Overconfidence and financial decision-making: a meta-analysis

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Abstract

Purpose – This meta-analysis reviews and summarizes the results of 34 studies to investigate the relationship between overconfidence and financial decision-making.

Design/methodology/approach – A correlation meta-analysis was conducted with three moderators of the relationship between overconfidence and financial decision-making examined: the type of overconfidence construct, the type of overconfidence measuring method and the type of financial decision-making.

Findings – It was found that the effect of overconfidence on financial decision-making was significant, but the magnitude of this effect was low. Additionally, indirect measures of overconfidence showed to have stronger effect than direct measures, and the overconfidence was mostly related to investment, followed by trading and innovativeness.

Originality/value – This was the first attempt to meta-analytically integrate results concerning the relationship between overconfidence and financial decision-making. Although overconfidence is described as a keystone for understanding financial decision-making, it was shown that it has rather limited effect on individuals' financial decisions. The findings suggest that indirect measures increase the overall effect and may cause the overvaluation of overconfidence in literature. The results call for more rigorous and consistent conceptualization of overconfidence in behavioral research.

Keywords Overconfidence, Trading, Investing, Innovativeness, Financial decision-making, Overestimation, Overplacement, Overprecision

Paper type Research paper

1. Introduction

In psychological literature, the concept of overconfidence effect started to appear in the 1960s. A few decades later, economists started to implement findings from psychology into economic models and investigate the effect of overconfidence, mainly in the area of financial markets and corporate finance (see Skala, 2008; Malmendier and Tate, 2015; Daniel and Hirshleifer, 2015). A number of influential studies in this field found that overconfidence leads to excessive investment, trading or innovativeness (Heaton, 2002; Malmendier and Tate, 2005a; Hayward and Hambrick, 1997; Camerer; Lovallo, 1999). Soon, many authors started to omit using direct measures of overconfidence, and instead used various indirect measures and proxies of overconfidence (e.g. Malmendier and Tate, 2005a, 2005b; Verberne, 2010; Jouber, 2013; Park and Chung, 2017; Wong, 2017; Choi *et al.*, 2018; Hayward and Hambrick, 1997; Adebambo and Yan, 2016). Some of them even did not measure overconfidence and instead used excessive investment or trading as a proxy for overconfidence (e.g. Chuang and Lee, 2006; Hwang *et al.*, 2014; Khajavi; Dehghani, 2016; Liu *et al.*, 2016; Zia *et al.*, 2017; Gupta *et al.*, 2018). Moreover, the overconfidence started to be linked and sometimes confused with other similar concepts, like optimism or illusion of control (e.g. Lowe and Ziedonis, 2006; Hackbarth, 2008; Cassar, 2010; Han *et al.*, 2015; Hilary *et al.*, 2016). This inconsistency in operationalization of overconfidence brought some contradictory results, resulting in the difficulty in the integration of findings concerning the effect of overconfidence on financial decision-making.

The contribution of this study is threefold. First, we contribute to the positive illusions theory and, specifically, to the overconfidence literature by integrating and analyzing the overall effect of overconfidence on specific domain of financial decision-making. Second, we contribute to the discussion about the effect of different types of overconfidence on financial decision-making. We examine three very commonly investigated decisions, namely, trading, investing and innovativeness. Third, we contribute to the discussion about methodological issues of overconfidence measuring by investigating the effect of different overconfidence constructs and measuring methods on financial decision-making. We aim to find out whether indirect measures and proxies of overconfidence show similar effects like the original direct measures stemming from psychological literature.

2. Theory and the development of hypotheses

2.1 Bounded rationality, positive illusions and overconfidence

Early works in social cognition theory assumed that people act like naïve scientists, that is, rationally and logically test their hypotheses in order to understand social events (Heider, 1958). The natural need to understand social aspects and behavior should motivate individuals to develop correct perceptions of themselves and others (Festinger, 1954; Fiske and Taylor, 1984; Nisbett and Ross, 1980). In order to do so, the theory assumed that people tend to gather and process information in an unbiased manner. However, it soon became obvious that individuals' actual judgment and decision-making is not like the social cognition theory suggested. It was determined that individuals do not always engage in complex and effortful cognitive process when making social judgments and decisions. Instead, they tend to use simple shortcuts and make errors during reasoning (see Kahneman *et al.*, 1982; Fiske and Taylor, 1984; Nisbett and Ross, 1980). Especially, individual's prior expectations and self-serving biases shape social judgment (Taylor and Brown, 1988). In the literature, these phenomena are often grouped into one joint concept of positive illusions (see Taylor and Brown, 1988; Flanagan, 2009; Makridakis; Moleskis, 2015; Collard *et al.*, 2016; Jefferson *et al.*, 2017). They are defined as a "systematic small distortions of reality that make things appear better than they are" (Taylor, 1989, p. 228). Jefferson *et al.* (2017) emphasize personal aspect of these biases. They define positive illusions as a systematic tendency to have excessively optimistic beliefs or predictions about the self. For instance, individuals naturally see positive personality attributes as more descriptive of themselves than of the average person but at the same time see negative personality traits as less descriptive of themselves than of the average person (e.g. Alicke, 1985; Brown, 1986). In fact, the finding that people have systematic tendency to see themselves as better than others or having better perceived skills than their actual skills is described as the most robust and consensual finding in the judgment and decision-making literature (e.g. Meloy *et al.*, 2006; Sternberg, 2008; Schaefer *et al.*, 2004; Blake, 2009). This phenomenon – the overconfidence effect – stems from the need to hold a positive socially desirable self-image, which serves as a certain self-protective factor-enhancing feelings of self-worth or reducing cognitive dissonance and feelings of uncertainty (Blanton *et al.*, 2001).

In psychological literature, the overconfidence appears mainly in three different constructs: overprecision, overplacement and overestimation (Moore and Healy, 2008; Olsson, 2014). Overprecision is measured by comparing individuals' subjective probability judgments (often estimated in confidence intervals) with actual objective probability. Overplacement – often called better-than-average effect (see Benoît and Dubra, 2011) – is measured by comparing individuals' beliefs about their performance or abilities with their beliefs about performance or abilities of other persons. Lastly, overestimation is based on a comparison of individuals' beliefs or predictions of their performance in a certain task with their actual performance. According to these three constructs, overconfidence is defined as a

systematic tendency to overestimate one's own ability to make accurate probability judgments, or as an overestimation of one's own performance, knowledge and abilities compared to his/her actual performance, or others' knowledge and abilities (Koellinger *et al.*, 2007).

2.2 Overconfidence and financial decision-making

In the 1990s, economists started to widely implement findings about overconfidence into economic models and use the overconfidence construct for explaining individual economic behavior in the context of financial markets and corporate finance (Skala, 2008). In these studies, overconfidence is often described as an extreme excessive self-confidence or managerial personal self-assessment causing excessively optimistic beliefs about one's own judgments, decisions or predictions (e.g. Hayward and Hambrick, 1997; Hiller and Hambrick, 2005; Tang *et al.*, 2015). These inaccurate beliefs about oneself affect various financial decisions, like deciding about entering market (Cain *et al.*, 2015), level of debt (Malmendier *et al.*, 2011; Rihab and Lotfi, 2016), dividend policy (Desmukh *et al.*, 2013), retirement decisions (Gort, 2009) or insurance decisions (Han *et al.*, 2015). Although in recent years, there is an undisputable growth in the interest in these specific topics, the research still remains fragmented and suffers by a relatively low comparability of studies in most of the cases. Therefore, in this meta-analysis, we have decided to focus only on three most commonly investigated financial decisions: trading, investing and innovativeness.

2.2.1 Trading. In the area of financial markets, the research suggests that overconfidence increases trading volume and leads to excessive trading. The importance of overconfidence in explaining excessive trading of individuals was first proposed by De Bondt and Thaler (1995, p. 393), who argued that overconfidence is "the key behavioral factor needed to understand the trading puzzle." The negative effect of overconfidence is that overconfident investors trade more than rational investors, leading them to a lower expected utility (Odean, 1998). According to Daniel *et al.* (1998), overconfident investors overreact to their private information signals and underreact to public information. This leads them to overestimate their own precision of predictions or expectations. Subsequently, this results in an underestimation of risk and higher trading volume (Odean, 1998; Graham *et al.*, 2009). So far, the positive association between overconfidence and trading volume was shown in numerous studies using different methodologies, measurements and proxies for overconfidence (e.g. Odean, 1999; Barber and Odean, 2001; Barber and Odean, 2002; Chen *et al.*, 2007; Grinblatt and Keloharju, 2009; Cueva *et al.*, 2017; Glaser and Weber, 2007; Deaves *et al.*, 2009; Abreu and Mendes, 2012; Zaiane, 2013a; 2013b; Merkle, 2017). According to these studies, we hypothesize that:

H1. There is a positive overall effect of overconfidence on trading volume.

