Secondary market trading of non-listed real estate funds

'Defining premiums and discounts to net asset value'

Amsterdam School of Real Estate
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‘*For Anna, because I promised*’

Acknowledgement

In front of you lies my Master thesis 'Secondary market trading in non-listed real estate funds'. The research is the capstone of my master (MSRE) journey at Amsterdam School of Real Estate and an attempt to contribute to improve the transparency of the non-listed real estate fund market.

I've always been taught to focus on things that energize, to look beyond the given in life and to challenge myself to achieve more ambiguous goals. I've also tried to reflect this in this thesis. The matter around the secondary trading market of non-listed real estate funds has grabbed my attention the last years from a business perspective. This inspired me to put this subject central for my thesis. The non-listed real estate market is generally known as an opaque market, which would make it more challenging to perform research in this field. Instead of running away from this thought, I was determined to break through this mindset and aimed to contribute to new insights for the non-listed real estate fund market. Off course this journey has not been easy, has cost me hours of toiling and made me decide to compromise on social life. However, I'm very proud on the final product.

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I hope you enjoy the content of this thesis as much I've enjoyed writing it.

Joey Korteland

20 February 2022

Abstract

This study focusses on understanding the mechanism of market pricing deviations (premiums and discounts) from fundamental value of secondary trades in European non-listed real estate funds at the one hand and determinants that influence these pricing deviations at the other hand. Net asset value (NAV) has been used as a proxy for fundamental value. The following research question is answered:

What are the business economic determinants that cause pricing deviations (premiums and discount) from fundamental value of European non-listed real estate funds on the secondary trading market?

The efficient market hypothesis (EMH) embraces the 'law of one price' in which equilibrium asset prices equal fundamental value, reflect all available information at any point in time, investor are rational in a competitive market and countervailing irrationalities are arbitraged away. The behavioral view challenges this theory and found anomalous patterns to the EMH in price can differ insistently from the rational fundamental market value.

In the study 12 anomalous patterns have been regarded for pricing deviations (premiums and discounts) from fundamental value on the secondary trading market, based on existing empirical research. A comprehensive dataset of PropertyMatch on European secondary traded non-listed real estate funds is used including 1435 transactions of 91 different investment vehicles over the period 2010 until 2018. This dataset is complemented with specific fund characteristics from INREV, AREF or original company fund documentation.

(H_1) Managerial performance [*AGE*], (H_2) asset illiquidity [*VEH*], (H_4) market diversification [SECT/COUNTRY/STYLE], (H_6) investor sentiment [$SENT_{-1}$], (H_9) leverage [*LEV*] and (H_{12}) size [SIZE] are investigated as possible causes of pricing deviations to NAV [NAV_{DEV}]. Other possible causes of NAV_{DEV} such as capital gain tax liabilities (H_3), dividend yield (H_5), adverse selection costs (H_7), transaction costs (H_8), P/E ratio (H_{10}) and valuation skepticism (H_{11}) have not been examined due to a lack of (representative) data availability and matching issues with the PropertyMatch database.

By means of descriptive statistics, cross sectional bivariate analysis and simple- and multiple regression analysis an answer is given on the question if patterns can be distinguished in market pricing deviations (premiums and discounts) from fundamental value in historic data of European non-listed real estate funds that are traded on the secondary market.

It is found that on basis of the cross-sectional analysis that *AGE*, *VEH, LEV,* $SENT_{-1}$, *SECT, STYLE and SIZE* show to be a significant predictor of pricing deviation from fundamental value of European non-listed real estate funds on the secondary trading market at a 5% significance level. Although for $SENT_{-1}$ H_6 and for LEV H_9 could not be supported, a significant negative relation and predictable value has been found regarding NAV_{DEV}. *COUNTRY* show only to be a significant predictor of pricing deviation at a 10% significance level.

The findings contribute to the anomalous behavioral view on the EMH that markets are not efficient. The secondary trading market of non-listed real estate funds is not complete. Investors are not rational, information is not universally distributed amongst investors and not quickly absorbed and rationally reflected in asset prices. This results in errors of share price compared to fundamental value on the short run. Extreme market movements are difficult to observe and short-term arbitrage trading strategies difficult to exploit. As a result market prices can differ from their fundamental value over longer periods of time. Time varying mean reversion patterns on the long run have not been observed in this cross sectional study. This might be an interesting topic for further research.

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List of abbreviations

AREF The Association of Real Estate Funds
CEF Closed-end fund
CEFP Closed-end fund puzzle
CGT Capital gain tax
DTL Deferred tax liability
DV Dependent variable
EMH Efficient Market Hypothesis
ETF Exchange Traded Fund
EU Europe
FX Foreign exchange
GP General Partner
IV Independent variable
LP Limited Partner
LSE London Stock Exchange
LTV Loan to value
GAV Gross asset value
IPO Initial public offering
INREV European Association for Investors in Non-Listed Real Estate Vehicles
ISH Investor sentiment hypothesis
MSCI Morgan Stanley Capital International
NAV Net asset value
NYSE New York stock Exchange
OTC Over-the-counter
OEF Open-end fund
P/E Price-to-earnings
REIT Real Estate Investment Trust
ROFR Right of first refusal
SOEF Semi-open-end fund
UK United Kingdom
US United States

Introduction

1.1 Cause of investigation

The investment universe of real estate is generally assumed as 'alternative investment' and frequently divided into direct investments, listed real estate and non-listed (private) real estate vehicles. Listed and non-listed real estate funds are assumed separate asset classes with different correlations and volatilities. Listed real estate funds are open market and frequently traded funds, merely seen as tactical equity holdings rather than strategic real estate investments (Baum, 2012). Non-listed funds are non-frequently traded and non-publicly disseminated funds that are typically associated with a lack of transparency, limited size and complicated structures (Brounen, Op 't Veld, & Raitio, 2007) (Roulac, 1988). Although, non-listed funds avoid the exposure to sentiment and volatility on the stock market and allow investors for easier diversification in e.g. sectors and countries, they are much less liquid than listed funds.

In early 21st century a secondary trading market for non-listed real estate funds emerged in which interests of real estate funds are traded over-the-counter (OTC) (CBRE, 2018). An investment structure that dates back to the 1980s, when the private equity secondaries market emerged (CAIA Assocation, 2016). The positioning of the secondaries market in the real estate investment universe is visualized in figure 1. The secondary market provides investors with an alternative path to real estate exposure and decreases the liquidity issue of the non-listed sector. In addition, this secondary market enables investors for relatively quick and efficient trading in real estate risk. It increases their flexibility and supplies in a portfolio management tool. Hence, it gives them the ability to better rebalance portfolio's in changing market environments and invest in real estate along the cycle.

Figure 1 Position secondary market of non- listed real estate funds in real estate investment universe

Generally non-listed real estate funds are structured as partnerships with the investors as limited partnerships (LP's) and a specialized Fund Manager as general partner (GP) as referred to in figure 2. These funds are commonly characterized as long-term investments and have no or limited redemption rights or similar liquidity right for the LP's in unusual circumstances (Barker, Seah, & Shilling, 2018)

In this case the OTC market allows investors (mostly limited partnerships) to sell their interest in non-listed funds, prematurely of the exit possibility of their holding, to a new owner in case investment funds do e.g. not offer redemption possibilities or liquidity mechanisms. The buyer assumes all rights and obligations of the seller including any remaining open commitments to the funds that are sold. Usually consent of the Fund Manager (or general partner) is required to conclude a transfer process (CAIA Assocation, 2016). This trading structure is presented in figure 2.

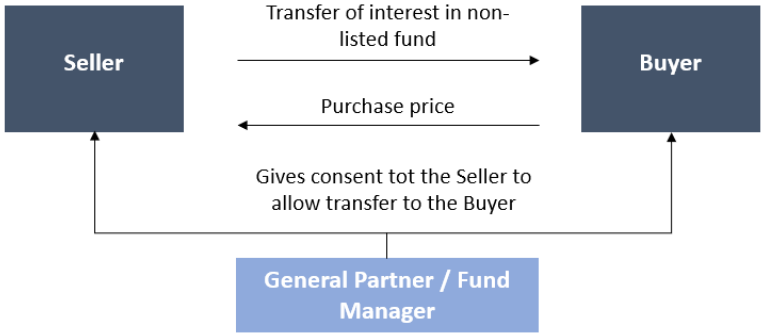


Figure 2 Involved parties in secondary transaction of non-listed fund. Source: *(CAIA Assocation, 2016)*

Based on data from Landmark Partners, a longstanding investor in the real estate secondary market, the market for secondary trading of non-listed real estate funds has grown significantly from 1996 until 2018. Trading volumes increased from $ 406 million to $ 5.3 billion respectively, with a trading volume peak in 2015 at $ 7.5 billion. See Figure 3. These numbers exclude trades that are not disseminated publicly and therefore understate the total market volume. The expected total market volume is $ 9 billion (Zander, 2019). This trend is also substantiated by secondary market trade volume reports of Setter Capital (2013-2018), in which ~~trades~~ trade volumes of most active global fund managers and institutional investors in the secondaries market for alternative investments are reported. Trading volumes of non-listed real estate funds went up to $4.0 billion in 2018, with a trading volume peak in 2015 of $8.1 billion.

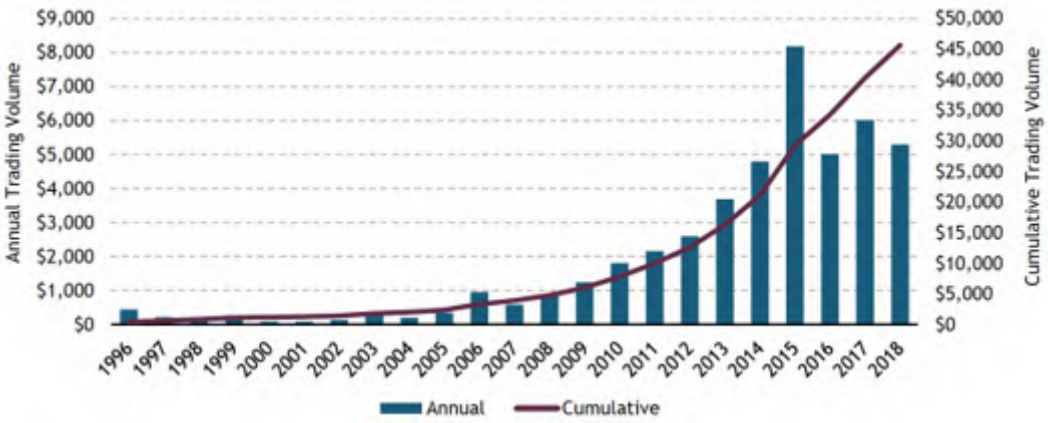


Figure 3 Real Estate secondary transaction volume 1996-2018 (in million $) Source: Landmark Partners

During the financial crisis in 2008 and 2009 the belief was that secondary transactions in non-listed real estate funds were merely used by investors to exit illiquid real estate holdings while not being able to correctly underwrite the original investment. Thus accepted losses on net asset value (NAV). Since the market has become more mature, more (world leading) investors are noticing chances to use the secondary market for their portfolio management strategy: e.g. simplify portfolio's, consolidate relationships with GP's and reduce management fees. (PERE, 2016). It is expected that this has a positive effect on liquidity and spreads in asset pricing of non-listed real estate funds (Bodner, Furlan, & Vasilieva, 2018).

1.2 Problem Statement

Following the Efficient Market Hypothesis (EMH), in a 'perfect financial market' stock prices fully reflect available information and respond immediately to new information (Fama, 1970). In this mechanism, it is assumed that stock price movement are random and unpredictable and that there are no possibilities to identify mispriced securities and outperform stock markets by active trading. Investors can expect a normal rate of return and a fair value of their shares, perfectly reflecting present value of the underlaying asset. (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, pp. 345-347)

However, as e.g. Brounen et al. (2007), Barker et al. (2018) and Roulac (1988) already indicated, the real estate market is opaque. In contrast to public real estate investments that are merely based on stock market fundamentals, private real estate investments are mainly focused on fund characteristics. Particular non-listed vehicles do not publicly publish e.g. prospectuses, real asset holdings, performance data, valuations and day trade levels. This might have an effect on the system of dynamic asset pricing in which market values may defer from fundamental values of assets, so called premiums and discounts**.**

1.3 Objective

This research focusses on (further) understanding the OTC market of non-listed real estate funds. The purpose of the research is to better understand the mechanism of pricing deviations (premiums and discounts) from fundamental value in general and European non-listed real estate funds on the secondary market more specifically. In addition, the purpose of the research is to explore which determinants influence the pricing deviations from fundamental value of non-listed real estate funds that are traded over the counter, potential (causal) relations, underlying motivations and arbitrage possibilities.

1.4 Relevance

Due to the inefficient and inaccessible market of non-listed real estate funds, to date there have been performed limited empirical studies on the non-listed real estate market. And as such on the asset pricing mechanism in this market. As the market is becoming more mature and legit for professional investors, a more profound insight in the asset pricing mechanism and determinants of pricing deviations (premiums and discounts) is needed to make better informed investment decisions.

The research will build on and relate to existing general financial theory on asset pricing in secondary trading markets and will translate understanding of the emergence of premiums and discounts in these markets to the real estate investment industry.

At the one hand this research will increase the transparency in the real estate investment universe and lever on better informed decision-making in the real estate investment industry. As Roulac (1988, p. 35) indicated in his research, further securitization of the real estate investments will pave the way for a sizable market in which investors can create their own investment portfolios that suit their needs. Including e.g. the selection on property types, geographic regions and manager styles. Together with more transparency, which is expected to result in higher liquidity, this will help grow the potential for this trading market and might open the market for new investors whom never had the ability to invest in this sector.

Additionally, Fund managers or GP's of non-listed real estate funds will be better able to understand their product offering and market their products in the real estate investment universe. Which enables them to adjust their fund documentation accordingly, so investment analyst, whom currently not have a focus on the non-listed real estate sector because of the lack in transparency, will be better able to evaluate this segment (Kempen, 2017).

1.5 Research question

The problem statement as set out in paragraph 1.2 has led to the following research question:

What are the business economic determinants that cause pricing deviations (premiums and discount) from fundamental value of European non-listed real estate funds on the secondary trading market?

The definitions used in the research question, are defined as the following:

Secondary trading market: *The market place where an 'existing investor transfers units or shares in a vehicle directly to another investor (either a new investor, or one already invested in the vehicle), based on pricing and terms agreed between the two parties, without the occurrence of new share/unit issue or redemption by the vehicle itself' (INREV, 2017)*

Non-listed real estate funds: *Real estate investment vehicles, from funds to joint ventures, which are not listed on the stock exchange and hold direct real estate assets. Non-listed real estate vehicles are part of the overall real estate investment industry, can take many forms and target a variety of strategies (INREV, 2017).*

Fundamental value: *The present value of all expected future cashflows of an investments, discounted at an appropriate discount rate given its level of risk (CFI, 2021). In this research, Net Asset Value (NAV) is used as a proxy for fundamental value. NAV is described as the gross asset value (GAV) or fair value that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date less total liabilities.* (IFRS® Foundation, 2020) (INREV, 2017)

Premium and discount: *The 'absolute' price offered by an investor for units or shares in a vehicle above (premium) or below (discount) the fundamental value of an investment (Baum, 2009).*

Business economic determinants: *Economic, financial, legal or fiscal causes that control or affect pricing deviations (premiums and discounts) from fundamental value* (Cambridge University Press, 2020).

1.6 Sub-questions

The research question will be answered by using the following sub-questions. The first three sub-questions regard the theoretical framework to pronounce several expectations for the empirical research. Sub question four and five regard the empirical research of this study and sub question six makes the connections between theory and empiricism to answer the central research question.

1. How is the mechanism of pricing deviations (premiums and discounts) from fundamental value explained from the Efficient Market Hypothesis (EMH) on asset pricing?
2. Which (causal) determinants of de pricing deviations from fundamental value can be determined from empirical studies on secondary trading markets?
3. How are the determinants of pricing deviations from fundamental value, as reported in empirical studies on the secondary trading market in general, reflected on trading opportunities and/or limitations in the secondary trading market of non-listed real estate funds?

4. Which quantitative research methodology is predominantly used in empirical studies to identify (causal) effects on pricing deviations from fundamental value?
5. Can any patterns be distinguished by projecting the outcomes from sub question 1 up and until 4 on historic data of premiums and discounts on the secondary trading market of European non-listed real estate Funds?
6. How do these outcomes on the secondary trading market of non-listed real estate funds relate to the Efficient Market Hypothesis (EMH) on asset pricing?

1.7 Research method

1.7.1 Type of research

This study can be classified as an explorative research, exploring potential (causal) relations and underlying motivations of pricing deviations (premiums and discounts) from fundamental value within the secondary market of non-listed real estate funds. A general theory is formed on the outcomes of the study and hypothesis are formulated for further research.

1.7.2 Research scope

The study will focus on secondary trading of European non-listed real estate funds. Therefore the study is limited to the OTC market and does not focus on private placements of shares (IPO's). The study includes both countries from Continental Europa and its surrounding islands (e.g. United Kingdom, Nordics and Mediterranean islands). At the one side to minimize the noise from regulatory risk of several business environments (e.g. European, American and Asian markets). At the other side to base the study on a reliable data set. Unless the secondary market in securities is a formal trading exchange since early 1600s (Petram, 2011), the secondary market for non-listed real estate funds has emerged from the first century of '00s. CBRE and GFI Group launched PropertyMatch[1] in 2009 to bring e.g. transparency, liquidity and professionalism to what previously had been an opaque and irregular market (CBRE, 2018). Although trades are currently being made in Europe, United States and the Asia-Pacific region, PropertyMatch has grown from the United Kingdom and therefore the database is most extensive for European trades (including the United Kingdom and Nordics). PropertyMatch has a unique but confidential database in which data is registered from September 2009 until present. To be better able to compare results, for this research only data from full calendar years 2010 until 2018 have been used.

Furthermore this research has been mainly approached from a business economic perspective, covering economic, financial, legal and fiscal aspects. This perspective is in the scope of the real estate investment domain, which has been chosen as specialization in the master's degree and stays closest to the background of the researcher.

[1] A platform to market property derivatives

1.7.3 Research model

The research has been executed and drawn up according to the TPA-structure of Van Hoek-Gerritsen (2015, pp. 102-103). The elements Theory, Practice and Analysis (TPA) have been integrated in the research as presented in figure 4:

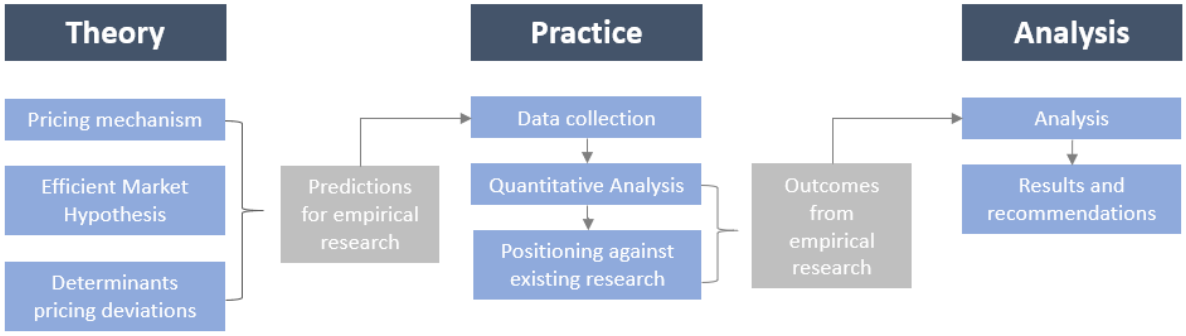


Figure 4 Research model

1.7.3.1 Theoretical framework

To research the theoretical and empirical foundations of the EMH in relation to the asset pricing mechanism and (causal) determinants of market pricing deviations from fundamental value (sub questions 1 and 2), desk research has been performed. The goal of the desk research is twofold. At the one side to investigate the mechanism of asset pricing in general and specifically in relation to the EMH. Also anomalies on the EMH are discussed that have been empirically proven and explain the existence of pricing deviations from fundamental value. At the other side the desk research examines which (causal) determinants of market pricing deviations from fundamental value have been empirically determined in the secondary trading market. The outcomes of the theoretical and empirical foundations have subsequently been reflected on trading opportunities and/or limitations in the secondary trading market of non-listed real estate funds. The theoretical framework is concluded with predictions that are examined in the empirical research part.

1.7.3.2 Empirical research

To research market practice of secondary trades of non-listed real estate funds in relation to the theoretical framework, empirical research have been performed with quantitative analysis (sub question 3, 4 and 5). Determinants that explain market pricing deviations (premiums and discounts) from fundamental value in secondary trading markets are combined with data from secondary market trades of non-listed real estate funds. First, the predictions from sub question 2 are put in relation to the secondary market of non-listed real estate funds (sub question 3). Further, the research methodology of the empirical research has been substantiated (sub question 4). Also a justification is given on the data collection and the structure of the database, including choices for the selected determinants in the statistical analysis. Comprehensive data from PropertyMatch trading platform for the period 2010 until 2018 is used, enriched and analyzed in software program Stata (version 14.0). NAV is used as a proxy for fundamental value of non-listed real estate funds. By means of descriptive statistics and cross sectional regression analysis an answer is given on the question if patterns can be distinguished in market pricing deviations (premiums and discounts) from fundamental value in historic data of European non-listed real estate funds that are traded on the secondary market (sub questions 5). Finally, the outcomes of the empirical research have been positioned in relation to existing research. Further justification of the methodology used in the empirical research can be found in chapter 3.

1.7.3 Critical synthesis and conclusion

To conclude the research, all outcomes of the theoretical framework and empirical research are integrally analyzed and discussed. A clear synthesis is given on the results. By means of the critical synthesis, an answer is given on sub question 6. Any observed effects on asset pricing, as well as their effect on (il)liquidity premiums and discounts are synthesized and brought in relationship to the EMH. Particularities are indicated and outliers explained. Finally the consequences of the research outcomes and managerial relevance to the real estate investment sector are regarded and general statements are formulated for further research.

1.8 Reading guide

The structure of this research is aligned with the research model as set out in the previous chapter. Chapter 2 covers the theoretical framework of the research and answers sub questions 1 up and until 3. In chapter 3 the empirical research framework is discussed and contains the justification of the research methodology and explanation of the dataset and selected variables. In this chapter sub question 4 is answered. Chapter 4 is devoted to the presentation and description of the outcomes of the empirical research. A critical synthesis on the outcomes of the empirical research in relation to the theoretical framework is discussed in chapter 5. In this chapter an answer is given on sub question 5 and 6. In chapter 6, the final conclusion is given on the research question. Final chapter 7 addresses outliers and particularities of the research as well as the practical consequences and managerial relevance. Also recommendations for further study are given in this chapter.

2. Theoretical framework

Investment theory is part of socio-economic science in which economy, behavioral science and business administration coincide in financial, legal and fiscal theorems. Asset pricing models are used to determine the required rate of return of an investment, which return seems to be in balance with e.g. risk and pricing. In this research the mechanism of asset pricing is put central. And more specifically the existence of premiums and discounts on net asset value.

In this chapter the terms 'price' and 'value' will be operationalized and put in relation to the research question. In addition, an answer is given to the questions how the mechanism of pricing deviations from net asset value is explained from the Efficient Market Hypothesis (sub question 1). And, in addition, which (causal) determinants of de pricing deviations from fundamental value can be determined from empirical studies on secondary trading markets (sub question 2).

After a substantiation of the selected literature for the theoretical framework in paragraph 2.1, in paragraph 2.2 a definition of the term price and value is operationalized and the general theory on asset pricing is discussed. In paragraph 2.3 the asset pricing mechanism will be accessed from the efficient market hypotheses (EMH) that is conceived in neoclassical finance. The chapter will discuss what the EMH entails and which predictions come forward from this theory. Contrary, in paragraph 2.4 the critics and anomalies on the EMH will be discussed, which comes forward from the intellectual legacy of behavioral finance. This chapter gives answer to sub question 1. In paragraph 2.5 empirical evidence from research on determinants of pricing deviations from fundamental value is regarded. This evidence is translated into predictions on expected pricing deviations from fundamental value in paragraph 2.6. This paragraph gives answer on sub question 2. Chapter 2 is concluded in paragraph 2.7 by a brief background on the characteristics of non-listed real estate funds and a perspective on the predictions that are summarized in paragraph 2.6. In this chapter an answer is given on sub question 3. The prediction on expected pricing deviations from fundamental value of non-listed real estate funds in the secondary trading market form the basis for the empirical research chapters of this study (Chapter 3 and 4). Last a critical evaluation of the outcomes of the theoretical framework is set out in paragraph 2.8.

2.1 Selection of studies

To set out the theoretical framework, articles are searched through Google Scholar, the literature library of the Amsterdam School of Real Estate ("Vastgoedbibliotheek") and the research database of EBSCO Information Services. These databases have proven to deliver sufficient qualitative material for academic research. To find suitable articles in relation to the research questions, keyword such as 'price definition', 'asset pricing', 'efficient market hypothesis', 'secondary trading', 'premiums- and discounts' and 'closed end fund puzzle' have been used. These search queries appeared to be effective. To increase the reliability of the theoretical framework, preferably scientific journals have been used that have a high ranking on the Scientific Journal Ranking (e.g. Quarterly Journal of Economics, Journal of Finance, Review of Economic Studies and Review of Financial Studies). Therewith the reliability of the theoretical framework increases.

In case academic research was not sufficient to substantiate certain predictions or argumentation, publications and professional literature of universities, leading firms and business authorities in the industry are used to complement argumentations such as Baum (2009), CBRE (2018), Hillier et al. (2016), Krause (2001) and Qian (2019).

2.2 Asset pricing mechanism

Asset pricing theory has a central role in general finance theory and its application. Every asset, liability or cash flow has a (fundamental) value, but a poignant problem is how to determine the right price (Cheng & Tong, 2008). The theory of asset pricing is focused on the explanation and determination of asset prices in a uncertain world. Mispricing of assets would result in inefficiencies in investments as well as consumption in the real economy (Qian, 2019).

2.2.1 Cost base pricing theory

The scientific terminology that describes the term 'price' has a long historical setup. In this study 'price' is regarded as:

'The quantity of goods given or received in exchange for another good when viewed as payment for the goods against which they are traded' (Fetter, 1912, p. 813).

In classical economics the term 'price' has been best characterized by economist and philosopher Adam Smith (1776). He introduced the concept that the cost of production is the most important factor in a products price. Smith implied 'price' as a non-monetary objective from commodities which he defined as 'natural price' and is neither more nor less than the costs to produce a product (including e.g. land rent and labor costs) and bring it to the market for sale according to natural rates and at a sufficient profit (Smith, 1776, p. 72). A natural price is the lowest price the seller can afford to take and continue its business. A price below the natural price will not be adequate to guarantee a continuing supply (Smith, 1776, p. 79). Relating this to current financial terminology, natural price can best be identified with 'fundamental value' of an asset (Krause, 2001, p. 11).

Smith also explained that the 'natural price' is a gauge for 'real value' of the non-monetary commodities (Smith, 1776, p. 73). This price can best be identified with 'market price' of an asset (Krause, 2001, p. 11). A competitive mechanism of demand and supply may diverge the 'market price' from its 'fundamental value'. However, following Smith, due to competition among producers, in the long run the 'market price' will continuously converge to the 'natural price'. As such the 'natural price' is an equilibrium to which prices of commodities continuously gravitate (Smith, 1776, p. 73). From this body of thought it can be reasoned that the market price of an asset may deviate from its fundamental value in the short term, but in the long run will smoothen and follow the fundamental value.

This characterization of 'price' and the competitive asset pricing mechanism theory of Smith have become an important concept in classical economics. Later, e.g. Fetter (1912) regarded the definition of price and defended that 'price' is not limited to a non-monetary objective exchange value as Smith implied, but could also be monetary and expressed as a subjective value or ratio of exchange.

2.2.2 Consumption based pricing theory

In neoclassical economics, which emerged around 1900s, a competitive idea was introduced to the classical concept of asset pricing grounded on cost base pricing. One of the key assumptions of the neoclassical idea on price is that the consumer's perception of a products value is the driving determinant in a products price (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016).

From the early 1950's many economist and researchers have created consumption based pricing methodologies to find the answer on the poignant problem how the right price of an asset could be determined. Empirical proof of two main principles have driven the development of the neoclassical asset pricing theory, namely (1) the existence of a general equilibrium in asset pricing, and (2) asset pricing based on rationality. The latter corresponding with risk-neutral asset pricing (Cheng & Tong, 2008, pp. 1-5).

1. General equilibrium: The French economist Leon Walras in 1874 introduced the general equilibrium theory, in which prices and quantities in economic systems interact dynamically on supply and demand and eventually culminate in a price equilibrium (1955). Arrow and Debreu (1954) were the first to find empirical evidence of the existence of a general equilibrium of 'state price' in which utility of the consumer (demand) and profit of the producer (supply) are maximized and in seamless balance, taking into account conditions of a perfect competitive market. The latter is also defined as 'Pareto Efficiency' or 'Market clearing' in which the redistribution of resources cannot make one individual better off without making one other individual worse off.

The most important contributions to the general equilibrium model of asset pricing are the mean-variance efficient frontier from the modern portfolio theory of Markowitz (1952) and the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Linter (1965) and Mossin (1966). The theory of Markowitz considers a balance between risk (variance) and return (mean) to obtain an optimal portfolio with a minimum risk level. CAPM is a consumption based single factor model for financial markets at equilibrium state, which elaborates on the mean-variance measure of Markowitz and relates expected returns to market (or systematic) risk.

2. Rational asset pricing: The assumption of rational pricing is that asset prices reflect an arbitrage-free price of the asset, also known as the 'law of one price'. Any deviations on the equilibrium price will be inevitably eliminated by the market. In rational asset pricing models, capital markets are assumed efficient in which asset prices fully reflect available information at any point in time and respond immediately to new information (Fama, 1970) (Fama, 1991).

2.2.3 Fundamental theorems of asset pricing

Both, the concepts of a (1) general equilibrium and (2) rational asset pricing, are interrelated through the fundamental theorems of asset pricing. A theory on which most modern finance theories are based. The theory assumes two fundamental concepts:

a. The first fundamental theorem of asset pricing: '*Markets are arbitrage free'*
b. The second fundamental theorem of asset Pricing: '*Markets are discrete and complete'*

The theorems stemmed from the urge to further understand the concept of pricing by 'no arbitrage' and the approach of consisting in value expectations in asset pricing. Both theorems assume that a price can be derived for every asset under these conditions.

The first fundamental theorem (a) relates the concept of no arbitrage to the existence of an equivalent martingale measure. Here arbitrage means that one generates profit from the simultaneous purchase and sale of identical assets (or substitutes) in different (same) markets. The profit is generated at a risk-free basis, while taking advantage of market inefficiencies that eventually dissolve themselves (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, p. 347). The equivalent martingale measure is explained as a risk-neutral probability measure that represents risk aversion of investors in investment markets (Downarowicz, 2010). Ross (1976) was the first to propose the Arbitrage Pricing Theory (APT) as an alternative model to CAPM. APT assumes that in investment markets sometimes securities are mispriced, before market prices correct and diverge to fundamental values. In contrast to CAPM, which sets of expected return to a one-dimensional risk factor, the APT is a multi-factor linear model in which the expected return is explained by several (undefined) risk factors and sensitivities.

Harrison and Kreps (1979), Harrison and Pliska (1981) and Kreps (1981) made significant contributions to the APT theory and included finite probability space and time dimensions. As well as Dalang et al. (1990) who concluded that in finite discrete time the condition of no arbitrage is equivalent to the existence of an equivalent martingale measure (risk neutral probability). These findings bring one

another to the second fundamental theorem of asset pricing (b), which concerns discrete and complete markets. The theorem relates the notion of market completeness to the uniqueness of the equivalent martingale measure. In the theory complete markets are characterized as liquid and frictionless markets with a finite number of assets in which conditional claims can be approached and duplicated by other investment strategies (Battig & Jarrow, 1999). A complete market embraces all commodities and contingencies in which transaction costs are neglectable and there is no information asymmetry (Arrow & Hahn, 1971).

Concluding on both fundamental theorems of asset pricing, in markets with finite space and time dimensions, the existence of a fixed equivalent martingale measure implies that there are no arbitrage opportunities. And as in these markets, completeness equals with the uniqueness of the equivalent martingale measure, complete markets are assumed arbitrage free.

2.3 Efficient market hypothesis (EMH)

Although asset pricing theories are focused on explaining (observed) prices, in reality they merely present explanations for the determination of fundamental value (Krause, 2001). The efficient market hypothesis (EMH) has arisen the proposal that there is a close connection between the fundamental value of assets and their price, suggesting that asset price should always equal its fundamental value. As this theory has a central position in finance for more than 30 years (Schleifer, 2000), In this research this theory is put central to further understand the general mechanism of asset pricing.

