Overconfidence and Real Estate Research: A Review of the Literature

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Abstract

Real estate investment has recently been advancing rapidly in both volume and complexity. A sound understanding of behavioral issues in this sector benefits all stakeholders, such as investors, regulators, and local residents. We focus on one of the most robust behavioral anomalies in business and finance research: overconfidence. Overconfidence significantly influences financial decision and investment performance. However, theoretical and empirical studies are lacking in real estate sector. We conduct a critical review of the overconfidence literature to bridge this gap, identify future research directions for the study of overconfidence in real estate markets, and suggest strategies to handle technical issues, such as the robustness of overconfidence measurement and data availability. Findings provide useful guidelines for researchers and practitioners to design and implement overconfidence studies in real estate research.

Keywords: Judgmental bias; behavioral finance; investment decision; overconfidence; real estate investment

1. Introduction

Investors' enthusiasm for active trading is pervasive in stock markets worldwide. Although evidence shows that trading frequency and returns are negatively related (Magron, 2014; Odean, 1999), investors regularly engage in active speculation when markets turn into boom phases. Moreover, more than 50% of investors consider their stock selection skills to be better than average (Daniel et al., 1998; Statman et al., 2006), which is statistically untrue. These irrational behaviors have sound cognitive psychological foundations and are identified in a wide range of experiments and surveys although they are at odds with predictions by standard economic theory and are labeled as market anomalies (see Odean, 1998 for a review). All theoretical and empirical findings identify human weakness as the cause of these anomalies, that is, individuals tend to be overconfident in their abilities. This topic has attracted growing interest from both the academe and industries, particularly in the financial sector. Evidence show that overconfidence has significant implications to investment decisions, such as saving behaviors and motives (Sakalaki et al., 2005), retirement planning (Parker et al., 2012), stock trading frequency (Glaser and Weber, 2007; Statman et al., 2006), and stock market participation (Xia et al., 2014). It also affects investment performance (Daniel et al., 1998; Hanauer, 2014; Janus et al., 2013). DeBonbt and Thaler (1985) explain that overconfidence is one of the most robust findings in the psychology of judgment. This argument is effectively supported by findings from the financial sector.

Overconfidence is essential in investors' decision-making and investment market performance. In the decision-making process, overconfident investors attribute much of their past success to their superior ability instead of chance; hence, they irrationally trade in the future (Odean, 1998; Gervais and Odean, 2001; Hilary and Menzly, 2006; Statman et al., 2006). Such behavior could reduce investment profits and utility (Odean, 1998; Barber and Odean, 2000, 2001). An overconfident investor also overestimates the precision of his private information at the expense of ignoring public information, which could lead to suboptimal investment decisions (Daniel et al., 1998). In terms of market performance, overconfidence could increase market depth and volatility (Odean, 1998), generate excessive trading (Odean, 1998; Statman et al., 2006; Griffin et al., 2007), and create speculative bubbles (Scheinkman and Xiong, 2003). Thus, overconfidence plays an important role in investment decisions.

Studies on overconfidence greatly enhanced our understanding of investor behaviors in financial markets, whereas research to-date focuses on stock markets. Real estate investment has not received sufficient attention in this stream of research. Real estate markets are different from stock markets in terms of liquidity, transparency, and geographical heterogeneity although many studies show an integrated relationship between real estate and stock returns (Ling and Naranjo, 1999; Okunev et al., 2000). In real estate markets, high return in 2000–2006 made people in America celebrate their gains and purchase more houses. Speculative housing bubbles gradually came into being and eventually led to the 2008 subprime crisis. Housing booms are mainly

driven by investors' irrational expectation instead of the fundamentals (Clayton, 1997). Evidence shows that real estate markets are slow in absorbing market news; hence, it is inefficient (Fu and Ng, 2001; Byrne et al., 2013). Real estate markets are characterized by information asymmetry, illiquidity, and short sales constraints, all of which are found to aggravate judgmental biases (Ling et al., 2014). Therefore, overconfidence is expected to play an even bigger role in real estate investment decisions and performance. However, existing real estate literature have yet to address behavior approaches in real estate markets (Salzman and Zwinkels, 2013).

The issue is even more pressing given the recent development in international real estate investment. The 2014 International Investment Atlas published by Cushman and Wakefield[1] mentioned that global commercial property investment increased by over 20% in 2013. The transaction volume stood at USD 1.18 trillion, which is the highest global total since 2007. The Asia-Pacific region claims almost one half of this lucrative market with an impressive 25% annual growth in investment volume. Similar trends also form in the residential sector. The National Association of Realtors in the 2014 Profile of International Home Buying Activity report[2] shows that buyers from Canada, China, Mexico, India, and the U.K. accounted for 54% of foreign sales, which is estimated to be 7% of the total US Existing Homes Sales market of USD 1.2 trillion for the period April 2013 through March 2014. This shows annual growth of 35% from the previous period. The recent trend in international real estate investment poses both opportunities and challenges to investors, regulators, and government policy makers worldwide. A good understanding of the behaviors of various agents in international real estate investment benefits all parties involved. However, behavioral research findings from developed economies do not necessarily hold in emerging real estate markets, such as India and China. This is particularly true in overconfidence studies, where the effect of overconfidence varies significantly across countries and cultures (Breuer et al., 2014; Chui et al., 2010; Stankov and Lee, 2014). The effect of overconfidence has only been tested in the US REITs market (Eichholtz and Yönder, 2014) although some promising investigations into the role of market sentiment (Hui and Wang, 2014; Jin et al., 2014; Teng et al., 2013), investor sentiment (Gallimore and Gray, 2002; Hui et al., 2013; Lin et al., 2009; Ling et al., 2014), and information asymmetry (Cline et al., 2014; Hui et al., 2013; Liu et al., 2013; Qian et al., 2013) exist in real estate investment. Conducting a critical review of the overconfidence literature is necessary to develop a strategy for research in international real estate markets and to bridge the gaps in the literature.