2.2.2 Investing. In addition to individuals' decision-making on financial markets, overconfidence effect was shown to also affect corporate decision-making of entrepreneurs and managers. More specifically, literature often shows that overconfidence accounts for corporate investment distortions by making entrepreneurs and managers invest more and therefore exposing their firms to risk (Glaser *et al.*, 2008; Malmendier and Tate, 2005a, 2005b; 2008). Besides their own abilities, entrepreneurs and managers tend to overestimate the profitability of their firm (Russo and Schoemaker, 1992) as well as possible returns of their investment projects (Malmendier and Tate, 2005a). Moreover, they are more confident of defeating their competitors (Camerer and Lovallo, 1999) and often follow more aggressive corporate policies like investing more and using more debt financing (Ben-David *et al.*, 2007; Ben-David and Graham, 2013). Heaton (2002) proposed a theoretical model, which predicted that the problem of overinvesting by overconfident mangers appears mostly in case of large

internal cash flow of the firm. This is caused by the managers' biased view of their investment opportunities. Overconfident managers overvalue their investment opportunity, but also think that market undervalues their firm; therefore, they see external financing as costly. This leads them to overinvesting when free cash flow is sufficient. This model was empirically supported by several studies (e.g. Lin *et al.*, 2005; Malmendier and Tate, 2005a; Campbell *et al.*, 2011; Huang *et al.*, 2011; Ben Mohamed *et al.*, 2014a, 2014b). Moreover, further empirical evidence from the last decade strongly supports the positive relationship between managerial overconfidence and excessive investment (Wang *et al.*, 2008, 2009; Jiang *et al.*, 2011; Li *et al.*, 2014; Lonjie and Anfeng, 2017; Park and Chung, 2017; Choi *et al.*, 2018; He *et al.*, 2019). Therefore, we hypothesize that:

H2. There is a positive overall effect of overconfidence on investing.

2.2.3 Innovativeness. Going deeper into the investigation of the effect of overconfidence on investing, several studies examined whether overconfident individuals tend to innovate more, that is, invest more into corporate research and development (R&D) activities. In these studies, theorists assume that individuals tend to pursue new innovative projects because they think of themselves as efficacious workers, who are in control (Hayward and Hambrick, 1997) and capable of successfully managing difficult tasks (Griffin and Tversky, 1992). Accomplishing such complex and difficult task can be perceived as an opportunity to use and show their talent and better-than-average abilities (Tang *et al.*, 2015). Additionally, overconfident individuals tend to overestimate not just their abilities, but also their chance for success in business (Cooper *et al.*, 1988), which leads them to pursue new risky business opportunities (Camerer and Lovallo, 1999). As suggested, overconfidence was found to be positively associated with more investing into innovations (Jouber, 2013; Wang *et al.*, 2018). Firms with overconfident CEOs tend to pursue new firm innovations (Galasso and Simcoe, 2011), obtain more patents and patent citations and also achieve greater innovative success for given R&D expenditures (Hirshleifer *et al.*, 2012). However, several studies suggested that the association between overconfidence and innovativeness is not so straightforward, and it is moderated by numerous contextual factors. It was found that this association is greater mostly in more munificent and complex environments (Li and Tang, 2010; Tang *et al.*, 2015), more competitive industries (Galasso and Simcoe, 2011), high-growth firms (Jouber, 2013) or firms with less independent board and dedicated institutional ownership (Wong *et al.*, 2017). In this meta-analysis, we therefore decided to integrate studies conducted within various contexts in order to examine the overall effect of overconfidence on innovativeness. We hypothesize that:

H3. There is a positive overall effect of overconfidence on innovativeness.

2.3 Multiple faces of overconfidence

As stated above, psychological literature defines overconfidence in three constructs, namely, overprecision of one's ability to make accurate probability judgments, overplacement of one's performance or abilities relative to others or overestimation of one's own performance, knowledge and abilities compared to his/her actual performance (Moore and Healy, 2008). These three constructs are based on a direct measure, that is, an experimenter directly asks about individuals' estimates or beliefs about their knowledge, performance or abilities. However, an interdisciplinary aspect in the field of overconfidence brought variability in definitions, operationalizations and measurements of this construct. Researchers from economic disciplines started to omit the direct measurement of overconfidence and instead often searched for various indirect proxies for overconfidence (Michailova, 2010). The most common method for measuring overconfidence of CEOs is observing specific decisions they make on their personal portfolio of company stock options (Malmendier and Tate, 2015). Very

influential studies using indirect measures of overconfidence were proposed by Malmendier and Tate (2005a; 2005b). They used three different measures. First – holding options beyond rational threshold – captured CEO's beliefs on a firm's future performance. Specifically, it examined whether CEOs hold company stocks and options beyond rational thresholds (called Holder 67), thus excessively betting their wealth on future company stock performance. Second measure, called Net Buyer, was defined as a tendency of CEOs to purchase additional stocks of their own company to add to their personal property, despite already high exposure to company risk. Finally, the third measure was based on the perception of outsiders. This approach was based on investigating press portrayals of CEOs using a quantitative content analysis. In this analysis, authors searched for articles in the media referring to CEOs and examined the number of articles containing words such as: "confident, confidence, optimistic, optimism, reliable, cautious, steady, conservative, practical, and frugal." If the CEO was more often described as "confident or optimistic" compared to "reliable, cautious, conservative, practical, frugal, or steady," he was perceived as being overconfident. These three different proxies for overconfidence were widely used in many further studies (e.g. Verberne, 2010; Jouber, 2013; Park and Chung, 2017; Wong et al., 2017; Choi et al., 2018). Besides these three measures, economic research uses many other proxies for overconfidence, like biased earnings forecasts (Longjie and Anfeng, 2017, Hribar and Yang, 2016; Lin et al., 2005; Wang et al., 2016; Huang et al., 2011; Otto, 2014; Jokar and Daneshi, 2018), manager's relative pay (Hayward and Hambrick, 1997), overestimating investment risk (De Long et al., 1991) or index based on several personality or behavioral components, like age, management structure, portfolio performance and portfolio idiosyncratic risk (Adebambo and Yan, 2016).

The designing and using different measures and operationalizations of overconfidence brought several methodological problems in the overconfidence literature. In many studies, overconfidence is investigated using more than one measure (e.g. Hayward and Hambrick, 1997; Glaser and Weber, 2007; Deaves et al., 2009; Jiang et al., 2011; Hirshleifer et al., 2012; Simon and Shrader, 2012; Merkle, 2017), but often there is a lack of distinction in the interpretations of results between the different types of overconfidence, which causes problems in integrating knowledge. Additionally, overconfidence started to be linked and sometimes confused with other similar concepts, such as optimism, illusion of control, self-efficacy and excessive confidence (Lowe and Ziedonis, 2006; Koellinger et al., 2007; Puri and Robinson, 2007; Hackbarth, 2008; Cassar, 2010; Han et al., 2015; Hilary et al., 2016). Some studies used prior findings from multiple constructs to create their own hypotheses (e.g. better-than-average effect, overprecision and unrealistic optimism), but used conceptually different measurement tools or proxies for examining overconfidence, compared to the studies they described (De Paola et al., 2014; Cesarini et al., 2006). A comprehensive analysis of disputable using of overconfidence measures was conducted by Zhang and Cueto (2017). Among other things, they showed that three out of eight analyzed papers conceptualizing overconfidence as overestimation indeed measured overestimation, while four measured overprecision and one measured overplacement. This confusion of different forms of overconfidence causes difficulty in integrating knowledge about particular overconfidence constructs. As Olsson outlined (2014), it is unknown whether all these measurement forms represent the same psychological construct. So far, several studies measured two or more overconfidence constructs at a time (e.g. Glaser et al., 2013; Larrick et al., 2007; Hilton et al., 2011; Fellner; Krügel, 2012; Menkhoff et al., 2013). In fact, the findings of these studies showed different effects of various overconfidence constructs on individual's financial reasoning and decision-making, while the relationship between these constructs ranged from weak positive, non-significant or even negative, suggesting the importance of distinguishing different overconfidence constructs (see Moore and Swift, 2011; Moore and Schatz, 2017). Based on these findings, we decided to investigate and compare the effect of specific types of overconfidence on financial decision-making. To the best of our knowledge, to date, there has

not been any attempt to systematically compare the effect of different overconfidence constructs or overconfidence measuring methods on financial decision-making, making it hard to formulate any hypothesis. Therefore, we formulate the following research questions:

RQ1. How do different overconfidence constructs affect trading, investing and innovativeness?

RQ2. How do different overconfidence measuring methods affect trading, investing and innovativeness?

3. Materials and methods

3.1 Literature search

We carried out extensive literature search to identify relevant articles on the effect of overconfidence on financial decision-making by using the following strategies. First, we searched electronic databases including *Scopus, ScienceDirect, Web of Science, EBSCOhost* and *ProQuest*. For this purpose, the following keywords were used: for overconfidence – *underconfidence, self-confidence, overconfidence, overconfident, miscalibration, optimism, underconfident, better-than-average effect, positive illusion, overplacement, overestimation* and *self-attribution*; for financial decision-making – *invest, investment, trade, trading, purchase, sell, finance, financing, earning, earn, financial decision, cash flow sensitivity* and *profit*; for venture – *start-up, entrepreneur, business owner, small business, small firm* and *venture*. Since Sciencedirect database allows using only eight Boolean connectors, we used the following keywords: *overconfidence, miscalibration, optimism, overprecision, overplacement, overestimation, invest, trade* and *finance*. Second, we manually searched journals relating to the scope of this study, namely, *Journal of Finance, Entrepreneurship Theory and Practice, Journal of Business Venturing, Journal of Behavioral and Experimental Finance, Small Business economics, Journal of Small Business Management, Journal of Corporate Finance, Journal of Behavioral Finance, Journal of Economic Perspectives, Journal of Economic Psychology*. Third, we used Google Scholar to manually search for relevant studies not included in the databases and journals listed above. In order to avoid publication bias, we used Google Scholar to search for unpublished studies, theses, dissertations and reports. Finally, using e-mail and ResearchGate web page, we contacted all the authors whose studies were not available, asking for a copy of their study or the data.

