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# Overconfidence in Psychology and Finance – an Interdisciplinary Literature Review

## Nadmierna pewność siebie w psychologii i finansach – interdyscyplinarny przegląd literatury

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### Abstract

This paper reviews the literature on one of the most meaningful concepts in modern behavioural finance, the overconfidence phenomenon. Overconfidence is presented as a well-developed psychological theory, with main facets comprising miscalibration, better-than-average effect, illusion of control and unrealistic optimism. The primary applications of overconfidence in contemporary finance are analysed, from the perspective of financial markets and corporate behaviour. Experimental studies, formal models and analyses of market data demonstrate that overconfidence at least partially solves some financial market puzzles that cannot be accounted for by standard economic theory. Overconfidence in the corporate context may affect not only a company's internal financing structure, but also its interactions with other market participants through merger and acquisition activity.

**Keywords:** overconfidence, behavioral finance, investor psychology, financial markets, corporate policies, overconfident investors

**JEL:** D8, G1, G32, G34

### Streszczenie

W artykule przedstawiono przegląd literatury na temat jednej z najważniejszych koncepcji finansów behawioralnych: zjawiska nadmiernej pewności siebie. Nadmierna pewność siebie jest ukazana jako zaawansowana teoria psychologiczna, której głównymi aspektami są: brak kalibracji, efekt lepszy niż przeciętny, iluzja kontroli i nierealistyczny optymizm. Analizowane są zastosowania zjawiska nadmiernej pewności siebie w teorii finansów, w kontekście rynków finansowych i przedsiębiorstw. Badania eksperymentalne, modele teoretyczne i analiza danych rynkowych udowadniają, że nadmierna pewność siebie może być częściowym rozwiązaniem niektórych zagadek rynku finansowego, które nie są wytłumaczalne w ramach konwencjonalnej teorii ekonomicznej. Nadmierna pewność siebie w perspektywie przedsiębiorstw może mieć wpływ nie tylko na wewnętrzną strukturę finansowania tych jednostek, ale również na ich interakcje z innymi uczestnikami rynku poprzez mechanizmy fuzji i przejęć.

**Słowa kluczowe:** nadmierna pewność siebie, finanse behawioralne, psychologia inwestorów, rynki finansowe, polityka przedsiębiorstw, nadmierna pewność siebie inwestorów

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## 1. Introduction

Economics has been strongly increasing its interdisciplinary character in the recent years, extensively using developments from sociology, psychology and even neurology to better explain economic behaviour of individual agents and whole markets. Nonetheless, the depth of research in all these originally distinct fields makes it very tedious to maintain a full picture of the original idea, without the oversimplifying shortcuts.

In order to warn against such oversimplifications in the area of behavioural finance, we review one of the popular traits studied presently in finance, namely the overconfidence phenomenon. On the intuitive level overconfidence seems a clear concept and this may be the reason for its somewhat scanty definitions used in some behavioural finance research. The aim of this paper is to present overconfidence as a well developed psychological concept, and describe its origins, forms and definitions, as well as to summarise the main applications of overconfidence in the current finance research. Our extensive treatment of overconfidence in the psychological part aims to demonstrate that the nature and reasons for overconfidence continue to be discussed among psychologists, with some of them going as far as to claim that the phenomenon itself does not exist. Thus, applying overconfidence to economic models as a “well-established fact” should be treated with caution, as it seems to be a developing field within psychology itself. In addition, putting together different and distinct measures of overconfidence, which can be found in some of the finance and economics literature, is not necessarily practised by psychologists and from that point of view may represent an important oversimplification. Although “believing we know more than we truly know” and “believing we are better than others” may seem to mean almost the same thing, psychological research sets these two beliefs clearly apart. In our paper we outline the most important aspects of overconfidence found in the psychological literature to avoid similar misconceptions.

Our brief overview of finance research demonstrates that applying even a general concept of overconfidence allows to account for many phenomena in finance that the standard economic theory does not explain. Some examples are excessive trading volumes on financial markets, persisting security misvaluations or unfavourable acquisitions undertaken by some companies. The economic effect of overconfidence on financial markets and companies has been under closer scrutiny for some time now and the studies continue to grow, with the most important ones included into the mainstream of finance research.

The paper is structured as follows: Section 2 provides an overview of the main findings on overconfidence in psychology, dividing it into miscalibration and positive

illusions concepts. We present various definitions of and reasons for overconfidence and review an important discussion on its very existence among psychologists. We conclude this part with a summary of expert calibration, as studied by psychologists. Section 3 describes the main applications of overconfidence in finance research, split between the financial markets and the corporate finance area. Section 4 concludes.

## 2. Overconfidence in psychology

The term “overconfidence” has been widely used in psychology starting from the 1960s. As researchers in other fields, including economics, have stretched its meaning beyond its original definition, we will try to include in our review the most popular extensions and interpretations of overconfidence that are currently being studied in economics and finance. Overconfidence in psychology is most closely related to the calibration and probability judgment research and the term itself is frequently equalled with one of the forms of miscalibration.<sup>1</sup> The most important extensions to this definition scope, usually applied by economists, are studies of overconfidence in the context of positive illusions, i.e. the better-than-average effect, illusion of control and unrealistic optimism. The review discusses psychological studies on overconfidence separately for each of the above categories, to highlight differences between them, even if economists tend to regard them jointly.

### 2.1. Overconfidence as miscalibration

In psychology, calibration is usually studied on the basis of general knowledge questions generated by researchers (e.g. comparisons of population sizes of different cities or their geographical position). Experiment participants answer sets of questions and after each particular item (or after a set of questions or at the end of the whole task) have to assess the probability that the given answer (or the whole set) was correct. Appropriate calibration takes place “if over the long run, for all propositions assigned a given probability, the proportion that is true is equal to the probability assigned” (Fischhoff et al. 1977, p. 552). Putting it bluntly, a well-calibrated judge is able to correctly assess the amount of mistakes he makes.

Miscalibration is the difference between the accuracy rate and probability assigned (that a given answer is correct). Overconfidence has been defined as a particular form of miscalibration, for which the assigned probability that the answers given are correct exceeds the true accuracy of the answers. This rough definition of overconfidence as a form of miscalibration

<sup>1</sup> See for example Brenner et al. (1996); Dawes and Mulford (1996); Fischhoff et al. (1977; 1980).

has been widely used by psychologists since the end of the 1970s. An even shorter description was provided by Oskamp (1965) in his analysis of psychologists' clinical judgment, where overconfidence is studied simply as an excess of confidence over accuracy. Oskamp proved that confidence in expressed judgment and accuracy of this judgment lie far apart and they may diverge further, as the confidence of a judge may grow during an evaluation task, while his accuracy remains largely unchanged. He found a significant mismatch between the level of confidence (53%) expressed by clinical psychologists and their diagnosis accuracy rate (28%), which indicated a high degree of overconfidence, defined later by Fischhoff et al. (1980, p. 108) as "an unwarranted belief in the correctness of one's answers".

Oskamp's general conclusions have been specified further in later judgment calibration studies. Overconfidence was found in a series of experiments, including general knowledge questions, by Fischhoff et al. (1977) and it proved especially strong for items where the participants were certain, or almost certain, of being right. Overconfidence prevails even if specific instructions as to the nature of probability and calibration are presented to experiment participants. Introducing financial incentives to reward correct calibration does also not change the picture (Fischhoff et al. 1977). Improved calibration results from instructing participants to consider reasons supporting and opposing chosen hypotheses in the experiment of Fischhoff et al. (1980). Overconfidence diminishes in such a case due to a mixture of two results, a decrease in declared confidence and an increase in the number of correct answers. Important factors influencing the level of overconfidence comprise also the presence (or lack) of clear and rapid feedback, and a repetitive and simple nature of the task, implying that calibration may fluctuate (Lichtenstein et al. 1982; Russo, Schoemaker 1992). Nonetheless, the discussion as to whether overconfidence is a steady trait or a dynamic process subject to manipulation has not yielded conclusive answers to date.