2.3.1 Theoretical foundations of the EMH

The Efficient Market Hypothesis (EMH) is an investment theory that primarily originates from the research of Eugene Fama (1970). The theory entails an equilibrium pricing mechanism in a competitive market with fully rational investors. Fama defined an efficient financial market as one in which (i) there are no transaction costs for trading securities, (ii) stock prices fully reflect available information at any point in time and (iii) stock prices respond immediately to new information. In this mechanism, it is assumed that stock price movement are random and unpredictable and as such mispriced securities do not exist. In case new information is presented in an efficient market, all actors will adjust their expectations on stock prices immediately. Pessimistic and optimistic trading behavior of investors will diverge immediately in a new equilibrium. Therefore, investors cannot outperform stock markets by active trading and earn a balanced rate of return in relation to risk. This means that securities reflect a fair value that equals the net present value of future cash flows discounted at a proportionate risk. (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, pp. 345-347) (Fama, 1991).

Following Schleifer (2000) market efficiency is led by three theoretical foundations, namely (1) rationality, (2) independent (emotional) deviations from rationality and (3) arbitrage:

1. **Rationality.** In a perfect efficient market all investors are assumed rational, whom have full access to new information and adjust this information into stock value estimates in a rational manner.
2. **Independent (emotional) deviations from rationality.** Stock prices follow ‘random walks’. See e.g. Samuelson (1965) and Mandelbrot (1966). Stock trades are random and, in case investors are not acting rational, cancel each other out without affecting prices. The trading strategies of investors do not correlate and as such irrationalities (excessive optimism and pessimism) countervail and are offset at all times.
3. **Arbitrage.** In case investors are irrational in similar ways and thus trading strategies correlate (e.g. strategies of amateurs led by emotions), rational arbitrageurs (generally professionals)

eliminate price deviations. In this case arbitrage balances out speculative behavior and keeps markets efficient. This foundation is e.g. explained by Friedman (1953) and Fama (1965).

Concluding on the EMH, the theory set out the following predictions:

i. Market are complete and competitive in which all information is easily accessible to and obtainable by any investor;
ii. Stock prices fully reflect available market information at any point in time;
iii. Stock price movements are random and unpredictable; countervailing irrationalities of investors (under- or overreactions to information) are cancelled out or arbitraged away;
iv. Expected returns in excess of equilibrium expected returns are not possible. The stock price equals the stocks' fundamental value.

2.3.2 Variations on the EMH

The EMH assumes that in the pricing mechanism of efficient markets, prices respond immediately to all (new) available information. This response is expected to be 'quickly' and 'correctly', meaning that investors whom receive the information late will not profit from this information (quickly) and price adjustments will never underreact nor overreact to this information (correctly) (Schleifer, 2000). Based on historical empirical research Fama (1970) concluded that share prices may react more quickly to some information than others and thus empirical predictions of the EMH can be classified in different categories. In this classification system differential response rates of prices on information supply are taken into account. Fama (1970) distinguishes three types (1) a weak form based on information of past prices (or return) histories, (2) a semi-strong form based on publicly available information and (3) a strong form that includes all information including non-publicly available information.

1. *Weak form:* A capital market that satisfies weak form efficiency, fully incorporates past share price information. In this form share prices change based on past price information, supplemented with an expected (risk adjusted) return correction on equity and a random error correction. The latter component follows the earlier discussed 'random walk' concept as researched by Samuelson (1965) and Mandelbrot (1966) and is therefore not predictable and has an expectation of zero (Fama, 1970). Weak form efficiency is assumed the weakest type of efficiency that one can expect from a financial market. Any investor has access to this type of information and prices match fundamental values following a 'fair game' model. As such technical analysis is useless to predict cyclical regularities and generate (riskless) profits (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016).

2. *Semi-strong form:* A capital market is said to be semi-strong efficient if all public information is fully reflected in share prices, including e.g. financial reports and public announcements of share splits, new share issues or dividend distributions (Fama, 1970). The theory is e.g. supported by studies from Fama, Fisher, Jensen and Roll (1969) on stock splits (future earning potential) and subsequent patterns in price movements, Ball and Brown (1968) on the effects of annual earnings announcements on share prices and Scholes (1972) on the effects of large secondary offerings of common stocks as well as new issues of stocks on share price. In case the semi-strong efficiency form holds, most financial analysis techniques are useless to uncover patterns to exploit (riskless) profits (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016).

3. *Strong form:* If all knowable information, including public and private information, is reflected in share prices a market is strong efficient. Any information that is pertinent to a share's value and at least known by one investor, is fully incorporated in the share price (Fama, 1970). As such the

market would recognize trading behavior of investors with (valuable) inside information and eliminate consistent possibilities to prosper from excessive (riskless) profits. Strong form efficiency is assumed the strongest type of efficiency that one can expect from a financial market. (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016). Nevertheless, Fama (1970, p. 409) already indicates that this form is expected to 'not be an exact description of reality' as contradictory evidence exists. This will be later set out in paragraph 2.4.

2.3.3 Predictions from the EMH on asset pricing

Relating the EMH as set out in the previous paragraphs to the mechanism of asset pricing as set out in paragraph 2.2, in perfect efficient (or 'complete') markets the following predictions on asset prices will hold:

(i) Asset prices equal fundamental value and as such represents a fair value that equals the net present value of future cash flows discounted at a proportionate risk. No transaction costs apply;
(ii) Asset prices fully reflect available information at any point in time and respond immediately to new information (strong form efficiency). Pricing levels will continuously culminate to a new equilibrium, leaving no space for arbitrage (or riskless) trading possibilities;
(iii) Asset prices are set by fully rational investors that have same beliefs on the probability distribution of assets, including their price levels, expected returns and risk levels;
(iv) Asset prices are following a 'random walk'. Meaning that price movements are random, identically distributed and trading strategies of investors do no correlate. Irrational behavior (excessive optimism and pessimism) is cancelled out without having effect on asset prices;
(v) Asset prices are unpredictable, but in seamless balance with expected returns and risk levels. In this mechanism expected return is a function of its risk. In a ceteris paribus situation, given future expected cashflows and assuming that asset prices equal fundamental value, a high current asset price results in a low expected return. And a low current asset price in a high expected return. Vice versa, to obtain a high expected return, the asset price has to be low and to obtain a low expected return the asset price has to be high.

2.4 Critics and anomalies on the EMH

In the last decades, both the theoretical foundations of EMH and the empirical evidence supporting the theory have been challenged. The logic of the theory is assumed to be too basic (Ross S. A., 1987) and the extreme version (strong form efficiency) to be false (Fama, 1991). Behavioral finance studies the 'influence of psychology on the behavior of financial practitioners and subsequent effect on markets' (Sewell, 2007) and has played an important role in the critical evaluation of the EMH. Behavioral finance assumes financial markets not to be efficient. Rather they profess that significant and systematic deviations from market efficiency may keep on for long time periods. This perspective has been empirically proven and appears to be anomalous to the EMH as returning patterns that cannot be explained by any other theory (Schleifer, 2000) (Krause, 2001, p. 149).

2.4.1 Behavioral Finance critics on the EMH

In contrast to the theoretical foundations of Schleifer (2000) as set out in paragraph 2.3.1., the behavioral view assumes that (1) markets are not complete (2) Investors are not rational (3) irrational behavior will not be offset but reinforced across investors and (4) arbitrage strategies contain too much risk to eliminate inefficiencies. These contrasting views will be discussed. In addition, the cross sectional patterns 'Size effect', 'Valuation effect' and 'Momentum effect' will be highlighted. These patterns are claimed to be predictable in relation to asset pricing and are based on firm characteristics

and valuation parameters (Malkiel, 2003) (Lamont & Thaler, 2003) (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, pp. 355-361).

2.4.1.1 Markets are not complete

Referring to the second fundamental theorem of asset pricing (see paragraph 2.2.3), empirical research have proven that financial markets are not 'complete'. Unless a price can be determined for every asset, the Arrow-Debreu equilibrium model (see paragraph 2.2.2) will not hold as e.g. information distribution is not perfect (see paragraph 2.4.2.4), a general equilibrium model is too rigorous as markets are not homogenous (Mehra & Prescott, 1985), transaction costs do apply and inclusion of a finite number of assets is arguable (Flood, 1991). In case the number of Arrow-Debreu securities (that follow the equilibrium model) is less than the total of theoretical securities altogether, an optimal allocation of assets (and thus return and risk) is not possible. This may elicit mispricing of assets and would lead to inefficiency in investments and consumption in real economy (Qian, 2019). This is assumed as 'suboptimal' as welfare and risks cannot be distributed equally among investors (Geanakoplos, 1990).

2.4.1.2 Investors are not rational

Instead of what the EMH assumes, the behavioral view assumes that financial markets are not dominated by rational, risk-averse investors. Behavioralists do not claim that all investors are irrational, but that some or many are. (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, p. 356). Investors that fully rely upon the conditions of the EMH (see paragraph 2.3.1.) and thus act on a rational basis without any interference of sentiment (or: emotions) or past patterns are called 'fundamentalists'. Investors whom base their investments (partly) upon sentiment are the so called 'noise traders'. If capital markets are always efficient, sentiment would not have any implications. But many researchers, including Shleifer (2000), claim that none of the foundations that should cause efficiency are likely to hold in reality.

Financial markets consist of investors that assess their own personal value to set reasonable contingent claims. One of the most extensively researched psychology-based theories is the implication of investor sentiment on stock price returns. See e.g. De Long et al. (1990) and Baker & Wurgler (2007). Investor sentiment is understand as the inclination of financial practitioners to act upon emotions and 'noise' rather than on facts. As a result of sentiment, investors forecast future cash flows and investment risks that are not justified by any (neo)classical theory. In this theory overreaction (optimism) and underreaction (pessimism) of investors is put central that is not validated by fundamental analysis. Investor sentiment is assumed to affect asset prices as a result of overly optimistic (pessimistic) judgements of financial practitioners (Schleifer, 2000). Several empirical studies e.g. (Fama, 1998) (Shiller, 2000) (Malkiel, 2003) have shown that stock prices do reflect underreaction and overreaction of investors to new information and thus contradict with rational assumptions from the EMH.

2.4.1.3 Irrational behavior is reinforced across investors

Behavioral finance assumes irrational behavior not to follow a complete random walk. In the behavioral view deviations from rationality are not completely cancelled out amongst investors, but partly follow similar patterns. First of all, they assume that investors follow a basic principle of '*representativeness*' in which they make (quick) judgements under uncertainty that are based on outcomes of a small sample of similar instances about (in this case) the probability of asset price movements. This psychological assumption originates from Tversky and Kahneman (1974) and causes overreaction of investors. This principle underlies biases and may lead to systematic and predictable errors in share price predictions. Hence, making an occasion representative (as it is assumed similar to an outcome of similar instances), doesn't make it automatically more likely. People may

overestimate the likeliness of an event, and as such neglect relevant decision factors that are taken into account in rational decision making. Consequently an overreaction in share price (returns) takes place.

Second, the behavioral view assumes investors to be 'conservative'. Basic principles of the EMH suggest that asset prices should rationally rise when earnings are higher than expected and prices should fall when earnings are lower than expected. Instead, behavioral finance assumes investors to be conservative and adjust relatively slow to the information coming from these earning announcements (Kolansinski & Li, 2010) (Gerard, 2012). Also Edwards (1968) and Grether (1980), concluded that individuals who are conservative, update their beliefs too slowly to new information. And, additionally, investors whom attach too little weight to new information, make behavioral mistakes in their investment decision. This would likely lead to underreaction of investors. Barberis et al. (1998) created a model that exposes that in the short run investors underreact to news and in the long run overreact to consistent good or bad news, resulting from the conservatism- and representativeness heuristic. This pattern is related to a mean reverting regime (asset prices revert to a long term mean) and trending regime (asset prices are assumed to follow a certain trend). A regime that already has been noticed by Smith (1776). He distinguished that price on the short run may deviate from its natural price to maintain an ongoing supply of commodities into the market. A economic concept that fundamentally differs from long-run outcomes and thus smoothens over time. Although the pattern is recognized over a longer period of time, adherents of behavioral finance have not yet determined whether overreaction or underreaction of investors dominates in particular situations.

2.4.1.4 Asymmetric information among investors exist

The basic theory of EMH assumes availability of heterogenous information, which is rationally reflected in asset prices. In efficient markets daily price moments are assumed consistent with efficiency as new information will result in subsequent rational price adjustments. In these public markets new information is processed on a daily basis or at least very frequent. The absence of daily price moments (based on new information) might suggest an inefficiency. As Fama (1970) already indicated in his study, 'strong form' market efficiency (see paragraph 2.3.2.) is not expected to be 'an exact description of reality' (Fama, 1970, p. 409)**.** Under the EMH investors are not presumed to form seamlessly accurate forecasts of future cashflows, but they are presumed to make effective use of the information they receive (LeRoy, 1990). There is ample example that information is not symmetrically distributed among investors and therefore excessive (riskless) profits can be generated by investors whom have monopolistic access to information. This is e.g. supported in research from Sharpe (1965), Jensen (1969) en Scholes (1970). In alignment with Fama (1970) The behavioral view claims that new information is not heterogenous and publicly disseminated. For example in non-public financial markets. In these markets information is (i) not universally distributed amongst investors such as firm insiders and outside equity investors and (ii) not quickly absorbed and thus rationally reflected in asset prices (Brounen, Op 't Veld, & Raitio, 2007). The asymmetry in information availability causes an uncertainty risk-variance effect and consequently influence expected price levels in the market trade mechanism (Akerlof, 1970). And as such the 'law of one price' (see paragraph 2.2.2.) does not hold.

2.4.1.5 Arbitrage limits

The behavioral view advocates that there are limits to arbitrage and as such ~~it~~ markets may be inefficient for longer periods of time. As set out in paragraph in 2.2.3 and 2.3.1 under the EMH countervailing irrationalities of investors (under- or overreactions to information) are arbitraged away. Meaning that arbitrageurs - professional (rational) investors - who notice that securities are mispriced by the market will buy underpriced securities while selling correctly priced (or overpriced)

substitutes. In the EMH, as well as the Arbitrage Pricing Theory of Ross (1976), it is assumed that investors have identical (or homogenous) market expectations and trading strategies. As discussed in paragraph 2.4.2.3 investors may behave irrationally. Additionally, referring to paragraph 2.4.2.4, as irrationality may be related across investors instead of cancelled out amongst investors, arbitrage strategies may involve too much risk to cancel out inefficiencies in financial markets. Hence, risk considerations may drive arbitrageurs to take positions that are not sufficient to cancel out all irrationalities. In case noise traders take opposite positions and the relative share of arbitrageurs to noise traders is limited, arbitrageurs need to take (too) large positions to cancel out inefficiencies for which they are not equally compensated and may register large losses. As a result markets can stay longer irrational that the EMH assumes (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016, pp. 356-357). This conclusion is found by several empirical studies. Battig & Jarrow (1999) stated that in complex economies, which contain infinite number of assets, the first fundamental theorem of no-arbitrage is not empirically proven. Froot and Dabora (1999) and Lamont and Thaler (2003) found evidence that deviations from pareto efficiency may occur and remain for longer periods.

2.4.1.6 Returns are predictable

The EMH assumes asset price (returns) to be unpredictable, but in seamless balance with expected returns and risk levels. Several empirical studies have shown that stock price (returns) can be predicted from e.g. valuation ratios such as dividend yields and short term interest rates. See e.g. Fama and Schwert (1977), Fama and French (1988) and Campbell and Shiller (1998). Many of these strategies are claimed to reflect time varying risk premiums rather than market inefficiencies and have not proven to be useful to generate profitable trading- or allocation strategies (Malkiel, 2003).

Yet, some firm characteristics and valuation parameters are claimed to have predictive patterns relating to asset prices and are therefore found anomalous to the EMH. These characteristics are presented below.

Size effect: Several empirical studies presented evidence that market capitalization of portfolios have a predictive pattern on asset price returns. Researchers presented evidence for several time periods and stock markets. E.g. Banz (1981) found that smaller stock firms have higher risk adjusted returns on average than large stock firms and as such debated efficient markets. Banz couldn't however conclude if size was a factor for the deviation in risk adjusted returns, or that size is a proxy for unknown factors that are correlated with size. Reinganum (1981) additionally concluded that these risk adjusted returns based on firm size may last for at least two years. Their findings are based on US stock market return data between 1926 and 1977. Fama and French (1993) came to similar conclusions by examining data from period 1963 to 1990. And Bauer et al. (2010) found significant evidence of the presence of the size effect in the cross-section of European common stock returns from 1985 to 2002. Keim (1983) came to similar conclusions and found that since 1926 smaller firms have on average 1 percentage point larger risk adjusted returns than larger firms. An explanation for the size effect is generally allocated to the fact that smaller firms may face higher specific company risks in comparison to large firms and as such are compensated for extra risk. However, researchers argued that not all of the performance difference can be allocated to risk difference. (Malkiel, 2003)

Valuation effect: There are several studies that suggest that value stocks (stocks with a low price-to-earnings [P/E] ratio or share-to-book value ratio) have higher risk adjusted returns than growth stocks (stocks with a high P/E ratio or share-to-book value ratio). See for example Basu (1977), Rosenberg et al. (1985) and Fama (1993). In these studies prices ~~are~~ tend to be biased with P/E ratios as proxy for this bias. Fama additionally concluded that price-to-book-value together with size (see previous paragraph) provide a considerable predictable power for future returns.

Some studies conclude that the valuation effect serves as a compensation effect for risk or transaction costs. That is given an earning yield, the book-to-price ratio indicates additional return associated with the risk of buying earnings and earnings growth (e.g. Fama and French (1995), Zhang (2005) and Penman & Reggiani (2013)). Others found empirical evidence that this tendency is consistent with the '*representativeness*' principal as set out in paragraph 2.4.2.3 in which investors tend to overreact to the likeliness of an event (e.g. Lakonishok et al. (1994) and La Porta (1996)). In the valuation effect investors are overconfident in their earnings growth projections and therefore overpay for growth stocks. The outcomes of the studies question the validity of the EMH and CAPM, which assumes stock prices to represent all available information at an unbiased way. Although outcomes may be time-dependent (Malkiel, 2003).

Momentum effect: Price momentum refers to the trend (direction and speed) of stock price movements that may last a longer period of time. A momentum effect relates to investors that capitalize on this price momentum (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016). The EMH supports the view that asset prices follow a 'random walk' in which past returns do not divine future price predictions. However, research has shown empirical evidence for an anomalous pattern in which time series correlations between successive stock price changes exist. De Bondt and Thaler (1985) were the first to translate over- and underreaction of investors to stock price movements and found weak form market inefficiencies. They found that stocks that have most experienced price drops in the past 3 up to 5 years, so called 'loser stocks', show price reversals (trend changes) for the subsequent 3 up to 5 years. In addition they found a vice versa effect for so called 'winner stocks'. Fama and French (1988) came to similar conclusions and found that on the long run (3-5 year period) for stock holdings in small firms (up to 40%) and large firms (up to 25%), return variations can be predicted from negative serial (auto)correlations with past returns. They found weak evidence for daily and weekly holding periods. Later, also empirical evidence is found for short-term time periods. E.g. Howe (1986), Lehmann (1990) found short-term price reversals of stocks with resulting significant positive returns for a time horizon up to ten weeks. They found significant patterns that portfolio's which had a good or bad performance in the one week, show significant price reversals the subsequent week(s). Jegadeesh & Sheridan (1993) found the same evidence for 3- to 12 months holding periods, after which the price reversal dissipated in the subsequent two years. O' Keeffe and Gallagher (2017) found evidence for price reversals in Greek stocks for an 18 month investment horizon.

To conclude, the anomalies presented above should be considered with caution as patterns have not been proven to be robust in every occasion and should therefore not be overemphasized. Results are found for limited sample periods, outcomes might be susceptible to data mining and patterns may self-destruct over time (Malkiel, 2003).

2.4.2 Predictions from the EMH on price deviations from fundamental value

Reflecting on the predictions of EMH on asset pricing (paragraph 2.3.3.) and the critics and anomalies on the EMH (paragraph 2.4), one can consider how the general concept of pricing deviations from fundamental value (premiums and discounts) are explained from the EMH. And as such give an answer on the first sub question:

1. *How is the mechanism of pricing deviations (premiums and discounts) from fundamental value explained from the Efficient Market Hypothesis (EMH) on asset pricing?*

The EMH assumes an equilibrium pricing mechanism in a competitive market with fully rational investors, in which asset prices reflect all available information (strong form efficiency) at any point in time and countervailing irrationalities (if any) are arbitraged away. Asset prices equal the fundamental

value of an asset that represents a fair value based on the net present value of future cash flows discounted at a proportionate risk. Also called the 'law of one price'. Price movements are assumed random and no transaction costs apply. Since trading strategies of investors are assumed to be based on same probability distributions amongst assets, in which expected return is a function of its risk, active trading or arbitrage strategies to earn an excessive rate of return are not possible.

The 'law of one price' as discussed in paragraph 2.2.2 states that identical goods (with either same cash flows) should have identical prices. From the perspective of behavioral finance market valuations (price) can differ insistently from the rational market fundamental (fundamental value), in which asset prices are not rationally related to economic realities. Numerous studies have shown evidence that expected returns differ from their fundamental value. As a consequence, price anomalies exist and stock markets may face disparity. Adherents of behavioral finance have empirical proven that the EMH theory is too basic and financial markets are not always efficient. Rather they found that significant and systematic deviations from market efficiency may keep on for longer periods of time and conclude that returning patterns they found appear to be anomalous to the EMH. They assume:

(i) **Markets are not complete:** Markets are not homogenous, information is not perfectly distributed and transaction costs do apply. This makes the assumption of a general equilibrium model too rigorous. Also an inclusion of a finite number of assets in this model is arguable, which makes an optimal allocation of assets not possible that may elicit mispricing of assets from their fundamental value and an inequal distribution of welfare and risks among investors;

(ii) **Investors are not rational:** Some or many investors (noise traders) base their investments (partly) upon sentiment instead of rational decisions. These investors may underreact or overreact to new information while forecasting future cash flows and investment risks. This is eventually reflected in stock prices and may cause price inefficiencies;

(iii) **Asymmetric information among investors exist:** Information is not homogeneously distributed amongst investors in al financial markets, which creates a risk-variance effect that affects rational asset pricing. As such the 'law of one price' does not hold;

(iv) **Irrational behavior is reinforced across investors:** Deviations from rationality are not completely cancelled out amongst investors, but partly follow similar patterns. Investors follow a basic principle of representativeness and conservatism. As a result in the short run investors tend to underreact to news and in the long run overreact to consistent good or bad news. These patterns may cause to systematic and predictable errors in share price predictions on the short run and revert back to a mean on the long run;

(v) **Arbitrage possibilities are limited:** Arbitrage strategies may involve too much risk to cancel out inefficiencies in financial markets, for which they are not equally compensated, and therefore markets may be inefficient for longer periods of time.

(vi) **Returns are predictable in a certain way:** Stock price movements do not completely follow a 'random walk' and seem to have some predictable (cross sectional) patterns. Patterns that seem to have predictable attributes in relation to asset pricing are based on firm characteristics and valuation parameters such as the size-, valuation- and momentum effects. In some cases these patterns also show that similar stocks may have different risk adjusted returns and as such show market inefficiencies.

2.5 Theoretical claims on (causal) determinants of pricing deviations

In previous paragraphs the general mechanism of asset pricing is discussed and approached from the EMH. In addition, the predictions of the EMH are put in relation to the general concept of market pricing deviations from fundamental value. As such a basic understanding is given on the existence of pricing deviations from fundamental value. In this paragraph and appendix I more specific empirical evidence is regarded on these pricing deviations. As such to determine factors that explain the existence of premiums and discounts on fundamental value and which can be reflected on trading opportunities and/or limitations in the secondary trading market of non-listed real estate funds. This paragraph gives an answer on the second sub question:

2. *Which (causal) determinants of de pricing deviations from net asset value can be determined from empirical studies on secondary trading markets?*

First in paragraph 2.5.1. one of the longest standing price anomalies in finance will be introduced, known as the closed-end fund puzzle (CEFP). The puzzle is used as a starting point to structure (causal) determinants for pricing deviations from fundamental value. In paragraph 2.5.2. empirical evidence of market imperfections is discussed that explains pricing deviations from a neoclassical perspective. In paragraph 2.5.3. empirical evidence of the investor sentiment hypothesis is discussed that explains pricing deviations from a behavioral finance approach. In 2.5.4. Other relevant factors that may have explanatory power to price deviations from fundamental value are shortly discussed. For sake of readability, the extensive elaboration and critical assessment of each factor that tends to explain the existence of premiums and discounts on fundamental value is included in appendix I. In this appendix and in paragraph 2.5.6. the hypothesis are concluded on which is reflected in the empirical research chapters of this study (Chapter 3 and 4) regarding the secondary trading market of non-listed real estate funds.

2.5.1 The closed-end fund puzzle

In general two types of investment funds can be distinguished: open-end mutual funds (OEF) and closed-end mutual funds (CEF)[2]. A CEF is a portfolio of pooled assets that holds publicly or privately held securities which does not continuously issue and redeem shares (Garay & Russel, 1999). Like an OEF, the fund has a professional investment manager that oversees the portfolio and may distribute periodical income and/or capital gains to its shareholders. CEFs are actively managed and typically concentrates on a specific geographic market, industry and/or market segment. Since investment firms that more actively manage their investments require higher management fees, CEFs generally charge a higher management fee than OEFs that are more passively managed.

Unlike an OEF, a CEF issues a fixed number of securities and therefore has no new capital inflow in the fund after its initial placement. In contrast to OEFs, shares of CEFs are generally not redeemed by the fund but traded at the secondary market. The main benefit of a CEF compared to an OEF is the security of a stable capital pool throughout the duration of the fund as there are no possibilities for inflow or outflow of capital. This protects investment managers for negative effects on securities, even in illiquid markets (Garay & Russel, 1999). In addition, CEFs offer on average higher returns and income streams to their investors as these funds do not have to maintain large cash reserves to redeem shares and can use higher levels of leverage (Hillier, Ross, Westerfield, Jaffe, & Bradford, 2016).

[2] Also semi-open-end investment funds (SOEFs) exist in the investment market, but are less frequently seen. Like an OEF, the number of securities issued is not fixed. In contract to OEFs, in special occasions such as extreme market situations SOEFs do not have the obligation to offer liquidity provisions and match supply and demand of securities. SOEFs therewith approach characteristics of CEFs.

CEFs appear to violate the fundamental rule of 'one price' (Lenkey, 2013). The fundamental value (here NAV) is calculated on a regular basis. The shares of a CEF typically trade at a price different from the NAV and fluctuate according to supply and demand in the market. Hence, to liquidate a CEF holding, investors must sell their shares to other investors rather than selling their stake holding back to the fund at NAV that is generally the case for OEFs. The fact that the price of CEFs differs from its NAV is generally referred to as the closed end fund puzzle (CEFP). According to Cherkes et al. (2009) the CEFP is one of the longest standing anomalies in finance as no full satisfactory explanation is yet accepted for this price phenomenon, neither from a neoclassical nor from a behavioral perspective.

It is commonly documented that pricing deviations of CEFs behave following a certain pattern. There are commonly four important findings that characterize the lifecycle of CEFs (Lee, Schleifer, & Thaler, 1991):

1. **Shares trade at a premium to NAV at IPO:** Often a premium is observed at an initial public offering (IPO) of a CEF. Cherkes (2012) states that on average a premium exist for approximately one third of CEFs that are in account for at least 60 days. On average a premium of 10% is reported, which is classified as a derivative of start-up and underwriting costs that will affect NAV. See e.g. Roenfeldt & Tuttle (1973), Weiss (1989) and Peavey (1990).
2. **Trading discounts to NAV:** After the IPO prices move to a discount to NAV over time towards the end of the duration. Weiss (1989) reported a movement to an average discount to NAV of 10% within 120 days. This phenomenon constitutes the time-series aspect of the CEFP. After this movement trades at discounts to NAV are seen as the 'norm' on the secondary market. This constitutes the cross-sectional aspect of the CEFP. See e.g. Roenfeldt & Tuttle (1973), and Weiss (1989)**.**
3. **Discounts vary over time and across funds:** Discounts are subject to wide variations over time and across funds. The variations appear to be mean reverting and highly correlated amongst funds. See e.g. Thompson (1978) and Brauer (1988).
4. **Liquidation or reorganization results in price conversion to NAV:** When CEFs terminate trough either a liquidation, merger or conversion to an open-end fund, prices tend to converge to NAV and discounts will diminish. See e.g. Brauer (1984) and Brickley and Schallheim (1985).

The above findings are in line with the assumption that irrational behavior is reinforced across investors (see paragraph 2.4.1.3) and as such systematic and predictable errors exist in share prices in the short run and revert back to a mean on the long run (mean reversion regime).

Pratt (1966) was the first to document the discount characteristics of CEFs and related the existence to of this phenomenon to the lack of public understanding and sales effort. E.g. Malkiel (1977) regarded the same anomaly and carefully considered several possible causes that could give an adequate explanation why CEFs may trade at a discount from their underlying assets. Both 'rational' factors that relate to company specific properties (e.g. Tax effects, managerial fees, unrealized capital appreciation and fund illiquidity) and the 'noise trader' factor that relates to irrational investors that operate in the market. Both researchers did not find adequate results that could give a significant explanation for the phenomenon. In the below paragraphs and appendix I further empirical evidence is regarded relating to pricing deviations from net asset value, seen from both the rational- and the behavioral approach.

2.5.2 Rational explanations for price deviations

The neoclassical finance perspective tries to explain price deviations from fundamental value (premiums and discounts) by market imperfections. As set out in paragraph 2.3.1 the neoclassical approach assumes investors to be rational.

Assuming that the determination of asset price is based on the present value of all future expected cashflows, any deviations may be either explained by the fact that (i) the expectations of the future cash flows or (ii) the rate that is used to discount these cashflows are not rational aligned with the proportionate risk level (Siegel, 2003). From a neoclassical finance perspective typically market frictions such as expenses, liquidity and taxes are regarded. Following e.g. Lee et al. (1991) and Garay & Russel (1999) three main factors are often claimed to give a standard explanation for price variations to NAV, namely agency costs, illiquidity of assets and tax liabilities. Charrón (2009) and Cherkes (2012) also added market segmentation and dividend yield. Based on the literature studies, summarized and critical assessed in appendix I, it is assumed that the amount of capital gain tax (CGT) liabilities on unrealized appreciations tend to have a negative relation with share price deviations compared to fundamental value. Meaning that a higher value or existence of the variable results in an expected price discount to NAV. And vice versa. The management performance in relation to management fees (Managerial Performance), liquidity of investment funds compared to their asset holdings (illiquidity of assets), the level of country and/or segment diversification (market diversification) and yield distribution (dividend yield) tend to have a positive relation with share price discounts compared to fundamental value. Meaning that a higher value or existence of the variable results in an expected premium to fundamental value. And vice versa. In table 1 a summary of the estimations and reference to further elaboration in appendix I are presented.

Including the CEFP. Empirical evidence is regarded on pricing deviations from three perspectives (i) rational explanations for pricing deviations based on most profound market frictions, (ii) a behavioral explanation for pricing deviations based on investors sentiment or so called noise trading and (iii) other explanations that are less profound and researched. In these perspectives two types of investment funds are distinguished: OEFs and CEFs.

Determinant	Proxy	Effect on NAV_{DEV}	Appendix
Managerial performance (H_1)	Management fees and alpha (α) of non-listed real estate fund compared to market index	+	I. A1
Asset illiquidity (H_2)	Bid/ask spread, Free float or restricted stocks	+	I. A2
Capital Gain Tax (CGT) liabilities (H_3)	CGT Liabilities on unrealized appreciations	-	I. A3
Market diversification (H_4)	Country allocation, asset type, property segment or Herfindahl – Hirschman index	+	I. A4
Dividend Yield (H_5)	Distributed dividend yield to investors	+	I. A5

Table 1 Neoclassical determinants that tend to explain pricing deviations from fundamental value

2.5.3 Behavioral explanations for price deviations

The behavior finance perspective tries to explain price deviations from fundamental value (premiums and discounts) by investor sentiment and claims that mispricing is the result of noise traders in the investment market. The presence of noise traders in the market is assumed as an additional (systematic) risk for rational investors in the market. As set out in paragraph 2.4.1 the behavioral approach assumes investors to be predominantly irrational. Following e.g. Lee et al. (1991) and Garay & Russel (1999) the investor sentiment hypothesis (ISH) provides a competing explanation for the rational explanation of pricing deviations from fundamental value. As already pointed out in paragraph 2.4.1.2. financial markets are not dominated by rational, risk-averse investors. Instead so called noise traders, who base their investment (partly) on their sentiment, influence pricing mechanisms on the investment markets. The ISH is therefore also frequently explained as the 'noise

trader approach'. In the ISH ~~is~~ it assumed that rational investors are not able to fully arbitrage away irrational price deviations, so markets may remain inefficient for longer periods of time. As earlier set out in paragraph 2.4.1. this is substantiated by (i) the principle of representativeness, (ii) the principle of conservativeness and (iii) the fact that noise trader risk is a systematic risk and therefore more difficult to diversify away. Based on the literature study and the critical assessment in appendix I, it is assumed that disproportionate optimism or pessimism (investor sentiment) tends to have a positive relation with price deviations compared to fundamental value. Meaning that periods of high (low) investor sentiment should be followed by share prices above (below) their fundamental value. In table 2 a summary of the estimation and reference to further elaborations in appendix I are presented.