3.2 Selection and exclusion criteria

Our search resulted in 3,594 studies. We defined a set of inclusion criteria to filter these studies. First, studies had to be both empirical and quantitative. Therefore, we excluded qualitative studies, theoretical studies, case studies and financial reports. Second, we excluded studies which did not include indicators of both overconfidence and financial decision-making. Third, we excluded studies which did not report the data required for performing a correlation meta-analysis, that is, did not provide at least one correlation coefficient, simple linear regression model or multiple regression model. Following these criteria, we reached a total number of 83 effect sizes from 34 studies. A description of all the studies involved in the meta-analysis can be seen in Table 1.

3.3 Variable coding

We coded all the variables that may relate to the variation in the results of the meta-analysis. Table 2 shows the operationalizations, coding and frequencies of overconfidence and financial decision-making included in all studies. As it was suggested in the theoretical background, authors have used a variety of overconfidence measures. We categorized them

Authors (year)	Type of FDM	Type of overconfidence	Country of origin	Published paper
Abreu and Mendes (2012)	trading	overestimation	Portugal	no
Aziz *et al.* (2016)	trading	overestimation	Egypt	yes
Ben-David *et al.* (2007)	I&E	overprecision	USA	no
Ben-David and Graham (2013)	I&E	overprecision	USA	no
Bias *et al.* (2005)	trading	overprecision	France, UK	yes
Cueva *et al.* (2017)	trading	overplacement	Spain	no
Deaves *et al.* (2009)	trading	overprecision, overplacement, char. proxy	Canada, Germany	yes
Glaser and Weber (2007)	I&E, trading	overprecision, overplacement	Germany	yes
Grinblatt and Keloharju (2009)	I&E, trading	overplacement	Finland	yes
Haarmans (n.d.)	R&D	beh. proxy	International	no
He *et al.* (2019)s	I&E	overestimation	China	yes
Hirshleifer *et al.* (2012)	R&D	char. proxy, beh. proxy	International	yes
Cheley-Steeley *et al.* (2009)	trading	char. proxy	UK	no
Chen (2019)	R&D	overestimation	China	yes
Choi *et al.* (2018)	I&E	beh. proxy	USA	yes
Jiang *et al.* (2011)	I&E	overestimation, char. proxy	China	yes
Jouber (2013)	R&D	beh. proxy	USA	yes
Kangarlouei *et al.* (2013)	I&E	overestimation	Iran	yes
Kim *et al.* (2018)	R&D	char. proxy	USA	yes
Longjie and Anfeng (2017)	I&E	overestimation	China	yes
Malmendier and Tate (2005a)	I&E	beh. proxy	USA	no
Merkle (2017)	trading	overestimation, overprecision, overplacement	UK	yes
Michailova (2010)	trading	overprecision	Germany	no
Moez and Amina (2018)	I&E	char. proxy	USA	yes
Park *et al.* (2010)	trading	overprecision	South Korea	no
Park and Chung (2017)	I&E	beh. proxy	USA	yes
Verberne (2010)	I&E	beha. proxy	Netherlands	no
Wang *et al.* (2009)	I&E	overestimation	China	yes
Wang *et al.* (2016)	I&E	overestimation	China	yes
Wang *et al.* (2018)	R&D	overestimation	China	yes
Wong *et al.* (2017)	R&D	beh. proxy	USA	yes
Yang and Zhu (2016)	trading	overprecision, overplacement	China	yes
Yeoh and Wood (2011)	trading	overprecision, overplacement, char. proxy	UK	no
Zavertiaeva *et al.* (2018)	R&D	char. proxy	International	yes

Note(s): FDM – financial decision-making, I&E – investment and expenditures, R&D – research & development, char. proxy – characteristic proxy, beh. proxy – behavioral proxy, n.d. – not dated

into five different categories. First three categories refer to three basic operationalizations used in cognitive research, namely, overprecision, overestimation and overplacement (see Olsson, 2014). Fourth overconfidence category groups all proxy measures based on an

individual's actual behavior or decisions. This includes placing less weight on new info, Holder 67, Longholder and Net Buyer. Finally, fifth overconfidence category groups proxies based on an individual's characteristics. This category includes age, tenure, individual's press portrays, CEO's relative salary, CEO's decision-making power and illusion of control. As with overconfidence, financial decision-making was operationalized in various ways. We divided them into three categories as trading, investing (I&E – investments and expenditures) and innovativeness (R&D – Research and Development). The frequencies of these categories are listed in Table 2. Finally, we coded the publication status of primary studies (published vs. unpublished).

3.4 Effect sizes used

For investigating the relationship between overconfidence and financial decision-making, we used two indices. The unbiased Pearson product-moment correlation coefficient (r) was used when bivariate correlations were reported in primary studies (16 studies). For studies reporting only multiple regression models (18 studies), we computed the semipartial correlation coefficients rsp (see Aloe, 2009; Aloe and Becker, 2012; Aloe and Thompson, 2013). The semipartial correlation coefficient is perceived as a reasonable substitution for bivariate correlation coefficient and can be computed when multiple predictors are included in a primary study (Aloe and Thompson, 2013). The rsp index can be computed as:

$$rsp = tf\sqrt{1 - RY2}\sqrt{(n - p - 1)} \tag{1}$$

where tf is the value of the t-test of the regression coefficient, RY2 is the squared multiple correlation for the full model, n is the sample size and p is the number of predictors in the model. After computing rsp indices for all primary studies including multiple regression models, we merged these studies with those reporting r coefficients into one data set and conducted a meta-analysis based on a correlational data (see Hunter and Schmidt, 2004).

3.5 Meta-analytic procedures

3.5.1 Primary analysis. We conducted a "bare bones" type of psychometric meta-analysis proposed by Hunter and Schmidt (2004) to estimate the mean of a distribution of effects from primary studies. Since all measures of independent variable and a vast majority of measures of dependent variable of primary studies were objectively measured (i.e. the reliability was 1.00), we did not correct for measurement errors. We decided to correct only for a sampling error and therefore computed the sample-size-weighted mean observed correlation r to

Overconfidence	
Operationalization	Frequency
Overestimation	14
Overprecision	28
Overplacement	17
Behavioral proxies	12
Characteristic proxies	12
Financial decision-making	
Operationalization	Frequency
Trading	45
Investing	27
Innovativeness	8

Table 2.
Overconfidence and financial decision-making operationalizations and their frequencies

determine the main effect of overconfidence on financial decision-making. In order to test whether the main effect was significant, we calculated the 95% confidence interval for the effect size (Whitener, 1990). The main effect was considered to be significant if the confidence interval did not include zero.

3.5.2 Moderation analysis. We tested for the effect of three categorical moderators of the relationship between overconfidence and financial decision-making, namely, the type of overconfidence construct, the type of overconfidence measuring method and the type of financial decision-making. To test moderator hypotheses, we first investigated homogeneity of the observed effects. We calculated 80% credibility intervals to investigate the presence of moderators. Effects were considered homogeneous if the credibility interval did not include zero (see Whitener, 1990). When effect sizes showed to be heterogeneous, we examined whether the differences in moderator categories were significant using the subgroup analysis. The principle of this testing is very similar to analysis of variance (ANOVA). We calculated the *Q*-statistics, which is analogous to the main effect in analysis of variance test, and it indicates whether the categorical moderator explains the heterogeneity of correlations between all groups (Lipsey and Wilson, 2001). In order to examine the differences in effect sizes of specific pair of moderator groups in cases where the moderator includes more than two groups (type of overconfidence and type of financial decision-making), we calculated *z*-statistics which is analogous to *t*-test.

3.5.3 Publication bias analysis. To check for publication bias, we used a file drawer analysis (Rosenthal, 1979). We calculated the number of studies required to nullify the observed effect, that is, the Fail-Safe *N*. As a criterion for the presence of publication bias, we chose the $5k + 10$ rule (Hedges and Olkin, 1985). If the Fail-Safe *N* is smaller than the 5 times the number of samples plus 10, it could indicate that publication bias probably impacted the results. We also performed Begg and Mazumdar's (1994) rank correlation test for funnel plot asymmetry. As a supplementary analysis of publication bias, we performed a *Q*-statistics to examine the difference between the effect sizes of published ($n = 22$) and unpublished studies ($n = 11$).