One of the essential concepts in overconfidence research, identified already by Fischhoff et al. (1977), is a so-called "hard-easy effect". This finding demonstrates that overconfidence surfaces mostly in difficult or very difficult tasks, while easy tasks may generate underconfidence (where the proportion of correct answers exceeds expressed probability judgment). The hard-easy effect was strongly confirmed by Lichtenstein et al. (1982) and has been present in most calibration research since then.

The next sub-sections will briefly outline two important discussions among psychologists within the miscalibration area, concerning the reasons for overconfidence and its very existence.

### *Reasons for overconfidence*

Despite extensive research on overconfidence, its origins or reasons for its existence have not been clearly and unanimously defined. Many researchers either take it for granted, or analyse its degree, but its roots are still being debated. Although this seems to be much more an area of interest and further exploration for psychologists, its meaning for other fields (such as economics) is crucial, as only the identification of the origins of overconfidence may allow to find measures mitigating it, or spurring it, if necessary.

Several psychological reasons for overconfidence emerge in the literature. Keren (1997) divides them into cognitive and motivational ones (overconfidence as a self-motivating mechanism). Similarly, Russo and Schoemaker (1992) name cognitive, psychological and motivational areas. Cognitive reasons include biases, which may be alleviated by accelerated and accurate feedback, counterargumentation, or careful consideration of the problem. The motivational side exposes the need to believe in one's efficacy to make progress.

Within the cognitive process, various reasons may lead to the misalignment of confidence and accuracy. Overconfidence may arise due to faults in the process of arriving at answers which are not readily stored in memory, or the erroneous belief that answers are stored in memory, when it is not the case. The reconstructive nature of memory and perception creates room for errors, without the subjects realising them. In addition, the selective nature of memory, bringing the more "salient" items into the foreground, causes further mistakes in generating answers, while leaving the confidence levels unchanged (Fischhoff et al. 1977). There is also no certainty as to when miscalibration arises, be it while forming the confidence judgment or later, while translating that judgment into a probability (Fischhoff et al. 1980).

A partly cognitive and partly motivational reason for overconfidence is a so-called confirmation bias, widely explored in the literature. A confirmation bias arises with the excessive usage of confirming evidence (for a chosen hypothesis) and the negligence of contradictory arguments by experiment participants. The improvement in calibration following a specific instruction to consider both kinds of evidence documented by Fischhoff et al. (1980) strongly supports the role of the confirmation bias in the emergence of overconfidence. In addition, confidence judgments seem to be related primarily to the amount and strength of supporting, rather than contradicting, evidence and the latter has very little, if any, bearing on the confidence judgment formation as such (Fischhoff et al. 1980). The confirmation bias argumentation thus implies that miscalibration is not merely a cognitive mistake during the translation of the confidence judgment into a numerically expressed probability.

The discussion of the reasons for overconfidence also includes the hard-easy effect. Although in most research this effect is a standard finding, some authors claim that in fact (unnaturally) difficult questions are the reason that overconfidence emerges at all and without these no miscalibration is observed.<sup>2</sup> A more detailed discussion of this can be found in the next sub-section. An already mentioned factor influencing overconfidence is the presence (or lack) of clear, rapid feedback, which in some cases may lead to perfect calibration, such as enjoyed by US weather forecasters (see research quoted in Lichtenstein et al. 1982).

Originating from the faulty cognitive processing, the next important area of potential sources of overconfidence emerges, namely the heuristics and biases argumentation. Discussed in detail by Kahneman and Tversky (1982), it points at three main heuristics that could play important roles in spurring overconfidence, namely:

- the representativeness heuristic,
- the availability heuristic,
- the adjustment and anchoring heuristic.

The representativeness heuristic consists of phenomena such as base-rate neglect (ignoring prior probabilities that directly impact the final probability), sample size neglect (where generalised conclusions are drawn on the basis of very small samples), misconceptions of probability (including the “gambler’s fallacy”, where spinning a roulette wheel is expected to “certainly” result in a “red” after a series of “blacks”), insensitivity to predictability (using rather the favourability of a description than its reliability), illusion of validity (confidence in items matching certain stereotypes, even if their descriptions are unreliable) and, last but certainly not least, failure to appreciate a regression to the mean (assigning various causes to events which in fact are just a regression towards the mean).

The availability heuristic causes people to assess the frequency or probability of an event by the easiness with which they bring to mind similar situations or items. As a result more drastic events will seem more frequent than is really the case, only because they are remembered more vividly due to their drastic character. Illusory correlation is also part of the availability heuristic, where people mistake co-occurrence of events with interdependence between them. Anchoring and adjustment heuristic can be observed when people anchor their initial assessment at some level (which may be completely random) and then adjust the final judgment in relation to this anchor, but the adjustment is usually not sufficient.

Griffin and Tversky (1992) confirm the importance of the representativeness heuristic and the anchoring and adjustment heuristic, concluding from their studies that a role played by the “strength” of evidence (i.e. its “extremeness”) largely exceeds that of its

“weight” (predictive validity, credibility, sample size etc.). Overconfidence emerges when strength is high and weight is low. In a series of studies the authors confirm also the existence of the hard-easy effect, with overconfidence being dramatically high for extremely difficult, “impossible” items.

Some researchers associate differing levels of overconfidence with gender issues, which accommodates the common belief of men being more confident than women given the same level of knowledge. Nonetheless, the link between gender differences and overconfidence has not been unequivocally established. In an attempt to demonstrate that women underestimate their abilities and performance, Beyer (1990) establishes that expectancies have a significant effect on self-evaluations, but the men-women differences in overconfidence itself are not very strong. No significant gender differences are found by Lundeberg et al. (1994) in single item assessments of confidence (as opposed to general confidence studies), with comparable overconfidence emerging for both sexes, especially for wrong answers. Meaningful discrepancies in self evaluation (general evaluation of performance on the whole task) and calibration (evaluation of single items) in specifically masculine tasks performed by men and women are demonstrated by Beyer and Bowden (1997).<sup>3</sup> However, the discrepancies between sexes demonstrated by these studies are not dramatic and depend on the context. Despite this, some economists use gender as a proxy for overconfidence in financial tasks, where men are inclined to feel more competent than women (e.g. Barber, Odean 2001) and indeed gender differences are confirmed.

The last, most extreme group of reasons for overconfidence put forward by Gigerenzer et al. (1991), are faulty procedures on the side of researchers studying overconfidence. Gigerenzer et al. reject cognitive or motivational factors influencing or causing overconfidence and attribute it largely to a (biased) structure of the task and its relation to the environment. If this is corrected, calibration will be close to perfect. The major findings of Gigerenzer et al. are presented below.

#### **Overconfidence – fiction or fact?**

A heated discussion among psychologists on the sources of overconfidence and its prevalence was started, among others, by Gigerenzer et al. (1991). They constructed a new model of confidence, the probabilistic mental model (PMM) and questioned the very existence of overconfidence. They argued that its foundations were faulty structures of studies rather than true cognitive biases affecting judgments. According to the PMM,

<sup>3</sup> A masculine task is a task at which both sexes *believe* that men perform better. Beyer and Bowden (1997) use a sports question set as a masculine task and a show business question set as a feminine task. Other examples of masculine areas cited by Beyer and Bowden (1997) are e.g. mathematics, physics, technical problems etc.

<sup>2</sup> See for example Gigerenzer et al. (1991); Juslin (1994).

people are good judges of what they know provided this concerns their natural environment. Previous studies would make subjects answer questions that were not representative of their natural environments or, even if they were, researchers hand-picked them so that they were more difficult than it seemed, which caused overconfidence to appear. Overconfidence disappears if questions are chosen randomly and the hard-easy effect does not always prevail. Depending on the task, “overconfidence and the hard-easy effect emerge, disappear, and invert at will” (Gigerenzer et al. 1991, p. 526). Despite the fact that these results were not confirmed by other researchers, the “well-established” nature of overconfidence has been put to further verification.<sup>4</sup> Random selection of items was experimentally proven by Juslin (1994) to significantly mitigate overconfidence, while including hand-picked questions increased it. The prevalence of overconfidence and the hard-easy effect as a general cognitive bias across domains has been strongly reduced and some results were associated with faulty interpretations of regression effects (Dawes, Mulford 1996). The degree of overconfidence may be modified by the distribution of correct and wrong answers and the methodology of analysing the answer patterns.<sup>5</sup> A random error component in judgment is introduced in Soll’s (1996) modification of the PMM, where confidence is a function of the validity of information and of the random error. In this model, the interaction between the random error and the environment, as well as unrepresentative questions and biases, all contribute to overconfidence, while the existence of the hard-easy effect is proven experimentally, contrary to Gigerenzer’s original findings. Further extensions of Gigerenzer’s methodology comprise an introduction of a stochastic component in judgment, in addition to various forms of errors, and analysing factors like response modes (half-range or full range), the structure of questions and the participants’ learning process (Juslin et al. 1997). A causal relation between the data analysis methodology and subsequent calibration results is demonstrated by Ayton and McClelland (1997), spanning diverse findings from overconfidence as a methodological illusion (Gigerenzer et al. 1991; Juslin 1994), through a strong impact of random error (Soll 1996; Juslin et al. 1997), up to overconfidence as a pervasive effect caused by cognitive biases.