This paper provides a selected review of 78 articles on overconfidence from 1998 to 2014, which focuses on business economic publications. The analysis of overconfidence studies on overconfidence measurement, investor overconfidence, and

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[1] http://www.cushmanwakefield.com/en/research-and-insight/2014/international-investment -atlas-summary-2014/. Accessed on 27 February 2015.

[2] http://www.realtor.org/news-releases/2014/07/international-home-buyers-continue-to- invest-in-profitable-us-market-realtors-report. Accessed on 27 February 2015.

CEO confidence demonstrates that real estate markets serve as a natural laboratory to test theories and models on overconfidence. The findings from real estate markets also enhance the understanding of both the nature and influences of overconfidence on investment decision and performance. We make recommendations by identifying future research directions for the study of overconfidence in real estate investment and by providing strategies to handle technical issues, such as the robustness of overconfidence measurement and data availability. The findings provide useful guidelines for researchers and practitioners to design and implement overconfidence studies in international real estate markets.

The remainder of the paper is structured as follows. Section 2 gives the article selection criteria and summary statistics of the sample. Section 3 provides a critical review of selected articles on overconfidence measurement, investor overconfidence, and CEO overconfidence. Section 4 discusses the motivations and strategies of conducting overconfidence research in real estate markets. Section 6 concludes the study.

2. Research Methodology

This research is conducted through a focused analysis of peer-reviewed literature on overconfidence. We adopt a broad definition of overconfidence, and select papers from a focused area, business and economics. The research methodology for the literature review is outlined below.

Various definitions and classifications of overconfidence are found. No consensus has been reached yet; however, the most common approach involves the concepts of overestimation, overplacement and overprecision (Moore and Healy, 2008; Grieco and Hogarth, 2009). The first definition relates to the overestimation of "one's actual ability, performance, level of control, or chance of success" (Moore and Healy, 2008). The second definition - overplacement, which is also known as the "better than average" effect, refers to the fact that investors classify themselves of above average level (Scott et al., 1999; Menkhoff et al., 2006; Moore and Healy, 2008). The third definition - overprecision, which is also known as "miscalibration," refers to the fact that people are sure about the precision of their estimation (Daniel et al., 1998; Biais et al., 2005; Menkhoff et al., 2006; Cesarini et al., 2006; Moore and Healy, 2008). Table 1 gives some examples of recent publications for each of the three definitions. Given that each of these three definitions focuses on different yet important aspects of overconfidence, papers that used any one of these three definitions were included. This strategy ensures that the literature review is comprehensive.

Table 1: Definitions of Overconfidence

| Type of overconfidence	Definition	Examples
Overestimation	Overestimation of actual ability, performance, level of control, or chance of success	Scott et al. (2003) Forbes (2005) Cesarini et al. (2006) Grieco and Hogarth (2009) Oberlechner and Osler (2012)
Overplacement (better-than-average)	Individuals classify themselves as those above the average level	Menkhoff et al. (2006) Grieco and Hogarth (2009)
Overprecision (miscalibration)	Overestimation of the precision of estimation	Daniel et al. (1998) Biais et al. (2005) Menkhoff et al. (2006) Cesarini et al. (2006) Grieco and Hogarth (2009) Oberlechner and Osler (2012)

Adopting a broad definition of overconfidence may risk losing focus. Thomson Reuters Web of Science is used as the database to keep the analysis relevant and focused, and several search rules are set as follows. First, we use "overconfident" and "overconfidence" as keywords and use "business economics" as the search category. Second, we narrow down publication time span to 1998–2014. The start time of the review period is determined by the publication year of Odean (1998) and Deniel et al. (1998), which are two pioneering studies in overconfidence research. A total of 343 publications are obtained from 37 academic journals on overconfidence. The *Journal of Finance* takes up 13% of the total publications included in this study with five theoretical articles and five empirical ones. The two influential papers mentioned above (i.e., Odean, 1998; Daniel et al., 1998) are from the journal. Apart from the *Journal of Finance (2014 impact factor: 5.424)*[3], this study's database also includes many publications with top journals in finance and economics, such as the *American Economic Review (2014 impact factor: 3.673)*, the *Journal of Financial Economics (2014 impact factor: 4.047)*, and the *Review of Financial Studies (2014 impact factor: 3.174)*. The wide acceptance by these top journals proves that overconfidence has been attracting significant attention among researchers in finance and economics.

We construct a "pool" of popular behavioral topics and calculated the proportion of overconfidence publications in this pool to further understand the importance of overconfidence as a research topic. We use "prospect theory," "loss aversion," "reference point," and "anchoring" as the keywords to identify other representative behavioral economic topics. The search was conducted within the 37 academic journals identified in previous steps. The statistics of the number of publications and proportion of overconfidence papers in each year are presented in Figure 1. The

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[3] Impact factors cited in this paragraph are based on Journal Citation Reports from Thomson Reuters.

relative importance of overconfidence studies among other behavioral economic topics also remains high and stable. For example, the proportion of overconfidence papers remains above 30% given that the number of publications on other behavioral topics has been growing notably between 2008 and 2014. The share of overconfidence publications is stabilized at approximately 40% in recent years. All evidences point to the same conclusion that overconfidence has been one of the most important research topics in behavioral economics.