4. Results
4.1 Primary analysis
The results for primary analysis based on 34 studies and 83 effect sizes are shown in Table 3. The Hypothesis 1 regarding the effect of overconfidence on financial decision-making was supported. The overall effect size of overconfidence on financial decision-making was shown to be positive $r = 0.045$, while the 95% confidence ranged from 0.028 to 0.061, hence did not include zero, indicating that the overall effect was significant.

4.2 Moderation analysis
For deeper investigation of the effect of overconfidence on financial decision-making, we searched for boundary conditions of this effect using moderation analyses. In the first step, we analyzed 80% credibility intervals of all study effects to assess the degree of heterogeneity. The heterogeneity of the main effect was shown to be significant ($Q = 795.4$; df = 80; $p < 0.001$; I2 = 89.94), and its credibility interval was wide and included zero (80% CRI = -0.036–0.126), suggesting potential moderators in this distribution. Therefore, in the second step, we analyzed the potential moderation impact of three categorical moderators using *Q*-statistics (see Table 3). We found that the relationship between overconfidence and financial decision-making was moderated by the overconfidence measure method (direct vs. indirect) and the type of financial decision-making. Credibility intervals of both overconfidence measure method and type of financial decision-making included zero, which indicated that potential further moderators might exist in these distributions. We did not find a significant moderation effect of publication status on the relationship between overconfidence and financial decision-making (see Table 3).

Variable	K	r	95% CI	Var.	80% CRI	Fail safe N (>5k + 10)	Q
Overall effect							
Fixed	81	0.037	0.033–0.042	0.004	−0.036–0.126	6,954 (yes)	–
Random	81	0.045	0.028–0.061				
Type of overconfidence measuring method							
Direct	57	0.020	0.014–0.027	0.002	−0.037–0.077	693 (yes)	4.444*
Indirect	24	0.052	0.046–0.058	0.005	−0.039–0.143	1,552 (yes)	
Type of overconfidence construct							
Overestimation	14	0.015	0.005–0.024	0.003	−0.055–0.085	89 (yes)	4.476
Overprecision	26	0.010	−0.004–0.024	0.004	−0.070–0.090	0 (no)	
Overplacement	17	0.033	0.022–0.043	0.001	−0.007–0.073	141 (yes)	
Char. proxy	12	0.091	0.078–0.104	0.019	−0.085–0.267	374 (yes)	
Beh. proxy	12	0.042	0.035–0.048	0.001	0.002–0.082	390 (yes)	
Type of financial decision-making							
Trading	45	0.022	0.013–0.031	0.002	−0.035–0.079	64 (no)	12.822**
Investing	27	0.051	0.045–0.056	0.004	−0.030–0.132	2,321 (yes)	
Innovativeness	9	0.014	0.004–0.024	0.003	−0.056–0.084	59 (yes)	
Publication status							
Published	58	0.035	0.031–0.040	0.004	−0.046–0.116	3,051 (yes)	0.574
Unpublished	23	0.055	0.041–0.069	0.003	−0.015–0.125	105 (no)	

Note(s): K – number of effect sizes; r – sample-size-weighted mean observed correlation, 95% CI – 95% confidence interval, Var. – variance in correlations, 80% CRI – 80% credibility intervals, Q – statistic based on the test for significance of difference in correlations between groups, Char. proxy – characteristic proxy, Beh. proxy – behavioral proxy, Direct – overestimation + overprecision + overplacement, Indirect – characteristic proxy + behavioral proxy

Table 3.
Results of meta-analysis of the relationship between overconfidence and financial decision-making

For both significant moderators, we additionally performed z-tests to examine differences in the observed effect sizes between specific pairs of moderation groups (see Table 4). For the type of overconfidence construct moderator, it was found that the characteristic proxy had the highest effect size on financial decision-making, followed by behavioral proxy, overplacement and overestimation. The confidence interval of the effect size of

Groups comparison	z-value	p-value
Type of overconfidence		
Behavioral proxy – Characteristic proxy	0.131	0.717
Behavioral proxy - Overestimation	0.313	0.576
Behavioral proxy - Overplacement	0.087	0.768
Behavioral proxy - Overprecision	3.958	0.047
Characteristic proxy - Overestimation	0.336	0.562
Characteristic proxy - Overplacement	0.213	0.645
Characteristic proxy - Overprecision	1.361	0.243
Overestimation - Overplacement	0.093	0.761
Overestimation - Overprecision	1.397	0.237
Type of financial decision-making		
Investing - Trading	12.575	<0.001
Investing – Innovativeness	1.251	0.263
Trading – Innovativeness	2.016	0.156

Table 4.
The comparison of effect sizes between specific pairs of moderation group

overprecision included zero; therefore, this effect was non-significant. For the type of financial decision-making moderator, the overconfidence had the highest effect for investment and expenditures, followed by trading and research and development (Table 4).

4.3 Publication bias analysis
File drawer analysis of the overall effect size indicated that it would require us to include another $K = 6,954$ studies with zero effects to make the found overall effect insignificant. Considering the $5k + 10$ rule requirement for the overall effect ($5*81 + 10 = 415$), these results suggested the absence of publication bias. When investigating the possible publication bias in moderation results, we found that 3 out of 13 distributions fail to satisfy the $5k + 10$ rule (see Table 3, column 7 for those distributions with "no" statement). This indicates that one should be cautious when interpreting these effect sizes. Begg and Mazumdar's test for rank correlation ($\tau = 0.076$; $p = 0.316$) indicated no evidence of publication bias. Finally, the supplementary Q-statistics analysis of the comparison of effects of published and unpublished studies showed no significant differences (see Table 3), suggesting that publication status had no effect on the study results.

5. Discussion and conclusions
For the last couple decades, behavioral economists have been extensively examining the impact of overconfidence on various specific decisions in the context of financial markets and corporate finance. In a current literature, overconfidence is often described as one of the most robust and significant predictors of individual's financial decisions (DeBondt and Thaler, 1995; Camerer, 1997). In this meta-analysis, we combine results of 34 studies in order to estimate the overall effect of overconfidence on three specific financial decisions, namely, trading, investing and innovativeness. The results show that there is an overall positive and significant relationship between overconfidence and financial decision-making. Therefore, our study is in line with the long-standing notion that overconfidence significantly shapes individuals' financial decisions. However, the result on the strength of this relationship suggests that the effect of overconfidence on financial decision-making is far from being strong and convincing. On the contrary, our findings suggest that this effect is very low and dependent on what specific type of financial decision is being considered. Another important finding is that the relationship between overconfidence and financial decision-making was demonstrated to be moderated by the type of overconfidence measuring method. Indirect measures had stronger effect on financial decision-making than original direct measures. Without indirect measures included in the analyses, the effect of overconfidence on trading or innovativeness would be even lower. These results brought several implications. In the next sections, we discuss our findings in detail and in accordance to how they contribute to overconfidence theory and future research as well as practice.

5.1 Implications for theory and future research
Our study contributes to overconfidence literature in several ways. First, our findings extend the current literature on positive illusions by examining the effect of specific illusion of overconfidence on specific domain of financial decision-making. To the best of our knowledge, there has not been any attempt to meta-analytically integrate results concerning the relationship between overconfidence and financial decision-making. Although overconfidence is often described as a keystone for understanding financial decision-making (De Bondt and Thaler, 1995), our results suggest that it has rather limited effect on individuals' financial decisions – lower than other specific areas of decision-making, such as clinical decision-making (Miller *et al.*, 2015). When considering our results on the overall effect

of overconfidence on financial decision-making, a possible question arises as to whether current literature does not overvalue this effect (Yeoh and Wood, 2011). Moreover, this question seems to be more relevant when we consider our further findings. We found that original direct measures of overconfidence (overestimation, overprecision and overplacement) had significantly lower effect on financial decision-making than indirect measures. This may suggest that indirect measures increase the overall effect and may cause the overvaluation of overconfidence in literature. This could be particularly problematic because there are some suggestions that indirect measures may not measure overconfidence properly (Urbig et al., 2009; Michailova, 2010; Yeoh and Wood, 2011). As Yeoh and Wood (2011) or Merkle (2017) state, indirect overconfidence proxies may show stronger associations with various financial decisions because they often involve other causal factors, like risk propensity, which are positively associated with one's actual overconfidence and as a result they confoundingly strengthen the relationship between the proxy used and financial decision-making. A relatively recent research supports these interpretations, showing that an individual's risk perception is indeed an important factor mediating the relationship between overconfidence and financial decision-making (Kraft et al., 2017; Zaiane and Moussa, 2018).

Second, our findings contribute to the discussion about the effect of different types of overconfidence on decision-making (Olsson, 2014). So far, primary studies on financial decision-making brought inconclusive findings. A number of them showed that different types of overconfidence affect various financial decisions differently (e.g. Glaser et al., 2013; Larrick et al., 2007; Hilton et al., 2011; Fellner and Krügel, 2012; Menkhoff et al., 2013). However, besides these studies, there were other findings showing no differences between different types of overconfidence (Merkle, 2017) or providing mixed results (Yeoh and Wood, 2011). In this sense, this meta-analysis could provide first conclusive results on the effect of different types of overconfidence on financial decision-making. Overall, our findings highlight the importance of distinguishing between different types of overconfidence constructs, because they may indeed have different effect on financial decision-making. We found that original direct measures of overconfidence (overestimation, overprecision and overplacement) had significantly lower effect on financial decision-making than indirect measures. Moreover, proxies based on individual's characteristics showed an effect more than twice as strong as proxies based on individual's behavior. These findings could be explained by our previous thoughts that these proxies may involve other important factors, like risk propensity, which positively interact with overconfidence and also have similar effect on financial decision-making. Considering this confounding support of indirect proxies (Yeoh and Wood, 2011; Merkle, 2017), it seems not surprising that these measures showed greater effect on financial decision-making than direct measures.