Numerous researchers argued with the above-stipulated illusory nature of overconfidence, proving the existence of miscalibration. Overconfidence may not be “made to disappear” as claimed by Gigerenzer et al. (1991) and Juslin (1994), as long as the questions are difficult enough and thus the hard-easy effect

prevails.<sup>6</sup> As pointed out by Griffin and Tversky (1992), an important role in spurring overconfidence is played by biases, as people attach more attention to the “strength” of evidence (“extremeness”) rather than to its “weight” (predictive validity, e.g. sample size, credibility of arguments). Strength participates in the cognitive processes at the stage of forming the initial hypothesis and weight is only taken into account to adjust the final answer, but this adjustment is usually not enough to outweigh the mistakes made in forming the initial impression. This is parallel to the processes of anchoring and adjustment proposed by Kahneman and Tversky (1982). Griffin and Tversky (1992) demonstrate that overconfidence could be mitigated if people recognised that evidence they use fits an alternative hypothesis equally well. Overconfidence is found to reach its maximum in single item evaluation and to drastically diminish in assessments of overall task performance. This has been found already by Gigerenzer et al. (1991) and is sometimes used as an argument to reduce the effect of overconfidence as such. However, the case-by-case nature of decision making in general and the diverse bases of single item and overall task performance does not allow to dismiss miscalibration on these grounds. As pointed out by Brenner et al. (1996), single items are evaluated according to arguments for and against a given hypothesis, while an overall judgment is formed on the basis of perception of task difficulty, knowledge of the judge, or past experience with similar tasks. Brenner et al. (1996) experimentally demonstrates that if these evaluations are based on the same evidence, they result in miscalibration being equal.

The misconception of regression effects and their interpretation as overconfidence put forward by Dawes and Mulford (1996) are rejected by Griffin and Vary (1996), which also introduce a differentiation between optimistic overconfidence (belief that our favoured outcome will occur in the future) and overestimation of one’s knowledge (with no favoured hypothesis involved). Aggregation and faulty analysis of data is recognised to affect overconfidence, but it is not sufficient to make it disappear altogether. Questionnaire studies of various professions prove the existence of overconfidence (Russo, Schoemaker 1992), with the exception of US weather forecasters, where calibration is almost perfect. This finding proves the crucial role of accurate, precise and timely feedback in eliminating overconfidence, both in the sense of miscalibration and the better-than-average effect (Russo, Schoemaker 1992).<sup>7</sup> The analyses of the development of calibration and probability research done by Keren (1991) and Keren (1997) support the hypothesis of robustness of overconfidence and hard-easy effects, despite possible methodological flaws in the process of measuring or assessing calibration.

<sup>4</sup> Griffin and Tversky (1992) confirm the existence of overconfidence in a general knowledge task with randomly selected questions, representative of the environment.

<sup>5</sup> Note, however, that Wallsten (1996) does not regard such methodological mistakes as sufficient grounds to reject the existence of miscalibration as such.

<sup>6</sup> See for example Griffin, Tversky (1992), Brenner et al. (1996).

<sup>7</sup> For a detailed description of the better-than-average effect see section 2.2.

Similarly, an overview of Klayman et al. (1999) finds that even if question framing, response mode and unsystematic error have all been experimentally found to influence miscalibration and important individual differences between levels of overconfidence emerge, overconfidence as a phenomenon still prevails. More recent meta-studies of overconfidence, including the expert judgment study of Koehler et al. (2002) and the summary of probability calibration of Brenner and Griffin (2004) assume overconfidence as a well-established fact, even if allowing for some criticisms as to the methodology of measuring it or its various causes. Brenner and Griffin (2004) propose their own structure in calibration research, with the main areas being optimistic overconfidence (building on the self-serving bias, the better-than-average effect, unrealistic optimism and illusion of control), confirmatory bias (seeking evidence which confirms only our already formed, original hypothesis), case-based judgment (the heuristics and biases area), ecological models (e.g. Gigerenzer et al. 1991; Juslin 1994) and error models (e.g. Soll 1996). All these fields are seen as possible causes or explanations of miscalibration, with none of the aspects per se being able to fully explain miscalibration. In our paper we use a slightly different approach to overconfidence, similar to the one applied by Glaser and Weber (2007), dividing it into miscalibration and other positive illusions (better-than-average effect, unrealistic optimism and illusion of control). The last area in miscalibration studies, the expert calibration, is shortly described below.

#### **Expert calibration**

Apart from the numerous experimental studies on miscalibration of lay people (students answering general knowledge questions), psychologists analysed various professionals with respect to their potential overconfidence. In general, the conclusions here are mixed, depending on the profession and task difficulty. Lichtenstein et al. (1982) found highly differing results, with weak calibration displayed by physicians and excellent calibration showed by US weather forecasters and horse-betting commentators in a UK newspaper. The crucial role of feedback here has already been mentioned earlier in the paper. Griffin and Tversky (1992) find experts better calibrated than lay people if the predictability of a task is high, while experts are much more prone to overconfidence than lay people if it is very low. Juslin (1994) claims that if a task is generated on the basis of an expert's work environment, overconfidence will not emerge. This clearly goes against the findings of Lichtenstein et al. on calibration of physicians. Keren (1997) on the other hand discusses bridge experts calibration, with amateur players showing considerable overconfidence and expert players calibrated almost perfectly. He underlines the difference between accuracy

(usually carefully studied) and resolution (also called discrimination – an ability to judge whether an event will take place or not), as there is no agreement whether these are two forms of expertise or rather two different kinds of expertise<sup>8</sup>. A meta-analysis of expert judgment performed by Koehler et al. (2002) finds mixed results for various professional groups, such as physicians, weather forecasters, lawyers, business professionals and sports experts. Overall, the existence of systemic miscalibration is confirmed, but its strength differs. Little evidence for optimistic bias is found, apart from the situation where the judgments concern the subjects themselves. Generally, probability judgments reflect evidence supporting a given hypothesis (meaning the “strength” of evidence), with little regard to the reliability of that evidence (“weight”) or the base rate of the outcome (prior probability that should be included in the “final” probability). In addition, Koehler et al. (2002) declare that while expertise improves resolution (ability to discriminate between more and less likely events) it does not ensure good calibration (ability to assess a probability of a given outcome in itself).

#### **2.2. Overconfidence as a sign of other positive illusions**

Although psychological research primarily concentrates on overconfidence seen as a form of miscalibration, a part of psychological overconfidence studies extends beyond that scope. The main secondary area relates to positive illusions, including the better-than-average effect, unrealistic optimism and illusion of control. Although positive illusions are not in the foreground of psychological debates on overconfidence, their impact is much more pronounced in applied fields, such as economics and finance. Moreover, some studies in economics and finance do not precisely define overconfidence, and do not introduce a distinction between the miscalibration and positive illusions approach. Thus it is important to keep these distinctions in mind for a more thorough understanding of underlying psychological processes and findings that directly influence the agents' behaviour. In the following sections we shortly describe each of the main types of positive illusions, even if despite definitional differences they frequently overlap in theoretical and experimental studies.