**Figure 1: Proportion of overconfidence publications (1998–2014)**
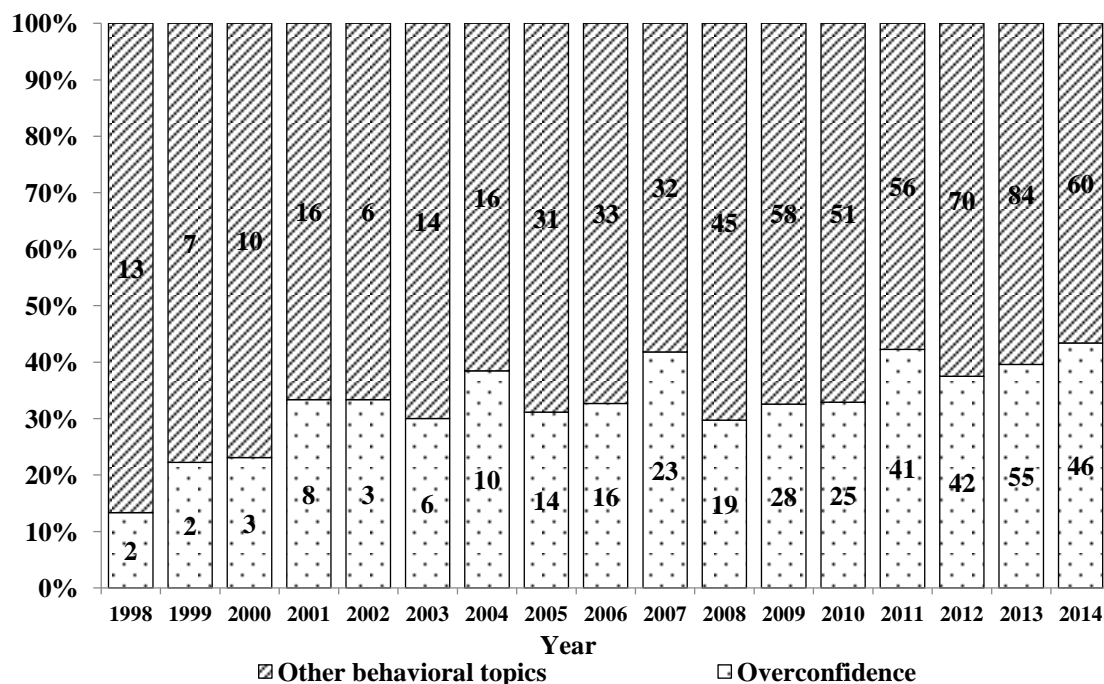
Source: Web of Science

The papers resulted from previous steps involves overconfidence. However, some of them do not study overconfidence directly. For example, one paper may use overconfidence as one of its keywords, but overconfidence may be one of the many control variables in the model. We choose to analyze papers in which overconfidence plays a significant role in their main conclusions to keep the literature review focused. Therefore, we examined the content of selected papers manually and selected a final list of 78 articles for further analysis in the final step of publication search.

In Figure 2, we break down these papers by years and report the corresponding citation statistics. The increasing trend is consistent with what is observed from Figure 1. The number of publications on this topic has been growing steadily in the last two decades following Odean (1998) and Daniel et al. (1998)'s pioneer works on overconfidence. Overconfidence studies were sparse before 2005, and many of them are theoretical studies. Overconfidence had gradually drawn researchers' attention since 2006. A growing number of papers were focusing on this important concept in behavioral economics, and citation count increased accordingly. This increasing trend

is particularly strong after the recent Global Financial Crisis. Given that behavioral economics theories are used as the main tools to analyze the cause and consequences of this crisis, publications on overconfidence also grew in number.

Figure 2: Publication and citation statistics
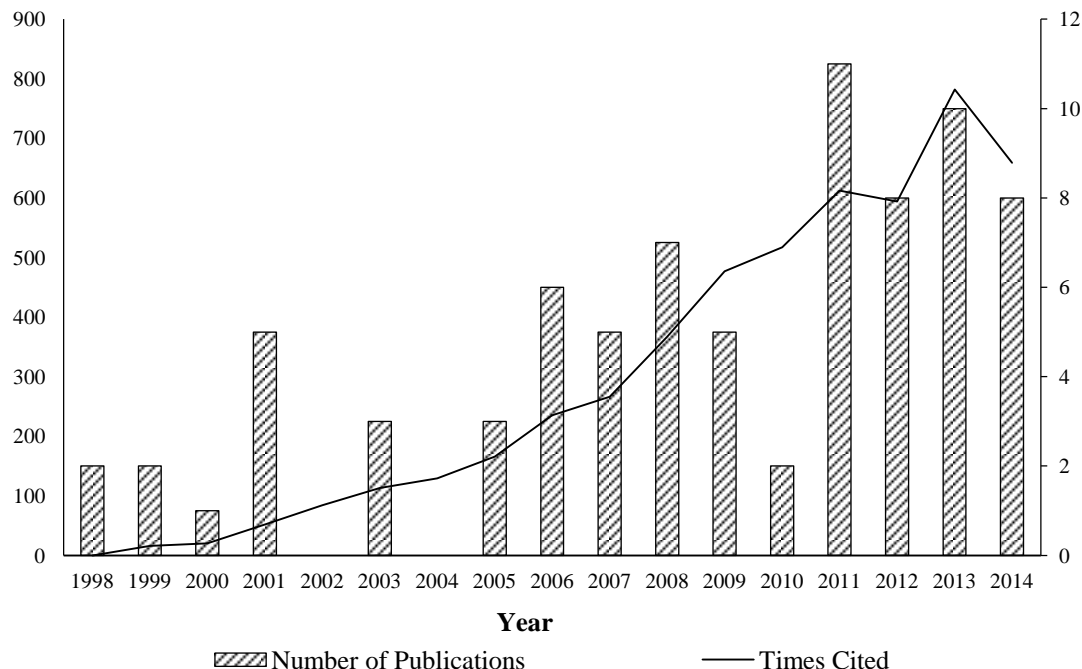
3. An Overview of Overconfidence Research

We have discussed the basic research methodology and presented selected articles. This section examines the existing findings of overconfidence research. We identify and discuss the three main streams of overconfidence studies: overconfidence measurement, investor overconfidence, and CEO overconfidence.

First, the reliable measurement of overconfidence is a crucial step in any overconfidence study. A summary of common approaches in the literature and a critical evaluation of the strength and weakness of each method is helpful for researchers to select suitable methods for future studies. Second, we turn our focus to the subjects of overconfidence research, which include various agents in financial markets, such as investment analysts, policy makers, and institute and individual investors. Among these agents are the "end-users" of the financial products (i.e., individual and institutional investors) who receive the most attention. We summarize findings on investor overconfidence and CEO overconfidence in Sections 3.2 and 3.3, respectively. The distribution of papers among these themes is given in Table 2.