Determinant	Proxy	Effect on NAV_{DEV}	Appendix
Investor Sentiment (H_6)	Bullish- and Bearish sentiment index or bull- bear spread	+	I. B1

Table 2 Behavioral determinants that tend to explain pricing deviations from fundamental value

2.5.4 Other explanations for price deviations

Despite of factors that are either classified as market imperfections following the neoclassical view or noise trader effect following the behavioral view, empirical research has also proposed other factors that may have explanatory power to price deviations from fundamental value (premiums and discounts). As these factors are less frequently researched and are seen as less profound explanations for the phenomenon based in literature studies, these factors are included in the research but less profound discussed and critically assessed in appendix I. It is assumed that the level of information gathering costs to compensate for adverse selection (adverse selection costs), non-amortized transaction costs (transaction costs) and leverage provision (leverage) tend to have a negative relation with share price deviations compared to fundamental value. Meaning that a higher value or existence of the variable results in an expected discount to fundamental value. And vice versa. The level of trading stocks on a funds balance sheet (valuation skepticism), price-earnings ratio (P/E ratio) and market capitalization (Size) of an investment fund tend to have a positive relation with share price deviations compared to fundamental value. Meaning that a higher value or existence of the variable results in a premium to fundamental value. And vice versa. In table 3 a summary of the estimations and reference to further elaborations in appendix I are presented.

Determinant	Proxy	Effect on NAV_{DEV}	Appendix
Adverse selection costs (H_7)	Information gathering costs, bid-ask spread, % block holders in the market, % local vs. foreign market investors or % informed vs. uninformed investors	-	I. C1
Transaction costs (H_8)	Non amortized transaction costs (e.g. due diligence costs, legal fees and property tax)	-	I. C2
Leverage (H_9)	Debt as percentage of total assets on balance sheet or cost of debt	-	I. C3
Price-earnings (P/E) ratio (H_{10})	P/E ratio or share-to-book ratio	+	I. C4
Valuation skepticism (H_{11})	Share of trading- or letter stock on balance sheet	+	I. C5
Size (H_{12})	Firm size or Fund's market capitalization	+	I. C6

Table 3 Other determinants that tend to explain pricing deviations from fundamental value

Other determinants

Other determinants that are sometimes mentioned in empirical researched on the topic researched are e.g. Reputation, insider ownership, investment activity, exchange rate uncertainty, ease of portfolio replication and accounting issues. Since there are only a few cases in which these factors are researched because they are e.g. hard to test empirically, these determinants are not further elaborated in this research. See e.g. (Malkiel, 1995), (Garay & Russel, 1999), (Morri & Benedetto, 2009) and (Cherkes, 2012) for more a comprehensive background.

2.5.5 Predictions on price deviations from fundamental value

Elaborating on the predictions from the EMH on pricing deviations from fundamental value as set out in paragraph 2.4.2., the empirical evidence from paragraph 2.5.1 up and until 2.5.4 and appendix I an answer can be given on the second sub question:

1. *Which (causal) determinants of de pricing deviations from net asset value can be determined from empirical studies on secondary trading markets?*

In general two types of investment funds can be distinguished on which this price deviation theory can be reflected: OEFs and CEFs. Due to the characteristics of CEFs they appear to violate the fundamental rule of 'one price'. The CEFP is regarded as one of the longest standing anomalies in finance as no full satisfactory explanation is yet accepted for this price phenomenon. Commonly four patterns are found that characterize the lifecycle of CEFs: (1) shares trade at a premium to NAV at IPO, (2) After the IPO prices move to a discount to NAV, (3) Discount are mean reverting and subject to wide variations over time and across funds and (4) Liquidations or reorganizations to and OEF result in price conversion to NAV. Since the CEFP is not solved yet, many perspectives on pricing deviations from fundamental value are regarded from a CEF position.

Three perspectives are assessed to explain price deviations from fundamental value. They include (i) rational explanations for pricing deviations based on most profound market frictions, (ii) a behavioral explanation for pricing deviations based on investors sentiment or so called noise trading and (iii) other explanations that are less profound and researched.

From a rational view it is expected that price deviations are explained by the fact that either the investor expectations on future cashflows or the rate that is used to discount these cashflows are not rationally aligned with proportionate risk. The variables agency costs, illiquidity of assets, tax liabilities, market segmentation and dividend yield have been regarded.

From a behavioral view it is expected that investors are predominantly irrational. The presence of so noise traders in the market creates an additional (systematic) risk for rational investors and provokes price deviations from fundamental value. The variable investor sentiment have been regarded.

The other factors that in general have less profound or distinct explanations in existing literature for price deviations do commonly relate to company specific characteristics. Adverse selection costs, transaction costs, leverage, the price-earnings ratios, valuation skepticism and size have been regarded.

Based on the literature studies, the following variables tend to have a **negative** relation with share price deviations compared to fundamental value. Meaning that a higher value or existence of the variable results in a discount to fundamental value. And vice versa. The predictions are as follows:

Variables with an expected negative relation on price deviations compared to fundamental value:

H_3 (Capital gain tax liabilities): *The higher the amount of capital gain tax (CGT) liabilities on unrealized appreciations is embedded in an investment fund, the higher the expected price discount of its shares compared to its fundamental value. This discount effect is expected to be greater in periods of economic upswing. As CEFs are supposed to have higher levels of embedded CGT liabilities outstanding than OEFs, they are expected to presenter higher discounts to NAV in comparison to OEFs.*

H_7 (Adverse selection): *The higher information gathering costs are to obtain accurate information to compensate for adverse selection in the investment market, the higher the expected discount of its shares compared to its fundamental value.*

H_8 (Transaction costs): *The higher non-amortized transaction costs are in a real estate investment fund, the higher the expected discount of its shares compared to its fundamental value. As transaction costs are amortized over time, the discount is expected to mean revert on the mid long run.*

H_9 (Leverage): *The higher the leverage provision in a fund structure, the higher the expected discount of its shares compared to fundamental value as the risk for financial distress increases. Since CEFs can generally maintain higher levels of leverage compared to OEFs, it is expected that the discounts to fundamental value are larger for CEFs than for OEFs.*

H_{11} (Valuation skepticism): *The higher the share of trading stocks on the balance sheet of an investment fund, the higher risk that the reported NAV is lower than is assumed in the market, and thus the higher the expected discount of shares compared to their NAV.*

In contrast, the following variables tend to have a **positive** relation with share price deviations compared to fundamental value. Meaning that a higher value or existence of the variable results in a premium to fundamental value. And vice versa. The following predictions are made:

Variables with an expected positive relation on price deviations compared to fundamental value:

H_1 (Managerial performance): *If management performance results in a management overperformance to a certain benchmark return and exceeds the present value of management fees, fund shares are expected to trade at a premium to its fundamental value. And vice versa.*

H_2 (Asset Liquidity): *The higher the liquidity of investment funds are in comparison to their asset holdings, the higher the added value of the fund structure and thus the smaller the expected price discount (or even the higher the premium) of its shares compared its fundamental value. And vice versa. As OEFs are assumed to be more liquid than CEFs, the price deviation for OEFs is assumed to be smaller than for CEFs.*

H_4 (Market diversification): *The higher an investment fund is diversified to countries with investment restrictions or segment specific risks (and thus reduces its systematic risk), the lower the expected discount (or higher the premium) of its shares compared to its fundamental value*

H_5 (Dividend Yield)**:** *The higher the dividend yield of an investment fund, the lower the non-fundamental risk of its shares and thus the lower the expected discount compared to its fundamental value*

H_6 (Investor Sentiment): *If disproportionate optimism or pessimism drives prices away from their intrinsic value, periods of high (low) investor sentiment should be followed by share prices above (below) their fundamental value and as such low (high) returns on the short run. Since sentiment (based on 'news' and 'events') is incorporated only slowly into the price level of shares, share prices will revert to their fundamental values in equilibrium on the long run.*

H_{10} (Price-earnings (P/E) ratio): *The higher the price-earnings (P/E) or share-to-book value ratio of an investment fund, the higher the tendency that investors overpay for the shares and thus the higher the premium of its shares compared to its fundamental value.*

H_{12} (Size)*: The larger the firm size of an investment fund, the lower the expected price discount (or larger the premium) of shares compared to their NAV.*

2.6 Perspective on non-listed real estate funds

In previous paragraphs a substantiated background is given on determinants of pricing deviations from fundamental value and predictions on the relationship between share price discounts compared to their fundamental value in secondary trading markets in general. As already set out in paragraph paragraph 1.1, non-listed real estate funds are non-publicly disseminated funds that are not frequently traded and typically associated with a lack of transparency, limited size and complicated fund structures (Brounen, Op 't Veld, & Raitio, 2007) (Roulac, 1988). Although, non-listed funds avoid the exposure to sentiment and volatility on the stock market and allow investors for easier diversification in e.g. sectors and countries, they are much less liquid than listed funds. Therefore the predictions from paragraph 2.6 might be more susceptible for the secondary trading market of non-listed real estate funds.

In this paragraph a brief background is given on the characteristics of non-listed real estate funds. In addition these characteristics will be put in perspective to the predictions that are summarized in paragraph 2.5. An answer is given on the third sub question:

2 *How are the determinants of pricing deviations from fundamental value, as reported from empirical studies on the secondary trading market in general, reflected on trading opportunities and/or limitations in the secondary trading market of non-listed real estate funds?*

2.6.1 Listed vs. non-listed real estate funds

As pictured in figure 1 in chapter 1, the real estate investment market is separated in a private and public market. Direct investments and indirect investments (non-listed funds) characterize the private market. Listed real estate funds characterize the public real estate investment market. Although all real estate asset classes involve the ownership of physical buildings, the investment characteristics differ.

Listed and non-listed real estate funds are securitized investment instruments to gain exposure to real estate. As Baum (2012, p. 248) describes, the illiquid nature of direct real estate as an asset class makes indirect investments (either public or non-public) more attractive alternatives. Whereas listed real estate funds tend to have a higher correlation to the equity market in the short term, on the long term it is shown that listed and non-listed real estate funds have similar characteristics when results are corrected for smoothing, gearing and sector differences (Ling & Naranjo, 1999) (Pagliari, Scherer, & Monopoli, 2003) (Baum, 2009, p. p. 255) (Ang, Nabar, & Wald, 2013). The correlation to the equity market on the short term is explained by the fact that listed real estate funds tend to be traded by investors in tandem with other securities and might be affected by investor sentiment (De Long, Shleifer, Summers, & Waldmann, 1990). Idiosyncratic characteristics such as volatility, liquidity and diversification possibilities differ from non-listed real estate funds. Since non-listed real estate funds are assumed less liquid then non-listed funds, investors regularly allocate a certain risk premium to this asset class to compensate for information asymmetry and reinvestment risk. Non-listed real estate funds are priced in reference to NAV (fundamental value) and are therefore expected to deliver comparable performance as direct investments in real estate (Baum, 2009). On the long term, listed

real estate funds seem to show more similar characteristics with non-listed funds and are more influenced by developments in the underlying assets of the funds holding (Brounen, Op 't Veld, & Raitio, 2007) (Kempen, 2017) (Roulac, 1988).

In recent years the interest for investing in non-listed real estate has emerged due to e.g. the urge to invest in holdings that allow for more decision making power, reduce the number of general partner relationships (and thus fees) and lessening regulatory pressure (Bodner, Furlan, & Vasilieva, 2018). In addition, non-listed real estate funds allow for easier focus and/or diversification in comparison to listed funds since many funds are single country or single sector focused. Barker et al. (2018) presume non-listed (or private) real estate funds to consist of core and non-core (value-added and opportunistic) real estate strategies[3]. Core investments are focused on high quality assets on prime locations with predictable cashflows, typically allocated to major property classes such as offices, retail, industrial, residential premises or a mix of these. Non-core investments are usually allocated to focused specialized products such as hotels, health care and student housing and focus more on capital appreciation.

A significant difference remains that non-listed real estate funds are much less liquid than listed funds, involve generally higher management costs and do not always attain full exposure to immediate cash (Roulac, 1988) (Baum, 2009). In table 4 an overview is given of the most significant differences between listed and non-listed real estate funds.

	Listed real estate funds	Non-listed real estate funds
Holding Term	Generally short/medium term	Medium/Long term
Returns	Correlation with equities in short term and real estate in medium/long term	High correlation to direct real estate
Pricing	Transactional based; daily priced by equity market on centralised exchanges	Appraisal based; priced monthly, quarterly, bi-annually or annually by professional appraisal firms. Lagging and smoothing effects might be noticed[4].
Valuation	Valuation is subject to market sentiment, future developments and sector outlook	Valuation is based on estimated capital value of the assets held by the fund (based on future cashflows) and comparable market transactions
Volatility	High	Low
Leverage	Medium/High level of gearing	Lower gearing level (< 50% of NAV)
Liquidity	High liquidity level. Transactions are executed on a daily basis and reflect actual market prices	Low liquidity level. Transactions may last several month with less pricing information available

[3] Core investment strategies mainly focus on passive income producing investments. These strategies generally comprise low leverage levels and low exposure to real asset developments. Instead, opportunistic investment strategies are active investments that contain high leverage levels, high exposure to real asset developments and primarily gain returns from capital appreciation. Value add strategies are an intermediate investment form between core and opportunistic styles that contain moderate leverage levels, use active asset management to mitigate risks or add value and allocate part of its investments in real asset developments. Value add strategies gain returns from both income return and capital appreciation (INREV, 2017)

[4] Cannon & Cole (2011) show that appraisal based pricing of properties that are held by a fund may differ on average 12% from transacted prices and lag in both rising and falling markets. In portfolio context this difference is on average 4-5%.

Transparency	High due to mandatory public disclosure and analyst reviews/ ratings[5]	Low since information is generally not publicly disclosed (not mandatory) and as such limited analyst reviews/ ratings exist
Cost levels	Easy to compare between listed real estate companies	Easy to compare between non-listed real estate funds (incl. benchmarks)
Diversification	Easy to create a well-diversified portfolio from any initial investment amount	Difficult due to high investment needed to create a well-diversified portfolio
Investment structure	Often complex investment structures	Generally simpler unitised investment structures
Governance	Strong (by law) in which board of directors is responsible/accountable	Weak(er) as a result of fund structure and external management (agency problem)
Management structure	Often opaque management structure (e.g. stappled management entities)	Transparent management structure, merely specialist managers
Investor influence	Limited shareholder influence on strategy and management	High shareholder influence on strategy and management
Capital raising	New capitalisation based on market price and market demand	New capitalisation based on net asset value
Diversification	Easy to create a well-diversified portfolio from any initial investment amount	Difficult due to high investment needed to create a well-diversified portfolio

Table 4 Characteristics of Listed vs. Non Listed Real Estate Funds (Source: Baum (2009), Bodner et al. (2018), Kempen (2017) – own redaction)

As shown in figure 2 in chapter 1, non-listed real estate funds are generally structured in vehicles with investors as LP's and a specialized fund manager as GP. It is common that GPs manage a series of investment funds and have more insight information than LPs, resulting in information asymmetry between the LP and the GP. In addition, as discussed in paragraph 2.5.1, non-listed funds can either be OEFs or CEFs. These fund types come with different characteristics such as risk exposure, duration and leverage levels.

Generally core non-listed real estate funds are OEFs and non-core (value add and opportunistic) funds are CEFs. Leverage levels are generally higher for CEFs since they do not have to maintain large cash reserves to redeem shares. UK non-listed funds are mostly core OEFs. European non-listed real estate funds, either core or value-add, are merely CEFs and have higher leverage levels and are therefore more volatile and exposed to risk (Baum, 2009, p. 258).

Last, non-listed funds are commonly invested on the long term and have no or limited redemption rights or similar liquidity right for the LP's in unusual circumstances (Barker, Seah, & Shilling, 2018). OEFs generally offer monthly, quarterly or annual redemption possibilities, albeit with a fixed initial lock-up period of several years. In this case a LP can submit a redemption request to the GP to trade back shares at NAV. In case redemptions are accepted, GP's can e.g. comply with requests by directly sourcing equity from the cash pool of the fund or sell off assets. GPs can also decide to suspend redemption requests in case they cannot immediately facilitate the request. CEFs commonly offer no to little liquidity provisions. As indicated earlier in chapter 1, a secondary trading market in non-listed real estate funds offers an alternative mechanism to provide liquidity. The secondary market allows investors to sell their interest (both in OEFs and CEFs) and reallocate capital to other opportunities,

[5] Several stock market news websites (e.g. Reuters, Bloomberg and Financial Times) report real time investment characteristics of listed real estate funds such as market capitalization, dividend yields, P/E ratios, profit margins, leverage ratios and portfolio composition.

prematurely of the exit possibility of their holdings. It offers liquidity to the market in case investment funds e.g. do not offer (timely) redemption possibilities or exit mechanisms (Baum, 2009, pp. 248-249) (Bodner, Furlan, & Vasilieva, 2018) (CBRE, 2018).

2.7.2 Secondary trading market of non-listed real estate funds

The secondary trading market of non-listed real estate funds approaches the liquid market of listed real estate, taking into account the idiosyncratic characteristics of the non-listed real estate sector, and opens up the non-listed real estate market for more investor parties. Secondary trades, or so called 'secondaries', in non-listed real estate funds are generally seen as private equity trades. Regardless of fund investments strategies such as core, opportunistic or value add styles.

For transactions a thorough understanding of this specific market is needed since considerations need to be made regarding e.g. valuation, accounting, regulations, legal- and tax structuring principles. Given the relative opacity of the non-listed real estate market, thorough due diligence processes are generally seen to assess prospective transactions that are aligned with portfolio strategies and return requirements. (Bodner, Furlan, & Vasilieva, 2018).

The secondary trading market is not formally organized. Transactions by the LP can either be facilitated by (i) noticing the GP that it wants to sell its interest, after which the GP can facilitate a buyer for this interest or buys-out the LP itself or (ii) consulting a (specialized) third party such as a placement agent or investment bank to find a suitable buyer.

2.7.2.1 Secondary trades of open-end and closed-end non-listed real estate funds

As set out in paragraph 2.5.1. non-listed real estate funds are generally OEF's or CEF's. Open-end non listed fund (OEF) shares can be periodically redeemed on demand, where a trade is made between the LP and the GP on share NAV price. New investors (LPs) will normally be allowed to buy new units on demand, dependent on availability. The ask (or offer) price of new shares by the fund manager (GP) consist of the share NAV price corrected for an allowance for the costs to buy new assets. The bid price consists of share NAV price deduced by trading costs. Apart from the regular liquidity provisions, current/new investors in OEFs can also make use of the secondary market if they can sell/buy shares at a higher/lower price to NAV than can be realized with the GP. Since there is no need to immediate purchase or sell properties in the underlying fund, the bid-ask spread[6] may be lower than costs involved in regular redemption processes.

As already indicated in paragraph 2.5.1, CEFs have a limited number of issued shares, predefined duration and generally offer not a redemption facility. Investors are therefore reliant on the duration of the fund or a secondary trading market in case they want to exit on the fund prematurely of the expiration date.

In strong volatile (rising/falling) markets, secondary trades are more difficult to close since bid-ask spreads will diverge and therefore trades postponed. In strong falling markets, the trading costs for the GP are higher as it is more difficult to sell underlying assets in the market at NAV levels. In case NAV is remaining flat (based on periodical appraisal based valuations), the discount to NAV will be greater. In a strong rising market, the trading costs for new investors are higher since the costs to buy new assets at NAV levels are higher. In case NAV is remaining flat (based on periodical appraisal based valuations), the premium to NAV will be greater (Baum, 2009) (Bodner, Furlan, & Vasilieva, 2018).

[6] The bid-ask spread is the difference between a quoted offer (ask) price and a sudden purchase price (bid) of a share. The bid-ask spread is generally seen as a liquidity measure of a certain investment product or market and an indicator of transaction costs. The higher the bid-ask spread, the less frequent trades will commence and liquidity comes into the market.

In case markets are more stable and NAV levels adjust to new market levels, bid-ask spreads will converge and trades can be easier made. As already stated in table 1 non-listed real estate funds are appraisal based priced by reference to NAV on a monthly, quarterly, bi-annually or even annual basis. Therefore it might take some time that NAV levels adjust and secondary market trades will commence.

2.7.2.2 Pricing determinants secondary trading market non-listed real estate funds

Pricing is assumed as the most challenging aspect of secondary trades in non-listed real estate funds (CBRE, 2018). As discussed in paragraph 2.2. the concepts of NAV (as a proxy of fundamental value) and 'price' are different pricing estimations. As stated in paragraph 1.5, NAV is based on the balance sheet (also known as book value) and calculated as total value of assets held by a fund deducted by liabilities of the fund. This value estimation is retrospective and might be subject to valuation skepticism (see paragraph 2.5.4 and appendix I). In addition, based on accounting conventions and policies used (e.g. on capitalizing costs, cost amortization and mark-to-market estimation of deferred taxes), the NAV estimation may differ among funds. Also, since NAV has a retrospective approach, NAV does not take (full) account of prospective and diversification factors such as future operating costs, changing risk levels, profit expectations and dividend payments. For example NAV is a calculation of the sum of parts of the fund's holdings and does not correct for e.g. diversification in its discount factor. Unlike in NAV calculations, these factors are integrated in the price estimation of investors.

Secondary trades are usually made by investors on present value estimations of future cash flows, discounted at an appropriate risk premium. Estimations on either direct income from rent, indirect income from appraisals and cost estimations may differ amongst investors. But also factors such as capital structure of the fund, fungibility of shares and tax implications concerned are important. Following Barker et al. (2018), Bodner et al. (2018) and CBRE (2018) some striking factors that may have a bearing on pricing of secondary trades in non-listed real estate funds are the following:

- *Motivations:* Buyers and sellers may have different (strategic) intentions for a secondary trade, which have an impact on discount rates and pricing levels. Sellers generally have idiosyncratic reasons to sell and e.g. might want to liquidate on asset holdings, may not get a refinancing of debt or want to rebalance portfolio's and property type focus. They might e.g. find that their shares are fairly priced, but future market returns are relatively unattractive. Buyers tend to be more sophisticated buyers and have more financial- and performance grounded reasons such as private equity buyers. They might e.g. find that shares are underpriced and strive for a price anomaly by buying.
- *Process:* An orderly transaction which involves adequate timing and exposure to multiple purchasers, can impact pricing levels.
- *Timing:* The further a secondary market trade is from its last appraisal date to define NAV, the less relevant this NAV becomes. Also a structured sale transaction, which involves a deferred payment of the units purchase price, may have a significant impact on the price relative to NAV (CBRE, 2018, p. 8)
- *Information transparency:* The level of (financial) information disclosed to purchasers (under a non-disclosure agreement) in relation to the information level of the seller may have a price bearing effect. As discussed in paragraph 2.5.4 and appendix I, it is generally assumed that sellers of investment products know more about the quality of the underlying assets and fund characteristics than buyers do. The information asymmetry may have effect on net cashflow estimations and result in higher information gathering costs that may result in substantial lower expected pricing offers and vice versa. Core(+) non-listed real estate funds generally have a long lifecycle and continuously market their funds both to attract and retain capital.

Fund information is frequently readily accessible, which contributes to more transparency. Since transparency builds confidence in markets, a greater interest of a broader group of investors can be created and thus liquidity options for investors.

- *Fund structuring:* Fund structuring may have material impact on pricing levels. Efficient structuring, in which e.g. several sub-funds are created that contribute to a master LP, may constitute different economics to facilitate investors at different momentums, such as a private placement or secondary trades. These economics may include concern different fee structures or certain allocations to parts of the portfolio of the master LP. But most striking are tax efficiency provisions that are created for (non-domestic) investors amongst different jurisdictions, which have a downward effect on tax burden costs and thus expected higher gross-to-net returns. As different economics apply, different returns and share prices may concern in case shares are traded over the counter.
- *Cashflow estimations:* An investor makes a forecast of expected future (net) cash flow, timing of incurring this cash flow and discounts this against a discount factor that equals an appropriate risk weighted cost of capital. Aspects that will be anticipated on include income (growth and security), total expense ratio, diversification, market developments and track record of the investment manager (GP). An investor might be willing to pay a higher price in case future cashflows might be underestimated by the seller and vice versa.
- *Warranties:* The scope, terms, duration and extend of warranties to which sellers and buyers have agreed on in a share transaction may have an effect on price bearing. Warranties mitigate contingent liabilities risks between seller and buyer (sometimes offset by insurances), thus securing a certain level of future cashflows that drive price levels. Warranties may e.g. include fundamental warranties, exempts of litigations and/or warranties on undrawn commitments.
- *Right of first refusal (ROFR):* Some funds have a ROFR or pre-emption provision included in their fund documentation. This grants existing investors the right to first acquire the shares involved in a secondary trade at the price level that has been agreed between an purchaser and seller. This gives a high uncertainty level and upfront costs to a purchaser, especially when the existing investors have the right to acquire all involved shares (instead of a pro rata stake). A ROFR might therefore reduce liquidity of a fund and reduce pricing levels.
- *Currency:* Global and cross continental trades require different local currencies. Most funds incur some foreign exchange (FX) risk, for which hedging strategies are used to reduce foreign exchange risk. Since NAV prices are periodically changing, re-hedging might be needed. Between cut-off date and settlement data a purchases might incur significant FX risks that might impact the net present value from the non-listed real estate shares. This currency risk may have effect on pricing levels, unless clear agreements are made on FX risk between purchaser and seller.
- *Deferred tax liabilities (DTL):* A DTL (or CGT liability as reported in paragraph 2.5.2 and appendix I) represents an obligation to pay taxes, which are not due until a property is sold. The tax is owed on the difference between the transactions price and the NAV of the assets or vehicle, which is mainly a result of capital gains (INREV, 2017). In case the transaction price exceeds the NAV, the excess amount is subject to tax withholding and corporate tax. Non-listed real estate fund shares generally have a contingent tax liability outstanding, since underlying assets will not be sold in a secondary trade. Buyers generally require a tax warranty (generally a claw back provision in the contract) that protects them from tax assumptions that posthumously may be challenged by tax authorities. The higher contingent tax risk a purchaser

is bearing, the higher the discount rates and lower the share price and vice versa. This discount will be larger in case the remaining maturity of a fund is becoming shorter and vice versa.

- *Redemption queues:* In OEF structures, existing investors have a periodical redemption facility to (partly) exit a fund. This may be (un)restricted (e.g. 10% of equity per annum) and accepted (sequentially) in full or pro rata. Prices on the secondary market may differ, dependent on the availability of liquidity in the primary market and time to obtain the required liquidity (e.g. for some fund redemptions are subordinate to CAPEX requirements or debt repayments). To execute investors (either sellers and buyers) sometimes require pace over price and offer a premium or discount to NAV. Especially in rapidly changing markets in which asset appreciate en depreciate quickly.
- *Leverage:* The higher the amount of leverage a fund is bearing, the higher the risk for financial distress. Many investors on the non-listed real estate secondary market focus on (stable) income and aversion of risk. Funds with lower gearing levels generally have a lower risk premium and trade at premiums to NAV and vice versa.
- *Cost of capital:* Every investor has a different cost of capital based on the nature of the entity, exposure, loan structure and amount of risk. This has an effect on the discount rate.
- *Risk expectation:* Investors make their own estimation of either systematic and idiosyncratic risks of a certain fund, including property risk and financial (distress) risk. The risk expectation and assessment on liquidity of funds may differ among investors and result in a different discount rate.
- *Cut-off date*: In secondary transactions generally two dates are involved; the cut-off date on which the buy order is placed and the settlement date on which the legal ownership transfer of the shares is executed. The time frame between those dates is generally 6 until 9 months. In the period between both dates, income and appraisal are for the benefit of the purchaser and commitments made by the seller will be refunded. The closer parties are at the cut-off date, material changes to net cashflow may have a significant effect on pricing.

2.7.2.3 Arbitrage possibilities secondary trades non-listed real estate funds

Referring to paragraph 2.4.1.5 and 2.4.2, it is difficult to apply arbitrage strategies in the secondary trading market of non-listed real estate funds, despite the fact that market inefficiencies might exist for a longer period of time.

To be able to exploit arbitrage strategies in certain investment markets, arbitrageurs require a high market capitalization (volume), volatility in markets (with daily quotation of prices) and large spread between buying and selling prices so they can transact. This means that holding periods become shorter and liquidity rises. In addition, arbitrageurs need standard investment vehicles which they understand and can arbitrage between (Baum, 2009, p. 222).

Reflecting this on the non-listed market of real estate funds, neither the volume and daily quotation nor the standardized vehicle requirement are generally in place as pointed out in table 4. Since non-listed real estate funds are less actively traded, trade partners are harder to find and (ir)rational behavior is more difficult to cancel out, arbitrage strategies are difficult to apply and involve too much risk. Due to the illiquidity of the market, extreme market movements are difficult to observe and short-term trading strategies difficult to exploit. As a result the market for non-listed real estate funds can stay longer irrational than the EMH assumes (see paragraph 2.3) and shares can be less accurately priced over longer periods of time.

Furthermore, it is difficult to offset arbitrage risks for non-listed fund shares by derivative trading. For instance, in case shares trade at a premium, one should short on the shares and buy the underlying

assets. Contrary, in case of a discount, an investor should reverse this trading strategy. In the non-listed real estate market it is almost impossible and not seen that investors hold both a direct market position and shares in the indirect market. This strategy is expensive and cancels out the flexibility and supplies that the secondary trading market of non-listed funds offers as a portfolio management tool.

2.7.3 Price deviations from NAV in secondary trading market of non-listed real estate funds

Combining the pricing deviation predictions from fundamental value in paragraph 2.6 and the characteristics of the secondary trading market of non-listed real estate funds as set out in paragraph 2.7.1 and 2.7.2, we assume that the following predictions hold as presented in table 5.

Since there are limited results available from empirical studies and industry expert studies on pricing deviations of secondary trades of non-listed real estate fund shares compared to NAV, the hypothesis from paragraph 2.6 are assumed in case no other evidence is found in paragraph 2.7.1 and 2.7.2.

When applicable in the predictions a distinction is made between CEFs and OEFs, since these funds differ on characteristics of e.g. liquidity, leverage and duration (see paragraph 2.5.1). In case a common effect is expected for both OEFs and CEFs, no further addition is made to the predictions. Based on the predictions presented in table 2, the following conclusion is made on the third sub-questions:

2. *How are the determinants of pricing deviations from fundamental value, as reported from empirical studies on the secondary trading market in general, reflected on trading opportunities and/or limitations in the secondary trading market of non-listed real estate funds?*

From the factors presented in paragraph 2.7.2.2., which are assumed to have a price bearing effect on secondary trades of non-listed real estate funds, predictions H_1 trough to H_{11} are found to be aligned with the predictions that are stated in paragraph 2.6. For predictions H_1, H_3, H_4, H_6, H_7, H_8, H_9, and H_{11} a more profound interpretation has been added that substantiate characteristics of non-listed OEFs and/or CEFs. These interpretations are presented in table 2. For predictions H_2, H_5 and H_{10} no specific empirical evidence is found that further substantiate these characteristics. For these predictions the outcomes of the empirical research on the general investment market is followed.

For H_{12} regarding fund size an opposite relationship is assumed compared to the prediction found in paragraph 2.6. Unless large firms may profit form economies of scale and might e.g. have higher liquidity levels, better access to capital markets and high value properties, there also exist higher agency costs between the GP and LP as a result of information asymmetry. Since the private real estate market is assumed to be opaque, it is expected that larger funds trade at higher discounts to NAV than smaller funds as a result of higher information gathering costs for the LP.

Determinants that are found in paragraph 2.7.2.2., but which do not have a profound empirical substantiation in paragraph 2.6 include process, market timing, fund structuring, ROFR, currency risk, redemption queues and cost of capital. These determinants will therefore not be further regarded in the empirical research section. Some factors such as motivations, risk estimation, cut-off date (time frame) and warranties are indirectly (partly) included in determinants investor sentiment and CGT liabilities.