#### **Better-than-average effect**

Psychological research has established that, in general, people tend to have an unrealistically positive view of themselves. Most of us, when comparing ourselves to a group (of co-students, co-workers, random participants), believe to be superior to an average representative of that group in various fields. On the aggregate level this seems

<sup>8</sup> This division is also discussed by other authors, e.g. Koehler et al. (2002).

a statistical impossibility. Studies of a so-called “better-than-average effect” attempt to determine whether and to what extent people feel superior to their peers, what reasons this may have and which areas it influences. The better-than-average effect is often included by psychologists in the overconfidence research, but it is certainly overshadowed by miscalibration studies within psychological literature. However, economists have taken the better-than-average effect under closer scrutiny, and it is frequently used as an equivalent of overconfidence as such, with little or no attention paid to the miscalibration phenomenon. In a sense, the better-than-average effect can be seen as a form of miscalibration, where the subjects are not comparing their answers or performance to an “objective” benchmark (e.g. the true size of a city in question) but to their subjective view of the other subjects’ outcome. Thus the main question here is not (or at least, not only) whether the subjects believe their answers to be better than they really are, but if they believe their answers are better than the average answers.

The better-than-average effect may affect various fields of human activities. A well-known study of the better-than-average effect carried out by Svenson (1981) demonstrated that while comparing themselves with others, people generally believe to be more skilful and less risky drivers than an “average” driver, without a prior definition or knowledge on the “average” driving skills. The better-than-average effect, as studied by Taylor and Brown (1988), consists of various factors, such as a belief that positive traits describe us more accurately than an average person, an assessment of others from the perspective of our own positive traits, and a form of a self-serving bias in self-assessment. The self-serving bias analysed by Taylor and Brown (1988) makes people assign more responsibility for success and less for failure to themselves, while others are not given the same credit. The exception to the rule are relatives or close friends, who are also granted the same favourable treatment. Moreover, it may be extended even further to “primitive” groups, implying that even a low level of group integration may result in biased, favourable treatment of group members. An extensive analysis of self-serving biases in the attribution of causality can be found in a meta-study by Miller and Ross (1975). Its primary finding from extensive research indicates that people tend to attribute own success largely to internal reasons (such as knowledge, preparation) rather than external ones (such as luck).

The existence of the better-than-average effect has been proven in various experimental settings. Alicke et al. (1995) study the better-than-average effect as one of self-serving biases allowing people to maintain a relatively high level of self-esteem. The better-than-average effect is found to diminish if the object of comparison is made to be a real person, any real person,

about whom no further information is produced. This reduction is more marked if a personal contact with the comparison object is established, even if the contact is limited to reading of video recording transcripts. Nonetheless, even if diminished, the better-than-average effect persists. Babcock and Loewenstein (1997) also believe the better-than-average effect to be partly caused by a self-serving bias, the existence of which they prove in numerous experiments and find that it is pertinent and difficult to alleviate. The bias they use is a tendency to be biased towards our own interest and perceive fairness as something which benefits ourselves. As a result, agents believe their contribution to a joint task to be higher than is really the case, and their information processing for outcomes with personal involvement is different than for those of third party involvement.

The existence of the better-than-average effect, similarly to that of miscalibration, has also been questioned in the literature. Its emergence was attributed by Dunning et al. (1989) to the usage of ambiguous definitions in psychological studies (such as e.g. “competence”, “excellence”). Self-descriptions chosen by experiment participants only seem overconfident, or “better than average”, but in fact they are just individual interpretations of a vague definition. Once the definitions are no longer subject to interpretation but are restricted and generated externally, the comparison towards others becomes more accurate. This conclusion of Dunning et al. (1989) may seem plausible, but the important classification as to the acceptance of external and strict definition limits its impact significantly. In most cases people do use personal interpretations of seemingly “objective” traits, and making them accept new definitions, especially if these are less favourable towards themselves, is questionable.

In the financial literature, a recent theoretical study of Benoit and Dubra (2007) questions the claimed irrationality of the better-than-average effect.<sup>9</sup> The example of driving abilities is used to illustrate their main point, where the population consists of high, medium and low skilled drivers, with respective probabilities of causing an accident of 0, 2/5 and 4/5. The skill levels are accorded randomly, each with the same probability of 1/3. After the first period of driving, drivers assess their skills in comparison to the remaining population and come up with probabilities, derived according to Bayes’ rule, of 5/9 (high skill), 3/9 (medium skill) and 1/9 (low skill). As a result, all drivers with no accident rationally believe that there is a 5/9 chance that they belong to the high skilled part of the population. As 3/5 of the drivers would not have caused an accident, they all have rational grounds to believe to be above average (or mean, as indicated by the authors). The authors proceed to formalise their approach, using a signalling model

<sup>9</sup> This was pointed out by one of the referees. We are grateful for this suggestion.

framework, where the data is rationalised in various ways depending on the usage of the median or mean beliefs during comparisons to the general population. Although the concept of “apparent overconfidence”, as the authors call it, is very interesting, some assumptions within the model differ from the usual overconfidence framework. Both in the driving skills example and throughout the paper, an assumption of rational learning patterns is assumed, where people update their initial beliefs using Bayes’ rules, after receiving their signals and updating (in a rational pattern). The very important concept of biased self-attribution, mentioned above and discussed further in the financial literature context (e.g. Daniel et al. 1998; Gervais and Odean 2001) is omitted here, while other authors claim it to be an underlying process of forming overconfident beliefs as such. Benoit and Dubra (2007) also make a strong claim that if people have no information about themselves (e.g. on some unknown skill) they will rate themselves as average, which we find somewhat controversial. They also claim that overconfidence cancels out in the large population, as they formally prove the existence of underconfidence for difficult and overconfidence for easy tasks. This stands in clear opposition to the well known hard-easy effect (discussed in section 2.1), where under- and overconfidence surface exactly in the opposite settings. Nonetheless, we believe that the criticism of Benoit and Dubra (2007) constitutes a welcome “rational” direction in the analysis of the better-than-average effect, which should not be taken for granted, neither in the psychological nor financial literature.<sup>10</sup>

Although the scope of psychological research on the better-than-average effect is much narrower than that of probability calibration, its application and analysis in the field of economics and finance is more extensive. The relative simplicity of the concept allows straightforward comparisons between data sets, and potential survey studies do not demand an advanced structure, unlike much more detailed questionnaires on miscalibration.

#### *Unrealistic optimism*

Unrealistic optimism, or a so-called optimistic bias, is frequently analysed in the context of the better-than-average effect and biased self-attribution. In general, unrealistic optimism towards the future can be seen as an error in evaluating future events, either in the sense of the better-than-average effect (e.g. when all or most people believe their chances of achieving financial success are higher than the “average” person’s) or in absolute terms (when people believe their chance of winning a lottery are higher than the true probability). The shortest definition of several findings in that area could be “The future will be great, especially for me” (Taylor, Brown 1988, p. 197). In his famous paper Weinstein (1980) experimentally

analyses different aspects of people’s optimism towards the future, with participants comparing their chances of a potential fortune or misfortune to an average’ person. People are found to believe that positive events are more likely to happen to them than to others, with the opposite valid for negative events. This effect increases for especially desired occurrences, events with objectively higher probabilities and events perceived to be controllable (such as e.g. passing an exam). People believe that negative experiences would rather affect a subjectively formed (and often wrong) stereotypical “representative”, which obviously they do not resemble. These comparisons clearly overlap with the better-than-average research, with the qualification that they refer to future events. Unrealistic optimism is reduced through a careful re-examination of own and others’ chances and reasons for success, but it does not disappear, which indicates that it is not of a purely motivational origin (reducing anxiety) but may be caused by cognitive errors. The optimistic bias is persistent for both positive and negative events, especially if these are perceived to be controllable and people attach commitment to them or have invested emotionally in them.

#### *Illusion of control*

Psychological research and common observation demonstrate that people tend to believe they are able to influence events which in fact are governed mainly, or purely, by chance (Taylor, Brown 1988). An extreme example of this illusion is an insistence on throwing a dice personally as if it could then show a more favourable result. Moreover, if people expect certain outcomes and these outcomes do occur, the participants are prone to assign them to their doing rather than luck, and re-affirm their belief in control over a situation where the only factor is probability.