Table 2: Distribution of publications among themes

Topic	Number of publications	Proportion with each topic
Investor overconfidence	*29*	
− Overconfidence and trading activity	8	28%
− Overconfidence and investor characteristics	7	24%
− Overconfidence and market	7	24%
− Overconfidence and asset pricing	4	14%
− Overconfidence and wealth	3	10%
CEO overconfidence	*34*	
− Overconfidence and decision making	20	59%
− Overconfidence and firm performance	11	32%
− Overconfidence and innovation	4	12%
Overconfidence measurement	*20*	
− Overconfidence measure	15	75%
− Overconfidence measure critics	5	25%

Note: The total number of publications in this table exceeds 78 (i.e., the total number of papers selected for final analysis) because some of the papers are included in more than one categories.

3.1 Overconfidence measurement

The measure of overconfidence has been a fundamental topic after overconfidence was introduced into behavioral economics. Confidence interval experiment has been widely adopted to measure investor "miscalibration" (Cesarini et al., 2006; Glaser and Weber, 2007; Sonsino and Regev, 2013). Investors are asked to give confidence interval estimates to questions concerning general knowledge (e.g., stock portfolio performance). Overconfidence is then measured by calculating the percentage of the correct answer falling outside of the reported confidence interval. This percentage should equal α (i.e., the significance level) in the absence of overconfidence. However, Glaser and Weber (2007) find that the mean percentage of miscalibration is 75% in their sample, which is much higher than the expected proportion (i.e., 10% in their study). This percentage ranges between 40% and 70% in most empirical studies.

The point-estimates of overconfidence are another popular measurement in the literature. Both objective and subjective information are commonly used to derive point measurement of overconfidence. Malmendier and Tate (2005, 2008) use option exercise time and acquisition of own company's stock to quantify the level of overconfidence. Such information is readily available market data (i.e., objective information) that can enhance the reliability and replicability of the findings. On the other hand, subjective ranking or rating of confidence levels can be obtained by surveys or searches of press articles. A body of CEO overconfidence literature counted press description of overconfident CEOs to determine the degree of overconfidence (Shu et al., 2013; Galasso and Simcoe, 2011; Malmendier et al., 2011). For instance, "confident," "confidence," "optimistic," "optimism," "reliable,"

"cautious," "practical," "frugal," "conservative," and "steady" are the keywords used in Malmendier et al. (2011)'s counting.

Criticisms emerged although the number of publications in introducing and improving overconfidence measure grows rapidly in these years. For example, the overuse of this term may generate economical and statistical bias (Olsson, 2014). Fellner and Krügel (2012) indicate that these two concepts are unrelated although "miscalibration" was frequently measured as the overprecision of knowledge. Some researchers doubt the causal link between CEO overconfidence and innovation, which is mainly because of the potential measurement errors in CEO confidence (Herz et al., 2014). Researchers should attempt to demonstrate the reliability and validity of the measurement adopted in their studies to address these doubts and concerns about overconfidence measurement.

3.2 Investor Overconfidence

In early overconfidence literature, an overconfident investor is defined as one who overestimates the precision of private knowledge (Odean, 1998; Daniel et al., 1998; Scheinkman and Xiong, 2003). This definition is consistent with the "miscalibration" effect and has two advantages. First, the psychology foundation of overconfidence as a new concept in behavioral economics is sound. The overprecision of estimation was widely cited in psychology studies before overconfidence was applied in economics (Alpert and Raiffa, 1982; Lichtenstein et al., 1982). Therefore this definition has solid psychological underpinnings. Second, microstructure models, which consist of the precision of investors' signal, were comprehensively developed in the 1980s (Grossman and Stiglitz, 1980; Kyle, 1985). Researchers could easily modify the conditional variance in traditional economic models by defining overconfidence as the "miscalibration" effect, which derives equilibrium under overconfidence. This definition helps researchers in deriving estimable models and testable hypotheses.

The significant effect of generating trading by overconfident investors is the most robust conclusion among early studies (Odean, 1998). Benos (1998) and Odean (1998) were among the first to discover that the participation of overconfident investors in the market leads to high trading volume. Gervais and Odean (2001) developed a multi-period model describing both the process by which traders learn about their ability and how a bias in this learning can create overconfident traders to understand this phenomenon. When traders experience success, they attribute much of it to their own ability and become overconfident. They underestimate the risk of their investments (Hirshleifer and Luo, 2001) and trade more frequently in the subsequent period. Excessive trading volume is an inevitable consequence of overconfidence. Table 2 shows that this is also the most frequently studied subtopic in investor overconfidence research.

The effect of overconfidence on trading volume has also been tested empirically in many countries. These studies routinely use high market returns as the proxy

measurement of overconfidence (i.e., high market returns lead to investor overconfidence) and market turnovers as the measurement of trading volume/frequency. Statman et al. (2006) relate current volume to lag returns and found a significant tendency for market-wide turnover to increase in the months following high market returns. Griffin et al. (2007) further investigate this dynamic relation in 46 markets worldwide. They conclude that market turnover is strongly and positively related to past returns, and the relation is much stronger in developing countries. Chuang et al. (2014) extend these studies to cross-border investments. They find that trading volume in 10 Asian countries increase significantly subsequent to both US and domestic market gains, and that the overconfidence effect of generating trading is more pronounced in markets with short-sale constraints.

"Overconfidence and investor characteristics" is the second mostly studied topic after active trading. This line of research focuses on the moderators of overconfidence effects by investigating investor characteristics. For example, overconfident males trade 45% more than their female counterparts, and male investors have lower net returns because of the aggressive trading behavior (Barber and Odean, 2001). Moreover, age as an indicator of investment experience can also affect overconfidence although the findings are mixed (see, for example, the debate between Grinblatt and Keloharju, 2009 and Menkhoff et al., 2013). Similar discussions have been ongoing regarding the difference between individual and institutional investors. Individual investors are more overconfident than institutional investors because they have less investment experience (Chuang and Susmel, 2011). However, Lambert et al. (2012) find no difference in the impact of overconfidence on judgment among students and bankers in terms of investment decisions. Experienced investors (e.g., bankers) may be more overconfident owing to the high level of risk aversion. The moderating role of investor characteristics of overconfidence effect remains an open and fascinating topic.