Prediction	Interpretation in relation to secondary trades in non-listed real estate funds
H_1 (Managerial performance)	Aligned with H_1. In addition, since non-listed real estate CEFs are generally more actively managed, it is assumed that higher management cost apply to

	CEFs that need to be offset by higher management performance. Therefore it is assumed that NAV_{DEV} for CEFs are larger compared to OEFs. And vice versa.
H_2 (Asset liquidity)	Aligned with H_2
H_3 (Capital gain tax liabilities)	Aligned with H_3. Since non-listed real estate OEFs generally realize capital gains sooner than CEFs, the CGT liability risk for OEFs (and thus NAV discount) is expected to be lower than for CEFs. Additionally, it is expected that the discount to NAV is larger for CEFs in case the remaining fund maturity is becoming shorter, however dependent on (i) commencement of sell down programs and distributions made to investors and (ii) tax warranties agreed by parties in a secondary trade.
H_4 (Market diversification)	Aligned with H_4. Since non-listed real estate CEFs are generally value add or opportunistic funds that focus more on capital appreciation with investments in focussed specialized products, the price discount to NAV is expected to be higher compared to OEFs. Non-listed real estate OEFs are generally core investment funds that focus on high quality assets on prime locations from retail, offices, residential, logistic assets or a combination of these.
H_5 (Dividend yield)	Aligned with H_5
H_6 (Investor sentiment)	Aligned with H_6. However, since investor sentiment (based on news and events) only slowly incorporates into price levels, information on non-listed real estate funds (both OEFs and CEFS) is not or limitedly publicly disclosed, the non-listed real estate fund market is dominated by institutional (more rational) investors and secondary trades in non-listed real estate funds shares have longer time frames in which trade settlements are made, it is expected that investor sentiment shows lower price deviations than listed real estate share trades.
H_7 (Adverse selection)	Aligned with H_7. Since non-listed real estate OEFs, mostly seen as core(+) funds, generally have a long lifecycle and continuously market their funds both to attract and retain capital, fund information is frequently readily accessible. Therefore it is expected that non-listed real estate OEFs have a smaller discount to NAV in comparison to non-listed real estate CEFs that are mostly value add or opportunistic funds.
H_8 (Transaction costs)	Aligned with H_8. Since the holding periods of OEFs are generally longer than CEFs and the amortization period of transaction costs are commonly aligned with the expected holding period of the fund vehicle, it is expected that the discount to NAV for non-listed real estate CEFs is higher than for OEFs.
H_9 (Leverage)	Aligned with H_9.
H_{10} (Price-earnings ratio)	Aligned with H_{10}
H_{11} (Valuation scepticism)	Aligned with H_{11}. Since CEFs on average hold a low share of trading stocks on their balance sheet, is expected that non-listed real estate CEF shares on average trade at lower discounts to NAV than OEF shares. And vice versa.
H12 (Size)	Opposite to H_{12}. Since the market for non-listed real estate funds is opaque (compared to e.g. the listed real estate market), it is assumed that there is an information asymmetry between the GP and the LP. Therefore, unless larger firms generally have higher liquidity levels, better access to capital markets and high value properties, it is expected that the larger the size of the fund that a GP is managing, the higher agency costs and as such the larger discounts to NAV.

Table 5 Predictions on pricing deviations from fundamental value in the secondary trading market of non-listed real estate funds

2.8 Critical evaluation and discussion of studies

The theoretical framework of paragraph 2.2 up and until 2.7 gives a broad view on the general theorems of the asset pricing mechanism, its relation to the theoretical foundation of the EMH (both from a rational perspective and a sentiment perspective) and set clear predictions from the EMH on pricing deviations from fundamental value. Also an in-depth understanding is given on the theoretical claims and (causal) determinants of pricing deviations from fundamental value. Both from a

neoclassical perspective and from a behavioral view. And also in perspective to non-listed real estate funds.

Since this thesis is an explorative research in which potential (causal) relations and underlying motivations of pricing deviations (premiums and discounts) are investigated, it is decided to pay more attention on the rationale and background of the theorems and variables. This makes this paragraph more extensive than usual but, especially for the (causal) determinants, this will help to understand and reflect on any patterns that are found in the chapter 4. Further analysis on the methodology and proxies used in the different regarded studies will be considered in chapter 3.

In paragraph 2.2 up and until 2.7 different views and backgrounds of the topics are set out and discussed and compared to be able to come to considered predictions. Also specific critical side notes, where possible, have been included in the different paragraphs to consider. For sake of completeness the following general critical notes should be taken into account when evaluating the outcomes and predictions made:

- The regarded studies give broad support that the EMH is too basic to explain significant and systematic price deviations from market efficiency that remain for longer periods of time. Although it gives a good starting point to understand the general asset pricing mechanism, the existence of premiums and discounts in asset pricing from fundamental value are a contradiction to rational asset pricing models.

- The question about the 'right price' is not as simple as one might conceive and the assumption of the 'law of one price' is assumed no to hold. The efficient market hypothesis (based on rational assumptions) and the investor sentiment hypothesis (based on sentiment) represent two different views on the market efficiency and the asset pricing mechanism. There is no generally accepted model of asset pricing, neither from a rational perspective nor from a behavioral perspective or a collective approach. In addition, different studies show contradicting outcomes. Therefore price changes cannot be fully explained by either changing (rational) expectations of investors on future cashflows or sentiment driven by individual psychology of investors. Up until today no empirical research has given an answer to the question to which extend one of both theories prevails. And as such the pricing puzzle remains unsolved and the enigma continues.

- While considering explanatory variables for price deviations, it is important to stress that while a price may be stated as deviation (premium or discount) to a fundamental value, it must always be put in relation a well explained proxy for this fundamental value. Hence, market (in)efficiency is per se not testable without a certain equilibrium model such as CAPM. Therefore it cannot be said if mispricing is a result of market inefficiency or a lack of an adequate model to define the equilibrium state of a market. In case these principles are not met, any statement on variables that explain price deviations from fundamental value can be assumed invalid in advance.

- In line with the first comments made, rational asset pricing models such as CAPM are in many times aggregated single factor models which are mostly based on general market- or portfolio movements. Therefore these models are too rigid to explain certain anomalous patterns in asset pricing. Hence, the aggregation of risk may be problematic for the explanation of returns and prices of individual assets, which are not only driven by systematic risk that comes from market factors but also by idiosyncratic risk that relates to individual observations. But also

later developed multi-factor models such as the three- and five-factor models that have been e.g. reported by Fama (1993), Lenkey (2013) and Fama & French (2014), Jarrow & Protter (2019) do not provide a complete explanation of the asset price patterns. Explanatory factors as discussed in paragraph 2.5 have each (causal) expected explanatory power regarding share price deviations. Some more or less significant than others. However, none of stand-alone factors or a multi-factor set of factors (as far as empirically tested) prove to give a satisfying explanation for this price phenomenon.

- The regarded researched show that over the past decades researchers have estimated discounts to NAV as the norm in explaining the existence and persistence of price deviations compared to fundamental value. However, not many researches pay attention why stocks usually trade at a discount rather than at a premium and why the variance of the discounts between companies is sometimes large. Also the studies do not explain why discounts and premiums are sometimes observed simultaneously between companies.

- As set out in paragraph 2.5 price discount are assumed mean reverting and subject to wide variations over time and across funds. Many of the regarded studies show either cross-sectional and/or time varying outcomes. Assuming that price deviations are indeed mean reverting, general explanation of price variations might be susceptible since fund characteristics may evolve over time during their lifecycle. Therefore outcomes that might be significant in cross-sectional analysis do not always have to hold in time varying outcomes. And vice versa. This robustness of outcomes is not always evaluated in the studies regarded. Additionally, the studies also not clearly indicate by which process the convergence to a certain mean occurs.

- In the theoretical framework a best-guess consensus is sought of evidence from previous research and translated in different hypothesis. The studies observed concern empirical research based on different investment products (e.g. REITs, CEFs, OEFs, ETFs), investment markets (public or private), geographical allocations (US, UK an EU) and time horizons (‘70s, ‘80s, ‘90s and ‘00s). Since the investment market is heterogeneous, populations may differ in variance (so called heteroskedastic). As such, a careful consideration is needed whether outcomes are generalized to other markets. Hence, outcomes may be susceptible for samples that are not or limitedly researched such as the non-listed real estate fund market. For example, many studies observed are based on public equity markets (e.g. NYSE and LSE), but do are not taken into account illiquid characteristics and limitations of the non-public markets (such as the market for non-listed real estate funds).

- In the different studies it is seen that different proxies are used to express certain variables. For example to measure (il)liquidity in relation to price discounts e.g. free float, bid-ask spreads and trading activity have been used as proxy values. Although the outcomes of a certain relationship seem to match amongst studies, due to the different proxies used by the researchers, the reliability of such comparisons and general statements can be wrong.

- In the studies regarded the effect of price discounts is not always corrected for highly correlated variables. This can create noise and therefore influence the reliability of reported outcomes. For instance, management costs are assumed to perfectly correlated with asset value movements since they are commonly (in part) a fixed percentage of the NAV. In case

the effect on price discounts is not corrected for these variables, it is difficult to expose all causes that explain price deviations.

- In the several studies reviewed, many researchers are focused on explaining the influence of different rational and behavioral variables on asset pricing variations. The studies however, do not reflect on seemingly inversed relationships between these factors in which asset price deviations from fundamental vale signals an expectation about expected future performance of a company or fund. E.g. Leland and Pyle (1977) found that companies that trade at a discount at an IPO, generally have a positive future outlook. Additionally Johnson et. Al (2006) and Nanda & Wang (2006) found that dividend yield signals expected future performance of a company. So, premiums and discounts can give an indication of the investor confidence in a certain share.

- The insights and conclusions in paragraph 2.7, especially paragraph 2.7.2, are predominantly based on industry expert reports and are therefore not (always) empirical supported. Any predictions made with references to the secondary trading market of non-listed real estate funds are therefore hypothetical.

- Last, reflecting on the different studies and industry expert reports in relation to the secondary trading market of non-listed real estate funds, it becomes not clear if there are different scales of quality defined among non-listed real estate shares (including risk levels) and whether there are substitute products available in the market. And even more important, whether any differences in quality of these shares are recognized by investor buyers and sellers and reflected in trading prices in comparison to NAV.

3. Data & Methodology

In chapter 2 a clear framework is worked out regarding the asset pricing mechanism in general, its relation to the EMH and (causal) determinant of pricing deviations from fundamental value. Also predictions are made on determinants with an expected positive or negative relation to share price discounts on fundamental value. Last these predictions have been put in perspective to the secondary trading market of non-listed real estate funds. The outcomes of mainly paragraph 2.6 and 2.7 form the basis for the empirical research chapters of this study.

In this chapter an attempt is made to set up an empirical research framework to check if the predictions from the theoretical framework are seen in secondary trades of non-listed real estate funds (chapter 4). In paragraph 3.1 the research design is presented in which the nature of research is discussed. Also an answer is given on the fourth sub-question:

> 4. *Which quantitative research methodology is predominantly used in empirical studies to identify (causal) effects on pricing deviations from fundamental value?*

In paragraph 3.2 the research population and sampling is discussed. In paragraph 3.3 it is assumed which predictions from paragraph 2.6 can be tested in the empirical research, based on the available data in the dataset. In addition, the operationalization of the used measures is discussed and a relationship diagram is presented that visualizes the empirical research. In paragraph 3.4 a justification of the data collection is given. Paragraph 3.5 regards the data analysis part of the research and in paragraph 3.6 any methodological issues are discussed to sustain the validity and reliability of the research.

3.1 Research design

3.1.1 Nature of research

As set out in chapter 1 this research aims to understand the mechanism of market pricing deviations (premiums and discounts) from fundamental value of non-listed real estate fund trades on the secondary market and explore which economic determinants have an influence on these price deviations.

The mechanism of market pricing deviations from fundamental value has already been discussed in chapter 2. To explore the potential (causal) relationship of the determinants that have been set out in paragraph 2.6 and 2.7, an experimental research has been set up. Hence, this methodology enabled to manipulate one or more economic determinants and observe any effects on the price deviations from fundamental value.

Quantitative research methods and techniques have been used based on desk research. By collecting, complementing and analyzing data of secondary trades of non-listed real estate funds, a first insight could have been made if any (causal) relations exist with pricing deviations from NAV and whether these determinants have or have no significant effect. An inductive research strategy is implemented as presented in figure 5. Different manipulating

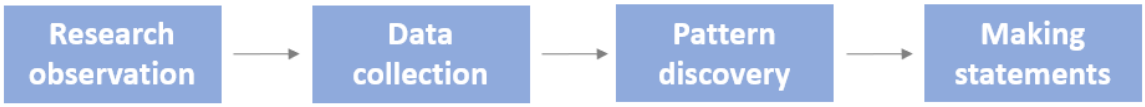


Figure 5 Inductive research approach

interventions are used on selected variables so the effects could be observed and ultimately reflected on the predictions as concluded in chapter 2.

3.1.2 Methodology

To identify the most suitable research methodology to apply to this research, a broad range of studies and journal articles have been regarded that investigated the relation between business economic determinants and market pricing deviations from fundamental value. This literature has already been regarded in chapter 2. As a result an answer can be given on the following sub-question:

> 4. *Which quantitative research methodology is predominantly used in empirical studies to identify (causal) effects on pricing deviations from fundamental value?*

Based on studies of e.g. Malkiel (1977), Barberis, Schleifer & Vishny (1998), Clayton & MacKinnon (2000), Chan, Jain & Yihong (2008), Lenkey (2013) and Frahn, Jonen & Schussler (2019) it is concluded that multiple regression analysis is most frequently used to research (causal) effects on pricing deviations from fundamental value. This methodology aims to analyze the (causal) relationship between a dependent variable (DV) such as the price deviation from fundamental value and several independent variables (IV's) such as e.g. managerial performance, diversification, investor sentiment, leverage and size. In addition multiple regression analysis enables to predict the value of the DV based on the value of two or more IV's.

Simple regression analysis is used to test the effect of a single IV on a DV, for which the following formula is used:

$$Yi = \alpha + \beta Xi + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

In this formula (Y) is the DV, (X) is the IV, (i) the number of observation, (α) the constant factor or intercept, (β) the regression coefficient and (ε) the error term which captures the part of the DV that cannot be explained by the IV due to an unobserved part of the population. In the simple regression it is assumed that (i) there exists a linear relationship between the DV en IV, (ii) a random sample of the population is selected for the data, (iii) the expected error term is 0 (exogeneity), and (iv) the variance of the error term is similar for all values of the IV (homoscedastic) and assumed to be normally distributed. (Baarda, et al., 2017)

Expanding on simple regression, multiple regression analysis incorporates more IV's to explain an effect in the DV and follows from the following formula.

$$Yi = \alpha + \beta_1 X_1 + \cdots + \beta_i X_i + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

In this equation the same definitions apply to the factors used in the simple regression formula, however multiple regression coefficients (β) of different IV's are included. In addition to the standard assumptions made for simple regression analysis, in a multiple regression it is also assumed that (v) there is no perfect linear relationship between the IV's (multicollinearity).

Referring back to the studies regarded, in all methodologies the researchers used parametric IV's that were measured on an interval or ordinal scale. Only in a limited amount of studies dummy variables are used to analyze the influence of non-parametric IV's on the researched DV. Barberis, Schleifer & Vishny (1998) for example distinguish good and bad news in their research to under- and overreaction of stock prices to news.

Furthermore, in the studies either cross sectional or time series regression analysis is performed. In some studies both analysis are executed. However, in most studies only cross sectional analysis is

performed, what is frequently seen in economic studies. In cross sectional analysis the existence and magnitude of (causal) effects of the IV's on the DV is observed for a representative sample of a population at a specific point in time. In time series analysis, these effects are regarded based on a sequence of data points over a specific time interval (Baarda, et al., 2017).

Based on the above, a multiple regression analysis has been performed in this research. In addition, a cross sectional approach is chosen since the research data that has been collected (see paragraph 3.4) does not allow for time series analysis. It is therefore not possible to regard changes in value of the DV following the changes in the value of the IV in a chronological order. Hence, only a few trades of non-listed funds are included multiple times over various time sections. Therefore the sample for time-varying analysis is too small to come to reliable outcomes.

3.2 Case selection

3.2.1 Population

The study relates to the real estate investment universe as shown in Figure 1. More specifically to the secondary trading market in non-listed real estate funds. MSCI estimates the total market size for the professionally managed global real estate investment market at $ 10.5 trillion or approx. € 8.5 trillion[7] as per year end 2020 (GG, Patkar, & Neshat, 2021). As is generally known and again stipulated by Brounen et al. (2007) and Roulac (1988), the real estate investments market for non-listed real estate funds is more opaque and not centrally registered. Therefore it is hard to estimate the global market capitalization and number of funds included in the non-listed real estate market. INREV (2021) however, which reports on non-listed real estate funds in Europe, reports a total of 382 funds with a total NAV value of € 217.7 billion as per year end 2020. It is not reported what their expected (European) market coverage is. The market capitalization of the secondary trading market of non-listed real estate funds is even more difficult to estimate and not easily traceable to the European market. As already set out in chapter 1, the global market for secondary trading of non-listed real estate funds has grown significantly over the last decades. Following Landmark Partners (see figure 1) the secondary trading market has grown from $ 406 million (approx. € 319 million) [11] in 1996 to $ 5.3 billion (approx. € 4.6 billion)[11] in 2018 with a trading volume peak at $7.5 billion in 2015 (approx. € 6.9 billion). Setter Capital (2013-2018) reported slightly different but comparable numbers with a trading volume of $4.0 billion (approx. € 3.5 billion) in 2018, with a trading volume peak in 2015 of $8.1 billion (approx. € 7.4 billion). These numbers exclude trades that are not disseminated publicly and therefore understate the total market volume. Following Zander (2019) the expected total global market volume should have been around $ 9 billion in 2018 (approx. € 7.9 billion). The share of trades in the European investment market is not estimated.

3.2.2 Sample selection

The study will focus on price deviations (premiums and discount) from NAV in secondary trading of European non-listed real estate funds. This includes trades in countries from Continental Europe and its surrounding islands (e.g. Great Britain, Scandinavia and Mediterranean islands). At the one side to minimize the noise from regulatory risk of several business environments (e.g. European, American and Asian markets). At the other side to base the study on a reliable data set. Unless the secondary market in securities is a formal trading exchange since early 1600s (Petram, 2011), the secondary market for non-listed real estate funds has emerged from the first century of '00s. CBRE and GFI Group launched PropertyMatch in 2009 to bringing e.g. transparency, liquidity and professionalism to what

[7] Based on a currency exchange rate of Dollars to Euro's at 0.7864 as per 31-12-1996, 0.9181 as per 31-12-2015, 0.87440 as per 31-12-2018 and 0.8186 as per 31-12-2020 (Source: exchangerates.org.uk)

previously had been an opaque and irregular market (CBRE, 2018). Although trades are currently being made in Europe, United States and the Asia-Pacific region, PropertyMatch has grown from the United Kingdom and therefore the database is most extensive for European trades (including the United Kingdom and Nordics). PropertyMatch has a unique but confidential database in which data is registered from September 2009 until present.

For this research an exclusive data sample of PropertyMatch registered secondary transactions is used. The dataset contains 1491 secondary trading transactions and consists of 107 different investment vehicles. For some vehicles only one single transaction is reported in the dataset. For other vehicles many transactions are reported, with a maximum of 199 reported trades for one vehicle.

To be better able to compare results, only data from full calendar years 2010 until 2018 have been used. In addition, since the research only focusses on the European investment market, secondary trades in Asia and the United States are excluded. After this selection a total sample of 1435 transactions remained of 91 different investment vehicles. Please see table 3 for a complete overview. In total approx. 1.4 billion shares trades of non-listed real estate funds have been registered over the period 2010-2018 with a total market value of €8.1 billion and NAV value of €9.6 billion. On overage this is a discount of 16.4% compared to NAV. See also table 6.

Since the dataset of PropertyMatch is based on random secondary trades of non-listed real estate funds in which PropertyMatch has been involved, the data sample can be assessed as a random data sample. The included samples are assumed to be relatively homogenous since the characteristics of many non-listed real estate funds (which underly the secondary trades) are fairly comparable and in many cases subject to uniform industry standards defined by The Association of Real Estate Funds (AREF) or the European Association for Investors in Non-Listed Real Estate Vehicles (INREV). The sample size consists of (n) 1435 secondary transactions of 91 unique non-listed real estate funds over the period 2010-2018. Although the total European population is not clear, the number of observations is quite extensive compared to e.g. the 528 unique registered non-listed real estate funds by INREV (2021). Therefore the sample is assumed to be representative enough to make general statement for the population based on the sample outcomes.

Year	# Trades	Traded units	Total NAV (€)	Trade price (€)	Premium / Discount (%)
2010	73	88,041,820	359,726,641	358,190,689	-0.4
2011	131	111,915,881	492,490,508	486,202,597	-1.3
2012	156	211,695,420	871,637,891	833,032,834	-4.4
2013	235	222,341,936	2,400,171,360	820,224,931	-65.8
2014	199	70,271,408	702,561,054	691,495,354	-1.6
2015	163	91,537,365	941,338,486	978,424,121	3.9
2016	167	337,054,759	1,549,792,432	1,533,764,778	-1.0
2017	153	125,876,903	1,259,671,836	1,260,880,729	0.1
2018	158	161,018,222	1,074,045,409	1,103,058,817	2.7
Total	**1435**	**1,419,753,714**	**9,651,435,616**	**8,065,274,851**	**-16.4**

Table 6 Overview of PropertyMatch registered non-listed real estate secondary trades between 2010-2018. All trades are expressed in Euro's. Registered trades in Pound Sterling or US Dollars have been converted to Euro's at their applicable exchange rate on the trading date. ***Source: PropetyMatch (Own redaction).***

3.3. Operationalization of research

As already indicated in paragraph 2.7 the theoretical framework for the majority refers to observations on the public equity market. Which is described as a relatively transparent and efficient market. The predictions made as summarized in paragraph 2.6 therefore do take into account the characteristics and limitations of non-public market. In paragraph 3.3.1 the selection of testable predictions is

explained and in paragraph 3.3.2 the dependent and independent variables of these testable predictions are operationalized as they are used in the empirical research and in paragraph 3.3.2 a relationship diagram is presented that result from these testable predictions.

3.3.1 Selection of testable predictions

As Brounen et al. (2007) and Roulac (1988) already indicated, the real estate market is opaque. In contrast to public real estate investments, which are merely based on stock market fundamentals, private real estate markets are mainly focused on fund characteristics. In contrast to the listed sector, non-listed vehicles do not publicly publish economic determinants such as e.g. prospectuses, real asset holdings, annual reports, historical performance data, valuations and day trade levels on a periodical basis. There are only limited data source available such as INREV, AREF and MSCI[8] to obtain these fund specifications. Since these organizations need to cope with privacy and confidentiality agreements of their client base, it has not always been possible to obtain additional fund characteristics and performance data on a large scale within the time frame of the research and/or match data with the observations from the PropertyMatch dataset. In table 7 an overview is made which predictions have been tested in this empirical research. Predictions H_1, H_2, H_4, H_6, H_9 and H_{12} are tested. Due to a lack of (representative) data availability and matching issues with the PropertyMatch database H_3, H_5, H_7, H_8, H_{10} and H_{11} could not be tested.

Prediction	Proxy	Data availability	Prediction tested?
H_1 (Managerial performance)	Management fees and alpha (α) of non-listed real estate fund compared to market index	Available with MSCI, but not obtained and/or matchable with dataset. Fund age might be an indicator for managerial performance track record and can be calculated from available data from INREV/AREF.	✓
H_2 (Asset liquidity)	Bid/ask spread, Free float or restricted stocks	Classification as OEF or CEF may suffice to proxy for (non) restricted stock. This data is available with INREV/AREF. Bid/ask spreads and free float are not publicly disseminated	✓
H_3 (Capital gain tax liabilities)	CGT Liabilities on unrealized appreciations	Not publicly disseminated	X
H_4 (Diversification)	Country allocation, asset type, property segment or Herfindahl – Hirschmanindex	Herfindahl- Hirschmanindex is not available for the non-listed real estate sector. Country allocation, asset type and property segment are available with INREV/AREF.	✓
H_5 (Dividend yield)	Distributed dividend yield to investors	Not publicly disseminated	X
H_6 (Investor sentiment)	Bullish- and Bearish sentiment index or bull- bear spread	Several investor sentiment indices are publicly available	✓
H_7 (Adverse selection)	Information gathering costs, bid-ask spread, % block holders in the market, % local vs. foreign market investors or % informed vs. uninformed investors	Not publicly disseminated. In addition the dataset of Propertymatch does not contain information of buyers/sellers involved in the secondary trades. Therefore % blockholders or % local vs.	X

[8] MSCI is a leading provider of portfolio analytics and benchmarking tools to supply the global investment community with critical business intelligence regarding key drivers of returns and risks of real estate investments, such as performance analysis, investment performance benchmarking, market indices, risk management tools and market research.

		foreign investors cannot be determined.	
H_8 (Transaction costs)	Non amortized transaction costs (e.g. due diligence costs, legal fees and property tax)	Not publicly disseminated	X
H_9 (Leverage)	Debt as percentage of total assets on balance sheet or cost of debt	Loan to value (LTV) as percentage of the fund's GAV available with INREV/AREF	✓
H_{10} (Price-earnings ratio)	P/E ratio or share-to-book ratio	Not publicly disseminated	X
H_{11} (Valuation scepticism)	Share of trading- or letter stock on balance sheet	Not publicly disseminated	X
H_{12} (Size)	Firm size or Fund's market capitalization	Gross- and net asset value of the non-listed real estate fund available with INREV/AREF	✓

Table 7 Overview of testable predictions. The check marks indicate that a prediction has been tested in this research, the crosses that a prediction has not been tested.

3.3.2 Operational definitions

Based on table 4 in this paragraph a further substantiation and operationalization is given of the DV and the IV's for the testable predictions H_1 (Managerial performance), H_2 (Asset Illiquidity), H_4 (Diversification), H_6 (Investor sentiment), H_9 (Leverage) and H_{12} (Size). In appendix II a summarizing overview is given of all involved variables, the proxy codes, measurement scale (continuous or categorial) and measurement outcome (qualitative or quantitative) of the variables in the empirical research. Also a short description of the various dummies and items is presented.

3.3.2.1 Dependent variable

The DV, applicable to all tested predictions, is classified as the pricing deviation (premium or discount) from fundamental value. In this study NAV is used as proxy for fundamental value. In line with paragraph 1.5 the NAV entails the gross asset value (*GAV*) or fair value of the non-listed real estate fund shares less total liabilities (IFRS® Foundation, 2020) (INREV, 2017). The price deviation means the 'absolute' market price offered by an investor for the non-listed real estate fund shares above (premium) or below (discount) the NAV (Baum, 2009). The price deviation to NAV (NAV_{DEV}) is calculated as following:

$$NAV_{DEV} = \frac{(NAV - MP)}{NAV}$$

In this formula net asset value (*NAV*) and market price (*MP*) are equated. In case $NAV_{DEV} > 0$, a premium to NAV is applicable. When $NAV_{DEV} < 0$ then a discount to NAV applies. In the remainder of the study the term NAV_{DEV} will be used to indicate the DV.

3.3.2.1 Independent variables

For each of the tested predictions (H_1, H_2, H_4, H_6, H_9 and H_{12}), different IV's are in place. Since all of the variables are unobservable, different proxies have been used that serve in place to represent these variables.

H_1 (Managerial performance)

As set out in table 7, data for proxies such as the percentage management fees or outperformance to a certain market index (α) could not be obtained or matched with the PropertyMatch dataset within the time frame of the research. In this study the age of the fund (AGE) is used as a proxy for managerial performance. Fund age has been calculated by the rounded year in which the secondary trade has

been made following the PropertyMatch database ($YEAR_{TRADE}$) subtracted by the rounded year of first closing of the underlying non-listed real estate fund ($YEAR_{CLOSING}$). It is assumed that the higher the age, the longer the track-record of the fund and its GP. Since a track record shows all historical performance achievements or failures of a non-listed real estate fund, it is assumed to be an indicator for likely future performance. Therefore the longer the track record (or higher the age) the better managerial performance can be assessed by investors. The age of the fund (AGE) is calculated as following:

$$AGE = YEAR_{TRADE} - YEAR_{CLOSING}$$

H_2 (Asset Illiquidity)

In this research restricted marketability (or liquidity) has been proxied by the vehicle structure (*VEH*) of the investment funds involved in the secondary trades. Proxies that are frequently used to research illiquidity of investment funds in comparison to their holdings such as free float and bid-ask spreads are not publicly disseminated or were not included in the PropertyMatch dataset. For the *VEH* OEFs and CEFs are distinguished. Since this variable is dichotomous categorial, no dummy variables can be applied. Based on chapter 2 an appendix I it is assumed that OEFs have a higher level of liquidity compared to their asset holdings than CEFs, meaning a higher added value of its fund structure in terms of liquidity to the investor. OEF generally provide periodical redemption provisions or exit mechanisms. CEFs don't offer these liquidity provisions.

H_4 (Market diversification)

To investigate the effect of market diversification in this research three different proxies are used, namely a geographical (*COUNTRY*), sector (*SECT*) and investment style (*STYLE*) approach. In either proxy it is assumed that more diversification decreases specific (systematic) risk.

- The geographical approach assumes the effect of the country allocation risk (*COUNTRY*). A distinguishment is made whether funds are allocated to a single country or domestic fund or to multiple countries. Since this variable is dichotomous categorial, no dummy variables can be applied. In case a fund is allocated to a single country, the specific target countries (*TCOUNTRY*) are further distinguished with dummy variables France ($TCOUNTRY_{FR}$), Germany ($TCOUNTRY_{GER}$), Ireland ($TCOUNTRY_{IR}$), United Kingdom ($TCOUNTRY_{UK}$), The Netherlands ($TCOUNTRY_{NL}$) and the Nordics ($TCOUNTRY_{NO}$) included.
- The sector approach observes the effect of sector allocation risk (*SECT*). For this proxy single sector or focused funds and funds with allocation to multiple sectors are distinguished. Since this variable is dichotomous categorial, no dummy variables can be applied. In case funds are allocated to a single sector, the target sectors (*TSECT*) are further substantiated with dummy variables for the sectors healthcare ($TSECT_{HEALTH}$), leisure ($TSECT_{LS}$), logistics ($TSECT_{LOG}$), offices ($TSECT_{OFF}$), residential ($TSECT_{RES}$), retail ($TSECT_{RET}$) and student Housing ($TSECT_{STUDENT}$).
- In the investment style approach *(STYLE*), the allocation between long-term income driven and capital appreciated funds is made. INREV (2012) classifies the market for non-listed investment funds in three investment styles, namely core, value-add and opportunistic funds. Therefore dummy variables for core ($STYLE_{CORE}$), value-add ($STYLE_{VA}$) and opportunistic ($STYLE_{OPP}$) investment funds have been used. As set out in chapter 2 and appendix I, core funds are mainly risk mitigating and balanced investment funds with long term (less risky) predictable cashflows. Value-add and opportunistic funds are usually allocated to (riskier) focused and specialized products and merely concentrate on capital appreciation.

H_6 (Investor sentiment)

To proxy for investor sentiment in this study the orthogonalized sentiment index ($SENT^{\perp}$) is used. This sentiment index originates from Baker & Wurgler (2006). As set out in paragraph 2.5.3 and appendix I investor sentiment is not measured by a general instrument or tool. All proxies such as the bullish- and bearish sentiment index and the bull- bear spread have proven to be relevant in their field of study. $SENT^{\perp}$ is based on principal (time- series) components of five (standardized) sentiment proxies that all have been orthogonalized with a set of six macroeconomic indicator components to reduce the connection with systematic risk and create a clean sentiment index[9]. $SENT^{\perp}$ is calculated by the following formula, which is further elaborated in appendix III.

$$SENT^{\perp} = -0.241\, CEFD_{t^{\perp}} + 0.242\, TURN_{t-1} + 0.253\, NIPO_{t^{\perp}} + 0.257\, RIPO_{t-1^{\perp}} + 0.112 S_{t^{\perp}} - 0.283\, T_{t-1^{\perp}}^{D-ND^{\perp}}$$

In case $SENT^{\perp} > 0$, a bullish market applies in which investors expect the stock prices to increase. When $SENT^{\perp} < 0$ a bearish market applies, where investors expect stock prices to decrease. In case $SENT^{\perp} = 0$, investors are neutral on expected stock price changes. For further in depth understanding of $SENT^{\perp}$, the Baker & Wurgler (2006) study concerning 'Investor Sentiment and the Cross- Section of Stock Returns' is recommended. The reason why the orthogonalized sentiment index of Baker & Wurgler (2006) has been used in this research has various reasons. First, a sentiment index based om multiple proxies such as Baker & Wurgler (2006) is most comprehensive to proxy for investor sentiment. Secondly the orthogonalized sentiment index best preserves from systematic risk and includes time series variables to proxy for a sentiment index. Next to the fact that the index includes lagged sentiment components, the index is corrected for macroeconomic influences and is consistent with noise trading influences. Since the orthogonalized sentiment index is publicly available, clearly explained, transparent and therefore reproducible, this index is assumed to be most useful and reliable as a solid measurement for this study.

H_9 (Leverage)

Leverage (*LEV*) is proxied by the fund's loan to value (LTV) as a percentage of a fund's GAV. In the timeframe of the research no historic leverage data could have been obtained that match the fund's secondary trade dates included in the PropertyMatch dataset. Therefore *LEV* is based on latest available financial figures (mostly 30 September 2021) as reported with INREV or AREF. To mitigate risk for exaggerated claims, taking into account that leverage levels might change over time between latest available financial figures and the trade date, *LEV* has been split in leverage intervals of fund with low leverage 0-25% ($LEV_{LOW)}$, intermediate leverage 25-50% ($LEV_{MED)}$ and high leverage >50% ($LEV_{HIGH)}$. With this approach a certain change margin is taken into account for this proxy.