The existence of illusion of control in purely chance-driven tasks has repeatedly been proven experimentally, with the participants convinced that their skill or past experience can influence the outcome of predicting the result of the task (Langer, Roth 1975). After some result manipulations in a coin-tossing task, Langer and Roth (1975) led rational participants to believe they are able to better predict the outcome of coin-tossing than others and were convinced that their success in predictions was not pure chance, but that they were able to “control” the outcome. If certain factors usually involved in situations depending on skill, such as competition, choice, familiarity or involvement, are introduced into purely chance-driven tasks, individuals will believe they control the tasks more than the probability itself indicates (Langer 1975). Illusion of control is found by Langer (1975) in a variation of experiments on chance-driven tasks, including a participation of a confident or a nervous competitor, choosing lottery tickets or being

<sup>10</sup> See Benoit, Dubra (2007) for further references.

assigned one, engaging in familiar or unfamiliar lotteries or chance games, making own guesses or through a proxy. In all these situations participants are found to express excessive confidence in their control over outcomes of chance-driven tasks. A meta-analysis of Presson and Benassi (1996) documents the prevalence of illusion of control effects across a wide range of studies and experimental variations. Situational variables which were found to increase the illusion of control comprised choice (people value lottery tickets with self-chosen numbers more than those with randomly chosen), outcome sequence (experiment participants receiving positive feedback on a pure chance task in an early stage of the experiment tend to believe their control to be higher than the control of those with positive feedback towards the end of the trial), familiarity with the task, information regarding the outcome of the task and active involvement in the task. Nonetheless, few authors measure illusory control as such and frequently use proxies instead. These proxies include the participants' judgments of their prediction ability, judgments of contingency, willingness to trade lottery tickets, or even participants' confidence on succeeding on a task. Especially this last item makes illusion of control studies closer to overconfidence. Indeed, Presson and Benassi (1996) propose to use the term "illusory judgment" instead, to better convey different effects found in the underlying research, including participants' judgments of their prediction ability. This seems to align more with the overconfidence definitions in term of miscalibration than the effect of illusion of control per se.

To conclude this part, we would like to mention an interesting finding presented by Taylor and Brown (1988) in their study of relations between positive illusions (unrealistically positive self-evaluations, exaggerated perceptions of control and mastery and unrealistic optimism) and mental well-being. The most "realistic" participants, i.e. those scoring lowest on positive illusions, are people with low self-esteem or mildly and severely depressed. They are able to most adequately assess a degree of control they exert over different events and most precisely judge their chances for the future. However, no causality has been established here, so it is not clear whether a positive mood or belief in one's potential, cause positive illusions, or rather if these illusions make us happier. Research on motivation does show that positive beliefs are associated with a higher drive and effort to succeed, and thus they may just constitute a self-fulfilling prophecy. Nonetheless, the authors claim that people distort reality to maintain their positive illusions, including high self-esteem, belief in personal efficacy, control, and optimistic view of the future. If this is truly the case, the role of positive illusions and overconfidence as a whole should not be underestimated, and its impact on economic and financial behaviour in the real-world setting should be carefully studied.

### 3. Overconfidence in finance

Economists started implementing psychological findings into economic models starting in the 1970s, but the most rapid development of that trend began in the 1990s. Since then, overconfidence has also become a field of interest for economists, mainly in the context of behaviour on financial markets. Overconfidence is defined here usually as an overestimation of one's knowledge or precision of private information, or the interpretation thereof. Alternatively, an underestimation of variance of signals or volatility of asset values are also considered. Some puzzles found on the financial markets, which previously could not be solved using the standard economic theory, were successfully accounted for once overconfidence of investors was assumed. These issues include primarily continuing securities misvaluations, excessive trading volumes and the disposition effect, i.e. a tendency to sell well-performing stocks and to hold on to losing ones. The potential presence of overconfidence on the markets and its persistence in the longer term spurred an on-going discussion on the well-established idea of efficient markets and economic agent rationality. Despite some scepticism among economists on the existence and effect of overconfidence as such, its prevalence on financial markets has been proven repeatedly, through methods ranging from experimental and questionnaire studies to formal models and financial market data.

A field less explored is the existence and possible implications of overconfidence in the corporate finance context. Assuming the prevalence of overconfidence as a common human characteristic, its existence in the corporate environment may not be ruled out. Nonetheless, research on its implications for corporates has developed only very recently and remains a growing field. The limited scope of available data presents some obstacles, and its interpretation does not always provide straightforward answers, unlike the investor trading data from the financial market. The two main directions of overconfidence research in the context of corporate finance are studies of merger and acquisition activities of corporates and analyses of internal corporate financing structures. Corporate mergers and acquisitions have been under academic scrutiny for some time now and numerous researchers suggest that their impact is not necessarily only positive in terms of shareholder gains. This becomes especially interesting nowadays, when large corporate "divorces" start taking place.<sup>11</sup> Overconfidence studies follow this critical path and indicate that some mergers may originate from overconfident CEOs overestimating their knowledge or their positive influence on profitability of merged companies, and the result for shareholders can prove

<sup>11</sup> For example the split-up of Daimler and Chrysler in 2007.

negative. As to the corporate financial structure, the existing overconfidence research focuses on the optimal proportion of debt versus equity financing of new investments and a possible over-dependence on free cash-flow in that respect. The timing of executing managerial stock options is used as a proxy for overconfidence here, as overconfident managers are prone to believe in their ability to keep the share price rising so they refrain from realising the options they hold. The potentially crucial implications of overconfidence for the performance and risk profile of corporates make this field an important addition to the standard corporate finance models.

### 3.1. Overconfidence on financial markets

The presence and impact of overconfidence on financial markets is analysed through experimental and questionnaire studies, borrowed from psychology, and through standard economic tools of formal modelling and data analysis. The experimental and questionnaire methodologies face the usual criticisms, including non-representative sampling, small sample size, artificially generated problems and laboratory conditions different from the real-world environment. Nevertheless they allow to outline new research directions and hypotheses, which are subsequently analysed through formal economic modelling and verified by market data analysis. In the following sections we will present overconfidence research referring to financial markets in the context of all of the above tools.

#### *Experimental and questionnaire studies*

The existence of overconfidence on financial markets is demonstrated experimentally in varying conditions. Overconfidence of financial experts, including professional traders and investment bankers, proves higher than that of lay men (students) in different experimental tasks (taken from the area of finance) designed by Glaser and Weber (2005). Although personal overconfidence levels across domains and tasks fluctuate, a permanent rank-order is maintained confirming stable individual differences. However, the frequently assumed relation between the two aspects of overconfidence, the miscalibration and the better-than-average effect, is disconfirmed here. On an experimental asset market with varying private information, constructed by Biais et al. (2005), overconfidence of participants is diagnosed through a general knowledge question set. Miscalibrated (overconfident) agents perform worse than their better-calibrated counterparts. In addition, despite the fact that miscalibration itself is approximately the same for both men and women, it reduces trading performance in the experimental market only for men, who turn out to be much more active traders than women. The usual relation originating from investor data, stipulating

that overconfident investors trade more, is not found here.<sup>12</sup> This may be partly due to a narrow definition of overconfidence assumed by Biais et al. (2005), namely the general knowledge miscalibration. This hypothesis is confirmed in Glaser and Weber's (2007) study of a direct relation between investor overconfidence and trading volume, where only the better-than-average effect is demonstrated to correspond with higher trading volumes. Miscalibration, defined here as overly tight probability distributions and underestimation of volatilities, bears no relation to trading volumes. Both facets of overconfidence are measured by Glaser and Weber (2007) through questionnaire studies and are subsequently analysed in conjunction with investor trading data, which is a rare and valuable study of direct links between overconfidence and financial market behaviour. Usually investor overconfidence levels are determined with the use of proxies and, as a result, the direct impact of overconfidence itself can be easily questioned. The prevalence of all overconfidence facets on an individual investor level is confirmed in a large questionnaire study of De Bondt (1998). This consists of the better-than-average effect, the illusion of control and unrealistic optimism, as investors are overly optimistic about the performance of shares they themselves own but not about the level of the stock index in general. Moreover, individual investors are miscalibrated and their confidence intervals as to the variability of security prices are always too narrow. In addition, they underestimate the covariation in returns between their own portfolio and the market index, which again could originate from the better-than-average effect (De Bondt 1998).