When comparing effects of direct measures, overplacement was shown to have the strongest effect. This pattern was demonstrated in several primary studies. For instance, in studies of Deaves et al. (2009) and Yang and Zhu (2016), overplacement had a stronger effect on trading activity (and trading volume, respectively) than did overprecision and illusion of control. Similarly, Glaser and Weber (2007) reported overplacement having a stronger effect on stock transactions, stock purchase and turnover than overprecision. Dorn and Huberman (2005) reported a positive effect of overplacement on portfolio turnover, while the biased self-attribution and illusion of control had no effect. These studies are in line with our findings that, among direct measures, overplacement was shown to have the strongest impact on financial decision-making. Moreover, when examining the impact of other two direct overconfidence types, overestimation showed trivial effect, while overprecision showed insignificant effect on financial decision-making. These findings suggest that rather than overconfidence based on estimation of one's own performance (overestimation) or probabilities of future events (oveprecision), overestimating one's own abilities compared to others seems to have the strongest effect on whether one tends to invest, trade or innovate. Although overconfidence is

a widely studied phenomenon, the literature still does not provide sufficient explanations on what cognitive and psychological mechanisms generate overconfident judgments (Burks *et al.*, 2013). Moreover, causes and consequences of overconfidence differ across different types of overconfidence (Moore and Schatz, 2017). This results in a limited knowledge that could explain why the overprecision did not significantly affect financial decision-making. One possible explanation could be that overprecision shows a great task and domain dependence, that is, compared to other types of overconfidence, overprecision is not perceived as a stable individual trait (Erev *et al.*, 1994). Rather than that, whether overprecision occurs fairly depends on what, how and whom an experimenter asks (Klayman *et al.*, 1999). Perhaps the most relevant finding of this research stream is that overprecision was mostly observed in studies using very hard and randomly selected items, while representative item selection showed to decrease or even completely eliminate overconfidence (e.g. Gigerenzer *et al.*, 1991; Juslin *et al.*, 2000). In other words, asking individuals about the knowledge in their field (e.g. asking investors to predict future returns or entrepreneurs to provide the confidence interval of their possible success) results in less overconfidence than asking them about areas and domains in which they are not experts. Given the fact that overprecision is not a stable trait and its level might be low in individuals experienced in financial decision-making, it is not surprising that it did not significantly affect financial decision-making in our study. The same pattern was observed in the study of Glaser and Weber (2007) who found that overprecision did not increase trading volume. Our results support and extend these findings, suggesting that the effect of overprecision is questionable not only in trading itself but also in more general area of financial decision making involving trading, investing and innovating.

Third, our findings contribute to the discussion on methodological issues regarding overconfidence. The results suggest the importance of further searching for proper measuring methods and, most importantly, investigating whether all overconfidence methods used really measure the same variable (Olsson, 2014). The current literature uses dozens of variations of overconfidence measures. Some recent studies even use various trading or investing variables as a proxy for overconfidence (e.g. Chuang and Lee, 2006; Hwang *et al.*, 2014; Khajavi and Dehghani, 2016; Liu *et al.*, 2016; Zia *et al.*, 2017; Gupta *et al.*, 2018). One specific study of Murhadi (2018) used managers' profile photos to assess their overconfidence. Unfortunately, such measures are methodologically distant from the original direct measures based on investigating one's actual reasoning (Michailova, 2010). As Merkle (2017) suggested, some of the widely used overconfidence proxies may be used as proxies for other variables, like risk aversion. This causes complications in integrating knowledge (Zhang and Cueto, 2017). Our results extend the current findings and support the need to further address these methodological issues. The differences in effects of specific types of overconfidence constructs on financial decision-making suggest that various overconfidence measures may not measure one common construct. As a result, authors should be very careful when choosing their overconfidence measures and proxies, and they should carefully distinguish different overconfidence constructs when formulating hypotheses and research questions. We strongly encourage researchers to use direct overconfidence measures together with indirect proxies in order to identify their relationships and determine which indirect methods show similar effects with particular overconfidence construct.

5.2 Implications for practice

Besides theory and future research, our findings could provide some implications for practice. These concern mostly entrepreneurs employing managers or individuals hiring financial advisors to make decisions about their finances. Overall, our findings suggest that the effect of overconfidence on financial decision-making is limited. However, one should at least be cautious when manager or financial advisor is evidently overrating his or her own abilities,

compared to other individuals, and there are also some characteristics that are very commonly investigated as proxies for overconfidence, such as being male, young-aged or single. Especially financial advisors, who rate themselves as better than others, often show very poor performance (even compared to lay people) in financial analyzing or predicting future prices (e.g. Staël von Holstein, 1972; Glaser *et al.*, 2013; Menkhoff *et al.*, 2013; Grežo, 2017). In such a case, using financial advices and services of overconfident individuals could potentially lead to suboptimal decisions and financial losses.

5.3 Study limitations

Our study has some limitations. First, given that overconfidence is a robust predictor of financial decision-making (DeBondt and Thaler, 1995), one might be curious why there were only 34 studies included in the meta-analysis. In fact, we were able to identify more than 200 studies including relevant empirical data on the relationship between overconfidence and financial decision-making. Unfortunately, despite the great number of available studies, most of them do not report correlation coefficient between observed variables. A vast majority of these studies use multiple regression analyses, and, what is important, they do not provide specific statistics necessary for computing semipartial correlation coefficients. In order to avoid these problems, we strongly encourage authors to provide bivariate correlation coefficients between study variables, regardless of the study design. For studies reporting only multiple regression models, we encourage reporting the value of the *t*-test of the regression coefficient, the squared multiple correlation for the full model and the sample size. This will allow other authors to include these primary studies in new meta-analyses.

The second limitation of this study is connected with the first one. In this meta-analysis, we were able to include only three types of financial decisions. Our first intention was to include also widely researched merger and acquisition decision-making. However, since majority of studies used multiple regression models without providing necessary statistics for computing semipartial correlation coefficients (only one study of Ben-David *et al.*, 2007 provided the necessary statistics), we had to remove merger and acquisition key words from our searching and conduct repeated literature search. In addition to merger and acquisition, there are a number of financial decisions that have been shown to have unclear relationship with overconfidence, including investment risk-taking (Adam *et al.*, 2015; Hirshleifer *et al.*, 2012), insurance decision (Han *et al.*, 2015), debt level decisions (Rihab and Lotfi, 2016) or dividend policy (Desmukh *et al.*, 2013). However, more primary research is needed to make it possible to integrate results from these areas in order to investigate the overall effect of overconfidence.

Note

1. References marked with an asterisk indicate studies included in the meta-analysis.

References [1]

*Abreu, M. and Mendes, V. (2012), "Information, overconfidence and trading: do the sources of information matter?", *Journal of Economic Psychology*, Vol. 33 No. 4, pp. 868-881.

Adam, T.R., Fernando, C.S. and Golubeva, E. (2015), "Managerial overconfidence and corporate risk management", *Journal of Banking and Finance*, Vol. 60, pp. 195-208.

Adebambo, B.N. and Yan, X.S. (2016), "Momentum, reversals, and fund manager overconfidence", *Financial Management*, Vol. 45 No. 3, pp. 609-639.

Alicke, M.D. (1985), "Global self-evaluation as determined by the desirability and controllability of trait adjectives", *Journal of Personality and Social Psychology*, Vol. 49 No. 6, pp. 1621-1630.

Aloe, A.M. and Becker, B.J. (2009), "Teacher verbal ability and school outcomes: where is the evidence? ", *Educational Researcher*, Vol. 38 No. 8, pp. 612-624.

Aloe, A.M. and Becker, B.J. (2012), "An effect size for regression predictors in meta-analysis", *Journal of Educational and Behavioral Statistics*, Vol. 37 No. 2, pp. 278-297.

Aloe, A.M. and Thompson, C.G. (2013), "The synthesis of partial effect sizes", *Journal of the Society for Social Work and Research*, Vol. 4 No. 4, pp. 390-405.

*Aziz, W.M.A., Ismail, E.A. and El-Hennawi, M.S. (2016), "Overconfidence, trading frequency, and portfolio size in the Egyptian stock market", *Journal of Business Management*, Vol. 2 No. 6, pp. 21-37.

Barber, B. and Odean, T. (2001), "Boys will be boys: gender, overconfidence, and common stock investment", *The Quarterly Journal of Economics*, Vol. 116 No. 1, pp. 261-292.

Barber, B. and Odean, T. (2002), "On line investors: do the slow die first?", *The Review of Financial Studies*, Vol. 15 No. 2, pp. 455-487.

