & Harvey, N. (2004). Combining advice: The weight of a dissenting opinion in the consensus. *Journal of Behavioral Decision Making* 17, 333-348.

Harrison, G., List, J. A. (2004). Field experiments. *Journal of Economic Literature, 42*, 1009–1055.

Hirshleifer, D., Subrahmanyam, A., & Titman, S. (1994). Security analysis and trading patterns when some investors receive information before others. *Journal of Finance, 49*, 1665-1698.

Hirshleifer, D., & Teoh, S. H. (2003). Herd behavior and cascading in capital markets: A review and synthesis. *European Financial Management, 9*, 25-66.

Holden, C. W., & Subrahmanyam, A. (1996). Risk aversion, liquidity, and endogenous short horizons. *The Review of Financial Studies, 9*, 691-722.

Hong, H. G., Kubik, J., & Solomon, A. (2000). ”Security analysts” career concerns and herding of earning forecasts. *RAND Journal of Economics, 31*, 121-144.

Hung, A. A., & Plott, C. R. (2001). Information cascades: Replication and an extension to majority rule and conformity-rewarding institutions. *The American Economic Review, 91*, 1508-1520.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58*, 697-720.

Kerr, N. (2002). When is a minority a minority? Active vs. passive advocacy and social influence. *European Journal of Social Psychology, 32*, 471-484.

Keynes, J. M. (1936). *The general theory of employment, interest and money*. London: Harcourt Brace.

Lakonishok, J., Shleifer, A., & Vishny, R. W. (1992). The impact of institutional trading on stock prices. *Journal of Financial Economics, 32,* 23-24.

Larrick, R. P., & Soll, J. B. (2006). Intuitions about combining opinions: Misappreciation of the averaging principle. *Management Science, 52*, 111-127.

Latané, B., & Wolf, S. (1981). The social impact of majorities and minorities. *Psychological Review, 88*, 438-453.

Maass, A. & Clark, R. D. (1983). Internalization versus compliance: Differential processes underlying minority influence and conformity. *European Journal of Social Psychology, 13*, 197-215.

Maass, A., & Clark, R. D. (1984). Hidden impact of minorities: Fifteen years of minority influence research. *Psychological Bulletin, 95*, 428-450.

Mackie, D. M. (1987). Systematic and nonsystematic processing of majority and minority persuasive communications. *Journal of Personality and Social Psychology, 53*, 41-52.

Martin, R, Gardikiotis, A., & Hewstone, M. (2002). Levels of consensus and majority and minority influence. *European Journal of Social Psychology, 32*, 645-665.

Martin, R., & Hewstone, M. (2001). Conformity and independence in groups: Majorities and minorities. In M. A. Hogg and R. S. Tindale (Eds.), *Blackwell handbook of social psychology, Vol. 1: Group processes* (pp. 209-234). Oxford: Blackwell.

Martin, R., & Hewstone, M. (2003). Majority versus minority influence: When, not whether, source status instigates heuristic or systematic processing. *European Journal of Social Psychology, 33*, 313-330.

Martin, R, Hewstone, M., & Martin, P. Y. (2007). Systematic and heuristic processing of majority and minority-endorsed messages: The effects of varying outcome relevance and levels of orientation on attitude and message processing. *Personality and Social Psychology Bulletin, 33*, 43-56.

Martin, R., Hewstone, M., & Martin, P. Y. (2008). Majority versus minority influence: the role of message processing in determining resistance to counter-persuasion. *European Journal of Social Psychology, 38*, 16-34.

Martin, R., Martin, P. Y., Smith, J., & Hewstone, M. (2007). Majority versus minority influence and prediction of behavioral intentions and behavior. *Journal of Experimental Social Psychology, 43*, 763-771.

Massey, C., & Wu, G. (2004). Understanding under- and overreaction. In I. Brocas & J. D. Carrillo (Eds.), *The psychology of economic decisions*. (Vol. 2, pp. 15-29). Oxford: Oxford University Press.