The potentially dynamic nature of overconfidence remains one of the unresolved issues in psychology and is also discussed in finance, especially in the context of introducing appropriate incentives spurring or diminishing overconfidence when needed. In an experimental asset market where agents trade one risky asset, Maciejovsky and Kirchler (2002) find the largest overconfidence towards the end of the experiment, when the participants gain more experience and start to rely more heavily on their (overestimated) knowledge. This finding indicates that overconfidence may be subject to modifications, which goes back to the crucial role of clear, rapid feedback in shaping individual overconfidence levels (Russo, Schoemaker 1992).

#### *Theoretical models*

In behavioural finance models analysed below, overconfidence is often interpreted as:

- investors overestimating the precision of their information (sometimes more specifically: overestimating

<sup>12</sup> For a more detailed discussion on trading volume and overconfidence please see the sub-section "Financial market data".

private signals and underestimating the public ones),

– and/or investors underestimating risk, which makes them e.g. hold riskier portfolios.

Assuming the existence of such (and similar) facets of overconfidence, they are analysed as to their effects on financial markets, including: excessive trading volumes, trading profitability, short- and long-term asset misvaluations and stock returns. Various scenarios proving the persistence of overconfidence on the market are also frequently modelled.

Odean (1998) assumes that traders, insiders and marketmakers may unconsciously overestimate the precision of their information and rely on it more than is warranted, while traders display the better-than-average effect, evaluating their information as better than that of their peers. Such overconfident market participants cause an increase in the trading volume. The same results are demonstrated by Benos (1998) in his model of an auction market with informed traders, where again the participation of risk-neutral investors overestimating the precision of their information leads to an increased trading volume.<sup>13</sup> Overconfidence can also lead to larger market depth and volatility (Odean 1998; Benos 1998), as well as higher market efficiency, lower expected results (utility) of traders, market underreaction to new information of rational traders (Odean 1998) and more informative prices (Benos 1998).

There is no consensus as to the effect of overconfidence on trading profits. The speculative trading model with asymmetric information constructed by Kyle and Wang (1997) predicts that overconfident traders with overly tight distribution intervals of private signals may be perceived as trading more aggressively and may make a higher profit than their rational opponents. A similar conclusion is reached by Benos (1998), where despite the fact that both overconfident and rational traders realise each other's propensities (to trade more or less aggressively), the overconfident traders enjoy a "first mover's advantage" and achieve higher individual profits. This does not result from higher risk-taking, but is due to the aggressive trading approach. In the model of De Long et al. (1990) noise traders also achieve higher profits than rational traders, but this is a premium for an increased level of risk they themselves create. De Long et al. (1991) in turn examine noise traders who are overconfident as they underestimate risk and thus the assets they hold are more risky, but earn higher expected returns.

On the other hand, Gervais and Odean (2001) assume overconfident traders realise, on average, lower gains, as they increase both trading volume and volatility, which in turn negatively affect their trading results. Daniel et al. (1998) in their model also demonstrate

that overconfident informed investors are loss-making, on average, but indicate that profits of overconfident traders can in some cases exceed profits of rational investors, and indeed Daniel et al. (2001) make such an assumption.

A broad spectrum of possible overconfidence effects on the security market is analysed by Daniel et al. (1998; 2001). The first model assumes that investors are overconfident only towards private (and not public) signals, similarly to Odean (1998).<sup>14</sup> Daniel et al. (1998) present a complex model of overconfidence and biased self-attribution of investors, where security market under- and overreactions follow – respectively – public and private signals. Such overconfidence effects imply long-run negative autocorrelation in stock returns and excess volatility. Daniel et al. (1998) consider both static and time-varying confidence. Adding a self-attribution bias to the overconfidence effect, makes confidence fluctuate in the model, similarly as in Gervais and Odean (2001).<sup>15</sup> Investor confidence increases after confirming evidence of previous private signals is received. However, if previous private information is disconfirmed, investor confidence falls only slightly, if at all. This results in short-term momentum in security prices (an overreaction), which is reversed in the long run as further public information modifies the stock price back towards the fundamentals. Other issues are also studied within the overconfidence framework, including detailed analysis of volatility around public and private signals and relations between stock misvaluations and selective events announcement effects.

Daniel et al. (2001) present an asset pricing model with overconfidence causing a mispricing of securities in equilibrium. The pricing errors are exploited by some rational market participants through arbitrage, but are not fully eliminated due to risk aversion. The model studies expected future returns on securities as a function of both risk and investor misvaluation. In order to jointly demonstrate the effect of risk aversion, multiple risky securities and arbitrageurs, Daniel et al. (2001) analyse only static overconfidence in a single period, in contrast to the earlier intertemporal model.

Chuang and Lee (2006) put together a complex theoretical model of major findings on overconfidence in behavioural finance and then evaluate it empirically.<sup>16</sup> They provide both theoretical and empirical evidence for their four hypotheses: overconfidence causing investor over- and underreactions to private vs. public information (see Daniel et al. 1998, Odean 1998), experienced market gains resulting in increasingly aggressive trading (e.g. Gervais, Odean 2001; De Long et al. 1991; Kyle and Wang 1997; Benos 1998), persistent excessive volatility being due to excessive trading of overconfident market participants

<sup>13</sup> Empirical studies of the excessive trading volume using financial market data are discussed in the following section.

<sup>14</sup> Similar assumptions are frequently made in other models, e.g. Hirshleifer and Luo (2001).

<sup>15</sup> The self-attribution bias is another name for the psychological effect of a self-serving bias in self-assessment (described in section 2.2.), where success is attributed to internal reasons (e.g. skill) and failure to external ones (e.g. luck).

<sup>16</sup> See the next sub-section for the description of the empirical part.

(Benos 1998, Daniel et al. 1998; Odean 1998; Gervais, Odean 2001), and overconfident traders underestimating risk (Hirshleifer, Luo 2001 – see below).<sup>17</sup>

Persistence of overconfidence on the market in the long term is modelled by various authors through different mechanisms. Fund management companies may promote overconfidence through incentive schemes, to profit from the traders' more aggressive behaviour (Kyle, Wang 1997). Basing on the concepts of informational cascades, herding and group selection, Bernardo and Welch (2001) show how overconfident individuals provide their social groups with valuable information. Such "outsiders" behave against the general "herding" direction of their group, and although this may be to the individuals' detriment, it allows the group to explore possibilities that otherwise would not be considered. Thus groups with a certain proportion of overconfident "entrepreneurs" have an evolutionary advantage over groups with no overconfidence, and overconfidence can survive. Even in the dynamic approach of Gervais and Odean (2001), despite the fact that overconfidence is driven out of the market on an individual basis, it remains present on the aggregate level. The authors assume biased self-attribution, where people attribute success more to their own doing rather than to external factors (such as luck) and overconfidence is allowed to change over time and be influenced by learning. In consequence, originally rational traders may learn to be overconfident in a dynamic process, as they wrongly link their success in forecasting dividends with superior own abilities. At a certain point, however, experienced traders recognise their true abilities, benefiting from frequent, rapid and clear feedback and their individual overconfidence diminishes. Nonetheless, overconfidence on the aggregate level is not driven out of the market, as old, better calibrated traders die or leave the market and new overconfident ones arrive constantly.

Another potential reason for overconfidence persisting on the market is presented by Hirshleifer and Luo (2001). Overconfident traders are more aggressive than their rational counterparts in exploiting mispricings brought about by noise or liquidity traders. As a result, they are more profitable, too. They trade aggressively due to two effects: their underestimation of risk and overestimation of own trading strategies. Even without the underestimation of risk, crucial in De Long et al. (1991), the model of Hirshleifer and Luo (2001) demonstrates that the high profits of overconfident traders would also arise, solely due to the second effect, being simply the overreaction in mean assessments by overconfident investors, making them exploit their information more intensely and thus trading more aggressively. As a result, given a replication of trader types in accordance to the

profitability of their trades, overconfident traders survive in the long run.<sup>18</sup> This conclusion of Hirshleifer and Luo (2001) is strengthened in a dynamic setting, as they assume that overconfident traders learn very little (if at all) from past experiences, due to the already mentioned self-attribution bias. Overconfidence can thus persist even if overconfident traders lose money. Hirshleifer and Luo (2001) hold trader confidence steady also during periods of high profitability. This is unlike the dynamic learning model of Gervais and Odean (2001), where confidence fluctuates depending on trading outcomes, which intuitively seems closer to the reality of financial markets.