Begg, C.B. and Mazumdar, M. (1994), "Operating characteristics of a rank correlation test for publication bias", *Biometrics*, Vol. 50 No. 4, pp. 1088-1101.

*Ben-David, I., Graham, J.R. and Harvey, C.R. (2007), "Managerial overconfidence and corporate policies", NBER Working Paper No. 13711.

*Ben-David, I. and Graham, J.R. (2013), "Managerial miscalibration", *The Quarterly Journal of Economics*, Vol. 128 No. 4, pp. 1547-1584.

Ben Mohamed, E., Fairchild, R. and Bouri, A. (2014a), "Investment cash flow sensitivity under managerial optimism: new evidence from NYSE panel data firms", *Journal of Economics, Finance and Administrative Sciences*, Vol. 19 No. 36, pp. 11-18.

Ben Mohamed, E., Souissi, M.N., Baccar, A. and Bouri, A. (2014b), "CEO's personal characteristics, ownership and investment cash flow sensitivity: evidence from NYSE panel data firms", *Journal of Economics, Finance and Administrative Science*, Vol. 19 No. 37, pp. 98-103.

Benoît, J.P. and Dubra, J. (2011), "Apparent overconfidence", *Econometrica*, Vol. 79 No. 5, pp. 1591-1625.

*Biais, B., Hilton, D., Mazurier, K. and Pouget, S. (2005), "Judgemental overconfidence, self-monitoring, and trading performance in an experimental financial market", *The Review of Economic Studies*, Vol. 72 No. 2, pp. 287-312.

Blake, C. (2009), *The Art of Decisions: How to Manage in an Uncertain World*, FT Prentice Hall, Harlow.

Blanton, H., Pelham, B.W., DeHart, T. and Carvallo, M. (2001), "Overconfidence as dissonance reduction", *Journal of Experimental Social Psychology*, Vol. 37 No. 5, pp. 373-385.

Brown, J.D. (1986), "Evaluations of self and others: self-enhancement biases in social judgments", *Social Cognition*, Vol. 4 No. 4, pp. 353-376.

Burks, S.V., Carpenter, J.P., Goette, L. and Rustichini, A. (2013), "Overconfidence and social signalling", *The Review of Economic Studies*, Vol. 80 No. 3, pp. 949-983.

Cain, D.M., Moore, D.A. and Haran, U. (2015), "Making sense of overconfidence in market entry", *Strategic Management Journal*, Vol. 36 No. 1, pp. 1-18.

Camerer, C. (1997), "Progress in behavioral game theory", *Journal of Economic Perspectives*, Vol. 11 No. 4, pp. 167-188.

Camerer, C. and Lovallo, D. (1999), "Overconfidence and excess entry: an experimental approach", *American Economic Review*, Vol. 89 No. 1, pp. 306-318.

Campbell, C., Gallmeyer, M., Johnson, S., Rutherford, J. and Stanley, B. (2011), "CEO optimism and forced turnover", *Journal of Finance and Economics*, Vol. 101 No. 3, pp. 695-712.

Cassar, G. (2010), "Are individuals entering self-employment overly optimistic? An empirical test of plans and projections on nascent entrepreneur expectations", *Strategic Management Journal*, Vol. 31 No. 8, pp. 822-840.

Cesarini, D., Sandewall, Ö. and Johannesson, M. (2006), "Confidence interval estimation tasks and the economics of overconfidence", *Journal of Economic Behavior and Organization*, Vol. 61 No. 3, pp. 453-470.

Chen, G., Kim, K., Nofsinger, J. and Rui, O. (2007), "Trading performance, disposition effect, overconfidence, representativeness bias, and experience of emerging market investors", *Journal of Behavioral Decision Making*, Vol. 20, pp. 425-451.

*Chelley-Steeley, P., Kluger, B. and Steeley, J. (2009), *Overconfidence, Hindsight Bias and Trading Activity in an Experimental Asset Market*, Unpublished manuscript, Aston Business School, Birmingham.

*Chen, S. (2019), "Weakening effect of executive overconfidence on equity incentive —the empirical evidence from Chinese listed companies", *Open Journal of Business and Management*, Vol. 7 No. 1, pp. 151-166.

*Choi, P.M.S., Chung, C.Y. and Liu, C. (2018), "Self-attribution of overconfident CEOs and asymmetric investment-cash flow sensitivity", *North American Journal of Economics and Finance*, Vol. 46, pp. 1-14.

Chuang, W. and Lee, B. (2006), "An empirical evaluation of the overconfidence hypothesis", *Journal of Banking and Finance*, Vol. 30 No. 9, pp. 2489-2515.

*Cueva, C., Iturbe-Ormaetxe, I., Ponti, G. and Tomás, J. (2017), *Gender Differences in Trading Volume: Not Just Overconfidence*, Unpublished Manuscript, Universidad de Alicante, Alicante.

Collard, J.J., Cummins, R.A. and Fuller-Tyskiewicz, M. (2016), "Measurement of positive irrational beliefs (positive cognitive illusions)", *Journal of Happiness Studies*, Vol. 17 No. 3, pp. 1069-1088.

Cooper, A.C., Woo, C.Y. and Dunkelberg, W.C. (1988), "Entrepreneurs' perceived chances for success", *Journal of Business Venturing*, Vol. 3 No. 2, pp. 97-108.

De Long, J.B., Shleifer, A., Summers, L.H. and Waldmann, R.J. (1991), "The survival of noise traders in financial markets", *Journal of Business*, Vol. 64 No. 1, pp. 1-19.

De Paola, M., Gioia, F. and Scoppa, V. (2014), "Overconfidence, omens and gender heterogeneity: results from a field experiment", *Journal of Economic Psychology*, Vol. 45, pp. 237-252.

Daniel, K. and Hirshleifer, D. (2015), "Overconfident investors, predictable returns, and excessive trading", *The Journal of Economic Perspectives*, Vol. 29 No. 4, pp. 61-88.

Daniel, K., Hirshleifer, D. and Subrahmanyam, A. (2015), "Investor psychology and security market under- and overreactions", *The Journal of Finance*, Vol. 53 No. 6, pp. 1839-1885.

Deaves, R., Lüders, E. and Luo, G.Y. (2009), "An experimental test of the impact of overconfidence and gender on trading activity", *Review of Finance*, Vol. 13 No. 3, pp. 555-575.

DeBondt, W.F.M. and Thaler, R.H. (1995), "Financial decision making in markets and firms: a behavioral perspective", in Jarrow, R., Maksimovic, V. and Ziemba, W.T. (Eds), *Finance, Handbooks in Operations Research and Management Science*, North Holland, Amsterdam, pp. 385-410.

Desmukh, S., Goel, A.M. and Howe, K.M. (2013), "CEO overconfidence and dividend policy", *Journal of Financial Intermediation*, Vol. 22 No. 3, pp. 440-463.

Dorn, D. and Huberman, G. (2005), "Talk and action: what individual investors say and what they do", *Review of Finance*, Vol. 9 No. 4, pp. 437-481.

Erev, I., Wallsten, T.S. and Budescu, D.V. (1994), "Simultaneous over- and underconfidence: the role of error in judgment processes", *Psychological Review*, Vol. 101 No. 3, pp. 519-528.

Fellner, G. and Krügel, S. (2012), "Judgmental overconfidence: three measures, one bias?", *Journal of Economic Psychology*, Vol. 33 No. 1, pp. 142-154.

Festinger, L. (1954), "A theory of social comparison processes", *Human Relations*, Vol. 7 No. 2, pp. 117-140.

Fiske, S.T. and Taylor, S.E. (1984), *Social Cognition*, Random House, New York, NY.

Flanagan, O. (2009), "'Can do' attitudes: some positive illusions are not misbeliefs", *Behavioral and Brain Sciences*, Vol. 32 No. 6, pp. 519-520.

Galasso, A. and Simcoe, T.S. (2011), "CEO overconfidence and innovation", *Management Science*, Vol. 57 No. 8, pp. 1469-1484.

Gigerenzer, G., Hoffrage, U. and Kleinbölting, H. (1991), "Probabilistic mental models: a brunswikian theory of confidence", *Psychological Review*, Vol. 98 No. 4, pp. 506-528.

Glaser, M. and Weber, M. (2007), "Overconfidence and trading volume", *Geneva Risk Insurance Review*, Vol. 32 No. 1, pp. 1-36.

Glaser, M., Schäfers, P. and Weber, M. (2008), "Managerial optimism and corporate investment: is the CEO alone responsible for the relation?", Working Paper, University of Mannheim, Mannheim.

Glaser, M., Langer, T. and Weber, M. (2013), "True overconfidence in interval estimates: evidence based on a new measure of miscalibration", *Journal of Behavioral Decision Making*, Vol. 26 No. 5, pp. 405-417.

Gort, C. (2009), "Overconfidence and active management: an empirical study across Swiss pension plans", *Journal of Behavioral Finance*, Vol. 10 No. 2, pp. 69-80.

Graham, J.R., Huang, H. and Harvey, C. (2009), "Investor competence, trading frequency, and home bias", *Management Science*, Vol. 55 No. 7, pp. 1094-1106.