Moscovici, S. (1976). *Social influence and social change*. London: Academic Press.

Moscovici, S. (1980). Toward a theory of conversion behavior. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 13, pp. 209-239). New York: Academic Press.

Moscovici, S. (1985). In G. Lindsey & E. Aronson (Eds.). *Handbook of social psychology* (Vol. 2, pp. 347-412). Reading MA: Addison-Wesley.

Moscovici, S., Lage, E., & Naffrechoux, M. (1969). Influence of a consistent minority on the responses of a majority in a colour perception task. *Sociometry, 32*, 365-380.

Narayan, S., & Krosnick (1996). Education moderates some response effects in attitude measurement. *Public Opinion Quarterly, 60*, 58-88.

Nemeth, C. J., Wachtler, J., & Endicott, J. (1977). Increasing the size of the minority: Some gains and some losses. *European Journal of Social Psychology, 7*, 15-27.

Nofsinger, J. R., & Sias, R. W. (1999). Herding and feedback trading by institutional and individual investors. *Journal of Finance, 54*, 2263-2295.

Oberlechner, T., & Hocking, S. (2004). Information sources, news, and rumors in financial markets: Insights into the foreign exchange market. *Journal of Economic Psychology, 25*, 407-424.

Odean, T. (1999). Do investors trade too much? *American Economic Review, 89*, 1279-1298.

Palley, T I. (1995). Safety in numbers: A model of managerial herd behavior. *Journal of Economic Behavior and Organization, 3*, 443-450.

Petty, R. E., & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change.* New York: Springer-Verlag.

Puckett, A., & Yan, X. S. (2008). *Short-term institutional herding and its impact on stock prices*. Unpublished manuscript, University of Missouri.

Quiamzade, J-P., & L'Huillier, J-P. (2009). Herding by attribution of privileged information. *Journal of Behavioral Decision Making, 22*, 1-19.

Rajan, R. G. (1994). Why bank credit policies fluctuate: A theory and some evidence. *Quarterly Journal of Economics, 109*, 399-441.

Scharfstein, D. S., & Stein, J. C. (1990). Herd behavior and investment. *American Economic Review, 80*, 465-479.

Sgroi, D. (2003). The right choice at the right time: A herding experiment in endogenous time. *Experimental Economics, 6*, 159-180.

Shiller, R. J. (2000). *Irrational exuberance*. Princeton, NJ: Princeton University Press.

Sias, R. W. (2004). Institutional herding. *Review of Financial Studies, 17,* 165-206.

Smith, L., & Sørensen, P. (2000). Pathological outcomes of observational learning. *Econometrica, 68*, 371-398.

Spiwoks, M., Bizer, K., & Hein, O. (2008). Informational cascades: A mirage? *Journal of Economic Behavior & Organization, 67*, 193-199.

Surowiecki, J. (2004). *The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations*. London: Little, Brown.

Tormala, Z. L., DeSensi, V. L., & Petty, R. P. (2007). Resisting persuasion by illegitimate means: A metacognitive perspective on minority influence. *Personality and Social Psychology Bulletin, 33*, 354-367.

Treynor, J. L. (1987). Market efficiency and the bean jar experiment. *Financial Analysts Journal, 43*, 50-53.

Trueman, B. (1994). Analyst forecasts and herding behavior. *Review of Financial Studies, 7,* 97-124.

Welch, I. (2000). Herding among security analysts. *Journal of Financial Economics, 58*, 369-396.

Wermers, R. (1999). Mutual fund herding and the impact on stock prices. *Journal of Finance, 54*, 581-622.

Wermers, R. (2000). Mutual fund performance: An empirical decomposition into stock picking talent, style, transaction costs, and expenses. *Journal of Finance, 55,* 1655-1695.

Wood, W., Lundgren, S., Ouellette, J. A., Busceme, S., & Blackstone, T. (1994). Minority influence: A meta-analytic review of social influence processes. *Psychological Bulletin, 115*, 323-345.