#### *Financial market data*

Despite the numerous experimental and questionnaire studies, as well as the rapidly developing field of theoretical modelling, it is the analysis of financial market data that has marked a turning point in overconfidence research in finance. The widely quoted works of Terrance Odean and the co-authors (see: Odean 1999; Barber, Odean 2000; 2001), analysing trading data of individual investors taken from a large US brokerage firm, allowed overconfidence to evolve from a neglected psychological side-effect to a widely accepted factor influencing financial markets and investor behaviour. Following Odean's lead, this field of analysis continues to develop, despite the ever-present difficulties in obtaining suitable investment data.

The high turnover rates observed nowadays on world stock exchanges cannot be accounted for by the trading needs of rational investors. In fact, the profitability of active trading may equally be questioned, among other things through the existence of a so-called disposition effect, a tendency to hold on to losing securities and to sell the well-performing ones.<sup>19</sup> Odean (1999) proves this effect on a 1987–1993 data set of 10,000 accounts with trading records obtained from a US brokerage house. He finds that a frequent portfolio turnover not only does not guarantee higher income, but may be detrimental to the final result.

One of the possible explanations for the excessive trading volume in financial markets overall is the overconfidence hypothesis. The fact that trading is excessive can be proven, among others, by the lower performance of active traders in comparison to those who trade less. Such results are demonstrated by Barber and Odean (2000) on the 1991–1997 trading records of over 35,000 US households taken from a nationwide brokerage firm. The accounts with the

<sup>17</sup> All of these items are presented throughout this section (in a slightly different order), and the theoretical part of Chuang and Lee (2006) is largely based on the original models mentioned, so we shall not develop it further.

<sup>18</sup> Hirshleifer and Luo (2001) show that overconfident traders can even fully drive rational peers out of the market, if they display a sufficiently high degree of risk aversion, and there is a large volatility of noise trading or of the underlying security payoff.

<sup>19</sup> The disposition effect and its implications are described in detail by Shefrin and Statman (1985).

highest turnover are the lowest performers. Following down that path, the link between overconfidence and excessive trading volume is established on the same data set by Barber and Odean (2001). Gender is used as a proxy for overconfidence, basing on psychological research stipulating possible higher overconfidence of men, especially in tasks perceived to be masculine.<sup>20</sup> Although in fact psychology does not unanimously link gender to overconfidence, Barber and Odean (2001) confirm that overconfident traders (men) in their sample trade more than women. As a result, the performance of men is more hurt by excessive trading.

Chuang and Lee (2006) use data of US listed companies in the period of 1963-2001, to prove a variety of effects of overconfidence on financial markets. They find evidence for overreactions to private and underreactions to public signals, as well as the existence of the short-term momentum and long-term reversal, such as those suggested by Daniel et al. (1998). The assumptions of Gervais and Odean (2001), that trading profits induce overconfident investors to trade more frequently, are also confirmed empirically, both by Chuang and Lee (2006) and by Statman et al. (2003). In addition, Chuang and Lee (2006) provide support for investors displaying a self-attribution bias (putting more weight on their forecasts that prove to be correct, and less on those that turn out wrong), for high market volatility being due to the presence of investor overconfidence, and for overconfident investors being prone to trade more in relatively riskier securities, after experiencing market gains.

An increasing amount of research emerges where overconfidence in financial analysts' forecasts is analysed. The studies are based on large samples in the form of long-running panel data, are recurrent, and therefore distinct from the usually small-scale, targeted questionnaire studies described above. Based on survey data of financial market participants in Germany and using their confidence interval assessments of the stock exchange index DAX six months in advance, Deaves et al. (2005) study overconfidence of financial experts, defined here explicitly as miscalibration. Market participants are not only clearly miscalibrated, but their past success leads to higher overconfidence, both on the individual level and equally on the market as a whole. The same conclusion for individuals is reached by Hilary and Menzly (2006) on a large 1980-1997 sample of financial analyst predictions of corporate quarterly results. These empirical findings are in line with the model of overconfidence as a dynamic process rather than a stable trait (Gervais, Odean 2001). No consensus as to the learning from experience is reached however, as Deaves et al. (2005) do not confirm this, while both Gervais and Odean (2001) and Hilary and Menzly (2006)

find that past experiences allow forecasters to realise their true abilities and adjust their assessments accordingly (even if this adjustment is short-termed only, as in Hilary and Menzly 2006). Friesen and Weller (2006) estimate their theoretical model of overconfidence and cognitive dissonance, defined as a "psychological discomfort that accompanies evidence that contradicts one's prior beliefs or world view" (p. 342), which lies close to the confirmatory bias phenomenon (i.e. a tendency to seek evidence confirming our already formed hypothesis and disregard evidence contrary to our beliefs). Friesen and Weller (2006) formally prove overconfidence of financial analysts, seen as an overestimation of private information value, and verify it empirically using earnings forecasts. Interestingly, analysts seem to accommodate for the cognitive bias in the behaviour of other analysts, but do not apply it to their own forecasts.

### 3.2. Overconfidence and corporate finance

Overconfidence research concerning financial markets has continued to develop rapidly since the 1990s. Studies of overconfidence in the corporate context, however, are not equally advanced and are much less numerous. An easier access to data sets, such as analysts forecasts, stock market performance and turnover, and their potentially more straightforward interpretation could play a role here. Moreover, an internal nature of decision making within corporate structures make it challenging to separate overconfidence from other factors that affect corporate performance. To date, two main directions in the overconfidence research on corporates have emerged: analysis of mergers and acquisitions and corporate financial structure studies.

#### *Mergers and acquisitions*

An early work on the role of overconfidence in mergers and acquisitions (m&a's) by Roll (1986) stipulates that these may not be driven only, or primarily, by potential gains detected by the acquirer, but may result from managerial hubris. Although overconfidence as such is not named explicitly here, managerial hubris understood as "an overbearing presumption of bidders that their valuations are correct" (p. 200) lies very close to later definitions of overconfident traders, who overestimate the precision of their information and are willing to act on it (e.g. Odean 1998). The potential downside of managerial hubris in m&a activities is overpaying for target firms and negative net final effects of acquisitions for combined shareholders, in terms of stock valuation. At the same time, the role of individual, managerial decision-making in m&a's is underlined, building a solid argument against a later theory of Fama (1998) on behavioural anomalies cancelling out in the aggregate on an efficient market. Acquisitions are obviously strongly

<sup>20</sup> See Section 2.1. "Reasons for overconfidence" for a description of masculine tasks. Barber and Odean (2001) assume finance to also be a "masculine" area.

driven by company CEOs or management boards at best, which do not have the same potential of cancelling out individual irrationalities as e.g. a population of traders in a financial market. Although Roll himself demonstrates mixed evidence for gains and losses from mergers, the important conclusion that behavioural biases may influence m&a's paves the way for further research. Loosely following Roll's argumentation, Malmendier and Tate (2006) analyse corporate m&a's empirically, using a 1980–1994 data set for nearly 400 US companies. An innovative proxy for overconfidence is constructed, building on the concepts of biased self-attribution (CEOs attribute the success of their companies to their own influence) and the better-than-average effect (they believe their company will perform better than others on the market), with unrealistic optimism and illusion of control coming into play as well. Overconfident CEOs are assumed to delay the execution of stock options they have received (as compensation), because they “overestimate the returns they can generate in their own company” (Malmendier, Tate 2006, p. 1–2). As a result, they believe that the stock price of their company shares will continue to rise. This first measure is completed by a second, more straightforward proxy for overconfidence, namely the press portrayal of CEOs presented in the leading business publications.<sup>21</sup> Thus identified overconfident CEOs in the sample are empirically proven not only to be more likely to conduct mergers than their rational peers, but the mergers they perform are also prone to be much less favourable. These are for example acquisitions of companies outside the core activities of the acquiring firm, considered in the literature as potentially value-destroying. In addition, overconfident CEOs believe their companies to be undervalued and prefer internal financing, making merger activity dependent on free cash-flow or abundant internal resources.<sup>22</sup> Moreover, acquiring firms headed by overconfident CEOs suffer from higher negative price effects on stock prices than their rational counterparts, following merger announcements. As a result, overconfident CEOs not only engage more actively in acquisitions of little, if any, added value for their shareholders, but also possibly pay higher premiums for these bids.