Grežo, M. (2017), "We expect stocks to rise, but we do not know when and which ones: excessive optimism in predicting future stock indices returns", *Studia Psychologica*, Vol. 59 No. 2, pp. 113-126.

Griffin, D. and Tversky, A. (1992), "The weighing of evidence and the determinants of confidence", *Cognitive Psychology*, Vol. 24 No. 3, pp. 411-435.

Grinblatt, M. and Keloharju, M. (2009), "Sensation seeking, overconfidence, and trading activity", *The Journal of Finance*, Vol. 64 No. 2, pp. 549-578.

Gupta, S., Goyal, V., Kalakbandi, V.K. and Basu, S. (2018), "Overconfidence, trading volume and liquidity effect in Asia's Giants: evidence from pre-, during- and post-global recession", *Decision*, Vol. 45 No. 3, pp. 235-257.

*Haarmans, L. (n.d.), *CEO Overconfidence, Power, and Innovation*, Arno Academic Publications Online, Tilburg University, Tilburg, available at: https://arno.uvt.nl/show.cgi?fid=144087.

Hackbarth, D. (2008), "Managerial traits and capital structure decisions", *Journal of Financial and Quantitative Analysis*, Vol. 43 No. 4, pp. 843-882.

Han, S., Lai, G.C. and Ho, C.L. (2015), *CEO Confidence or Overconfidence? the Impact of CEO Overconfidence on Risk Taking and Firm Performance in the U.S. Property-Liability Insurance Companies*, Unpublished manuscript, Washington State University, Washington.

Hayward, M.L.A. and Hambrick, D.C. (1997), "Explaining the premiums paid for large acquisitions: evidence of CEO hubris", *Administrative Science Quarterly*, Vol. 42 No. 1, pp. 103-127.

Heaton, J.B. (2002), "Managerial optimism and corporate finance", *Financial Management*, Vol. 31 No. 2, pp. 33-45.

Hedges, L.V. and Olkin, I. (1985), *Statistical Methods for Metaanalysis*, Academic Press, Orlando, FL.

Heider, F. (1958), *The Psychology of Interpersonal Relations*, Wiley, New York, NY.

*He, Y., Chen, C. and Hu, Y. (2019), "Managerial overconfidence, internal financing, and investment efficiency: evidence from China", *Research in International Business and Finance*, Vol. 47, pp. 501-510.

Hilary, G., Hsu, C., Segal, B. and Wang, R. (2016), "The bright side of managerial over-optimism", *Journal of Accounting and Economics*, Vol. 62 No. 1, pp. 46-64.

Hiller, N.J. and Hambrick, D.C. (2005), "Conceptualizing executive hubris: the role of (hyper-) core self-evaluations in strategic decision-making", *Strategic Management Journal*, Vol. 26 No. 4, pp. 297-319.

Hilton, D., Regner, I., Cabantous, L., Charalambides, L. and Vautier, S. (2011), "Do positive illusions predict overconfidence in judgment? A test using interval production and probability evaluation measures of miscalibration", *Journal of Behavioral Decision Making*, Vol. 24 No. 2, pp. 117-139.

*Hirshleifer, D., Low, A. and Teoh, S.H. (2012), "Are overconfident CEOs better innovators?", *The Journal of Finance*, Vol. 67 No. 4, pp. 1457-1498.

Hribar, P. and Yang, H.I. (2016), "CEO overconfidence and management forecasting", *Contemporary Accounting Research*, Vol. 33 No. 1, pp. 204-227.

Huang, W., Jiang, F., Liu, Z. and Zhang, M. (2011), "Agency cost, top executives' overconfidence, and investment-cash flow sensitivity: evidence from listed companies in China", *Pacific-Basin Finance Journal*, Vol. 19 No. 3, pp. 261-277.

Hunter, J.E. and Schmidt, F.L. (2004), *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings*, Sage Publications, California.

Hwang, K., Cha, M. and Yeo, Y. (2014), "Does managerial overconfidence influence on financial reporting?: the relationship between overinvestment and conditional conservatism", *Review of Integrative Business and Economics Research*, Vol. 4 No. 1, pp. 273-298.

Jefferson, A., Bortolotti, L. and Kuzmanovic, B. (2017), "What is unrealistic optimism?", *Consciousness and Cognition*, Vol. 50, pp. 3-11.

*Jiang, F., Stone, G.R., Sun, J. and Zhang, M. (2011), "Managerial hubris, firm expansion and firm performance: evidence from China", *The Social Science Journal*, Vol. 48 No. 3, pp. 489-499.

Jokar, H. and Daneshi, V. (2018), "The impact of investors' behavior and managers' overconfidence on stock return: evidence from Iran", *Cogent Business and Management*, Vol. 5 No. 1, pp. 1-11.

*Jouber, H. (2013), "Are over-paid chief executive officers better innovators?", *Journal of Economics, Finance and Administrative Science*, Vol. 18 No. 35, pp. 63-71.

Juslin, P., Winman, A. and Olsson, H. (2000), "Naive empiricism and dogmatism in confidence research: a critical examination of the hard-easy effect", *Psychological Review*, Vol. 107 No. 2, pp. 384-396.

Kahneman, D., Slovic, P. and Tversky, A. (1982), *Judgment under Uncertainty: Heuristics and Biases*, Cambridge University Press, Cambridge.

*Kangarlouei, S.J., Bahrami, P. and Motavassel, M. (2013), "Agency costs, managers optimism and investment cash flow sensitivity: evidence from tehran stock exchange", *Journal of Commerce and Accounting Research*, Vol. 2 No. 4, pp. 1-9.

Khajavi, S. and Dehghani, G. (2016), "Board characteristics and managerial overconfidence in an emerging market", *International Journal of Economics and Financial Issues*, Vol. 6 No. 2, pp. 529-537.

*Kim, M.C., Xiong, G. and Kim, K.H. (2018), "Where does pride lead? Corporate managerial hubris and strategic emphasis", *Journal of the Academy of Marketing Science*, Vol. 46 No. 3, pp. 537-556.

Klayman, J., Soll, J.B., Gonzales-Vallejo, C. and Barlas, S. (1999), "Overconfidence: it depends on how, what, and whom you ask", *Organizational Behavior and Human Decision Processes*, Vol. 79 No. 3, pp. 216-247.

Koellinger, P., Minniti, M. and Schade, C. (2007), "'I think I can, I think I can': overconfidence and entrepreneurial behavior", *Journal of Economic Psychology*, Vol. 28 No. 4, pp. 502-527.

Kraft, P.S., Back, P., Lampe, J.O. and Bausch, A. (2017), "Overconfidence and risk behavior: the mediating role of risk propensity and risk perception", *Academy of Management Proceedings*, Vol. 2017 No. 1, p. 15137.

Larrick, R.P., Burson, K.A. and Soll, J.B. (2007), "Social comparison and confidence: when thinking you're better than average predicts overconfidence (and when it does not)", *Organizational Behavior and Human Decision Processes*, Vol. 102 No. 1, pp. 76-94.

Li, J. and Tang, Y. (2010), "CEO hubris and firm risk taking in China: the moderating role of managerial discretion", *Academy of Management Journal*, Vol. 53 No. 1, pp. 45-68.

Li, W.L., Xie, G.L. and Hao, J.Y. (2014), "The empirical study on the influence of managerial overconfidence on overinvest behavior", *Journal of Shanxi University of Finance and Economics*, Vol. 10, pp. 76-86.

Lin, Y., Hu, S. and Chen, M. (2005), "Managerial optimism and corporate investment: some empirical evidence from Taiwan", *Pacific-Basin Finance Journal*, Vol. 13 No. 5, pp. 523-546.

Lipsey, M.W. and Wilson, D.B. (2001), Practical meta-analysis, Sage Publications, California.

Liu, H., Chuang, W., Huang, J. and Chen, Y. (2016), "The overconfident trading behavior of individual versus institutional investors", *International Review of Economics and Finance*, Vol. 45, pp. 518-539.

*Longjie, X. and Anfeng, Z. (2017), "The impact of managers overconfidence on corporate investment", *International Journal of Social Science and Humanity*, Vol. 7 No. 2, pp. 109-114.

Lowe, R.A. and Ziedonis, A.A. (2006), "Overoptimism and the performance of entrepreneurial firms", *Management Science*, Vol. 52 No. 2, pp. 173-186.

Makridakis, S. and Moleskis, A. (2015), "The costs and benefits of positive illusions", *Frontiers in Psychology*, Vol. 6, p. 859.

*Malmendier, U and Tate, G. (2005a), "CEO overconfidence and corporate investment", *Journal of Finance*, Vol. 60 No. 6, pp. 2661-2700.

Malmendier, U. and Tate, G. (2005b), "Does overconfidence affect corporate investment? CEO overconfidence measures revisited", *European Financial Management*, Vol. 11 No. 5, pp. 649-659.

Malmendier, U. and Tate, G. (2008), "Who makes acquisitions? CEO overconfidence and the market's reaction", *Journal of Financial Economics*, Vol. 89 No. 1, pp. 20-43.

Malmendier, U. and Tate, G. (2015), "Behavioral CEOs: the role of managerial overconfidence", *Journal of Economic Perspectives*, Vol. 29 No. 4, pp. 37-60.