H_{12} (Size)

To proxy for the size (*SIZE*) effect, in this study the market capitalization of the non-listed real estate funds has been used based on NAV. Thus the GAV less total liabilities. In the timeframe of the research no historic NAV could have been obtained of the latest valuation figures prior to the fund's secondary trade dates included in the PropertyMatch dataset. Yet, to approach a certain SIZE variable in this research, latest available financial figures (mostly 30 September 2021) are used as reported with INREV or AREF. To mitigate risk for exaggerated claims, taking into account that market capitalization might change over time between latest available financial figures and the trade date, *SIZE* has been split in market capitalization intervals of small cap funds between

[9] The closed-end fund discount (CEFD), NYSE share turnover (TURN), the number of initial public offerings (NIPO), average first-day returns on initial public offerings (RIPO), the equity share in new issues (S) and the dividend premium (P_{D-ND})

€0-2 billion ($SIZE_{SMALL}$), medium cap funds between €2-5 billion ($SIZE_{MID}$) and large cap funds >€5 billion ($SIZE_{LARGE}$). By this means a certain growth and shrink margin is taken into account for this proxy.

Hence the secondary trades in which non-listed real estate funds are involved with a NAV of up to €2 billion (57.2%) and €2-5 billion (41.2%) are dominant. Only 22 secondary trades involve funds that have a NAV over €5 billion (1.6%).

3.3.3 Relationship diagram

Based on the testable hypothesis as set out in paragraph 3.3.1. and proxies presented in paragraph 3.3.2 a relationship diagram has been made up, which entails the expected direction of causality and the expected relationship between the IV's and the DV. See figure 6. The direction of causality is displayed by the arrows. Direct expected relations are expressed with a solid arrow line, unknown relations with a dotted arrow line. The relationship between the variables is indicated with a '-' sign (negative expected relationship), '+' sign (positive expected relationship) and '?' sign (unknown nature). This study is explorative and focusses on the direct relationships of the IV on the DV. No interaction and intersections are analyzed between the IV's and are therefore not included in the diagram. For the direction of influence the assumptions are used as reported in paragraph 2.5.

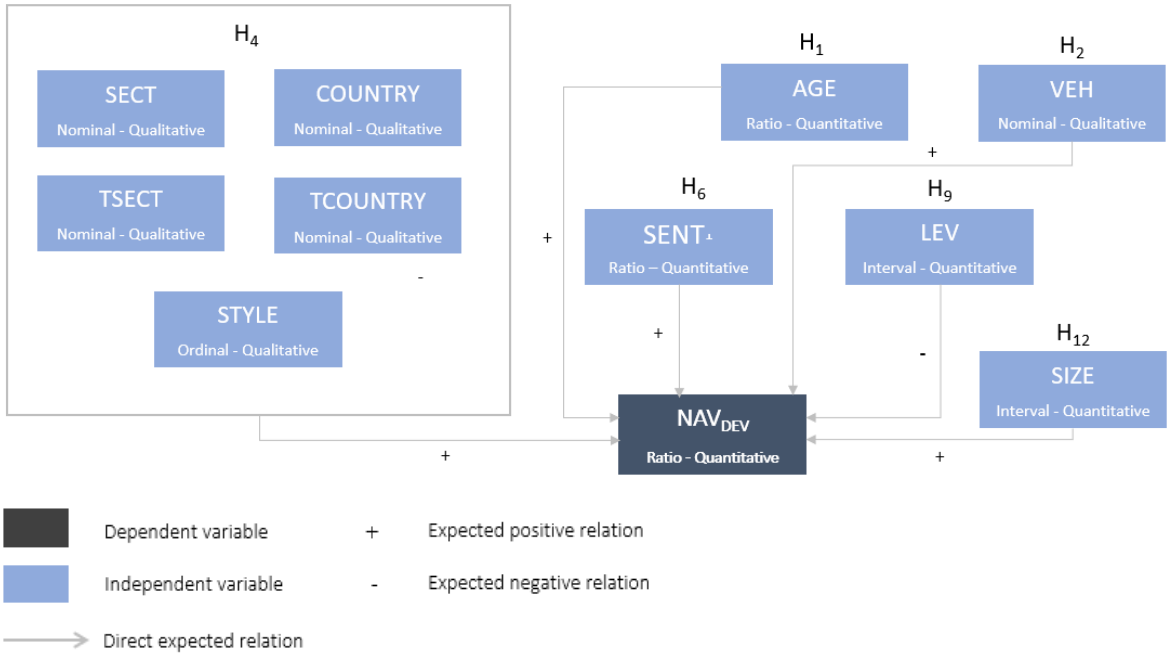


Figure 6 Relationship diagram variables empirical research

3.4 Data

In this paragraph a short description is given of the data- collection, cleaning process and modification of the empirical research, which has been performed to come to a reliable dataset for the quantitative analysis.

3.4.1. Data collection

The research data in this thesis is drawn from three main sources. All data is gathered directly from its original source, hereby no interference has occurred. Therefore the data is labelled as accurate, reliable and assumed to be valid.

First, as already indicated in paragraph 3.2.2, an exclusive data sample of PropertyMatch registered secondary transactions of non-listed real estate funds has been obtained. The dataset is made available by CBRE Capital Advisors. The dataset contained 1491 secondary trading transactions of 107 different investment vehicles from United Kingdom, United States, Asia and Europe over period 2009 until 2018. The dataset includes e.g. fund names, trade dates, traded units, unit trade prices, NAV per unit and premium/discounts to NAV. The dataset supplied data input for NAV_{DEV} and part of the *AGE* calculation. In addition the included funds and trade dates in the dataset acted as a link to further complement the dataset.

Second, industry data from leading market intelligence associations INREV and AREF have been used. Preferably standardized data from INREV has been integrated in the dataset. The INREV Vehicle Universe database (2021) has been accessed to obtain fund specific characteristics by searching for 'Vehicle Manager' or 'Vehicle Name'. In case the data could not be obtained from INREV, the Property Fund Vision Documents of AREF has been accessed as part of their periodical performance data reporting (AREF, 2021). For both the INREV and AREF database a member account is required. In case both INREV and AREF did not contain sufficient information, periodical distributions from specific fund documentations have been used that are found via search engine Google. Via these sources the input is obtained for e.g. proxies vehicle structure (*VEH*), investment style (*STYLE*), Leverage (*LEV*), Size (*SIZE*), sector allocation (*SECT*), geographical allocation (*COUNTRY*) and year of first closing ($YEAR_{CLOSING}$). In the dataset for each transaction the used source (INREV, AREF or company website) is indicated.

Third, for the investor sentiment proxy ($SENT_{-1}$) the orthogonalized sentiment index of Baker & Wurgler (2006) has been used. Baker & Wurgler have made all data publicly available on the Internet[10]. The data is presented in a excel worksheet and available for editing. This worksheet has been copied tot the dataset.

3.4.2 Data cleaning

The data cleaning process of the dataset has been performed in two parts. First, as already set out in paragraph 3.2.2, the PropertyMatch dataset has been modified. The obtained dataset from PropertyMatch contained 1491 secondary trading transactions of 107 different investment vehicles in United Kingdom, United States, Asia, Europe and Nordics over period 2009 until 2018. Since this study focusses on the European investment market, secondary trades from Asia an United states have been excluded from the dataset. Furthermore, for calendar year 2009 only 8 secondary transactions in two months have been registered. To be better able to compare full year results with a reliable number of observations, secondary trades of 2009 are excluded. Full calendar years 2010 until 2018 remained in the dataset. After this cleaning process a total sample of 1435 transactions remained for 91 different investment vehicles.

Second, The PropertyMatch dataset has been complemented with specific fund characteristics from INREV, AREF or original company fund documentation. For some vehicles the name of the GP was e.g. not clearly indicated in the PropertyMatch dataset or the GP had changed over time. This required additional research via Google search engine to complement the dataset. For 85 transactions of 32 different investment vehicles in the dataset no matching data has been found since e.g. the investment fund was dissolved or merged with another investment fund. These samples have been excluded from the dataset and as such 1350 secondary transactions remained from 59 investment vehicles on which analysis has been performed.

[10] http://http://people.stern.nyu.edu/jwurgler/

For some secondary transactions not all fund specific characteristics have been obtained as included in the dataset such as leverage (*LEV*) or fund size (*SIZE*). For these transactions the data input fields have been left blank and will result is less observations (missing values) of the proxy variables. Since other data input was available, these transactions have not been excluded from the dataset. Any outliers that are excluded in the data analysis are discussed in chapter 4.

3.4.3 Data modifications

To make the PropertyMatch dataset suitable for the empirical research, a few data modifications have been done. In the dataset all original Propertymatch data is earmarked by blue columns. Supporting data columns (e.g. conversion ratio's and sources) by yellow columns and proxy variables by orange columns (incl. $YEAR_{TRADE}$ and NAV_{DEV} that originate from PropertyMatch).

Each secondary transaction included in the PropertyMatch dataset has been indicated by a transaction ID (#). Also each identical non-listed fund has obtained an identical number (Fund #). Hence, the secondary trading data from PropertyMatch is made available on a confidential basis for research purposes. As such in all funds in the dataset have been pseudonymized. Only the researcher knows which code corresponds to which secondary trade.

The PropertyMatch dataset has been manually complemented with fund specific characteristics from INREV, AREF or original company fund documentation. For example for proxy *COUNTRY* it is added whether a fund is either single-country or multi country allocated. For proxy TSECT for each transaction it is complemented whether the target sector of the underlying fund is healthcare, leisure, logistics, offices, residential, retail or student housing. And for proxy *VEH* it is added whether a fund is closed-end or open-end. And so on. For SIZE and AGE further manual moderations were required. For SIZE the latest available NAV's of the non-listed real estate funds underlying the secondary transactions have been converted into three intervals $SIZE_{SMALL}$ (€0-2 Million), $SIZE_{MID}$ (€2-5 Million) and $SIZE_{LARGE}$ (> €5 Million). To calculate *AGE* the $YEAR_{TRADE}$ has been subtracted from $YEAR_{CLOSING}$.

All numeric values of the secondary trades (trade price and NAV) are expressed in Euro's. Any registered trades in Pound Sterling or US Dollars have been converted to Euro's at their applicable inter-bank spot rate conversion factors as per trading date.

The trading dates of each secondary transaction have been split in trading years and months, so e.g. $YEAR_{TRADE}$ could be determined. But also to match these transactions with the available orthogonalized sentiment index of Baker & Wurgler (2006). This index has been distributed on a monthly basis. In the research it is assumed that $SENT^{\perp}$ at moment 't' is immediately reflected in pricing and therefore results in a NAV_{DEV} at 't'.

3.5 Data analysis

For the data analysis all collected data as described in paragraph 3.4 has been uploaded in statistical program STATA (version 14.0). Strings from labelled numeric variables have been decoded and variables *SIZE* and LEV have been recoded into the three groups as displayed in appendix III. In the data analysis it is assumed that all variables are normally distributed within the population. After creating histograms for the distribution of the numeric variables ($NAV_{DEV,}$ AGE and $SENT^{\perp}$) only AGE seemed not to be fully normally distributed.

The study limits itself to investigate if any patterns can be found for NAV_{DEV} on the secondary trading market of non-listed real estate funds. Therefore cross sectional analysis has been applied. Univariate analysis and bivariate analysis has been performed to research systematic patterns between the research variables. Furthermore simple- and multiple regression analysis has been performed to

analyze the (causal) relationship between the IV's and NAV_{DEV}. However, this study does not aim to create a significant multi-factor model that gives a significant explanation for NAV_{DEV}.

Van Dalen & De Leede (2009) has been used as reference work for the statistical methods and techniques used in the data analysis.

3.5.1 Univariate analysis

First of all a descriptive (univariate) analysis has been performed on the data obtained regarding the non-listed real estate secondary trades. The observation results of the individuals variables are discussed. In this analysis the relationships between the variables are not yet discussed. Two elements are put central. First, a description of the main sample characteristics of the variables presented in Figure 6 are given. This includes means, standard deviations and confidence intervals of the measured quantitative variables. And frequency and percentages of the qualitative variables. In appendix II it is already set out which variables have qualitative or quantitative outcomes. Last in this analysis extreme values are discussed and summarized in an outlier analysis based on histogram analysis and Z-score[11] testing. Based on this analysis the data observations of NAV_{DEV} and $SENT_{\perp}$ found to have extreme values and have been corrected accordingly.

3.5.2 Bivariate analysis

Second, the pairwise relations between the IV's and NAV_{DEV} are analyzed that are included in Figure 6. In this bivariate analysis systematic patterns between both variables is put central. Not the causality has been observed, but the relationship between the variables. It has been observed whether the expected relationship between the variables is well-founded. The pairwise relationships have been tested using multiple statistical tests: (1) two-sample t-tests for nominally dichotomous variables *VEH, SECT and COUNTRY*, (2) one-way variation analysis (one-way Anova) for nominally non-dichotomous variables *TSECT* and *TCOUNTRY, (3)* Spearman's rank correlation coefficient for variable STYLE, LEV and SIZE and (4) Pearson correlation coefficient for AGE and $SENT_{\perp}$. To determine the testing method for the various relationships, table 5.1 from the book by van Dalen & de Leede (2009) has been used. See also appendix II for a complementary overview. In the analysis three main topics have been assessed, namely (1) the (significant) existence of a relationship between the variables. And if possible, (2) the nature of the correlation and (3) the degree of correlation.

3.5.3 Simple- and multiple regression analysis

Third, both simple- and multiple regression analysis has been performed to research the assumed (causal) relationships between the IV's and $NAV_{DEV.}$ Estimates of the direct effects are made in the simple regression analysis. In case of the multivariate analysis also the interdependence and joint effects of the variables are taken into account. In the analysis the independence of observations is checked with Durbin-Watson statistics for autocorrelation and multicollinearity by analyzing correlation coefficients. To test on the robustness of the simple- and multiple regression models, dummy variables have been used for the nominally non-dichotomous variables. The dummy variables are presented in appendix II.

[11] The Z- score indicates the number of standard deviations an observation lies above or below the mean of the variable. Observations that fall three standard deviations from the mean are usually treated as an outlier (van Dalen & de Leede, 2009)

3.6 Methodological issues, validity and reliability

While interpreting the results of the empirical research, several remarks need to be placed regarding the content of the dataset, the validity and the reliability of the outcomes and any other methodological issues.

As already indicated in earlier chapters, the market for non-listed real estate funds is an opaque market in which data is limited or not publicly available. Despite the fact that this created an interesting field of research for dynamic asset pricing of non-listed real estate fund secondary trades, it also limited the data availability for the empirical research. And thus the possibility to replicate or approach methodologies used in earlier research. Not all proxies used are therefore a common reflection of predictions and variables found in chapter 2. But the used proxies are the best possible interpretations of the variables to come to (valid) statement based on the data sample.

As already substantiated in paragraph 3.2.2. the data sample is assumed to be representative enough to make general statements about the population based on the sample outcomes of the empirical research. However, the secondary trades included in the dataset of PropertyMatch may be subordinate to infrequent sampling, selection bias and survivorship bias that exist in illiquid markets. Therefore any statements made, need to be interpreted with caution. In contrast, since only a few sources are used to complement the PropertyMatch dataset (mostly from leading market intelligence associations INREV and AREF), it could be argued that a solid and reliable dataset is used to come these statements.

As highlighted in paragraph 3.4.3. the PropertyMatch dataset is confidential and presented on an anonymous basis for research purposes. The names of the involved funds have been pseudonymized with identical codes for each fund included. The funds that match with the identical codes as well as the acknowledgements regarding the origin of the fund characteristics data is clearly documented. In case the dataset is called in question, references can be requested with the researcher.

Regarding the dataset and proxy assumptions, the following remarks are placed that might have a bearing effect on the outcomes of the empirical research:

- The dataset contains a few continuously measures variables and multiple categorial variables. This has effect on the scope of the conclusions made in the empirical research. Merely conclusions are made on the nature of the relations between the variables and limited conclusions on the magnitude of the relationship.
- The trade prices included in the secondary transactions and NAV's of the underlying non-listed real estate funds are based on appraisal-based valuation. Therefore it might be expected that lagging and smoothing effects apply to the research outcomes;
- Data of fund characteristics has been added to the dataset from last available INREV or AREF data (mostly Q3 2021). Within the timeframe of the research, and with the limited data sources, it could not have been determined whether e.g. sector allocations, leverage ratio's or vehicle structures have changed over time between the trading date and latest available INREV or AREF data. For example, it is not been regarded whether a CEF has changed over time through liquidation, merger or conversion to an OEF at earliest date of winding up;
- In the dataset the values are presented Euro's. In case other currencies were registered such as U.S. Dollars ($) or Pound Sterling (£), the currencies have been converted to Euro's based on the inter-bank spot rates as per trading date. There may be significant swings in exchange rates between the cut-off date and settlement date of the secondary trades, which may have accretive or dilutive effects on trade prices and as such the deviations from NAV;
- In the study some non-conventional proxies are used to research the selected predictions H_1, H_2, H_4, H_6, H_9 and H_{12}. For example *AGE* is used to approach a GP's track record and proxy for

managerial performance. And *VEH* is selected to proxy for asset illiquidity based on differences in the liquidity characteristics of investment vehicles. However, based on chapter 2 these proxies are not frequently used in other empirical studies and as such these proxies might not correctly;

- The orthogonalized sentiment index of Baker & Wurgler (2006) is a sentiment index that is based on the US investment market. Although outcomes of the index may deviate from the EU or UK investment markets, this sentiment index is the most comprehensive proxy that has been found to quantify investor sentiment. Since the dataset of PropertyMatch does not involve buyers and sellers in the secondary trades, investors may be either domestic or non-domestic trades including traders from the US. Therefore the orthogonalized sentiment index may still be reliable for the research;

Last, a cross sectional analysis has been performed in this research. Due to the limited amount of registered secondary transactions of identical funds over time, no time series analysis could be performed. The internal validity of cross sectional research is lower than time series analysis since it cannot be observed if a change in the DV is caused by any IV in a chronological order. Therefore incorrect causal effects may assumed as there is no comparison to a control group. This makes the research weaker for claiming causal effects. Also no intersections and have been analyzed. Empirical evidence on correlation between variables is not yet an indicator that there an actual causal relationship between two variables. By analyzing intersections and interactions, the authenticity and significance of observed relations can be tested. Since this analysis has not been performed, the outcomes of the empirical research are also more vulnerable for incorrect assumptions on causality. This might be interesting for further research.

4. Results

In this chapter the statistical outcomes of the empirical research are presented. In paragraph 4.1 the outcomes of the univariate analysis of the quantitative and qualitative variables are presented. Extreme values are discussed and summarized in an outlier analysis. In paragraph 4.2 the results of the bivariate analysis are reported in which the systematic patterns between the research variables are discussed. In paragraph 4.3 the outcomes of the simple- and multiple regression analysis are presented.

4.1 Univariate analysis

4.1.1 Quantitative variables

In order to analyze the observation results from the dataset, a description of the most important sample characteristics is given for each qualitative variable. This includes $NAV_{DEV,}$ AGE, $SENT_{t}$,LEV and SIZE. A distinction is made between measures of location that provide insight in the center of gravity of the data sample (including the minimum and maximum values and the mean) and distribution measures (standard deviation). To analyze the accuracy of the results, a confidence interval has been calculated using the standard error for each variable. An example of the calculation methodology can be found in appendix VI. The outcomes regarding the mean values, standard deviations and confidence intervals of the quantitative variables are presented in table 8. The STATA output can be found in appendix IV. No missing values apply to the variables in the dataset since the sample size (N) is equal to 1.350.

Variable	N	Mean	Std. Dev.	Min	Max	95% Confidence interval (CI)
NAV_{DEV}	1.350	-0.0013852	.00440559	-0.55	0.21	[-0.0037374, 0.000967]
AGE	1.350	23.32	15.56306	1	51	[22.48907, 24.15093]
$SENT_{t}$	1.350	-0.0500464	0.175446	-.8939431	.3841878	[-0.0594137, -0.0406791]

Table 8 Descriptive statistics quantitative variables empirical research before exclusion of outliers

NAV_{DEV}

As indicated in paragraph 3.3.2 the dependent variable NAV_{DEV} represents the pricing deviation (premium or discount) from NAV. The variable is measured on a rational scale since it has a possibility of ordering, a distance indicator and a natural zero point. The variable has a percentage interpretation, whereby the variable is measured on a scale from -1 to 1. In case $NAV_{DEV} > 0$, a premium to NAV is applicable. When $NAV_{DEV} < 0$ then a discount to NAV applies. The average price deviation of all secondary trades in the sample is -0.1% with a standard deviation[12] of 4.4%. Assuming that NAV_{DEV} is normally distributed, on average a discount to NAV is measured. The maximum discount to NAV is 55%. The maximum premium to NAV is 21%. A 95% confidence interval estimate gives an interval of [-0.0037: 0.00097]. This means that in 95% of the following observations a price deviation to NAV is expected to be observed between -0.3% and 0.01%. The interval width of the 0.4% (on a total scale of 0% to 100%) can be interpreted in this case as a reliable estimate.

AGE

Variable *AGE* refers to the rounded number of years between the trade data ($YEAR_{TRADE}$) of a secondary transaction included in the sample and the year of first closing ($YEAR_{CLOSING}$) of a transaction in the underlying non-listed real estate fund. Also interpreted as the track-record of the GP. The variable is

[12] The standard deviation indicates the amount of variability of a variables observations within a dataset (van Dalen & de Leede, 2009)

measured on a scale from 0 to an infinity of outcomes. A value of 0 implies that a secondary trade has exactly commenced at the first closing of the underlying fund (which in practice will not or rarely occur). The average age is relatively high with a large standard deviation (*M* = 23.32, *SD* =15.56). The minimum *AGE* included in the data sample is 1 year, the maximum 51 years. A 95% confidence interval estimate gives an interval of [22.49; 24.15], meaning that in 95% of the following observations an *AGE* is expected between 22.49 years and 24.15 years. The interval, about 1.67 years is small. However, as will be explained in 4.1.2., *AGE* seems not to be normally distributed and therefore one has to be cautious in making conclusions.

***SENT*$_{t+1}$**

The variable *SENT*$_{t+1}$ represents the sentiment of investors expressed at time 't' regarding expected future stock prices at 't+1'. The variable is measured on a rational scale and ranges from -1 to 1. In case *SENT*$_{t+1}$ > 0, a bullish market applies in which investors expect the stock prices to increase. When *SENT*$_{t+1}$ < 0 a bearish market applies, where investors expect stock prices to decrease. In case *SENT*$_{t+1}$ = 0, investors are neutral on expected stock price changes. The average sentiment is -0.05 or translated into a sentiment index this would be expressed as 95 compared to a base value of 100 (neutral). The standard deviation is 0.4. A 95% confidence interval estimate gives an interval of [-0.0594: -0.04068], meaning that in 95% of the following observations a *SENT*$_{t+1}$ is expected to be found between -0.059 and -0.0401 or equivalent to an index between 94.1 and 95.9. The interval, 0.0187 or index value 1.8, is small and can therefore be interpreted as reliable.

4.1.2 Outlier analysis

To observe if the dataset contains extreme values, an outlier analysis has been executed. This analysis could only be performed for the quantitative variables *NAV*$_{DEV}$, *AGE* and *SENT*$_{t+1}$. Outliers are extraordinary small or large datapoints in a dataset that do not fit the trend compared to the rest of the data. This can either be explained by incorrect observations or data entry. But also by exceptions in the sample. Keeping these extreme values included in the dataset, might lead to misleading information and incorrect conclusions. It is therefore critical to thoroughly analyze if extreme values are present, why they are present and whether they need to be excluded from the data sample.

First of all frequency histograms have been made up in STATA to see if any values fall outside the mean range and might be potential outliers. The histograms are presented in appendix IV and show that *NAV*$_{DEV}$ and *SENT*$_{t+1}$ are normally distributed with some extraordinary small and large observations. AGE However does not show a usual normal distribution, but a concatenation of three scatter peaks.

Then, on the basis of standardized values (Z-scores[13]), possible outliers were traced in the data set for verification. In case any of these values fall outside three standard deviations from the mean (-3 and +3), the corresponding observations are treated as an outlier (van Dalen & de Leede, 2009). In table 9 the Z-scores are presented before exclusion of outliers. In As already seen in the histograms outliers are seen for *NAV*$_{DEV}$ and *SENT*$_{t+1}$. In many cases the extreme values are only seen once or a few times and should therefore be excluded. For *SENT*$_{t+1}$ all observations with a value < -0.4 have been excluded, totaling 35 observations. For *NAV*$_{DEV}$ all deviations <-0.10 and > 0.10 have been excluded, totaling 26 observations. In table 10 the Z-scores are presented after exclusion of the outliers.

[13] The Z- score indites the number of standard deviations a variables observation lies above or below the mean of the variable observed (van Dalen & de Leede, 2009)

Variable	N	Min	Max
NAV_{DEV}	1.350	-12.45	4,80
AGE	1.350	-1.43	1.78
$SENT^{\perp}$	1.350	-4.81	2.48

Table 10 Z-scores quantitative variables before exclusion of outliers

Variable	N	Min	Max
NAV_{DEV}	*1.324*	*-2.82*	*2.21*
AGE	*1.350*	*-1.43*	*1.78*
$SENT^{\perp}$	*1.315*	*-2.59*	*3.01*

Table 9 Z-scores quantitative variables after exclusion of outliers

After correcting for outliers of NAV_{DEV} and $SENT^{\perp}$ in the dataset, the mean values, standard deviations and confidence intervals apply as presented in table 11. For NAV_{DEV} this means that the average price deviation of all secondary trades in the corrected sample is 0.08% with a standard deviation of 3.6%. The maximum discount to NAV is 10%. The maximum premium to NAV is 8%. In 95% of the following observations a price deviation to NAV is expected between -0.1% and 2.8%. For $SENT^{\perp}$ the average sentiment is -0.03 or equivalent to a sentiment index of 96.8. The standard deviation is 13.9. In 95% of the following observations a $SENT^{\perp}$ is expected to be observed between -0.040 and -0.025 or equivalent to an index between 96 and 97.5. The interval, 0.015 or index value 1.5, has become even smaller and therefore even more reliable.

Variable	N	Mean	Std. Dev.	Min	Max	95% Confidence interval (CI)
NAV_{DEV}	1.324	0.0008384	.0357489	-0.10	0.08	[-0.001089, 0.027657]
AGE	1.350	23.32	15.56306	1	51	[22.48907, 24.15093]
$SENT^{\perp}$	1.315	-0.0323775	0.1386092	-.3917551	.3841878	[-0.039876, -0.0248789]

Table 11 Descriptive statistics quantitative variables empirical research after exclusion of outliers

4.1.3 Qualitative variables

In contract to the quantitative variables, less meaningful statements about the results can be made for the qualitative variables since these are measured with dichotomous scales. On the basis of these scales one can only give an interpretation of the results, since a distance between the measured results and a natural zero point is missing. The findings regarding the mean sample characteristics of the qualitative variables are split into two schemes. Table 12 shows the key figures of the variables that are measured with a nominal and dichotomous scale. Table 13 shows the key figures with a multi-item scale. The STATA output can be found in appendix IV. In case missing values apply to a variable in the dataset the sample size (N) is lower than 1.350, which is the case for *LEV* and *SIZE*.

Variable	N	Item	Frequency	Percentage (%)	Cumulative (%)
VEH	1.350	Open-end	1.059	78.44	78.44
		Closed-end	291	21.56	100.00
SECT	1.350	Single-sector	581	43.04%	43.04
		Multi-sector	769	56.96	100.00

TSECT	1.350	Health care	6	0.44	0.44
		Leisure	14	1.04	1.48
		Logistics	91	6.74	8.22
		Offices	125	9.26	17.48
		Residential	5	0.37	17.85
		Retail	234	17.33	35.19
		Student housing	106	7.85	43.03
		Multi-sector	769	56.96	100.00
COUNTRY	1.350	Single-country	1.280	94.81	94.81
		Multi country	70	5.19	100.00
TCOUNTRY	1.350	France	2	0.15	0.15
		Germany	1	0.07	0.22
		Ireland	3	0.22	0.44
		Netherlands	19	5.19	5.63
		United Kingdom	1255	1.41	7.04
		Multi-country	70	92.96	100.00

Table 12 Key figures of variables with a nominal and dichotomous scale

VEH

The data sample includes two types of investment vehicles (*VEH*). The variable is measured on a dichotomous scale. Over three quarters of the funds involved in the secondary trades (78.4%) are an OEF (VEH_{OEF}). Approximately one quarter is a CEF. It is therefore assumed that the majority of the dataset has a higher level of liquidity compared to their asset holdings.

SECT

The variable *SECT* indicates the market diversification of the non-listed real estate funds that are trades on the secondary market based on sector allocation. The variable is measured on a dichotomous scale and distinguishes 581 single-sector focused funds (43.0%) and 769 blended or multi-sector focused funds (57.0%). The variable is almost evenly distributed within the data sample with 188 more multi-sector focused funds included.

TSECT

Elaborating on the variable *SECT*, *TSECT* further distinguishes the market diversification to specific niche sectors. *TSECT* is measured on a nominal scale and includes secondary trades of 234 (17.3%) non-listed real estate funds that are predominantly invested in the retail sector, 125 funds (9.3%) in offices, 106 (7.9%) in student housing, 91 (6.7%) in logistics, 14 (1.0%) in leisure, 6 (0.4%) in health care and 5 (0.4%) in residential. The remainder of 769 funds (57.0%) is not predominantly allocated to a specific sector and labelled as multi-sector.

COUNTRY

The variable *COUNTRY* assumes the market diversification of the non-listed real estate funds that are traded on the secondary market based on country allocation. The variable is measured on a dichotomous scale and separates 1280 single-country allocated funds (94.8%) and 70 multi-country allocated funds (5.2%). The majority of the funds is therefore focused in its country allocation.

TCOUNTRY

Expanding on the variable *COUNTRY*, measured on a nominal scale, *TCOUNTRY* breaks down the market diversification to specific niche countries. The vast majority of the non-listed real estate funds included in the secondary trades sample predominantly or only invests in the UK. This is a total of 1255 funds (93.0%). Not remarkable since the PropertyMatch business has grown from the UK. Further 19 (1.4%) of the funds are allocated to The Netherlands, 3 to Ireland (0.2%) and 2 to France (0.2%). A

single transaction is made for funds that are focused on both Germany (0.1%). The remainder 70 funds (5.2%) are not predominantly focused on a specific country and labelled as multi-country.

Variable	N	Item	Frequency	Percentage (%)	Cumulative (%)
STYLE	1.350	Core	1.095	81.11	81.11
		Value-add	253	18.74	99.85
		Opportunistic	2	0.15	100.00
		€0-2 Billion	767	57.15	57.15
SIZE	1.342	€2-5 Billion	553	41.21	98.36
		>€5 Billion	22	1.64	100.00
LEV	1344	0-25%	976	72.62	72.62
		25-50%	277	20.61	93.23
		> 50%	91	6.77	100.00

Table 13 Key figures variables multi-item scale (ordinal/interval)

STYLE

Variable STYLE indicates the market diversification of the non-listed real estate funds that are trades on the secondary market based on investment style. The variable is measured on a ordinal scale since the items can be ordered by risk level, assuming that Core funds bear the lowest risk and have predictable cashflows and opportunistic funds face the highest risk with a focus on capital appreciation. The majority of the observations in the data sample concern Core investment funds (81.1%). Value-add (18.7%) and opportunistic (0.2%) funds have been less frequently traded on the secondary market in the period 2010-2018. In chapter 2 is it assumed that most Core funds are also OEFs, which can also be concluded from the dataset since 78.4% of the observations concern an OEF.

SIZE

As described in paragraph 3.3.2.1. variable *SIZE,* based on NAV, has been split in three intervals. In general in it can be observed that secondary trades mostly concern small or medium sized non-listed real estate funds. Hence the secondary trades in which non-listed real estate funds are involved with a NAV of up to €2 billion (57.2%) and €2-5 billion (41.2%) are dominant. Only 22 secondary trades involve funds that have a NAV over €5 billion (1.6%).

LEV

Like the variable SIZE, also LEV has been split in three intervals as already discussed in paragraph 3.3.2.1. In the dataset 976 secondary trades (72.6%) concern funds with a low leverage level between 0-25%. In total 277 traded funds (20.6%) had a medium leverage exposure of 25-50% and only 6.7% of the secondary trades concerned funds with a high leverage level over 50%. This observation aligns with the assumption that most core funds and/or OEFs have lower leverage levels. Hence, these vehicles and investment styles are dominant in the dataset.

4.2 Bivariate analysis

This chapter will contain the analysis of all pairwise relations from the relationship diagram in figure 6. This concerns systematic patterns in the joint results of two variables. The analysis does not conclude on causality, but on the relationship between the IV's and NAV_{DEV}. It is assumed whether the assumed relationships are well-founded. As presented in appendix II nominal dichotomous variables *VEH, SECT and COUNTRY* are tested by using (1) two-sample t-tests. For non-dichotomous variables *TSECT* and *TCOUNTRY* a (2) variation analysis is performed on basis of one-way-Anova. The multi-items variables *STYLE, YEAR, LEV* and *SIZE* are analyzed with (3) the Spearman's rank correlation coefficient and categorial variables *AGE* and $SENT^{\perp}$ with (4) Pearson correlation coefficient. In all analysis the existence of relationship is assessed, if this relationship is significant and if possible also the nature

and degree of the relationship. Van Dalen & De Leede (2009) has been used as reference work for the used statistical methods and techniques.