Some studies on the role of overconfidence on specific topics/areas in finance are found (See Table 2). Investor overconfidence is used to explain some market anomalies or puzzles. Overconfidence can lead to disagreements of asset fundamentals and generates speculative bubbles accompanied by high trading volume and volatility (Scheinkman and Xiong, 2003). Investor overconfidence can even explain the forward premium puzzle in the way that investors overreact to their knowledge about future inflation (Burnside et al., 2011). Researchers also incorporate overconfidence in traditional asset pricing models to take into account "human factors" and study the long-term impact of overconfidence by investigating the relations between overconfidence and wealth. All studies conclude that investor overconfidence plays an important role in investment decisions.

3.3 CEO Overconfidence

We identified 34 articles that studied CEO overconfidence. Executives are prone to overconfidence in terms of both the "better than average" effect and the

"miscalibration" effect (Malmendier and Tate, 2005). We investigate the effect of CEO overconfidence because of the key role CEOs play in their firms.

The mostly studied topic in this category is "CEO overconfidence and decision-making." Early works on this sub-topic are extensions of investor overconfidence studies, which focus on behaviors of venture capitalists primarily (Zacharakis and Shepherd, 2001; Forbes, 2005). Corporate responsibilities are found to aggravate overconfidence effect. Forbes (2005) argues that entrepreneur venture managers are more susceptible to overconfidence compared with those who are not entrepreneurs, and that whether the managers founded their own firms determines the degree of overconfidence. However, we ask if overconfidence affects firm-level decision-making when it comes to corporate governance. More studies about CEOs' firm-level governance emerged to answer this question. Malmendier and Tate (2005) find that overconfident CEOs overestimate the returns of their firms' investment, and that the sensitivity of investment to cash flow is positively affected by CEO overconfidence. Moreover, overconfident CEOs interpret projects with negative net present value (NPV) as those with positive NPV to delay the recognition of losses (Ahmed and Duellman, 2013). Dividend payout is also lower when CEOs are overconfident because such CEOs view external financing as costly and tend to allocate more profit on further investment (Deshmukh et al., 2013). In summary, empirical findings suggest that overconfidence causes CEOs to make suboptimal decisions.

Learning the conclusions about the relations between CEO overconfidence and firm performance is not surprising. CEOs are optimistic about firm's future performance and often overestimate their contribution because of overconfidence (Libby and Rennekamp, 2012). Fund managers who made successful forecasts in the short run tend to be overconfident in their ability to forecast future earnings (Hilary and Hsu, 2011). This inevitably leads to firm underperformance compared with earning forecast. Chen et al. (2014) shows that firms with overconfident CEOs failed to generate positive abnormal returns following significant R&D expenditure increase using an alternative overconfidence indicator (i.e., R&D expenditure instead of capital expenditure). Thus, overconfident CEOs' decisions to increase investment in R&D do not produce returns as expected.

The third subtopic of CEO overconfidence studies, "CEO overconfidence and innovation", warrants attentions from both academia and industry. The first two topics lead to either biased decision making or weak firm performance. The findings in this category suggest that overconfidence may add values to firms. Overconfident CEOs are more likely to lead firms in an innovative way. Overconfident CEOs obtain more patents and citations, which hold the level of investments constant (Galasso and Simcoe, 2011). Hirshleifer et al. (2012) confirm these findings in their studies and further claim that CEO overconfidence may benefit shareholders in the long run by investing more in innovative and risky projects. These conclusions must be interpreted with caution because the positive relation between overconfidence and innovation may only hold true in innovative industries (Hirshleifer et al., 2012).

4. Overconfidence and real estate research

Given the fact that overconfidence is relatively well established in business economic literature, we ask why we should do it again in another financial market. Real estate markets are different from other financial markets in many different ways. What we learned from other asset markets do not necessarily apply to real estate markets. Some of the unique characteristics of real estate markets call for the fine-tuning of prevalent models in general overconfidence studies. On the other hand, some features of real estate markets also make it an ideal laboratory to test overconfidence effects. In this section, we argue the necessity of conducting overconfidence research in real estate field and discuss strategies and directions of implementing such research.

4.1 Why do we need to study overconfidence in real estate markets?

Researchers have identified a wide array of determinants and moderators to fully understand the nature and effect of overconfidence. Research relevant to real estate markets found that overconfidence is more prominent when a market is less liquid and has high cost for short selling (Daniel and Hirshleifer, 2015), but high transaction cost generally reduce the level of overconfidence (Odean, 1998). Given that real estate markets are characterized with low liquidity, high short-selling cost (sometimes even without short selling opportunities at all), and high transaction cost, no straightforward answer was found regarding the role of overconfidence in this sector. Will the effect of illiquidity and high short-selling cost be offset by those from high transaction cost, and subsequently makes real estate markets immune of overconfidence effect? Whether real estaete investors trade aggressively even when the gain is not enough to cover transaction cost (Odean, 1999), thus a significant overconfidence effect from real estate sector could provide stronger evidence to justify role of overconfidence? These are important questions to be answered by future research.

Another important feature that separates real estate from other asset classes is its tangibility and heterogeneity, which make decisions more personal and products less standardized in real estate markets. Buying a home is not only a transaction but also a life experience. A three-bedroom apartment in Hong Kong can be classified as a large home but may be considered as a "hole" in Canada. Therefore, psychological factors play a large role in real estate markets, and the effect of behavioral biases and heuristics deserve our attention. Equally important are the roles of cultural and social characteristics of market participants. These factors are defined as personal and local. Overconfidence may manifest differently in different countries. Investor's overconfident trading behavior has a large difference in stock markets around the world (Griffin et al., 2007); individualism is a measure of cultural difference that influences overconfidence level in the stock market (Chui et al., 2010). We should not expect that findings on overconfidence from one real estate market to be readily applicable in other parts of the world if overconfidence effects differ significantly in the transactions of homogenous and standardized products in the stock market.