Malmendier, U., Tate, G. and Yan, J. (2011), "Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies", *Journal of Finance*, Vol. 66 No. 5, pp. 1687-1733.

Meloy, M.G., Russo, J.E. and Miller, E.G. (2006), "Monetary incentives and mood", *Journal of Marketing Research*, Vol. 43 No. 2, pp. 267-275.

Menkhoff, L., Schmeling, M. and Schmidt, U. (2013), "Overconfidence, experience and professionalism: an experimental study", *Journal of Economic Behavior & Organization*, Vol. 86, pp. 92-101.

*Merkle, C. (2017), "Financial overconfidence over time: foresight, hindsight, and insight of investors", *Journal of Banking and Finance*, Vol. 84, pp. 68-87.

*Michailova, J. (2010), "Overconfidence, risk aversion and individual financial decisions in experimental asset markets", MPRA Paper No. 63821, Helmut Schmidt University, Hamburg.

Miller, D.J., Spengler, E.S. and Spengler, P.M. (2015), "A meta-analysis of confidence and judgment accuracy in clinical decision making", *Journal of Counseling Psychology*, Vol. 62 No. 4, pp. 553-567.

*Moez, E.G. and Amina, Z. (2018), "Overinvestment of free cash flow and manager's overconfidence", *International Business Research*, Vol. 11 No. 3, pp. 48-57.

Moore, D.A. and Healy, P.J. (2008), "The trouble with overconfidence", *Psychological Review*, Vol. 115 No. 2, pp. 502-517.

Moore, D.A. and Schatz, D. (2017), "The three faces of overconfidence", *Social and Personality Psychology Compass*, Vol. 11 No. 8, pp. 1-12.

Moore, D.A. and Swift, S.A. (2011), "The Three Faces of overconfidence in organizations", in De Cremer, D., Van Dick, R. and Murnighan, J.K. (Eds.), *Social Psychology of Organizations*, Taylor & Francis, Oxford, pp. 147-184.

Murhadi, W.R. (2018), "Managerial overconfident and firm financing decision: an Indonesian case", in Murhadi, W.R., Anandya, D. and Andajani, E. (Eds), *Proceedings of the 15th International Symposium on Management (INSYMA 2018)*, Atlantis Press, Thailand, pp. 71-75.

Nisbett, R.E. and Ross, L. (1980), *Human Inference: Strategies and Shortcomings of Social Judgment*, PrenticeHall, New Jersey, NJ.

Odean, T. (1998), "Volume, volatility, price, and profit when all traders are above average", *The Journal of Finance*, Vol. 53 No. 6, pp. 1887-1934.

Odean, T. (1999), "Do investors trade too much?", *American Economic Review*, Vol. 89 No. 5, pp. 1279-1298.

Olsson, H. (2014), "Measuring overconfidence: methodological problems and statistical artifacts", *Journal of Business Research*, Vol. 67 No. 8, pp. 1766-1770.

Otto, C.A. (2014), "CEO optimism and incentive compensation", *Journal of Financial Economics*, Vol. 114 No. 2, pp. 366-404.

*Park, J. and Chung, Y. (2017), "CEO overconfidence, leadership ethics, and institutional investors", *Sustainability*, Vol. 9 No. 14, pp. 1-28.

*Park, J.H., Konana, P., Gu, B., Kumar, A. and Raghunathan, R. (2010), "Confirmation bias, overconfidence, and investment performance: evidence from stock message boards", McCombs Research Paper Series No. IROM-07-10, The University of Texas at Austin, Austin.

Puri, M. and Robinson, D.T. (2007), "Optimism and economic choice", *Journal of Financial Economics*, Vol. 86 No. 1, pp. 71-99.

Rihab, B.A. and Lotfi, B.J. (2016), "Managerial overconfidence and debt decisions", *Journal of Modern Accounting and Auditing*, Vol. 12 No. 4, pp. 225-241.

Rosenthal, R. (1979), "The 'file drawer problem' and tolerance for null results", *Psychological Bulletin*, Vol. 86 No. 3, pp. 638-641.

Russo, J. and Schoemaker, P. (1992), "Managing overconfidence", *Sloan Management Review*, Vol. 33 No. 2, pp. 7-17.

Schaefer, P.S., Williams, C.C., Goodie, A.S. and Campbel, W.K. (2004), "Overconfidence and the big five", *Journal of Research in Personality*, Vol. 38 No. 5, pp. 473-480.

Simon, M. and Shrader, R. (2012), "Entrepreneurial actions and optimistic overconfidence: the role of motivated reasoning in new product introductions", *Journal of Business Venturing*, Vol. 27 No. 3, pp. 291-309.

Skala, D. (2008), "Overconfidence in psychology and finance – an interdisciplinary literature review", *Bank I Kredit*, Vol. 2008, pp. 33-50.

Staël Von Holstein, C.A.S. (1972), "Probabilistic forecasting: an experiment related to the stock market", *Organizational Behavior and Human Performance*, Vol. 8 No. 1, pp. 139-158.

Sternberg, R.J. (2008), *Cognitive Psychology*, 5th ed., Wadsworth, California.

Tang, Y., Li, J. and Yang, H. (2015), "What I see, what I do: how executive hubris affects firm innovation", *Journal of Management*, Vol. 41 No. 6, pp. 1698-1723.

Taylor, S.E. (1989), *Positive Illusions: Creative Self-Deception and the Healthy Mind*, Basic Books, New York, NY.

Taylor, S.E. and Brown, J.D. (1988), "Illusion and well-being: a social psychological perspective on mental health", *Psychological Bulletin*, Vol. 103 No. 2, pp. 193-210.

Urbig, D., Stauf, J. and Weitzel, U. (2009), "What is your level of overconfidence? A strictly incentive compatible measurement of absolute and relative overconfidence", Discussion Paper Series 09-20, Tjalling C, Koopmans Research Institute, Utrecht.

*Verberne, M.M.W.J. (2010), *Managerial Overconfidence in the Netherlands, Master Thesis in Finance*, Tilburg University, Faculty of Economics and Business, Tilburg.

Wang, X., Zhang, M. and Yu, F. (2008), "CEO overconfidence and distortion of firms' investments: some empirical evidence from China", *Nankai Business Review*, Vol. 2, pp. 77-83.

*Wang, X., Zhang, M. and Yu, F. (2009), "Managerial overconfidence and over-investment: empirical evidence from China", *Frontiers of Business Research in China*, Vol. 3 No. 3, pp. 453-469.

*Wang, Y., Chen, C.R., Chen, L. and Huang, Y.S. (2016), "Overinvestment, inflation uncertainty, and managerial overconfidence: firm level analysis of Chinese corporations", *North American Journal of Economics and Finance*, Vol. 38, pp. 54-69.

*Wang, D., Sutherland, D., Ning, L., Wang, Y. and Pan, X. (2018), "Exploring the influence of political connections and managerial overconfidence on R&D intensity in China's large-scale private sector firms", *Technovation*, Vol. 69, pp. 40-53.

Whitener, E.M. (1990), "Confusion of confidence intervals and credibility intervals in meta-analysis", *Journal of Applied Psychology*, Vol. 75 No. 3, pp. 315-321.

Wong, Y.J., Lee, C.Y. and Chang, S.C. (2017), "CEO overconfidence and ambidextrous innovation", *Journal of Leadership and Organizational Studies*, Vol. 24 No. 3, pp. 414-430.

*Yang, X. and Zhu, L. (2016), "Ambiguity vs risk: an experimental study of overconfidence, gender and trading activity", *Journal of Behavioral and Experimental Finance*, Vol. 9, pp. 125-131.

*Yeoh, L.Y. and Wood, A. (2011), *Overconfidence, Competence and Trading Activity*, Unpublished Manuscript, University of Essex, Colchester.

Zaiane, S. (2013a), "Investor overconfidence: an examination of individual traders on the Tunisian stock Market", *Advances in Management and Applied Economics*, Vol. 3 No. 5, pp. 41-55.

Zaiane, S. (2013b), "Overconfidence, trading volume and the disposition effect: evidence from the Shenzhen stock market of China", *Issues in Business Management and Economics*, Vol. 1 No. 7, pp. 163-175.

Zaiane, S. and Moussa, F.B. (2018), "Cognitive biases, risk perception, and individual's decision to start a new venture", *International Journal of Service Science, Management, Engineering, and Technology*, Vol. 9 No. 3, pp. 14-29.

*Zavertiaeva, M.A., López-Iturriaga, F.J. and Kuminova, E.V. (2018), "Better innovators or more innovators? Managerial overconfidence and corporate R&D", *Managerial and Decision Economics*, Vol. 39 No. 4, pp. 447-461.

Zhang, S.X. and Cueto, J. (2017), "The study of bias in entrepreneurship", *Entrepreneurship: Theory and Practice*, Vol. 41 No. 3, pp. 419-454.

Zia, L., Sindhu, M.I. and Hashmi, S.H. (2017), "Testing overconfidence bias in Pakistani stock Market", *Cogent Economics and Finance*, Vol. 5 No. 1, 1289656.

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