In the analysis a significance level of 5% has been used (P > | t | = ≤ 0,05), thus a chance of coincidence of the observations of 5% .

4.2.1 Two-sample t-test

T-tests are used to make statements about means of populations whose variation is unknown (qualitative – quantitative analysis).. In the t-test the difference of the means of a maximum of two groups (dichotomous) is compared. In case the difference between both means is large enough and thus is significant, a relationship can be observed that is not due to chance. Below the results of the t-tests of independent variables *VEH, SECT and COUNTRY* and dependent variable NAV_{DEV} are described. In appendix V the STATA output is presented for all t-test outcomes. As an example in attachment VII the step-by-step approach is worked out regarding the two sample t-test of *VEH* and $NAV_{DEV.}$ In this example unequal variances are assumed.

For all pairwise relations of *VEH, SECT and COUNTRY* and NAV_{DEV} a two-sample t-test has been used to check whether the assumption holds that the means of two independent groups are equal (H_0: $\mu 1 = \mu 2$). In case H_0 holds, no significant differences are observed between the means of the groups. The t-test for independent samples comes in two forms, namely equal and unequal variances. Before the t-test was performed first a F-test was used to determine whether the variances were equal or unequal. The outcome is defined as the quotient of the variances S^2_1 and S^2_2. If this quotient is close to 1, one can assume that the variances are equal to each other and test with T_p (paired variance). If the variances are unequal, the test is performed with T_s (single variance).

For *VEH* a T_s test has been performed, since the F-test proved that the variances between the subpopulations OEF and CEF were unequal based on a 5% significance level. The critical value of the T_s test has been determined at -2.244. It is found that the average price deviation from NAV for secondary traded CEFs (*M* = -0.0195, *SD* = 0.0418) and OEFS (*M* = 0.00062, *SD* = 0.03187) was significant (*t* (1324) = -9.5495; *p* = 0.0000). H_0 is rejected at a significance level of 5%. Based on the STATA output for CEFs an average price discount to NAV is found of -2.0% and a premium of 0.1% for OEFs. Since H_1 is accepted, it can be assumed with a reliability level of 95% that there is a significant difference in average price deviation from NAV between secondary trades of OEFs and CEFs.

Also for *SECT* a T_s test has been performed, since the F-value of 1.6379 fell out of the acceptance range [1.1678; 1.1657], so it can be concluded that the variances between the subpopulations multi-sector and single-sector focused funds are unequal based on a 5% significance level. The critical value of the T_s test is determined at 2.244. It is found that the average price deviation from NAV for secondary trades in multi sector allocated funds (*M* = 0.0101, *SD* = 0.2861) and single sector allocated funds (*M* = -0.0017, *SD* = 0.4036) was significant (*t* (1324) = 10.8933; *p* = 0.0000). H_0 is rejected at a significance level of 5%. On average for multi sector allocated funds a price premium of 1.0% to NAV is found and a discount of 1.2% for single sector allocated funds. Since H_1 is accepted, it can be assumed with a reliability level of 95% that there is a significant difference in average price deviation between secondary trades of multi- and single sector allocated funds.

Last, For *COUNTRY* also the F-value of 0.2525 fell out of the acceptance range [1.3803; 1.4590] and thus variances between the subpopulations multi-country and single-country focused funds are unequal based on a 5% significance level. A T_s test has been performed with a critical value of 2.244. The average price deviation from NAV for secondary trades in multi county allocated funds (*M* = 0.0.0082, *SD* = 0.03280) and single country allocated funds (*M* = 0.0004, *SD* =0.0328) was not

significant (*t* (1324) = 1.8787; *p* = 0.0624). H_0 is accepted at a significance level of 5%. On average for both multi country- and single country allocated funds that are traded on the secondary market a price premium to NAV is found of respectively 0.8% and 0.04%. Since H_0 is accepted, it can be assumed with a reliability level of 95% that there is no significant difference in average price deviation between secondary trades of multi- and single country allocated funds.

4.2.2 One-way-Anova

In variance analysis or Anova the difference of a multiple number of group means (K examples > 2) is compared simultaneously. A one-way-ANOVA is used *TSECT* and *TCOUNTRY*, since only one IV and DV are analyzed. First, the variance between groups (between-group variance) is observed. In other words, how much do the group means differ from each other. Secondly, the spread within each group (within-group variance) is analyzed. Combining the two analyzes, results in a single analysis of variance. The relationship between the between-group variance and within-group variance is tested by means of a *F*-test.

The larger an *F* ratio is, the variation among groups is higher than one might expect to see by chance. And, the more variance there is between groups, the more the groups predict the price difference to NAV. In this paragraph the results of the one-way ANOVA of independent variables *TSECT* and *TCOUNTRY* and dependent variable NAV_{DEV} are described. In appendix V the STATA output is presented for all Anova outcomes. As an example in appendix VIII the step-by-step approach is worked out regarding the one-way-Anova of *TSECT* and $NAV_{DEV.}$

For the expected difference between *TSECT* and NAV_{DEV}, F_{obs} appears to be 0.59. F_{obs} is lower than the critical value (F) of 2.02, meaning that H_0 holds at a 5% significance level. Therefore it can be concluded that there is no significant difference found in average price deviation to NAV between the target sectors of the investment funds involved in a secondary trades (*F(7,1316)* = 0.59, *p* = 0.7667). The variances are assumed to be equal. To verify if any groups variances significantly differ among each other, a Bonferroni test is executed. In total seven groups for TSECT have been distinguished, namely health care (*M* = -0.0050, *SD* = 0.0509), leisure (*M* = -0.0086, *SD* = 0.04167), logistics (*M* = -0.0034, *SD* = 0.0370), offices (*M* = -0.0179, *SD* = 0.0339), residential (*M* = -0.0020, *SD* = 0.0192), retail (*M* = -0.0017, *SD* = 0.0386) and student housing (*M* = 0.0007, *SD* = 0.0332) and multi-sector (*M* = -0.0020, *SD* = 0.0325). None of the outcomes present a *p* < 0.05 and thus no significant differences are seen among the individual groups. The *n* for secondary trades of funds that target at residential, logistics and healthcare sectors is limited. Any outcomes for these groups are assumed to be not reliable to make statements about the population.

The variable *TCOUNTRY* has in total six groups included in the empirical research, namely France (*M* = -0.0350, *SD* = 0.0353), Germany (*M* = -0.0100, *SD* = 0.0000), Ireland (*M* = 0.0033, *SD* = 0.0404), The Netherlands (*M* = 0.01316, *SD* = 0.0293), United Kingdom (*M* = 0.0006, *SD* = 0.0356) and multi-country (*M* = 0.0050, *SD* = 0.0391). The F_{obs} for the expected difference between *TCOUNTRY* and NAV_{DEV} is 2.22. F_{obs} is higher than the critical value (F) of 2.22. Therefore H_0 should be rejected at a significance level of 5% and one should conclude that there is a significant difference found in average price deviation to NAV between the target country of the investment funds involved in a secondary trades (*F(5,1318)* = 2.22, *p* = 0.0210). However, the data underlying *TCOUNTRY* is for 93% based on secondary trades from UK targeted non-listed real estate funds and therefore not normally distributed. When performing a Bonferroni test to verify if any groups variances significantly differ amongst each other, only the Netherlands and Germany show a significant difference in average price deviation to NAV (*p* < 0.030). Since the *n* for secondary trades of funds that target at France, Germany, Ireland and Netherlands is limited, any outcomes for these groups are assumed to be not reliable to make statements about the population. Therefore the rejection of the H_0 is assumed to be doubtful.

4.2.3 Pearsons correlation coefficient

The relationship of variables *AGE* and *SENT*$^{\perp}$ *with* NAV_{DEV} is analyzed by using Pearson's correlation coefficient. This method is used to recognize the strength and direction of a pairwise relationship between two quantitative variables. Yet, no causality is analyzed. The extent to which *AGE* and *SENT*$^{\perp}$ *are* positively (+) or negatively related to NAV_{DEV} is summarized in a correlation coefficient (*r*), which nature ranges between +1.00 (perfect positive correlation) and -1.00 (perfect negative correlation). In case a positive correlations is seen, the outcomes of the variables regarded move in the same direction. In case negative relation is in place, both outcomes move in opposite direction. A value of 0 indicates that there is no linear relationship at all. For the interpretation it is assumed that the size of the *r* value has the following meaning regarding correlation (±): between 0 and 0.3 (no or limited), 0.3-0.5 (weak), 0.5-0.7 (intermediate), 0.7-0.9 (strong) and 0.9-1 (very strong or perfect). In appendix V the STATA output is presented for all Pearson's correlation coefficient outcomes. In appendix IX a step-by-step approach is worked regarding the significance of the Pearson's correlation coefficient *SENT*$^{\perp}$ and $NAV_{DEV.}$

A negative relationship between *SENT*$^{\perp}$ and NAV_{DEV} is found (*r*= -0.0575; *p*=0.0392; *N*=1324). The correlation of -0.0575 is assumed to be limited in strength. To test whether this correlation is also significant in nature, a *T* test is performed. $T_{s,obs} = -2.1261$ and is lower than the critical value *(t)* of 1.646. H_0 is rejected at a significance level of 5%. There is a significant negative relationship between investors sentiment *(SENT*$^{\perp}$*)* and the price deviation to NAV (NAV_{DEV}*).*

A positive relationship between *AGE* and NAV_{DEV} is found (*r*= 0.2032; *p*=0.000; *N*=1324). The correlation is 0.2032 and therefore assumed to be limited in strength. The significance of the correlation is *p = 0.0000* and thus it can be concluded at a significance level of 5% that there is a significant (but limited) positive relation between the average age of a non-listed real estate investment fund traded on the secondary market *(AGE)* and its price deviation to NAV (NAV_{DEV}*).*

4.2.4 Spearman's rank correlation coefficient

The relationship between independent variables that are measured at an ordinal scale and NAV_{DEV} is measured by the Spearman's Rank Correlation. In this empirical study this concerns *STYLE*, *YEAR*, *LEV* and *SIZE.* The Spearman Rank Correlation (r_s) is comparable to the method of Pearson's correlation coefficient (paragraph 4.2.3 and appendix IX), except that in this form of analysis the data is calculated on the basis of ranking scores. It thus measures the extent to which there is a relationship between the ranks of two variables. The formula for r_s slightly differs from *r* as presented below. The interpretations of the results are similar as for *r*.

$$r_s = 1 - \frac{6 \sum d_i^2}{n^3 - n}$$

Here d_i is the difference in ranking between X_i en Y_i, and *n* is the number of observations. The *T* test for significance of the results is also similar to the approach for r and thus the step-by-step approach as presented in appendix VII can be used as a reference approach for the results presented below. In appendix V the STATA output is presented for all Spearman's rank correlation coefficients.

A negative relationship between *STYLE* and NAV_{DEV} is found (r_s = -0.1113; *p*=0.0000; *N*=1324). The strength of the correlation of -0.1113 is assumed to be limited. The significance of the correlation is *p = 0.0000* and thus it can be concluded at a significance level of 5% that there is a significant (but limited) negative relation between the investment style of a non-listed real estate investment fund traded on the secondary market *(STYLE)* and its price deviation to NAV (NAV_{DEV}*).*

For the leverage provision of non-listed real estate investment funds traded on the secondary market (*LEV*) a significant negative relation is found with price deviation to NAV (NAV_{DEV}). The correlation (r_s= -0.3365; *p*=0.0000; *N*=1317) is assumed to be weak in strength. The significance of the correlation is *p = 0.0000* and thus holds at a significance level of 5%

A positive relationship between *SIZE* and NAV_{DEV} is found (r_s= 0.1304; *p*=0.0000; *N*=1317). The correlation of 0.1304 is assumed to be limited in strength. The significance of the correlation is *p = 0.0000* and thus it can be concluded at a significance level of 5% that there is a significant (but limited) positive relation between the market capitalization of a non-listed real estate investment fund traded on the secondary market *(SIZE)* and its price deviation to NAV (NAV_{DEV}).

4.3 Regression analysis

To analyze the predictive value (not meaning causality) of the different IV's on NAV_{DEV} a regression analysis has been performed. Both simple- and multiple regression analysis are used, to both research the size and direction of individual- and joint effects. The direct effects are analyzed with simple regression analysis. Dummy variables have been used to check the effects of individual groups of the categorical variables. Already outliers of continuous variables have been analyzed and resolved in paragraph 4.1.2. The categorical variables have been reordered as much as possible to come to reliable conclusions. In the multiple regression analysis joint effects of variables are analyzed, in which is cross-checked whether significant direct effects from simple regression analysis remain significantly robust in a multiple regression analysis. For this analysis dummy variables are used, multicollinearity is regarded and Durbin-Watson statistics are used to check for independence of observations. Further interpretation of these components is discussed in more detail in the paragraphs.

In the analysis a significance level of 5% has been used (P > | t | = ≤ 0,05), thus a chance of coincidence of the observations of 5%.

4.3.1 Simple regression

Following on the explanation in paragraph 3.1.2, the subsequent simple regression equation is used to analyze the effects of the various IV on NAV_{DEV}:

$$NAV_{DEV} = \alpha + \beta Xi + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

In this formula for NAV_{DEV} (*X*) is the IV, (i) the observation, (α) the constant factor or intercept (β) the regression coefficient that explains the increase or decrease of NAV_{DEV} as a result of a factor 1 increase of the IV and (ε) the error term which captures the part of NAV_{DEV} that cannot be explained by the IV due to an unobserved part of the population.

In appendix X the results of the simple regression analysis are presented. For the categorial variables dummy variables are included to observe the individual effects of the specified groups regarding price deviations to NAV. For the dichotomous nominal variables no dummy variables are created since the model only includes 1 degree of freedom and therefore gives a single outcome for both groups.

The empirical analysis shows that several variables have a significant predictive value regarding NAV_{DEV}. The funds age (*AGE*) explains 4.1% of the variance in NAV_{DEV} (p < 0.0000) with a positive regression coefficient of 0.0005 (p < 0.0000).

Also the investment vehicle type (*VEH*), thus the fact that an investment fund is an OEF or CEF, shows to be a significant predictor of NAV_{DEV}. The predicted price deviation to NAV is 0.2576 (p < 0.0000) and shows to explain 8.6% of the NAV_{DEV} variance (p < 0.0000).

Furthermore the investment style (*STYLE*) is found to have a significant predictive value to NAV_{DEV}. The predicted decrease in price compared to NAV is -0.5% ($\beta = -0.0050$; $p < 0.0000$) and explains approximately 1.2% of the variance of NAV_{DEV} ($p < 0.0001$). Looking at the different groups in *STYLE*, it is noticed that secondary trades of investment vehicles with a low risk profile ($STYLE_C$) show a significant positive variance to price deviations to NAV ($\beta = 0.0102$; $p < 0.0000$). Instead vehicles with an intermediate ($STYLE_{VA}$) and high ($STYLE_{OPP}$) are negative predictors regarding NAV_{DEV}. The regression coefficients are respectively -0.0098 and -0.0509 ($p < 0.0000$) and thus increase in magnitude when the risk profile increases. All *STYLE* dummies show a significant explanation of approximately 1.2% of the variance in NAV_{DEV}. $STYLE_C$ ($p < 0.0000$) and $STYLE_{VA}$ ($p < 0.0001$) are highly significant. $STYLE_{OPP}$ ($p < 0.0441$) would have been rejected in case a significance level would have been used of 2.5%. This is mostly explained by the fact that $STYLE_{OPP}$ has a low number of observations (n= 2).

Another significant predictor is *SECT* ($p < 0.0000$), thus the fact that a fund is single- or multisector focused. The predicted price deviation to NAV is -2.1% ($\beta = -0.021$) and shows to explain 9.0% of the NAV_{DEV} variance ($p < 0.0000$). However, no significant predictive effects could be found in case NAV_{DEV} is offset against secondary trades of non-listed real estate funds that target at specific sectors (*TSECT* and its dummies).

Also *COUNTRY*, thus the fact if a non-listed real estate fund involved in a secondary trade is single- or multi-sector focused, shows not to be a significant predictor regarding NAV_{DEV} and explanatory variable for the variance in NAV_{DEV} at a 5% significance level ($\beta = -0.0078$; $p < 0.083$). Although the effect and variance explanation would have been accepted at a 10% significance level. When looking at secondary trades of non-listed real estate funds that target at specific countries (*TCOUNTRY and its dummies)* also no significant predictive effects and variance explanations are found. Except for $TCOUNTRY_{GER.}$ The predicted decrease in price compared to NAV is -1.0% ($\beta = -0.0101$; $p < 0.0050$) and explains approximately 0.6% of the variance of NAV_{DEV} ($p < 0.0060$). Nonetheless, this outcome is doubtful since this dummy variable has only one observation (n= 1) and therefore is not representative for the population.

Investor sentiment ($SENT_{-1}$) explains 0.3% of the variance in NAV_{DEV} ($p < 0.0392$) with a negative regression coefficient of -0.0148 ($p < 0.039$).

Also the leverage provision of a secondary traded non-listed real estate fund (*LEV*) is found to have a significant predictive value to NAV_{DEV}. LEV has a negative regression coefficient of -0.2184 ($p < 0.0000$) and explains 13.4% of the NAV_{DEV} variance ($p < 0.0000$). When regarding the different groups in *LEV*, it is noticed that secondary trades of non-listed real estate funds with lower exposure to external finance (LEV_{LOW}) and thus lower default risk, have a positive predictive value to price deviations to NAV ($\beta = 0.0272$; $p < 0.0000$) and explain 11.5% of the variance in NAV_{DEV} ($p < 0.0000$). Instead non-listed real estate funds with an intermediate (LEV_{MED}) and high (LEV_{HIGH}) are negative predictors regarding NAV_{DEV}. The regression coefficients are respectively -0.1962 and -0.0372 ($p < 0.0000$) and explain respectively 4.9% ($p < 0.0000$) and 6.7% ($p < 0.0000$) of the variance in NAV_{DEV}. It is not seen that the higher the exposure to external finance and thus higher default risk, the larger the negative regression coefficient is. The smaller number of observations of LEV_{HIGH} (n=91) might contribute to this finding.

Last, about 2.4% of the variance in NAV_{DEV} could be explained by the market capitalization (*SIZE*) of the non-listed real estate funds underlying the secondary trades ($p < 0.0000$). The predicted increase in price compared to NAV is 1.0% ($p < 0.0000$). Looking at different groups $dSIZE_{SMALL}$, $dSIZE_{MED}$, and $dSIZE_{LARGE}$ all significant predictive value regarding NAV_{DEV} are noticed with an ascending pattern in regression coefficient. For $dSIZE_{SMAL}$ the predicted decrease in price compared to NAV is -1.0% (β = -

0.0102; p < 0.0000). For $dSIZE_{MED,}$ and $dSIZE_{LARGE}$ an predictive value of respectively 0.8% (*β = 0.0008; p* < 0.0000) and 2.7% (*β = 0.0277; p* < 0.0000) is noticed. Contrary the individual contributions to variance in NAV_{DEV} descends. Respectively the contributions are 2.0% (*p* < 0.0000), 1.3% (*p* < 0.0000) and 0.9% (*p* < 0.0000) for $dSIZE_{SMALL,}$ $dSIZE_{MED,}$ *and* $dSIZE_{LARGE}$.

4.3.2 Multiple regression

To test the robustness of the outcomes of the simple regression analysis, also various multiple regression analysis are performed in relation to the predictions that are selected for the empirical research (*$H_{1,}$ $H_{2,}$ $H_{4,}$ $H_{6,}$ $H_{9,}$ H_{12})* based on paragraphs 2.5.5, 2.7.3 and 3.3.1. Based on the bivariate analysis and simple regression, already a profound answer can be given on $H_{2,}$ $H_{6,}$ H_{12}. Therefore, multiple regression models are set up for $H_{1,}$ H_4 and H_9. Following on the explanation in paragraph 3.1.2, the subsequent multiple regression equation is used to analyze the effects of the various IV on NAV_{DEV}:

$$NAV_{DEV} = \alpha + \beta_1 X_1 + \cdots + \beta_i X_i + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

In this equation the same definitions apply to the factors used in the simple regression formula, however multiple regression coefficients (β) of different IV's are included.

In case categorial variables are used to test for predictive patterns, one dummy group has been left out of the model to avoid multicollinearity. Dichotomous categorial variables do not need to be corrected since automatically one out of two groups is included in the analysis. To take into account autocorrelation in the multiple regression models, Durbin Watson statistics have been applied. Autocorrelation regards the residuals of regression analysis and assumes the similarity of current and past values of a variable. Autocorrelation can lead to underestimation of the standard error and therefore false conclusion on significance of the predictive value of regressions. The test is based on normal distribution and no lagged dependent variable. The statistics ranges from 0 to 4, in which a value of 2 means no serial correlation. A value between 0 up until 2 means positive autocorrelation and values from 2 up and until 4 negative autocorrelation. A rule of thumb is followed that models with Durbin Watson statistic between 1.5 and 2.5 are assumed to be normal and values below 1 or above 3 might lead to false conclusions (van Dalen & de Leede, 2009).

Managerial performance

H_1 assumes that if management underperformance compared to a certain benchmark exceeds the present value of management fees, a price discount is expected compared to fundamental value. Specifically for the secondary trading market of non-listed real estate funds, it is assumed that these discounts are larger for CEFs than for OEFs since higher management costs need to be offset by management performance as CEFs are generally more actively managed. This prediction is assumed by combining the variables *AGE* and *VEH in* a multiple regression model:

$$NAV_{DEV} = \alpha + \beta_1 AGE + \beta_2 VEH_{OEF} + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

Please find the outcomes of this analysis in appendix XI. It is found that the fund's age (AGE) remains to be a significant predictor for NAV_{DEV} once corrected for vehicle style (VEH) at a 5% significance level. The model explains 9.3% of the variance in NAV_{DEV} (*F (1.1321)* = 67.89, *p* < 0.0000) with a significant positive variance of AGE on NAV_{DEV} of 0.0002 (*β* = 0.0002; *t(1321)* = 3.25; *p* < 0.001). The Durban-Watson statistic (3, 1324) is 1.70 and represents a normal autocorrelation. Therefore it is assumed that the model does not present false conclusions on the significance levels of the predictive values. Filling in the outcomes of the multiple regression analysis into the multiple regression model gives the following formula and outcomes as presented in table 14:

VEH (OEF): NAV_{DEV} *= -0.04396 + (0.00022 * AGE) + (0.02218*1)*

VEH (CEF): NAV_{DEV} *= -0.04396 + (0.00022 * AGE) + (0.02218*0)*

AGE	NAV_{DEV} *VEH (OEF)*	NAV_{DEV} *VEH (CEF)*
1	-0.0216	-0.0437
10	-0.0196	-0.0418
25	-0.0164	-0.0385

Table 14 Outcomes multiple regression model $NAV_{DEV,}$ *AGE* and *VEH*

After filling in various values for *AGE* in the multiple regression model, one can conclude that on basis of cross-sectional variance between AGE, *VEH* and $NAV_{DEV,}$ secondary traded non-listed CEFs on average significantly have larger discounts to NAV than OEFs. And, this effect shows a descending pattern for both OEFs and CEFs once the age of the fund increases.

Market diversification

H_4 estimates that the higher an investment fund is diversified to reduce specific country risks and/or segment risks, the lower the expected discount (or higher the premium) of its shares compared to its fundamental value. And specifically for secondary trades of non-listed real estate funds, since CEFs are more often seen as focused specialized products for the short term and OEFs as conservative blended products for the long term, it is assumed that lower expected discounts (or higher premiums) are seen for OEFs than for CEFs.

This prediction is assumed by combining the variables *COUNTRY, SECT, STYLE and VEH in* a multiple regression model, representing the various variables as described in paragraph 3.3.2.1. For STYLE dummies $dSTYLE_C$ *and* $dSTYLE_{VA}$ are selected to include in the model since $dSTYLE_{OPP}$ only includes 2 observations (n=2) and therefore is assumed to be less reliable as a predictor for NAV_{DEV}.

$$NAV_{DEV} = \alpha + \beta_1 COUNTRY_{SINGLE} + \beta_2 SECT_{SINGLE} + \beta_3 dSTYLE_C + \beta_4 dSTYLE_{VA} + \beta_5 VEH_{OEF} + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

Please find the outcomes of this analysis in appendix XI. It is found that the model shows a significant predictive value regarding NAV_{DEV} and explains 11.6% of the variance in NAV_{DEV} (*F (5.1318)* = 34.57, $p <$ 0.0000). Most of the variables show a significant positive variance with NAV_{DEV}. The variance (*β)* of *SECT* is -0.0135 (*t(1318)* = -4.33; $p <$ 0.000), $dSTYLE_C$ is 0.0511 (*t(1318)* = 2.09; $p <$ 0.037), $dSTYLE_{VA}$ is 0.0497 (*t(1318)* = 2.00; $p <$ 0.046) and *VEH* is 0.01592 (*t(1318)* = 4.92; $p <$ 0.000). However, *COUNTRY* shows a *p value of* 0.099 *(β = -0.0071; t(1318) =-1.65; p < 0.099)* and therefore has a chance of coincidence of the observations of 9.9%. It is decided to keep the variable COUNTRY in the regression model, but decrease the significance level of the model outcome to 10% instead of 5%. The Durban-Watson statistic (5, 1318) is 1.74 and therefore represents a normal autocorrelation. One may conclude that the model does not present false conclusions on the significance levels of the predictive values.

Below the NAV_{DEV} outcomes of the regression model are presented in table 15. In the model α is -0.0453, *COUNTRY* is allocated by single (1) and multi (0) country focused funds, SECT by single (1) and multi (0) sector focused funds and *VEH* by OEFs (1) and CEFs (0). For example for a secondary trade in which a single country and single sector focused value add CEF is involved, the following equation is used:

NAV_{DEV} *= -0.0453 + (-0.0071*1) + (-0.0135*1) + (0.0511*0) +(0.0497*1) + (0.0159*0) = -0.0162*

VEH	NAV_{DEV} Single sector Single country Core	NAV_{DEV} Multi sector Single country Core	NAV_{DEV} Single sector Multi country Core	NAV_{DEV} Multi sector Multi country Core	NAV_{DEV} Single sector Single country VA	NAV_{DEV} Multi sector Single country VA	NAV_{DEV} Single sector Multi Country VA	NAV_{DEV} Multi sector Multi country VA
OEF	0.1443	0.1578	0.1514	0.1649	0.1430	0.1565	0.1500	0.1635
CEF	-0.0149	-0.0014	-0.0078	0.0057	-0.0162	-0.0027	-0.0092	0.0043

Table 15 Outcomes multiple regression model NAV_{DEV}, *COUNTRY, SECT,* $dSTYLE_C$, $dSTYLE_{VA}$ and *VEH*

First, on average a significant NAV_{DEV} difference is seen between focused and diversified funds. Second, on average a significant difference is seen between market diversification effects of OEFs and CEFs. Last, on average significant smaller premiums or higher discount are seen for value add funds ($STYLE_{VA}$) than for core funds ($STYLE_C$). These conclusions are made on basis of a significance level of 10%.

Leverage

H_9 assumes that a higher leverage provision results in a higher discount compared to NAV. In addition that the discount for CEFs is larger than for OEFs, since CEF generally maintain higher leverage levels. In de bivariate analysis between *LEV* and NAV_{DEV} a significant, but weak, negative relation has been found between LEV and NAV_{DEV} (r_s= -0.3365; p=0.0000; N=1317) based on a 5% significance level. Also, a significant negative predictive value regarding NAV_{DEV} is found (β=0.2184; $t(1322)$ = -14.28; p < 0.0000) in the simple regression analysis. However, based on the data available in the empirical research it cannot been concluded that the higher the exposure to external finance is, the larger the effect on discounts to NAV_{DEV}. In the empirical research on average a significant positive regression coefficient is found for LEV_{LOW} (β = 0.0272; t (1323) = 13.11; p < 0.0000) and a negative regression coefficient for LEV_{MED} (β = -0.1962; t (1323) =-8.25 ; p < 0.0000) and LEV_{HIGH} (β = -0.0372; t (1323) =-9.79 ; p < 0.0000). To test whether this finding holds if the regression is corrected for VEH, the following formula is used:

$$NAV_{DEV} = \alpha + \beta_1 LEV_{MED} + \beta_2 LEV_{HIGH} + \beta_3 VEH_{OEF} + \varepsilon_i \qquad \varepsilon_i \sim \mathrm{n}\,(0, \sigma)$$

Please find the outcomes of this analysis in appendix X. The model explains 17.0% of the variance in NAV_{DEV} and shows to be significant at a 5% level ($F\ (3.1320)$ = 89.88, p < 0.0000). It is found that the predictive values of LEV_{MED} and LEV_{HIGH} regarding NAV_{DEV} remain statistically significant at a 5% level, however the variance for both variables respectively decreased to -0.02234 ($t(1320)$ = -9.94; p < 0.0000) and - 0.02910 ($t(1320)$ = -7.20; p < 0.0000) in comparison to the simple regression outcomes. Also the predictive value of *VEH* in the model remains statistically significant (p < 0.0000) at a 5% significance level, but the variance decreased from 0.2576 to 0.01832 compared to the simple regression outcomes. Combining the variables has a significant impact on the variances due to overlapping effects. The Durban-Watson statistic (3, 1320) of the model is 1.72 and therefore anormal normal autocorrelation applies. Therefore, one may conclude that the model does not present false conclusions on the significance levels of the predictive values.

Filling in the outcomes of the multiple regression analysis into the multiple regression model gives the following formula en outcomes as presented in table 16:

$$NAV_{DEV} = -0.02550 + (-0.0223 * LEV_{MED}) + (-0.0291 * LEV_{HIGH}) + (0.183 * VEH)$$

LEV	NAV_{DEV} OEF	NAV_{DEV} CEF
LEV_{MED}	0.1355	-0.0478
LEV_{HIGH}	0.1287	-0.0546

Table 16 Outcomes multiple regression model NAV_{DEV}, *LEV* and *VEH*

The outcomes show that a significant difference in variance can be observed between the leverage levels of secondary traded OEFs and CEFs and NAV_{DEV} based on a 5% significance level. On average OEFs trade at a premium to NAV and CEFs on average trade at a discount to NAV. While considering these outcomes one must be aware that the total number of observed CEFs with LEV_{MED} and LEV_{HIGH} is relatively low, respectively n=55 and n=80, and therefore might not be representative for the population.

5. Evaluation of results

In this chapter a review of the results from the empirical research of chapter 4 is given and reflected on the theoretical framework and predictions as stated in chapter 2. First of all in paragraph 5.1 the individual predictions will be reviewed by evaluating the results of the univariate, bivariate and regression analysis of the secondary traded non-listed real estate funds. These results will be related to the theoretical framework of chapter 2 and appendix I to conclude on the reprehensibility of the predictions based on data from the secondary trading market of non-listed real estate funds. By this means an answer is given on sub question 5:

> *5. Can any patterns be distinguished by projecting the outcomes from sub question 1 up and until 4 on historic data of premiums and discounts on the secondary trading market of European non-listed real estate Funds?*

After assessing the outcomes on the individual predictions in paragraph 5.2 the results from the empirical research will be projected on the Efficient Market Hypothesis (EMH) of asset pricing as well as the anomalous patterns to the EMH as stated in chapter 2. An answer is given on sub question 6:

> *6. How do these outcomes on the secondary trading market of non-listed real estate funds relate to the Efficient Market Hypothesis (EMH) on asset pricing?*

5.1 Review of determinants pricing deviations from NAV

In chapter 2 several (causal) determinants of de pricing deviations from net asset value are determined based on existing empirical research. From this research 12 predictions have been established, which are in detail discussed in appendix I. Based on the available dataset, predictions $H_{1,}$ $H_{2,}$ $H_{4,}$ $H_{6,}$ H_9 and H_{12} are tested based on cross-sectional analysis, in which fundamental value is proxies by NAV. Due to a lack of (representative) data availability and matching issues with the PropertyMatch database, predictions $H_{3,}$ $H_{5,}$ $H_{7,}$ $H_{8,}$ H_{10} and H_{11} could not be tested. Below one can find a review of the results of $H_{1,}$ $H_{2,}$ $H_{4,}$ $H_{6,}$ H_9 and H_{12} and an evaluation of the established predictions. These reviews give a compelling answer on sub question 5, which is stated in the introduction paragraph of chapter 5.