Existing overconfidence studies are not geographically diversified. Table 3 provides the distribution of empirical papers by countries[4]. Studies using US data dominate and some of the large developing economies (such as China) receive minimal attention. The situation is even more extreme in real estate field. Four real estate related overconfidence studies are found in our database. All of them used US data. More empirical research on overconfidence should be conducted using data from different geographical regions. Potential findings do not only help in the decision making in this unique sector but also advance the general understanding of overconfidence.

Table 3: Distribution of papers by sample region

Topic (No. of Papers)	Investor overconfidence (15)	CEO overconfidence (20)	Total (35)
US	7	13	20
UK	0	2	2
China	0	1	1
Taiwan	4	2	6
Finland	2	0	2
France, Germany, Japan, UK, and US	1	0	1
Worldwide	0	2	2
10 Asian countries and US	1	0	1

On the other hand, real estate markets may offer ideal settings to test certain overconfidence effects than stock markets. Almost all studies on CEO overconfidence have assumed agency issues between managers and shareholders since Malmendier and Tate (2005)'s seminar work, which is hardly true in reality. Scores of scandals proved the presence of a conflict of interest between managers and shareholders. CEOs have excessive bonuses even they do not improve firm performance; investment projects with negative NPV are chosen; insider trading dampens the market value of firms. Hence, whether overinvestment is a sign of managerial overconfidence or the effect of CEOs' effort to maximize their utility is hard to tell. The confounding effect of agency problem cannot be separated within existing models. Agency problem in REITs market is less likely than that in common stock market (Bauer et al., 2010; Yung et al., 2015). REIT should pay at least 90% of their earnings as dividends, which follows the regulation of the REIT market. Therefore, the earning that can be used to pay for management is limited. When all else are equal, agency problem is reduced significantly in the REITs market. This potentially makes the REITs market an ideal setting for CEO overconfidence studies.

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[4] In this analysis, we included papers that used observed data only. Publications that used experimental data are excluded because most of them are not country specific.

4.2 How should we study overconfidence in real estate markets?

This section recommends potential topics of overconfidence studies in real estate markets. Our discussions are based on the general review in Section 3. We first present opportunities and challenges in investigating overconfidence effect among general investors and CEOs. This is followed by a discussion on some technical aspects of overconfidence studies, such as overconfidence measurements and data collection strategies.

4.2.1 Investor overconfidence

The investigation of investor overconfidence in real estate markets can be conducted in four areas: aggregate overconfidence effect, the relationship between overconfidence and investment performance, asset overpricing, and investor characteristics as overconfidence determinants or moderators. These topics are derived from our review in Section 3 with a real estate backdrop in mind. Table 4 gives key publications on each topic in the second column. The conclusions and data employed in these papers are in the third and fourth column, respectively. Real estate researchers may use these as the starting point to design their own research plans. The last column gives existing real estate publications for each topic. This helps researchers to identify gaps in the real estate literature regarding overconfidence studies.

To explore the aggregate overconfidence effect, the research question is whether there is excessive trading after market gains owing to overconfidence. The research question requires high-frequency transaction data, which could be a challenge. Real asset markets suffer from illiquidity and lack of public data. However, such data are often readily available from securitized real estate markets or REIT markets. Therefore, we are not surprised to find an existing study on this topic using US REIT data. Lin et al. (2010) examine overconfidence and trading volume in the US REIT market and found a positive return-volume relation. The finding is in line with evidences derived from stock markets. Hayunga and Lung (2011) assess the role of overconfidence in asset overpricing using publically available house price indices from US. Their conclusions are also consistent with evidences obtained using data from other financial markets. Applying existing research models to real estate markets are not difficult when public data are available. At least the two initial attempts mentioned above yielded interesting and convincing results. However, this is untrue for the other two topics.

Researchers need access to individual investors' profile and their trading records to investigate the relationship between overconfidence and investment performance or to identify investor characteristics as overconfidence determinants/moderators. Access to investor accounts is a luxury to have, which is a real challenge facing real estate researchers. We do not identify any real estate publications on this topic. However, these are two important aspects of overconfidence and have received substantial

attention in other fields (see the discussions in Section 3). The spectrum of participants in real estate markets is wide. It includes homebuyers, regulators, policy makers, and developers. Real estate investors' decisions and performance are affected by a much wider range of factors than typical investors in stock markets. Research is needed to aid the understanding of these complex decision making process. On the other hand the nature of the problems and the markets make data collection a real challenge. The two topics are present in both opportunities and challenges and deserve attentions from real estate researchers.

4.2.2 CEO overconfidence

We identified four potential research directions regarding CEO overconfidence following the strategy outlined in previous section: corporate investment decisions, firm performance, capital structure decisions, and innovation investment decisions. Key publications, main conclusions of existing literature, and typical data used in existing studies are given for each topic in Table 5.

All four topics involve information about CEO profiles and financial information at firm level, both of which are obtainable, particularly when public firms are involved. We find only two real estate publications on CEO overconfidence, both of which used data from listed real estate market (i.e., US REIT market) in their studies. Their findings are also consistent with conclusions reached in other fields. Eichholtz and Yönder (2015) found a significantly negative relationship between CEO overconfidence and firm performance. Yung et al. (2015) confirm that firms with overconfident CEOs have small dividend payout, and overconfident CEOs use more debt financing than equity. These relationships are significant in Yung et al. (2015) despite of REITs' unique dividend policy and capital structure. The effect of overconfidence seems to be strong enough to overcome these regulatory constraints. This offers strong support to the role of overconfidence in investment decisions by CEOs. The number of real estate publications in these two areas remains small, and existing findings need to be verified using data from other countries.