#### *Corporate structure*

A frequent reference point in research on overconfidence and potentially biased behaviour in the corporate context is a questionnaire study done by March and Shapira (1987) on risk taking attitudes of managers. Although it does not target overconfidence per se, it demonstrates that managerial decision making diverges significantly from the standard decision making theory. Managers do

not view risk in strictly probabilistic terms and reducing it into a single number is viewed with scepticism. The magnitude of possible loss matters more than its likelihood, and risk in general is approached much more intuitively than implied by standard decision research. On the other hand, managers seem to be under the impression that they are able to, at least partially, control risks and in that respect they view themselves as risk takers rather than gamblers, which can be seen as an illusion of control. At the same time, managers believe they are more risk-seeking than their colleagues, which in conjunction with a view that “good managers have to take risks” demonstrates a clear better-than-average effect.

A striking and very strong presence of overconfidence, mainly in terms of the better-than-average effect and unrealistic optimism, is demonstrated in an experiment on business start-ups performed by Camerer and Lovallo (1999). Although the majority of potential business founders recognises that most new businesses fail, they predict their own profit to be positive. As a result, despite the existing and easily available statistics on a high proportion of new business failures, there will always be an excess of start-ups in comparison to market capacity. This is caused by overconfidence of business founders, who strongly believe in their relative skill. The experimental results of Camerer and Lovallo (1999) confirm the better-than average effect in the behaviour of most business owners, who forecast negative returns for an average market participant, with themselves being an exception to the rule. Overconfidence becomes even stronger when subjects self-select into skill-related sessions, knowing that other participants of these sessions have self-selected too and thus their peer group “quality” is likely to be high. Camerer and Lovallo (1999) name this a “reference group neglect”, which potentially prevents people from gathering enough information on a peer group while entering into a competition. Participants are thus insensitive as to whether their competitors are forced to compete or choose to compete. An important implication arises here for hierarchical tournaments, where winners gradually advance to higher levels of competition. Overconfidence on each level is prone to increase, instead of decreasing, as implied by standard rational assumptions. Camerer and Lovallo (1999) link the reference group neglect with the “inside view” concept of Kahneman and Lovallo (1993). There, the focus lies on own abilities and resources and little attention is paid to statistical data or analysis of similar cases, leading to faulty judgment and biased forecasts.

Unrealistic optimism in a corporate setting is exposed in Heaton's (2002) theoretical model, where overconfident managers “systematically overestimate the probability of good firm performance and underestimate the probability of bad firm performance” (p.33). As a result, optimistic managers believe their company

<sup>21</sup> The two overconfidence measures are found to correlate and both are used.

<sup>22</sup> For the belief of CEOs in undervaluation of their companies, see also the next section.

securities to be undervalued by the market and thus they prefer to finance potential new investments through internal funds, i.e. free cash flow. The availability of free cash flow is regarded to have diverging effects, depending on the corporate setting. It is viewed as positive in cases when in its absence profitable investments would be dropped because of the excessive cost of external financing, wrongly assessed by overconfident managers. On the other hand, overconfident managers also tend to overvalue the firm's future cash flows and investment opportunities, and in the presence of free cash flow they may undertake investments with negative net present value. Free cash flow has a negative impact in this case. Another important prediction later used by other researchers in the overconfidence context is the pecking order of capital structure preferences, which assumes that managers display the strongest preference for internal financing, followed by debt, and then by equity. The bulk of Heaton's (2002) model was empirically verified by Malmendier and Tate (2005) on a corporate panel data for nearly 500 largest US companies between 1980 and 1994. Managerial optimism is extended here to more general overconfidence, defined as an overestimation of own skill (the better-than-average effect) and biased self-attribution. Overconfidence is assessed using a proxy of a delay in stock option execution and additional stock acquisitions by CEOs, which thus reveal that they overestimate a positive influence they personally exert on the value of company share prices in the future. Malmendier and Tate (2005) follow Heaton's (2002) argumentation, stipulating that overconfident CEOs consider the market valuation of their company as too low and restrict external financing through new share issues, so that the existing (undervalued) shares are not diluted any further. The data confirms these hypotheses, and managers identified as overconfident through the delay in stock option execution measure are found to make corporate investments more a function of cash flow than their non-overconfident peers. In consequence, the level of investment in companies with overconfident CEOs depends on the abundance of free cash flow and may be sub-optimal. This is an alternative explanation to the traditional solutions of the problem of investment distortions, namely the misalignment of managerial and shareholder interests and asymmetric information between corporate insiders and the capital market. As a result, standard measures undertaken to mitigate the corporate investment distortions, such as stock- and option-based compensation are unlikely to be effective due to managerial overconfidence (Malmendier, Tate 2005).

Using survey data from CFOs in US corporates for the period 2001-2006, Ben-David et al. (2007) find significant miscalibration in predictions of short-

and long-term stock market returns. The usual results from psychological research are confirmed, as the provided distribution probabilities prove too narrow in comparison with confidence intervals. However, the index constructed by Ben-David et al. (2007) measures overconfidence also in terms of unrealistic optimism rather than purely standard miscalibration, usually understood as an overestimation of one's knowledge. In addition, this optimism is not company-specific, but regards the general performance of the stock market. Stipulations of the dynamic nature of overconfidence (Gervais, Odean 2001; Hilary, Menzly 2006) are confirmed, as better recent performance of the market as a whole and the specific company as such both result in higher confidence of predictions in the subsequent period. Overconfidence grows weakly with age, education and skill but is unrelated to professional experience or gender. Ben-David et al. (2007) also find empirical support for corporate policy assumptions of Heaton (2002) and Malmendier and Tate (2005), as firms of overconfident CFOs are found to behave as if they were undervalued by the market. Corporates employing overconfident CFOs rely more heavily on cash flow, have higher average investment (in particular in acquisition of other firms), hold longer maturities of debt, and perform higher own share repurchasing following a share price decline and lower share issue following a share price increase.

Despite the fact that overconfidence in the corporate context needs further research, the results presented above demonstrate that it may affect profitability and financing structure of companies, as well as their growth through acquisitions, indirectly determining the returns or losses generated by potential shareholders.

#### 4. Conclusion

Stemming from research on calibration and probability, overconfidence has become an important interdisciplinary concept. Its structure and development are currently studied from both a psychological and an economic perspective. Some discussions, as to the origins of overconfidence, its dynamic or stable character and its dependence on the study context, continue in both fields.

The existence of an economic effect of overconfidence on individuals and markets, be it in the context of miscalibration or positive illusions, has been established through both theoretical models and financial data analysis. Puzzles such as excessive trading volumes or security misvaluations on financial markets can be explained at least partly with reference to overconfidence. Even if the degree and direction of the effect of overconfidence on some variables, such as trading profits, are not agreed upon, the phenomenon

itself has been helpful in explaining a significant range of financial market phenomena. Overconfidence in the context of corporate finance has potentially an even larger meaning. The individual character of decision making in companies, on the level of CEOs and management boards, not only allows for personal biases such as overconfidence, but may even strengthen them. In corporates there is no critical mass of other, rational participants with the same degree of power (as e.g. other traders on financial markets) that could cancel out overconfident managerial decisions. As a result, overconfidence could potentially play a much more significant role in the decisions made in the

corporate environment. However, an early stage of research in that field does not yet provide answers to such questions as whether overconfidence effects are positive or negative, or if there exists an “optimal” level of managerial overconfidence, from the point of view of company profits. Although establishing causality proves challenging here, innovative proxies for overconfidence, such as the stock option execution delay proposed by Malmendier and Tate (2005) pave the way for further research. Last but not least, a growing cooperation between psychologists and economists offers more chances to fully draw from both disciplines and build more coherent, common concepts.

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