Managerial performance

> ***H_1 :*** *If management performance results in a management overperformance to a certain benchmark return and exceeds the present value of management fees, fund shares are expected to trade at a premium against its fundamental value. And vice versa.*

H_1 can be supported at a 5% significance level, but the effect is found limited. Managerial performance is proxied by the (rounded) age of a non-listed real estate fund (*AGE*) that has been traded on the secondary market. It is assumed that the higher the age of a fund, the longer the track-record of the fund and its GP, and as such the better future performance estimations can be made based on historical performance. The variable *AGE* (M = 23.32, SD =15.56) seemed not to be normally distributed in the dataset. Based on the Pearson's correlation coefficient, a significant positive relation between *AGE* and NAV_{DEV} is found (r= 0.2032; p=0.000; N=1324) based on a 5% significance level. The correlation of 0.2032 is assumed to be limited in strength. In simple regression analysis it is found that the predicted increase in price compared to NAV on basis of *AGE* is 0.5% ($\beta = 0.0005$; $p < 0.0000$). This effect if found significant on basis of a 5% significance level and explains 4.1% of the variance in NAV_{DEV} ($p < 0.0000$). Based on bivariate analysis it can be concluded that a significant positive relation between managerial performance and pricing deviations from NAV (NAV_{DEV}) is found as predicted in H_1. However, this effect is found limited.

Specifically for the secondary trading market of non-listed real estate funds, it is assumed that the NAV_{DEV} larger for CEFs than for OEFs since higher management costs need to be offset by management performance as CEFs are generally more actively managed. This prediction is assumed by combining the variables *AGE* and vehicle style *(VEH) in* a multiple regression model. In the model AGE remained a significant (positive) predictor for NAV_{DEV} once corrected for *VEH* (β = 0.0002; $p < 0.001$). Thus the predicted increase in price compared to NAV 0.2% once corrected for *VEH*. The total model explains 9.3% of the variance in NAV_{DEV} ($p < 0.0000$) based on a 5% significance level. One can conclude that unless *AGE* remains a significant (positive) predictor for NAV_{DEV}, the predicted price deviation (β) decreases. And at the other hand the explanation of the variance in NAV_{DEV} increases. Unless the outcome of the model shows a discount compared to NAV for both OEFs and CEFs, the effect is descending in case the *AGE* increases. Additionally, it is found that the effect for CEFs is significantly larger than for OEFs. For example if the average age of a secondary traded fund is 10 years old, the NAV_{DEV} for CEFs is -4.2% and for OEFs is -2.0%.

Although the conclusions supports H_1, the conclusion is hard to compare with existing empirical research since in the studies used different proxies such as the percentage of management fees or outperformance to a certain market index (α). The direction of the effect between *AGE* and NAV_{DEV} is equal to the prediction, but the research approach and rationale different and thus hard to compare.

Asset Illiquidity

> ***H2:*** *The higher the liquidity of investment funds are in comparison to their asset holdings, the higher the added value of the fund structure and thus the smaller the expected price discount (or even the higher the premium) of its shares compared its fundamental value. And vice versa. Since OEFs are assumed to be more liquid than CEFs, the price deviation for OEFs is assumed to be smaller than for CEFs.*

H_2 can be supported based on a 5% significance level. Asset liquidity is proxied by investment vehicle type *VEH,* to be divided into OEFs and CEFs. In the study a significant difference in NAV_{DEV} is found between OEFs (*M* = 0.00062, *SD* = 0.03187) and CEFs (*M* = -0.0195, *SD* = 0.0418) taking into account a 5% significance level (p = 0.0000). For CEFs (n= 291) an average price discount to NAV is found of -2.0% and a premium of 0.1% for OEFs (n=1059). Based on simple regression analysis *VEH* is also found to be a significant predictor of NAV_{DEV} with a predicted price deviation of 0.2576 ($p < 0.0000$) and 8.6% explanation of the variance in NAV_{DEV} ($p < 0.0000$). These outcomes support the assumption that the liquidity of investment funds has a positive effect on NAV_{DEV} and OEFs show smaller price deviations than CEFs.

Referring to the theoretical framework (mainly appendix I. A2 and paragraph 2.5.1), first of all it stands out that of the total 1.350 secondary trades registered in the dataset 78.44% is a trade of an OEF. This contradicts the assumption that CEFs are more traded on the secondary market since shareholdings cannot be redeemed with the GP. Nevertheless, the outcomes support the assumption that the added value of the fund structure, being an OEF or a CEF, is a significant predictor for NAV_{DEV}. Although the proxy used in this empirical study differs from frequently used proxies used such as bid-ask spreads and free float, the rationale is comparable. The outcomes follow the assumption of e.g. Amihud and Mendelson (1987) and Datar (2001) that investors in CEFs discount on NAV to compensate for liquidity risk and obtain a higher expected return. In addition, that asset illiquidity explains only a small part of the cross-sectional variation of NAV_{DEV} such as stated by Malkiel (1977), Lee et al. (1991). Furthermore, the results are also supportive to the assumption of e.g. Chordia (1996) and Nanda et al. (2000) that market prices of OEFs diverge less from their fundamental than CEFs, since they are more vulnerable to liquidity redemption shocks. However, since no intersections of the effect are analyzed it cannot be

concluded from the research that trading restrictions such as pre-emption provision are significant influencing factors in asset liquidity that explain asset pricing deviations to fundamental value.

Market diversification

> ***H4 :*** *The higher an investment fund is diversified to countries with investment restrictions or segment specific risks (and thus reduces its systematic risk), the lower the expected discount (or higher the premium) of its shares compared to its fundamental value*

H_4 can be supported, partly only at a significance level of 10%. The prediction is proxied by a geographical (*COUNTRY*), sector (*SECT*) and investment style (*STYLE*) approach. In addition by the dominant target country (*TCOUNTRY*) and target sector (*TSECT*). In either proxy it is assumed that more diversification decreases specific (systematic) risk.

For COUNTRY a price premium to NAV is found of 0.8% for secondary traded multiple country allocated funds and 0.04% for single country allocated funds. However the difference in price deviation between both segments is not significant at a 5% significance level (p = 0.0624). Also no significant predictive value of *COUNTRY* regarding NAV_{DEV} is found (β = -0.0078; p < 0.083). Only when the accepted chance of coincidence of the observations is increased to 10%. This may be explained by the fact that the majority (94.8%) of the funds is single country focused and thus not normally distributed.

For *TCOUNTRY* only the Netherlands ($TCOUNTRY_{NL}$) and Germany ($TCOUNTRY_{GER}$) showed a significant difference in average price deviation to NAV (p < 0.030) at a 5% significance level. In addition, The predicted decrease in price compared to NAV for $TCOUNTRY_{GER}$ is -1.0% (β = -0.0101; p < 0.0050) and explains approximately 0.6% of the variance of NAV_{DEV} (p < 0.0060). Nonetheless, these outcomes are doubtful since the number of observations of The Netherlands (n=19) and Germany (n=1) are limited and therefore not representative for the population.

For *SECT* a significant difference in price deviation is found between funds that are allocated to a single country and multiple countries (p = 0.0000) based on a 5% significance level. On average for multi sector allocated funds a price premium of 1.0% to NAV is found and a discount of -1.2% for single sector allocated funds. SECT is also found to be a significant predictor for NAV_{DEV} (p < 0.0000). The predicted price deviation to NAV is -2.1% (β = -0.021) and shows to explain 9.0% of the NAV_{DEV} variance (p < 0.0000).

For *TSECT* (and its dummies) it can be concluded that there is no significant difference found in average price deviation to NAV (p = 0.7667). Also no significant predictive effects are found for *TSECT* in the simple regression analysis.

Regarding STYLE a limited negative relationship is found between *STYLE* and NAV_{DEV} (r_s = -0.1113; p=0.0000; N=1324) at a 5% significance level. Furthermore the investment style (*STYLE*) is found to have a significant predictive value to NAV_{DEV}. The predicted decrease in price compared to NAV is -0.5% (β = -0.0050; p < 0.0000) and explains approximately 1.2% of the variance of NAV_{DEV} (p < 0.0001). In the analysis STYLE is broken down secondary traded core funds ($STYLE_C$), value add funds ($STYLE_{VA}$) and opportunistic funds ($STYLE_{OPP}$). $STYLE_C$ shows a significant positive variance to price deviations to NAV (β = 0.0102; p < 0.0000). Instead vehicles $STYLE_{VA}$ (β = -0.0098; p < 0.0000) *and* $STYLE_{OPP}$ (β = -0.0509; p < 0.0000) are negative predictors regarding NAV_{DEV}. Based on the regression coefficients it can be concluded that the effect on NAV_{DEV} increases in magnitude in line with their risk exposure. All *STYLE* dummies show a significant explanation of approximately 1.2% of the variance in NAV_{DEV}. $STYLE_C$

(p < 0.0000) *and* $STYLE_{VA}$ *(p* < 0.0001) are highly significant. $STYLE_{OPP}$ (*p* < 0.0441) is only just significant, which might be explained by the fact that $STYLE_{OPP}$ has a low number of observations (*n*= 2).

When analyzing the joint effect of the various market diversification proxies, for which *COUNTRY, SECT,* $STYLE_C$, $STYLE_{VA}$ *and VEH are combined* a multiple regression model, a significant predictive value regarding NAV_{DEV} and explains 11.6% of the variance in NAV_{DEV} (*p* < 0.0000). Most of the variables show a significant positive variance with NAV_{DEV}. However, *COUNTRY* shows a *p value of* 0.099 *(β = -0.0071; p < 0.099)* and therefore has a chance of coincidence of the observations of 9.9%. It is decided to keep the variable *COUNTRY* in the regression model, but decrease the significance level of the model outcome to 10% instead of 5%.

In comparison to the simple regression analysis. The variance of $STYLE_C$ (*β* = -0.05105 (*p* < 0.037) increased and remained significant at a 5% significance level. The regression coefficients of *SECT* (*β* =-0.0135; *p* < 0.000) and *VEH* (*β* = 0.01592; *p* < 0.000) decreased and also remained significant at 5%. The variance of $STYLE_{VA}$ changed from a significant positive variance to a significant negative variance compared to NAV_{DEV} (*β* = -0.0497 (*p* < 0.046). The chance of coincidence decreased from 0.1% to 4.6%, but stays significant at 5%. The variance of *COUNTRY* decreased and increased its chance of coincidence from 0.5% to 9.9%. As said, this variable does not hold at a 5 % significance level, but holds at a significance level of 10%.

Concluding on the outcomes of the multiple regression analysis, first on average a significant NAV_{DEV} difference is seen between focused and diversified funds. Second from the outcomes it can be concluded that on average a significant difference is seen between market diversification effects on NAV_{DE} of OEFs and CEFs. For example, on average single country and single sector allocated core OEFs show a significant lower NAV_{DEV} variance (+14.4%) compared to multi sector and multi country core OEFs (+16.5%). For CEFs it is seen that the regression coefficient for less diversified funds shows a negative NAV_{DEV} variance and for diversified funds a positive NAV_{DEV} variance. These conclusions are made on basis of a significance level of 10%. Last, comparing the results of diversified core and value add funds, it is found that on average significant smaller premiums or higher discount are seen for value add funds ($STYLE_{VA}$) than for core funds ($STYLE_C$). On basis of the conclusions, one might conclude that more diversified funds on average show significantly lower discounts (or even premiums) to NAV. And OEFs on average show significantly lower discounts (or higher premiums) than CEFs. No statements about country allocation (*COUNTRY*) can be made since this variable shows not to be significant.

When relation the outcomes of the empirical research to the theoretical framework, it can be concluded that the results (partly) supports the market diversification hypothesis as discussed in appendix I. A4. The results show that (international) market segmentation of secondary traded non-listed real estate funds have an significant effect on the price deviations from fundamental value.

Based on a 5% significance level in the empirical research no significant empirical support if found for the assumption that price deviations from fundamental value is caused by country specific allocations of funds as concluded by e.g. Bonser-Neal et al. (1990), Bekaert & Urias (1996) Chan et al. (2008) and Kim & Song (2010) on the US and UK stock markets. However, based on a 10% significance level and accepting that the dataset contains 94.8% secondary traded single-country allocated funds, an average premium to NAV is found for both single- and multi-country allocated secondary trades, with a significant higher premium for multi-country allocated funds. These findings comply with Bekaert & Urias (1996) and Kim & Song (2010) that also found higher premiums for diversified traded funds in the UK and US.

Furthermore significant supportive evidence is found for property type concentration and deviations from fundamental value in the empirical research. It is found that for *SECT* significant difference in

price deviation exist between multi-sector and single sector allocated funds. This complies with the finding of e.g. Bond & Shilling (2004) whom concluded on a negative relationship between portfolio diversification and discounts to NAV on the European equity market. Or conversely interpretated in line with H_4. Although they used systemic risk as factor of total risk as a proxy for diversification, the direction of the effects are comparable. Due to a lack of significance on *TSECT* no associations can be made with research outcomes of e.g. Capozza and Lee (1995) and Brounen and ter Laak (2005) regarding property type focus.

Investor Sentiment

H_6: *If disproportionate optimism or pessimism drives prices away from their intrinsic value, periods of high (low) investor sentiment should be followed by share prices above (below) their fundamental value and as such low (high) returns on the short run. Since sentiment (based on 'news' and 'events') is incorporated only slowly into the price level of shares, share prices will revert to their fundamental values in equilibrium on the long run.*

H_6 cannot be supported based on a 5% significance level. H_6 assumes that disproportionate optimism (+) or pessimism (-) in investor sentiment results in respectively a share price above (+) or below (-) the NAV on the short run. In the empirical study a significant negative relation is found between investor sentiment ($SENT_{-1}$) and price deviation to NAV (NAV_{DEV}). Albeit that the correlation between both variables is assumed to be limited of strength (r= -0.0575; p=0.0392; N=1324). Simple regression analysis showed that $SENT_{-1}$ explains 0.3% of the variance in NAV_{DEV} (p < 0.0392) with a negative regression coefficient of -0.0148 (p < 0.039).
Based on the research outcomes, evidence is found that that investor sentiment can cause irrational divergences of price levels from their fundamental values and as such non-fundamental movements of future stock returns in comparison to market efficiency as is e.g. concluded by Solt & Statman (1988), Fisher & Statman (2000), Brown & Cliff (2005) and Baker & Wurgler (2006).

However, the empirical research shows a contrary outcome to H_6 that is aligned with the conclusions of e.g. De Long et al. (1990), Daniel et al. (1998), Baker & Wurgler (2007) and Stambaugh, Yu & Yuan (2012) whom found that excessive optimism (pessimism) will lead to overvaluation (undervaluation) of stocks compared to their fundamental value. A possible reason that different outcomes are found might be that the used orthogonalized sentiment index is regarded from the US investment market and may deviate from investors sentiment in the EU or UK investment markets. Since the dataset of PropertyMatch does not involve buyers and sellers of the secondary trades, it is not known which regional investor sentiment applies and thus this conclusion cannot be substantiated. Also the outcomes may differ since in all studies no independent measure of investor sentiment is used. Therefore, as Cherkes (2012) stated, outcomes of the studies are hard to compare and a compelling explanation for the ISH is difficult to make.

In the empirical research it is not regarded if there exists a significant difference in NAV_{DEV} for OEFs and CEFs based on investor sentiment. And as such whether the finding of Lee et al. (1991) on the CEFP are supported that CEFs trade at a significant larger discount to NAV to equally compensate for the higher noise trader risk or that contrary views of Abraham et al. (1993), Chen et al. (1993) Elton et al. (1998) hold.

Last, since the empirical study only focusses on the cross-sectional variation between $SENT_{-1}$ and NAV_{DEV}, no time varying effects of investors sentiment such as mean reversion of price discount is tested as e.g. assumed by Bodurtha et al. (1995) , Pontiff (1995), Pontiff (1997), Barkham and Ward (1999), Klibanoff et al.(1998), Veronesi (1999), Flynn (2003), Lin et al. (2008) and Hwang (2011).

Leverage

> ***H_9:*** *The higher the leverage provision in a fund structure, the higher the expected discount of its shares compared to fundamental value as the risk for financial distress increases. Since CEFs can generally maintain higher levels of leverage compared to OEFs, it is expected that the discounts to fundamental value are larger for CEFs than for OEFs.*

H_9 cannot be supported based on a 5% significance level. Leverage is proxied by the leverage provision (*LEV*) of secondary traded non-listed real estate funds. The variable is broken down in funds with a low (LEV_{LOW}), medium (LEV_{MED}) and high (LEV_{MED}) exposure to external finance. A significant negative (weak) relation is found between LEV and NAV_{DEV}. (r_s= -0.3365; p=0.0000; N=1317) at a 5% significance level. In addition (*LEV*) is found to have a significant predictive value to NAV_{DEV} (β = -0.2184; $p < 0.0000$) and explains 13.4% of the NAV_{DEV} variance ($p < 0.0000$). LEV_{LOW} is found to have a positive predictive value regarding price deviations to NAV (β = 0.0272; $p < 0.0000$). LEV_{MED} (β = -0.1962; $p < 0.0000$) *and* LEV_{HIGH} (β = -0.0372; $p < 0.0000$) are negative predictors regarding NAV_{DEV}. Based on these outcomes a negative (weak) relation is found between *LEV* and NAV_{DEV} in accordance with H_{12}. However it cannot be concluded that the higher the exposure to external finance and thus higher default risk, the larger the negative deviation to NAV. The smaller number of observations of LEV_{HIGH} (n=91) might contribute to this finding.

On basis of the multiple regression analyses one may conclude that a significant difference in variance can be observed between the leverage levels of secondary traded OEFs and CEFs and NAV_{DEV} based on a 5% significance level. On average OEFs trade at a premium to NAV, for which the premium for LEV_{MED} is higher (+13.6%) than for LEV_{HIGH} (+12.9%). CEFs on average trade at a discount to NAV, with on average a higher discount to NAV for secondary traded funds with LEV_{HIGH} (-5.5%) and a lower discount for LEV_{MED} (-4.8%). The results for OEFs are not supportive to H_{12}, the results for CEFs support H_{12} at a 5% significance level. However, the number of observations for CEFs is limited, respectively n=55 LEV_{MED} and n=80 for LEV_{HIGH}, and therefore might not be representative for the population.

Reflecting the outcomes on the theoretical framework and appendix I. C3, several connections can be made. In general the found negative relation between *LEV* and NAV_{DEV} is in accordance with Clayton and MacKinnon (2000), Bond and Shilling (2004), Bounen & Ter Laak (2005), Morri et. Al. (2005) and Morri & Benedetto (2009). However, the conclusions of these studies that a higher leverage provision results a higher discount to NAV as a result of higher exposure to financial distress, cannot be supported. Furthermore, the outcomes of the positive relation for OEFs might support the finding of e.g. Jensen (1986) and Barber (1996) that leverage may decrease the credit risk of a fund and as such lower deviations to NAV might be expected. However, the results of the empirical research did not report discounts to NAV for OEFs. Furthermore, the outcomes for CEFs are supportive to the assumption that CEFs report higher discounts to NAV than OEFs, since these funds do not have to maintain large cash reserves to redeem shares as is e.g. discussed by Hilliers, Ross, Westerfield, Jaffe & Bradford (2016).

Size

> ***H_{12}:*** *The larger the firm size of an investment fund, the lower the expected price discount (or larger the premium) of shares compared to their NAV.*

H_{12} can be supported based on a 5% significance level. In the empirical research a significant positive relationship between *SIZE* and NAV_{DEV} is found of limited strength (r_s= 0.1304; p=0.0000; N=1317) on basis of a 5% significance level. About 2.4% of the variance in NAV_{DEV} could be explained by the market capitalization (*SIZE*) of the non-listed real estate funds underlying the secondary trades ($p < 0.0000$).

SIZE has been split in market capitalization intervals of small cap funds *($SIZE_{SMALL}$)*, medium cap funds ($SIZE_{MID}$) and large cap ($SIZE_{LARGE}$). For $SIZE_{SMALL}$ the predicted variance to NAV_{DEV} is -1.0% ($\beta = -0.0102$; $p < 0.0000$, for $SIZE_{MID}$ 0.8% ($\beta = 0.0008$; $p < 0.0000$) and for $SIZE_{LARGE}$ 2.7% ($\beta = 0.0277$; $p < 0.0000$). Therewith, a significant ascending pattern is found between *SIZE* and NAV_{DEV}**.** Although $SIZE_{LARGE}$ includes a small number of observations (n=22) and might present susceptible outcomes.

The outcomes of the empirical research support the size effect rationale (see paragraph 2.4.1.6) that is e.g. supported by Adams & Venmore-Rowland (1989). Capozza & Lee (1995), Anderson et al. (2001), Clayton & Mackinnon (2001) and Brounen and ter Laak (2005). The effect assumes that firms (or funds) with a smaller market capitalization face higher company risks and bear relatively higher company specific costs in comparison to large firms and therefore trade at larger discounts. In contrast Larger firms are general more transparent, better able to diversify, have relatively lower overhead costs and have better access to capital markets than smaller firms. These funds tend to trade at lower discounts to NAV (or even premiums) as these funds tend to be more popular with investors. Since no interrelations are researched in this study it could not be tested if size also might be a proxy for unknown factors that are correlated with size as Banz (1981) concludes.

5.2 Review of the EMH

The outcomes as presented in paragraph 5.1 show different significant predictions for price deviations from fundamental value, albeit that effects are sometimes limited or have a significance level of 10%. To reflect how these outcomes relate to the general theory of efficient markets, in this paragraph an answer is given on sub question 6, which is set out in the introduction paragraph of chapter 5.

As is stated in chapter 2 the EMH assumes an equilibrium pricing mechanism in a competitive market with fully rational investors, in which asset prices reflect all available information (strong form efficiency) at any point in time and countervailing irrationalities (if any) are arbitraged away. The 'law of one price' applies in which asset prices equal fundamental value. The hypothesis is challenged by the behavioral finance movement, which assumes the theory to be too basis and financial markets not always to be efficient. Rather they found that significant and systematic deviations from market efficiency may keep on for longer periods of time and conclude that returning patterns appear to be anomalous to the EMH. The behavioral view assumes that (1) markets are not complete, (2) Investors are not rational, (3) information is not homogeneously distributed in the market, (4) irrational behavior will not be offset but reinforced across investors, (5) arbitrage strategies contain too much risk to eliminate inefficiencies and (6) predictable attributes apply to asset pricing and thus follow not a complete 'random walk'. The behavioral view is also applicable for the secondary trading market of non-listed real estate funds.

- The secondary trading market of non-listed real estate funds is assumed not to be complete. Investment structures of non-listed real estate funds are seen as non-homogenous since complex fund structures may apply to constitute different economics at different momentums, offer different fee structures and facilitate tax efficiency provisions for (non-domestic) investors. In addition, certain warranties, pre-emption rights and transaction costs may apply in secondary trades. Therefore a general equilibrium model for asset pricing cannot be applied and mispricing of assets from their fundamental value may be expected.
- An optimal allocation of assets is not possible in the secondary trading market of non-listed real estate funds. The secondary market has grown significantly from 1996 and is now becoming more mature and attractive to a larger group of (institutional) investors. However only a limited amount of non-listed real estate fund shares is on offer on the secondary market. Therewith an optimal allocation of assets not possible for investors. This may elicit mispricing of asset an inequal distribution of welfare and risks among investors.

- Investors on the secondary market of non-listed real estate funds are assumed not to be fully rational. Overreaction (optimism) and underreaction (pessimism) is integrated in future cashflow forecasts and reflected in asset pricing. On basis of the empirical research a significant negative effect is found between investors sentiment ($SENT_{-1}$) and NAV_{DEV}. In addition it is found that $SENT_{-1}$ has a significant negative predictive value regarding NAV_{DEV} and explains 0.3% of the variance in NAV_{DEV}. Although the outcome of the research cannot support $H_{6,}$ the outcome is found to be significant at a 5% significance level.
- The market of the non-listed real estate sector is assumed to be opaque. As a result information is not universally distributed amongst investors and not quickly absorbed and thus rationally reflected in asset prices (Brounen, Op 't Veld, & Raitio, 2007). The information asymmetry is expected to be lower for core funds (compared to value add or opportunistic funds), since they generally have a long lifecycle and continuously market their fund to attract and retain capital. Lagging and smoothing effects are generally noticed in the non-listed real estate market and as such pricing levels will culminate to a new equilibrium with severe delay. This will cause a risk-variance effect and influences expected price levels in the secondary trade mechanism. Therefore the law of one price does not hold.
- It is difficult to apply arbitrage strategies in the secondary trading market of non-listed real estate funds. The volume and daily quotation nor the standardized vehicle requirement are generally in place. Since non-listed real estate funds are less actively traded, trade partners are harder to find and (ir)rational behavior is more difficult to cancel out. Arbitrage strategies are therefore difficult to apply and involve too much risk. Due to the illiquidity of the market, extreme market movements are difficult to observe and short-term trading strategies difficult to exploit. As a result the market for non-listed real estate funds can stay longer irrational than the EMH assumes and shares can be less accurately priced over longer periods of time.
- Based on the empirical research it is found that asset prices of secondary traded non-listed real estate funds do not completely follow a 'random walk' and seem to have some predictable (cross sectional) patterns. This complies with the behavioral assumption that trading strategies correlate and irrational behavior is reinforced across investors and as such errors of share price predictions arise on the short run. The empirical research has proven (based on a significance level of 5%) that predictive patterns exist for e.g. *AGE*, *VEH*, *SECT*, *STYLE* and *SIZE* regarding pricing deviations from fundamental value and are therefore found anomalous to the EMH. Regarding the latter variable *SIZE* a significant size effect is found. The patterns might remain for longer periods of time since new information in the non-listed real estate sector comes only slowly into the market. Since only cross sectional analysis has been performed, it cannot be concluded if the secondary trading market of non-listed real estate funds is subject to mean reversion patterns.

6. Conclusion

This research aims to identify the mechanism of pricing deviations (premiums and discounts) of market value from fundamental value of secondary trades in European non-listed real estate funds. In addition to explore determinants that influence these pricing deviations. In a structured approach an answer is given on the following research question:

What are the business economic determinants that cause pricing deviations (premiums and discount) from fundamental value of European non-listed real estate funds on the secondary trading market?

First of all a general theory has been formed on the general asset pricing mechanism, in which the neoclassical and behavioral views on efficient markets are discussed. Anomalies on the efficient market hypothesis (EMH) are discussed that have been empirically proven and explain the existence of pricing deviations from fundamental value.

The EMH assumes an equilibrium pricing mechanism in a competitive market with fully rational investors, in which asset prices reflect all available information (preferably strong form efficiency) at any point in time and countervailing irrationalities (if any) are arbitraged away. The 'law of one price' applies in which asset prices equal fundamental value.

The behavioral view on the EMH assumes that (price) can differ insistently from the rational market fundamental (fundamental value), in which asset prices are not rationally related to economic realities. As a consequence, price anomalies exist and stock markets may face disparity. The behavioral view assumes that the EMH is too basic and financial markets are not always efficient. Significant and systematic deviations from market efficiency are seen as returning patterns and may keep on for longer periods of time. These patterns are found to be anomalous to the EMH.

In the study 12 patterns have been regarded for pricing deviations (premiums and discounts) of market value from fundamental value on the secondary trading market, based on existing empirical research. From a rational perspective the management performance in relation to management fees (H_1: managerial performance), liquidity of investment funds compared to their asset holdings (H_2: illiquidity of assets), the amount of capital gain tax (CGT) liabilities on unrealized appreciation (H_3: capital gain tax liabilities), the level of country and/or segment diversification (H_4: market diversification) and yield distribution (H_5: dividend yield) have been regarded. From a behavioral perspective, the disproportionate optimism or pessimism of investors (H_6: investor sentiment) have been assessed. Other explanations that are regarded are the level of information gathering costs to compensate for adverse selection (H_7: adverse selection costs), non-amortized transaction costs (H_8: transaction costs) and leverage provision (H_9: leverage), price-earnings ratio (H_{11}: P/E ratio), the level of trading stocks on a funds balance sheet (H_{10}: valuation skepticism) and market capitalization of an investment fund (H_{12}: Size).

These determinants are reflected on the secondary trading market of non-listed real estate funds. Characteristics of most common investment vehicles open-end funds (OEFs) and closed-end funds (CEFs) have been added to the interpretations of predictions H_1, H_3, H_4, H_6, H_7, H_8, H_9, and H_{11}. For H_{12} an opposite relationship has been assumed compared to the prediction found in existing research. Predictions H_2, H_5 and H_{10} remained unchanged. In all predictions fundamental value is proxied by NAV and price deviations from NAV are indicated by NAV_{DEV}.

By means of descriptive statistics, cross sectional bivariate analysis and simple- and multiple regression analysis an answer is given on the question if patterns can be distinguished in market pricing deviations (premiums and discounts) from fundamental value in historic data of European non-listed real estate funds that are traded on the secondary market.

A comprehensive dataset of PropetyMatch on European secondary traded non-listed real estate funds is used including 1435 transactions of 91 different investment vehicles over the period 2010 until 2018. This dataset is complemented with specific fund characteristics from INREV, AREF or original company fund documentation. Based on the available data, predictions H_1, H_2, H_4, H_6, H_9 and H_{12} have been tested. Due to a lack of (representative) data availability and matching issues with the PropertyMatch database H_3, H_5, H_7, H_8, H_{10} and H_{11} could not be tested.

H_1 (managerial performance) assumes that if management performance results in a management overperformance to a certain benchmark return and exceeds the present value of management fees, fund shares are expected to trade at a premium against its fundamental value. And vice versa. H_1 can be supported at a 5% significance level, but the effect is found limited. For this prediction managerial performance is proxied by average age of a secondary traded non-listed real estate fund (AGE) as in indicator for track record. *AGE* shows a significant positive effect with NAV_{DEV} (r= 0.2032; p=0.000; N=1324). This effect is significant at a 5% significance level, but found to be limited. This might be affected by the fact that AGE is not normally distributed. The observed predicted price deviation compared to NAV is 0.5% ($\beta = 0.0005$; $p < 0.0000$) and remains significant once corrected for the investment vehicle style *(VEH)*. The predicted effect then decreases to 0.2%. It is also found that the effect for CEFs is significantly larger than for OEFs. For example if the average age of a secondary traded fund is 10 years old, the NAV_{DEV} for CEFs is -4.2% and for OEFs is -2.0%.

H_2 (asset illiquidity) assumes that the higher the liquidity of investment funds are in comparison to their asset holdings, the higher the added value of the fund structure and thus the smaller the expected price discount (or even the higher the premium) of its shares compared its fundamental value. And vice versa. Since OEFs are assumed to be more liquid than CEFs, the price deviation for OEFs is assumed to be smaller than for CEFs. H_2 can be supported at a 5% significance level. Asset illiquidity is proxied by investment vehicle type *VEH*, to be divided into OEFs and CEFs. A significant difference in NAV_{DEV} is found between OEFs (M = 0.00062, SD = 0.03187) and CEFs (M = -0.0195, SD = 0.0418) taking into account a 5% significance level. For CEFs an average price discount to NAV is found of -2.0% and a premium of 0.1% for OEFs. Based on simple regression analysis *VEH* is also found to be a significant predictor of NAV_{DEV} with a predicted price deviation of 0.2576 ($p < 0.0000$) and 8.6% explanation of the variance in NAV_{DEV} ($p < 0.0000$). These outcomes support the assumption that the liquidity of investment funds has a positive effect on NAV_{DEV} and OEFs show smaller price deviations than CEFs.

H_4 (market diversification) presumes that the higher an investment fund is diversified to countries with investment restrictions or segment specific risks (and thus reduces its systematic risk), the lower the expected discount (or higher the premium) of its shares compared to its fundamental value. H_4 can be supported, partly only at a significance level of 10%. The prediction is proxied by a geographical (*COUNTRY*), sector (*SECT*) and investment style (*STYLE*) approach. In addition by the dominant target country (*TCOUNTRY*) and target sector (*TSECT*). For the latter two variables no significant effects are found. For *SECT* a significant difference in price deviation is found between funds that are allocated to a single country and multiple countries (p = 0.0000) based on a 5% significance level. On average for multi sector allocated funds a price premium of 1.0% to NAV is found and a discount of -1.2% for single sector allocated funds. SECT is also found to be a significant predictor for NAV_{DEV} ($\beta = -0.021$; $p <$

0.0000). Regarding STYLE a limited negative relationship is found between *STYLE* and NAV_{DEV} (r_s = -0.1113; *p*=0.0000; *N*=1324) and a predictive value regarding NAV_{DEV} (β = -0.0050; p < 0.0000). STYLE is furthermore broken down in core funds ($STYLE_C$), value add funds ($STYLE_{VA}$) and opportunistic funds ($STYLE_{OPP}$). $STYLE_C$ shows a significant positive variance to price deviations to NAV (β = 0.0102; p < 0.0000). Instead vehicles $STYLE_{VA}$ (β = -0.0098; p < 0.0000) and $STYLE_{OPP}$ (β = -0.0509; p < 0.0000) are negative predictors regarding NAV_{DEV}. Based on the regression coefficients it can be concluded that the effect on NAV_{DEV} increases in magnitude in line with their risk exposure. Although $STYLE_{OPP}$ has a low number of observations (*n*= 2). For *COUNTRY* is found that the difference in price deviation between single- and multi country allocated funds is only significant at a 10% level (p = 0.0624) as well as the predictive value regarding NAV_{DEV} (β = -0.0078; p < 0.083). This may be explained by the fact that the majority (94.8%) of the funds is single country focused and thus not normally distributed.

When analyzing the joint effect of the various market diversification proxies *COUNTRY, SECT,* $STYLE_C$, $STYLE_{VA}$ and correct these for VEH, on a 10% significance level it can be concluded that a on average a significant NAV_{DEV} difference is seen between focused and diversified funds. Second, on average a significant difference is seen between market diversification effects of OEFs and CEFs. Last, on average significant smaller premiums or higher discount are seen for value add funds ($STYLE_{VA}$) than for core funds ($STYLE_C$).