Studies on the last topic, overconfidence and innovation investment decisions, are not "mainstream," because they investigate the upside of CEO being overconfident. Existing findings are primarily relevant to innovation-intensive industries, such as IT or pharmaceuticals. The real estate sector is usually not considered as innovation or technology savvy. However, two recent developments in real estate research may benefit from overconfidence studies: green technology adoption and socially responsible investing.

Growing interest has been given in sustainable and responsible development and investment in real estate (see the discussions in Fuerst et al., 2014 and Deng and Wu, 2014). However, existing studies focus on physical and financial characteristics of firms or buildings. The characteristics of the decisions makers (e.g., CEOs) are often overlooked. Green technology adoption and socially responsible investing are risky

and long-term. The decisions often involve a significant amount of capital. Facing such a level of uncertainty and stake, will bolder decision-makers be more likely to take on the challenge, as suggested in the overconfidence literature? Researchers and policy-makers have been struggling to discover what motivates the adoption of sustainable technology or ideology (see the review by Revelli and Viviani, 2015 for examples). Whether CEO overconfidence contributes positively to the adoption of green technology and socially responsible investing would be interesting to find out given the significant role a CEO plays in these decisions.

Table 4: Studying investor overconfidence in real estate markets

Sub-topic	Key framework	Main conclusions	Type of data	Existing studies in RE
Aggregate overconfidence effect	Statman et al. (2006)	– Previous gains lead to overconfidence and active trading behavior. – Positive lead-lag relationship between return and turnover	Market level data (e.g., stock market indices)	Lin et al. (2010) reach similar conclusions by using US REIT data.
Investment performance	Barber and Odean (2000) Barber and Odean (2001)	– Overconfident investors trade more than necessary, and those who trade more lose more.	Individual investor profile and trading records	None
Asset overpricing	Scheinkman and Xiong (2003)	– Overconfident investors are overoptimistic about fundamentals. – Overconfident investors buy overvalued asset to sell them to more optimistic investors in the future. – Overconfidence leads to asset overpricing.	Market level data (e.g., stock market indices)	Hayunga and Lung (2011) use overconfidence to explain mispricing in the US housing markets.
Investor characteristics	Gervais and Odean (2001) Grinblatt and Keloharju (2009) Chuang and Susmel (2011)	– Investor characteristics influence the degree of overconfidence, such as age, gender, investment experience; individual vs. institutional.	Individual investor profile and trading records	None

Table 5: Studying CEO overconfidence in real estate markets

Sub-topic	Key framework	Main conclusions	Type of data	Existing studies in RE
Corporate investment decisions	Malmendier and Tate (2005, 2008)	– High corporate investment to cash flow sensitivities among overconfident CEOs – The relationship is especially significant for financially constrained firms because of the cost of debt financing is high.	– Individual CEO profile – Firm financial records	None
Firm performance	Libby and Rennekamp (2012) Chen et al. (2014)	– The shares of companies with overconfident CEOs perform weakly in the long run.	– Individual CEO profile – Firm financial records	Eichholtz and Yönder (2015) find similar results in US REIT markets.
Capital structure decisions	Deshmukh et al. (2013) Malmendier et al. (2011)	– Firms with overconfident CEOs have smaller dividend payout. – Overconfident CEOs use more debt financing than equity.	– Individual CEO profile – Firm financial records	Yung et al. (2015) find similar results in US REIT markets.
Innovation investment decisions	Galasso and Simcoe (2011) Hirshleifer et al. (2012)	– Firms with overconfident CEOs invest more in innovation, obtain more patents and patent citations, and achieve greater innovative success for given expenditures.	– Individual CEO profile – Firm financial records – Innovation measurements	None

4.3 Measurement of overconfidence and data collection strategy

Previous sections discussed the directions of overconfidence research in real estate markets. This section looks into the technical aspects of overconfidence studies by discussing the measurement of overconfidence and data collection strategy.

We summarize in Table 6 overconfidence measurements that have been proposed among the 78 publications reviewed in Section 3. We further classified the measurements by topics (i.e., investor overconfidence and CEO overconfidence). Real estate researchers may choose measurements from Table 6 based on the type of overconfidence under investigation. However, the determination of overconfidence measurement should not be confined to those given in Table 6 for the following two reasons.

First, the uniqueness of real estate markets should be considered. Eichholtz and Yönder (2014) borrow the same overconfidence measure from Malmendier and Tate (2005, 2008) because their study object (i.e., REITs) is similar to stocks. However, this measurement may not be suitable or even possible when it comes to direct real estate markets. High-frequency data are often not available in direct real estate market. Real estate researchers may need to modify existing measurements or even invent their own, which is true for the overconfidence study in the whole finance field where previous measures may not be valid under new market conditions or policies. For example, the option exercise time as a measure for CEO overconfidence may be invalid as the option-based compensation for CEOs declined (Malmendier and Tate, 2015).

Second, overconfidence is originally a psychology concept. The biggest challenge for its application in behavioral economics is constructing a reliable and robust measurement. Researchers work to improve existing measurements or propose new ones, which could offer more choices for others. On the other hand, determining which existing measurement is the most suitable one for the question at hand is equally challenging. Therefore, running a "horse race" among several alternative overconfidence measurements is helpful and necessary to check the robustness of findings. Thus, the measurements listed in Table 6 can be very helpful for real estate researchers to engage in this exercise.

Table 6: Summary of Overconfidence Measurements

	Descriptions	Representative publications
Investor Overconfidence		
• **Confidence Interval estimate**	Investors give confidence interval estimates to a set of questions. Overconfidence is measured by calculating the percentage of the correct answer, which falls outside of the reported confidence interval.	Biais et al. (2005); Glaser and Weber (2007)
• **Psychology assessment**	Psychological assessment is used to form overconfidence score.	Grinblatt and Keloharju (2009)
• **Turnover and return dynamics**	Overconfident investors attribute previous market gains to their ability and trade more in the future.	Statman et al. (2006)
• **Turnover/volume as a proxy**	Directly use turnover as a proxy for overconfidence.	Huang and Goo (2008)
CEO overconfidence		
• **Long holder**	CEOs do not exercise their vested stock options even if they have 40% in the money. (Rational CEOs should exercise their vested stock options before expiration to diversify.)	Malmendier and Tate (2005)
• **Net buyer**	CEOs are net buyers of own company equity during a period. (They have already exposed to company-specific risk.)	Malmendier and Tate (2005)
• **Earning forecast**	The proportion of earning forecasts exceed the realized earnings. (Overconfident CEOs overestimate the future performance of their firm.)	Otto (2014)
• **Business press portrayal**	Overconfidence related words are counted in leading business press.	Malmendier and Tate (2008)
• **Survey/questionnaires**	Psychological questions are designed, and the score of overconfidence is calculated.	Menkhoff et al. (2006)

Table 7: Summary of Ten Most Cited Papers in Overconfidence Studies

Year	Author(s)	Title	Source	Citation	Type
1998	Daniel, Hirshleifer, and Subrahmanyam	Investor psychology and security market under- and overreactions	Journal of Finance	837	Investor overconfidence
2001	Barber and Odean	Boys will be boys: Gender, overconfidence, and common stock investment	Quarterly Journal of Economics	476	Investor overconfidence
2000	Barber and Odean	Trading is hazardous to your wealth: The common stock investment performance of individual investors	Journal of Finance	464	Investor overconfidence
1999	Camerer and Lovallo	Overconfidence and excess entry: An experimental approach	American Economic Review	410	Investor overconfidence
1999	Odean	Do investors trade too much?	American Economic Review	335	Investor overconfidence
1998	Odean	Volume, volatility, price, and profit when all traders are above average	Journal of Finance	298	Investor overconfidence
2005	Malmendier and Tate	CEO overconfidence and corporate investment	Journal of Finance	287	CEO Overconfidence
2003	Scheinkman and Xiong	Overconfidence and speculative bubbles	Journal of Political Economy	263	Investor overconfidence
2001	Gervais and Odean	Learning to be overconfident	Review of Financial Studies	218	Investor overconfidence
2008	Malmendier and Tate	Who makes acquisitions? CEO overconfidence and the market's reaction	Journal of Financial Economics	176	CEO Overconfidence

Another important practical issue in overconfidence studies is data collection strategy or the decisions between field observations or experiment data. About 20 (or 27%) out of the 78 selected articles in our database are theoretical studies, whereas the other 58 (or 73%) are empirical ones. We classify empirical studies into two subcategories based on data collection methods: those using observations and those deal with experimental data. Observations are directly obtained from certain databases or private sources, including public market data (e.g., Statman et al., 2006; Grinblatt and Keloharju, 2009), account data from brokerage (e.g., Barber and Odean, 2001; Odean, 1999), press descriptions of CEOs (e.g., Hirshleifer et al., 2012; Shu et al., 2013), CEO transaction data (e.g., Doukas and Petmezas, 2007), and merger and acquisition data (e.g., Billett and Qian, 2008). Experimental data are collected through experiments, including laboratory experiments (e.g., Deaves et al., 2009; Lambert et al., 2012), survey data (e.g., Forbes, 2005; Glaser and Weber, 2007), and online questionnaires (e.g., Trevelyan, 2008)[5].

Observed data are often the true reflection of real life situations; however, overconfidence measurements based on this type of data are often indirect. For example, in Hirshleifer et al. (2012) and Shu et al. (2013), the level of CEO overconfidence is estimated indirectly by counting certain keywords relating to the overconfidence of CEOs in news media. On the other hand, experimental data can provide direct measurement of overconfidence through experimental designs. Our general review do not show strong preference toward either approach. Publications are nearly evenly split among the two categories.

However, observed data are used in five of them when we zoom into the 10 most cited papers (See Table 7), whereas only one paper uses experimental data; the other four are theoretical works. Among the five papers using observed data, investor transaction data obtained from brokerages are used three times (Odean, 1999; Barber and Odean, 2000, 2001) and CEO transaction data are used twice (Malmendier and Tate, 2005, 2008). Such findings suggest that transaction data are used more than experimental data in these leading empirical works because it involves high external validity. This poses a challenge to real estate researchers because similar data may not be readily available. Real assets transactions are far less frequent than most of other asset classes. However, experimental data may not even be an option because it is difficult to replicate the complex decision making scenarios in lab environment. Future research should consider this observation by carefully evaluating data availability to ensure both internal and external validity.

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[5] In this paper, we adopt a broad definition of experimental data by including survey and online questionnaire data to keep the classification concise. Our conclusions still hold when these two data types are separated from lab and field experiments and placed in separate categories.

5. Conclusion

This paper reviews the overconfidence literature from 1998 to 2014. A total of 78 peer-reviewed articles were selected for analysis. A growing number of publications and citations have been available over the past 16 years. The wide acceptance by top finance and economics journal reflects the importance of this topic.

Our analysis demonstrates that overconfidence studies in real estate markets face both challenges and opportunities. Although high-frequency transaction data are common in overconfidence studies in stock markets, this is not readily available in real estate markets because transactions are often far between. Moreover, experimental data is also hard to generate because real estate decisions are difficult to replicate or simulate in laboratory environment. Real estate investment decisions also involve more complex products and agents than other asset markets. These are the main challenges facing real estate researchers when studying overconfidence effects. On the other hand, real estate markets are less prone to agency problems, which provides a better environment to separate the net effect of overconfidence. Overconfidence may play a positive role in encouraging investment in innovations, such as energy conservation technology or socially responsible investment in the real estate sector. These are opportunities to further our understanding on the role of overconfidence.

The overconfidence research in real estate has just begun; however, this area is significant. The widely accepted research methods in stock markets could also be adopted in real estate research. Nevertheless, no theories should be applied without fine toning. This is particularly true when it comes to the real estate market, where information asymmetry and illiquidity is prevalent. Researchers and practitioners can leverage findings from this paper to better design and implement their research plans on the roles of overconfidence in real estate investment decisions.

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