H_6 (Investor sentiment) assumes that if disproportionate optimism or pessimism drives prices away from their intrinsic value, periods of high (low) investor sentiment should be followed by share prices above (below) their fundamental value and as such low (high) returns on the short run. Since sentiment (based on 'news' and 'events') is incorporated only slowly into the price level of shares, share prices will revert to their fundamental values in equilibrium on the long run. Investor sentiment ($SENT_{-1}$) is proxied orthogonalized sentiment index of Baker & Wurgler (2006). H_6 cannot be supported based on a 5% significance level. A significant (limited) negative relation is found between investor sentiment ($SENT_{-1}$) and NAV_{DEV} (*r*= -0.0575; *p*=0 .0392; N=1324). Also a significant negative predictive value of $SENT_{-1}$ is found regarding NAV_{DEV} (β= -0.0148; p < 0.039) that explains 0.3% of the variance in NAV_{DEV}. A possible reason that different outcomes are found might be that the used orthogonalized sentiment index is regarded from the US investment market and may deviate from investors sentiment in the EU or UK investment markets

H_9 (Leverage) supposed that the higher the leverage provision in a fund structure, the higher the expected discount of its shares compared to fundamental value as the risk for financial distress increases. Since CEFs can generally maintain higher levels of leverage compared to OEFs, it is expected that the discounts to fundamental value are larger for CEFs than for OEFs. H_9 cannot be supported based on a 5% significance level. Leverage (*LEV)* is proxied by the leverage provision (*LEV*) of secondary traded non-listed real estate funds and is broken down in funds with a low (LEV_{LOW}), medium (LEV_{MED}) and high (LEV_{MED}) exposure to external finance. A significant negative (weak) relation is found between LEV and NAV_{DEV}. (r_s= -0.3365; *p*=0.0000; *N*=1317) and is found to have a significant predictive value to NAV_{DEV} (β = -0.2184; p < 0.0000) LEV_{LOW} is found to have a positive predictive value regarding price deviations to NAV (β = 0.0272; p < 0.0000). LEV_{MED} (β = -0.1962; p < 0.0000) and LEV_{HIGH} (β = -0.0372; ; p < 0.0000) are negative predictors regarding NAV_{DEV}. Based on these outcomes a negative (weak) relation is found between *LEV* and NAV_{DEV} in accordance with H_{12}. However it cannot be concluded that the higher the exposure to external finance and thus higher default risk, the larger the negative deviation to NAV. The smaller number of observations of LEV_{HIGH} (*n*=91) might contribute to this finding. Furthermore a
a significant difference in variance of NAV_{DEV} has been observed between the leverage levels of secondary traded OEFs and CEFs. On average OEFs trade at a premium and CEFs at a discount to NAV, for which the average premium for LEV_{MED} is higher (+13.6%) than for LEV_{HIGH} (+12.9%) and the

discount for LEV_{MED} lower (-4.8%) than LEV_{HIGH} (-5.5%). The results for OEFs are not supportive to H_{12}, and the results for CEFs support H_{12} at a 5% significance level. Although the outcomes for CEFs might not be representative for the population (*n=91*).

H_{12} (Size) presumes that the larger the firm size of an investment fund, the lower the expected price discount (or larger the premium) of shares compared to their NAV. H_{12} can be supported based on a 5% significance level. Size (*SIZE*) is proxied by the market capitalization of the secondary traded non-listed real estate funds and is broken down to small cap funds *(*$SIZE_{SMALL}$), medium cap funds ($SIZE_{MID}$) and large cap ($SIZE_{LARGE}$). A 5% significant (limited strength) positive relationship between *SIZE* and NAV_{DEV} is found (r_s= 0.1304; *p*=0.0000; *N*=1317) and explains about 2.4% of the variance in NAV_{DEV}. For $SIZE_{SMALL}$ the predicted variance to NAV_{DEV} is -1.0% ($\beta = -0.0102$; $p < 0.0000$, for $SIZE_{MID}$ 0.8% ($\beta = 0.0008$; $p < 0.0000$) and for $SIZE_{LARGE}$ 2.7% ($\beta = 0.0277$; $p < 0.0000$). Therewith, a significant ascending size effect pattern is found between *SIZE* and NAV_{DEV}**.** Although $SIZE_{LARGE}$ includes a small number of observations (n=22) and might present susceptible outcomes.

To conclude on the research question, on basis of the cross-sectional analysis in the empirical research it is found that *AGE*, *VEH, SECT, SENT*$_{-1}$, *SIZE, LEV and STYLE* show to be a significant predictor of pricing deviation from fundamental value of European non-listed real estate funds on the secondary trading market at a 5% significance level. Although for *SENT*$_{-1}$ H_6 and for LEV H_9 could not be supported, for both variables a significant negative relation and predictable value has been found regarding NAV_{DEV}. *COUNTRY* shows only to be a significant predictor of pricing deviation at a 10% significance level.

These findings contribute to the anomalous behavioral view on the EMH that markets are not efficient. The secondary trading market of non-listed real estate is not complete and as such a general equilibrium model for efficient asset pricing is missing. An optimal allocation of asset is not possible. Investors on the secondary market are assumed to be irrational and information is not universally distributed amongst investors and not quickly absorbed and rationally reflected in asset prices. Secondary traded non-listed real estate funds seem to have some predictable (cross sectional) patterns and as such errors of share price predictions arise on the short run. However, due to the illiquidity of the market, extreme market movements are difficult to observe and short-term trading strategies difficult to exploit. As a result market prices can differ from their fundamental value over longer periods of time. Based on the empirical research it cannot be concluded if the secondary trading market of non-listed real estate funds is subject to (time varying) mean reversion patterns on the long run.

7. Discussion

In this chapter the outcomes of the research are briefly considered. The managerial relevance for the real estate industry is regarded and recommendations for further research are given. In paragraph 2.8 already a critical analysis is on the theoretical framework is given and in paragraph 3.6 methodological issues, validity and reliability of the data and methodology are regarded. Also in chapter 5 comments are made on the outcomes of the empirical research (if applicable). As such these elements will not be discussed in this chapter.

The outcomes of the study conclude on significant determinants that explain pricing deviations (premiums and discounts) from fundamental value. Results are based on explorative research of individual effects. The study does not explain why non-listed real estate fund trade at a discount rather than a premium and why discount might vary amongst different non-listed real estate funds.

Results are based on a cross sectional analysis. Due to the limited amount of registered secondary transactions of identical funds over time in the dataset, no time series analysis could be performed. The internal validity of cross sectional research is lower than time series analysis since it cannot be observed if a change between the independent variables and NAV_{DEV} occur in a chronological order. Therefore incorrect causal effects may be assumed as there is no comparison to a control group. This makes the research weaker for claiming causal effects.

Also no intersections and have been analyzed in the empirical research. Empirical evidence on correlation between variables is not yet an indicator that there an actual causal relationship between two variables. By analyzing intersections and interactions, the authenticity and significance of observed relations can be tested. Since this analysis has not been performed, the outcomes of the empirical research are also more vulnerable for incorrect assumptions on causality.

Nonetheless the research outcomes are interesting from both a business economic perspective and a real estate perspective. The practical implication of the research outcomes can be regarded in fourfold:

- The outcomes of the empirical research contribute to the anomalous view of behavioral finance on efficiency of markets;
- The outcomes contribute to the understanding of the pricing mechanism of secondary trades in the non-listed real estate fund sector and as such the transparency of the broader real estate investment universe. Although, the results can only be generalized for the population that has been studied and as such the European non-listed real estate market. The insights contribute to pave the way for growth of the secondary trading market of non-listed real estate funds and open the market for new investors. Hence, transparency builds confidence in markets and as such a greater interest of a broader group of investors can be created and thus liquidity options for investors;
- GPs of non-listed real estate fund can better understand their product offering in a market that is becoming more mature and understand patterns that may influence the asset pricing of their product offering in comparison to its fundamental value. By this means GPs e.g. can accelerate liquidity and obtain new capital to expand portfolio's, add long term strategic investors to their investor base, retain prime assets in their portfolio's and maintain economies of scale and offer customized solutions to their LPs.
- LPs that invest in non-listed real estate funds might use the research outcomes to optimize returns and realize lock-in gains at right momentum, generate liquidity, optimize asset selection and rebalance portfolio's.

Since the research has only been explorative, there are multiple related topics to further research on the secondary trading market of non-listed real estate funds. Further research could e.g. usefully explore:

- Multi variate analysis on intersections and interactions between the variables included in the empirical research. By analyzing intersections and interactions one can better draw conclusions on the basis of causality. This makes the outcomes of the empirical research stronger for incorrect assumptions;
- The reason why non-listed real estate fund shares generally trade at a discount rather than a premium and why discounts might vary amongst different non-listed real estate funds;
- The relation and (predictive) effects of fund specific characteristics of secondary traded non-listed funds on NAV_{DEV} such as pre-emptions, rights of first refusal, warranties, CGT and redemption queues;
- Time series analysis to conclude if the cross sectional outcomes for the secondary trading market of non-listed real estate funds hold on the long term and if mean reversion patterns can be distinguished such as assumed in the CEFP on the lifecycle of CEFs;
- Comparing analysis whether the cross sectional research outcomes on the European secondary market for non-listed real estate funds also are observed in other regions (e.g. Asia or US) or for other time spans in Europe other than 2010-2018.
- An in-depth analysis on the relation of pricing deviations from fundamental value with performance (risk/return) profiles of secondary traded non-listed real estate funds. And a cross sectional evaluation how these performance profiles relate to other investment classes such as securities, bonds, etc.

Appendix I. Explanations for price deviations

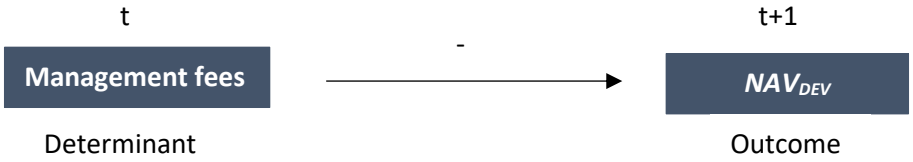
I. A. Rational explanations

I. A1 Agency costs

The theory of agency costs addresses the assumption that either management fees and/or management performance are reflected in asset price levels. Below both concepts are explained.

Management fees

Following Malkiel (1977) management fees should not be related to portfolio performance as no correlation is significantly proven between both factors. Instead management fees should be considered as shareholders deadweight costs (Ingersoll, 1977). Meaning that due to an inefficient allocation of resources in combination with an disequilibrium in supply and demand, price levels of real estate funds are not accurately reflected. So, if agency costs exist, these costs should be capitalized to NAV to maintain the portfolio performance level. And thus, funds with higher management fees should be expected to sell at larger discounts to NAV. The following relationship between the variables is assumed, in which it is in this case estimated that the determinant on momentum 't' has a negative influence on the price compared to NAV on momentum 't+1':



E.g. Malkiel (1995) and Barkham and Ward (1999) found no evidence for a significant effect between management fees and fund discounts. In contrast, e.g. Cherkes (2001), Gemmill & Thomas (2002), Ross (2002), Cherkes et al. (2009) and Frahn et al. (2019) stressed that managerial fees are a source of explanation for discounts to NAV. In many cases, their outcomes are connected with the added value of the fund manager in relation to the cost of management fees. This is discussed in the next section. I needs to be stated that the studies to which is referred above, are based on CEFs. Relating this standpoint to open-end funds, is could be argued that CEFs will obtain a higher yield than open-end funds as the disequilibrium in supply and demand and subsequent adjustments in price levels are expected to be less comprehensive for OEFs (Garay & Russel, 1999).

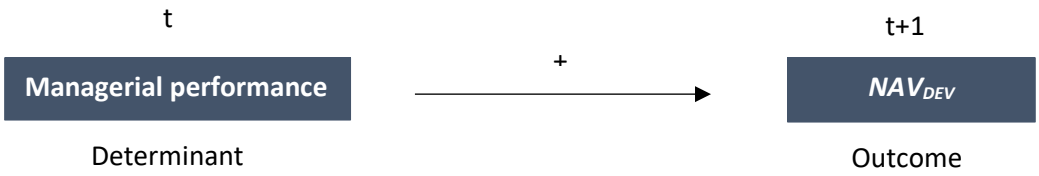
Management performance

The managerial performance theory considers once management fees for shareholders are larger than the value provided by the managers expertise, a discount on fundamental value is in place. And vice versa. In this phenomenon it is assumed that managerial ability is not reflected in the NAV and that past investment performance serves as a useful proxy for future investment performance. This theory is frequently put in relationship with the 'principal-agent problem' that discusses the issue of separation of ownership and control and conflict of interest between both parties (including incurred costs for information asymmetry, uncertainty and risk). See for example Jensen & Meckling (1976).

Malkiel (1977) researched managerial performance of CEF companies in the United States (US) over the period 1967 until 1974 but didn't find a significant effect between management performance and fund discounts. Barker, Seah and Shilling (2018) researched pricing discounts from NAV of LP interests

in the secondary trading market of US private equity real estate funds over the period 1994 until 2013. They didn't find proof that agency costs are significantly discounted on NAV.

In contrast e.g. Roenfeldt & Tuttle (1973), Lee et al. (1991), Gemmill and Thomas (2002), Berk and Stanton (2007) and Frahn et al. (2019) found marginal support that discounts and premiums on CEF shares reflect expected future performance and relate this to managerial ability. Roenfeldt & Tuttle (1973) state that "a discount reflects investors' expectations of a less than average risk-adjusted performance based on net asset values for these funds. Conversely, a premium reflects the expectation of superior risk adjusted performance based on net asset values." As such the following relationship between the variables is assumed:



A more comprehensive explanation for the agency cost theory is given when both management fees and management performance are combined. Berk & Stanton (2007) elaborate on the research of Ross (2002) and developed a rational model that relates both management fees and the perception of investors in managerial ability to fund discounts. Both studies emphasize that in case both management fees and managerial ability apply, funds may either trade at a premium or a discount depending on the level by which these costs are offset by higher management performance. Lenkey (2013) used management fees and time varying information advantage for an investment manager to explain premiums and discounts to NAV. Although a manager adds value by exploiting information, whether a fund trades at a premium or discount to NAV depends on the value of private information about the future performance of an underlying asset in relation to management fees. Frahn et al. (2019) come to the conclusion that when an investment manager is no longer willing or able to maintain a superior strategy (based on private information), the fund must trade at a discount in order to compensate for his management fee. Hence, when the a fund manager does not outperform on the market and thus has a low alpha[14], a discount is applied to compensate for the present value of management fees. Managerial ability is thus assumed as a source for added value in an asset pricing mechanism.

Last, like Lee et al. (1990), Cherkes (2009) and Lenkey (2013) presume, CEFs commonly trade at premiums when expected benefits of private information advantage of an investment manager outweighs the cost of the management fees. After private information is exploited, this premium will change in a discount. In addition the agency cost theory does generally not hold for OEFs (Garay & Russel, 1999). Both patterns are consistent with the life-cycle pattern of closed end funds as described in paragraph 2.5.1.

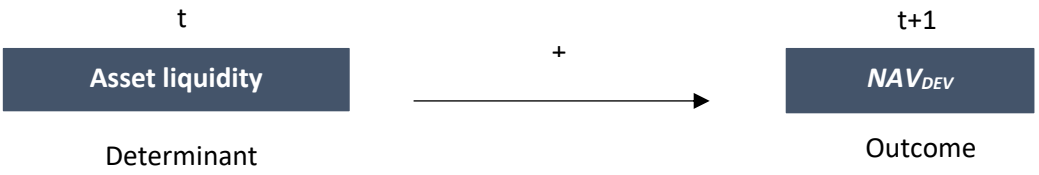
Following the above, the following hypothesis is supposed for the agency cost theory:

H_1: If management performance results in a management overperformance to a certain benchmark return and exceeds the present value of management fees, fund shares are expected to trade at a premium to its fundamental value. And vice versa.

[14] Alpha (α) represents the excess return on an investment relative to a benchmark return. Alpha is often referred to the managerial ability to 'beat' the market over a certain period of time due to active investing. The alpha may be either negative or positive.

I. A2 Illiquidity of assets

Investment funds provide in several portfolio services which may have benefits from direct market investments. The funds may specialize in certain asset classes, different time horizons of assets and/or different asset liquidities. Regarding the latter, investment funds have the unique opportunity to transform illiquid assets into liquid securities. This also allows e.g. smaller investor to access illiquid assets while profiting from several liquidity benefits, dependent on the fund structure (Cherkes, 2012). It is assumed that the higher the liquidity of investment funds are in comparison to their holdings, the higher the added value of the fund structure is and thus the smaller the discount to NAV. E.g. Amihud and Mendelson (1987) and Datar (2001) give a comprehensive explanation to the illiquidity theory and concluded that investors discount on CEFs as they expect higher expected returns to compensate for liquidity risk. In addition, some funds hold restricted or letter securities which have trading restrictions. These restrictions may include pre-emption provisions in favor of existing shareholders that grant these investors the right to acquire the secondary interest at same conditions and price at which the seller and third party agreed. The argument has been made that such assets are overvalued in the calculation of NAV and reduce liquidity. (Lee, Schleifer, & Thaler, 1991). Based on the argumentation above the following relationship between liquidity and price deviations to NAV is assumed:



Most studies found a negative relationship between liquidity and discounts to NAV. Although it needs to be mentioned that in the studies different proxies are applied to define liquidity. Frequently market exchange process outputs such as bid-ask spreads and free float[15] are used. Hence, finding an uniform proxy variable for liquidity is assumed difficult as the definition is complex and multidimensional (Capozza & Lee, 1995).

Malkiel (1977) found minor support for this theory and concluded that illiquid stock holdings only explain a part of the cross-sectional variation of discounts to NAV. In the study the level of restricted stocks is used as a proxy for liquidity, which stocks are not transferable until certain restrictions are met. Lee et al. (1991) used the same proxy and could conclude that illiquidity can explain a portion of the discount to specialized funds, but illiquidity cannot explain the substantial discount of large diversified stocks (that did not hold restricted stocks). More recent studies found more significant prove of the phenomenon, concluded for several investment products (e.g. CEFs, ETFs and REITs). Datar (2001) used trading activity as a proxy for liquidity and reported that funds with higher liquidity, had lower discounts than funds with lower liquidity. They came to similar conclusions for both equity and bond funds. Clayton and MacKinnon (2001) used the bid-ask spread as a proxy for liquidity and reported a negative relationship between Real Estate Investment Trust (REIT)[16] liquidity and discounts to NAV for years 1996-1999. Mean reversion of premiums to NAV are reported as a strong common element across REITs. Brounen and ter Laak (2005) also found a negative relationship between liquidity and discounts to NAV for European property shares in 2002. They used the ratio of traded stocks compared to a funds balance sheet (free float) as a proxy for liquidity. This approach connects with the restricted stock theory on which Malkiel (1977) elaborated. Engle & Sarkar (2006) found

15 Free float reflects the shares of a fund that are issued and publicly traded. Free float does not account for Inactive shares such as restricted stocks, which are only issued (to e.g. insiders) if certain restrictions are met.

16 Real estate investment trusts (REITs) are companies that 'own, operate or finance income-producing real estate'. REITs are frequently focused on certain specific real estate sectors and are commonly traded at public stock exchange markets (NAREIT, 2021)

empirical evidence that domestic Exchange Traded Funds (ETF), which resemble CEFs in many aspects, trade at relatively small premiums and discounts and last typically for several minutes and as such are priced close to their NAV. Instead, international ETFs are less actively traded (and therefore less liquid products) and therefore less accurately priced. These funds trade at larger premiums and discounts and last typically for several days. Chan, Jain and Xia (2008) researched illiquidity in segmented markets (or country funds) and found a strong negative relation between market illiquidity and premiums to US traded single-country CEFs. In addition they reported a higher effect for segmented markets. Cherkes et al. (2009) claim that the higher liquidity of CEF shares are in comparison to their holdings, the higher the added value of the fund structure and thus the smaller the discount to NAV. They propose that the level of a fund's premium or discount can be based on the positive value effects of liquidity benefits, offset by the negative effects of management fees. These liquidity benefits arise because transaction costs for CEFs tend to be much smaller than the transaction costs that would arise if the investors attempted to trade the underlying illiquid securities directly (see also paragraph 2.5.4).

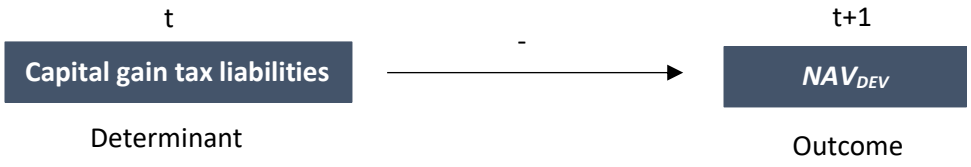
Based on e.g. Chordia (1996) and Nanda et al. (2000) it is assumed that funds that provide liquidity on demand such as OEFs hold more liquid assets in comparison to funds that do not, such as CEFs, and therefore market prices of OEFs diverge less from their fundamental value than CEFs. Hence OEFs are more vulnerable to liquidity due to liquidity redemption shocks. See also paragraph 2.5.1. for a short comparison.

Following the above, the following hypothesis is supposed for the liquidity issue theory:

H_2: The higher the liquidity of investment funds are in comparison to their asset holdings, the higher the added value of the fund structure and thus the smaller the expected price discount (or even the higher the premium) of its shares compared its fundamental value. And vice versa. As OEFs are assumed to be more liquid than CEFs, the price deviation for OEFs is assumed to be smaller than for CEFs.

I. A3 Capital Gain Tax liabilities

The unrealized capital gain taxes (CGT) liability theory is presumed as one of the most significant explanations for CEF discounts. Investors whom purchase shares of a fund that holds a portfolio of assets which has experienced substantial capital gains, should incur CGT when the underlying asset of the fund are sold or a fund is liquidated (e.g. after the duration of a CEF ends). This is also called the CGT liability (Morri & Benedetto, 2009). Funds with high accumulated capital gains (and thus a high CGT liability) are less attractive to investors (Cherkes, 2012). In case shares are traded OTC, it might occur that discounts will be calculated based on the embedded contingent liability outstanding. Hence, investors will not receive a full distribution of the NAV in case a fund is liquidated, but a lower amount as they have to incur taxes. In most cases a buyer and seller will negotiate about the tax risk that is deducted from the market price (Baum, 2012)**.** The tax explanation theory argues that capital gain tax (CGT) liabilities on unrealized appreciations are not captured by the standard calculation of NAV and thus should result in a price discount to NAV (Lee, Schleifer, & Thaler, 1991). In this assumption it is supposed that the higher the CGT liability is, the lower the price compared to NAV. And vice versa. And, as capital gains increase in rising markets, NAV discounts will increase in periods of economic upswing (Malkiel, 1977). The following relationship between the variables is assumed:



Malkiel (1977) found that CEF discounts are positively related to unrealized capital gains (and thus CGT). E.g. Venmore-Rowland (1989), Brickley et al. (1991), Malkiel (1995), Chay et al. (2006), Day et al. (2011) and (Jarrow & Protter, 2019) found similar conclusions in different investment markets and time periods. Lee et al. (1991) explain this phenomenon by the fact that discounts to CEFs are a rational compensation for a lower expected future cashflow so investors do not have to compromise on their returns.

Building on this theory it can be assumed that in case of OEFs, an investment manager is incentivized to realize capital gains as soon as they occur because this will lower CGT liabilities outstanding and has a positive effect on the price compared to NAV (as the OEF remains attractive to investors). Instead, as in general no new capital inflow is possible in CEFs (see also paragraph 2.5.1), the CGT is postponed to the end of the fund duration. As such the CGT liability accumulates and makes the CEF less attractive to new investors as more costs need to be incurred (resulting in price discounts to NAV) (Musto, 2011).

Last, two closing remarks need to be made on this theory. First CGT liabilities can only explain price deviations to NAV as these liabilities are assumed as costs in future cashflow explanations. In case no CGT liabilities apply to a certain investment (in case tax shields are applied), price should equal NAV and thus discounts and premiums to NAV cannot be explained by this theory (Morri & Benedetto, 2009). Second, this theory cannot explain price deviations to NAV in case tax exempt vehicles such as REITs are researched. So, although this variable is frequently assumed to have one of the largest explanatory powers to the CEFP, this variable does not give a holistic approach why market prices deviate from their fundamental value.

H_3: The higher the amount of capital gain tax (CGT) liabilities on unrealized appreciations is embedded in an investment fund, the higher the expected price discount of its shares compared to its fundamental value. And vice versa. This discount effect is expected to be greater in periods of economic upswing. As CEFs are supposed to have higher levels of embedded CGT liabilities outstanding than OEFs, they are expected to presenter higher discounts to NAV in comparison to OEFs.

I. A4 Market diversification

Investment funds may have various forms and allocations such as specific country funds, asset types (bonds, equities and/or properties) and may face certain influences from e.g. market integration, exchange rates and country specific risks. The market diversification hypothesis assumes that the level of (international) market segmentation has an effect on the price deviations from fundamental value. In different studies the phenomenon is frequently approached by country risk, asset type (bonds or equities) or property segment (retail, industrial, offices, etc.).

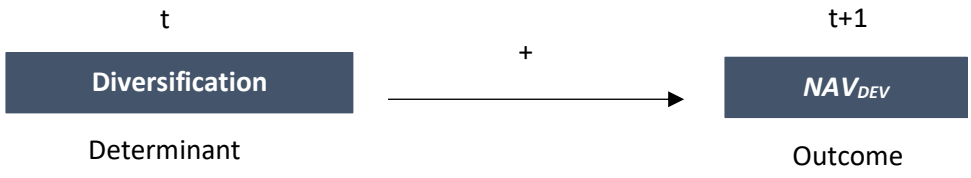
Regarding country fund specific allocations, Bonser-Neal et al. (1990) studied closed-end country funds in the US over the period 1981-1989 and examined whether international investment restrictions on the direct market raises prices of country specific CEFs. They found empirical evidence that some foreign markets are partially segmented. Patro (2005) used a larger sample of US traded emerging market country funds in the same sample period as Bonser-Neal et al. and find no evidence for the hypothesis. Prato rather concluded that the effect is reflected in both NAV and share price and as such no significant price deviation are noticeable. Bekaert & Urias (1996) find empirical support that UK traded country funds, which hold diversified emerging markets equities, decrease the size of the CEF discount or increase the size of a premium if a portfolio is wider diversified. They did not find evidence for this pattern on US traded funds, which is related to difference in portfolio holding.

However, Chan et al. (2008) did found empirical evidence for this theory on the US market for CEFs over the period 1987-2001. Kim & Song (2010) came to similar conclusion as Bekaert & Urius in the US market over the period 1995 to 2004 and found that funds which are investing in markets with higher country risks report higher premiums.

Regarding investment focus, Clayton and MacKinnon (2001) did not find significant evidence between the degree of investment focus and discounts to NAV for US REITS over the period 1996-1999. They used the Herfindahl-Hirschman index[17] as a proxy for concentration by property type. In contrary, Bond & Shilling (2004) found a negative relationship between portfolio diversification and discounts to NAV. They studied European equity market companies and used systemic risk (expressed as residual volatility) as a factor of total risk as a proxy for diversification. They related this finding to the fact that a greater diversification reduces costs associated with management performance risk. Danielson and Harrison (2000) found in their study that investment REITs that are more focused in their investments are more liquid than REITs that are more diversified. They relate this outcome to the fact that more diversified REITs are more difficult to value. This is a contrary outcome than most studies show.

Relating this theory to asset types, Capozza and Lee (1995) studied equity REITs found that diversification has a significant effect on discount levels to NAV, but that the effect is dependent on the property type. They found that retail REITs, which are generally more focused, trade at a premium in comparison to the REIT average in their study. And industrial REITs, which are also focused but more diversified by region, trade at a discount. Brounen and ter Laak (2005) researched pricing discounts of 72 European property shares and found a significant negative relation between focus on property types and property share discounts. In the study the segments offices, retail, residential, industrial, hospitals and other are defined and quantified by using the asset-based Herfindahl-Hirschman index. They could not find evidence that geographical spread is related to property share discounts, which they reflected on the fact that European property companies tend to be domestically focused.

Although there are contrary patterns found in empirical research on this theory, for the most part there is a positive relationship found between market diversification and price deviations to NAV. Therefore, the following relationship between the variables is assumed:



H_4: The higher an investment fund is diversified to countries with investment restrictions or segment specific risks (and thus reduces its systematic risk), the lower the expected discount (or higher the premium) of its shares compared to its fundamental value

I. A5 Dividend yield distribution

[17] The Herfindahl-Hirschman index is a generally accepted measure of market concentration. The index is calculated by squaring the market share of each firm that competes in a certain market and then summing up the results. A high degree means that the market is highly concentrated and a few parties hold a large percentage of the market share. And vice versa. The index ranges from 1 (least concentrated) to 10.000 (most concentraded) (CFI, 2021)

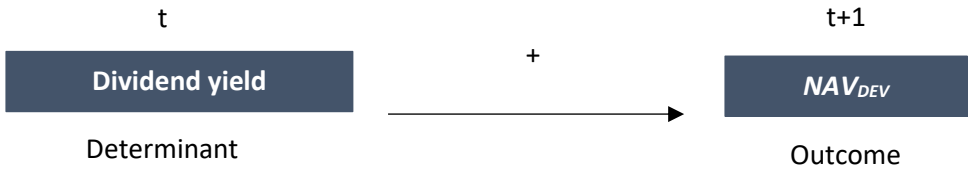
Fund performance is assumed to be an explanatory variable for share prices to deviate from the underlying fundamental value of the funds' assets. However, it needs attention which performance measures are used in the analysis. Factors frequently used are dividend yield, return on equity (ROE) and total return (dividends and capital appreciations). Dividend yield is assumed an eminent factor to explain share price deviations from fundamental value as this variable is put in relation with expected future performance. ROE and total return are merely measures of past performance and therefore vulnerable to other factors that might influence the pricing mechanism. In general it is assumed that the better the performance of an asset is, the lower the discount to the fundamental value. (Morri & Benedetto, 2009)

Relating this to dividend yield, a high dividend yield is expected to result in a more accurate market pricing of shares and thus a lower discount (or higher premium) to the fundamental value. Malkiel (1977) argues that the distribution of capital gains influences the level of discounts at which CEFs trade. He puts forward three explanations. First the distributions tend to lower unrealized capital gains and thus limit future tax liabilities (see appendix I. A3). Second, a distribution policy helps investors avoid brokerage costs in case they need to periodically sell off shares to match their liabilities. Third, distributions are seen as a liquidation of part of the asset holding in cash. As long as CEFs trade at a discount that is larger than can be explained by the unrealized capital gains (and thus a share is assumed to be mispriced), investors will be better off by cash distributions. Malkiel did not find empirical evidence for its argumentation.

Pontiff (1996) connects to the third explanation of Malkiel (explained as reduction of holding costs) and found empirical evidence that a high distribution policy of CEFs results in larger price discounts to NAV as its makes arbitrage strategies more risky (and thus costly) to cancel out market inefficiencies. And contrary, CEF share prices are more likely to deviate from their NAV for funds that pay out smaller dividends. In this conclusion Pontiff takes into account that CEFs that have a preferential tax status are required to pay out at least 90 percent of their dividends. Wang & Nanda (2004) concluded in their study that fund managers can reduce price discounts to NAV by adopting a target dividend distribution policy. By reducing the fund's growth rate, the fund manager reduces the non-fundamental risk of a fund (e.g. investor sentiment) and as such price discounts to net asset value.

Morri et al. (2005) found an opposite relation between dividend yield distributions and price discounts to NAV for UK property companies between 2000 and 2003. They found empirical evidence for a positive relation on 'ungeared' discounts. Later Morri (2006) again concluded on a positive relationship between both factors, but explained the theory by the fact that investors would rather have their money invested in properties than to reinvest the gained dividend in new properties in a growing real estate market. However, they also concluded that e.g. dividend yield may be a result of other factors that drive price discounts.

Since a positive relationship between dividend yields and price deviations to fundamental value seems to have more convincing and supportive evidence, the following relationship between the variables is assumed:



H_5: The higher the dividend yield of an investment fund, the lower the non-fundamental risk of its shares and thus the lower the expected discount (or higher the premium) compared to its fundamental value

I. B Behavioral explanations

I. B1 Investor sentiment hypothesis

In the ISH, it is assumed that there is a variability in stock prices (systematic risk) arising from unpredictable trading that seems unrelated to valid information. See e.g. De Long *et al*. (1990); Lee et al. (1991), Barberis et al. (1998) and Lee et al. (2002). Basically, noise traders value assets and make buy, hold and sell decisions without or limited use of fundamental stock data. Mistakes made by these investors comprise the misinterpretation of genuine new information such as (small) events and publicly or privately available information ('news') (Daniel, Hirshleifer, & Subrahmanyam, 1998). Inaccurate expectations of this information will consequently lead to investor overconfidence about the accuracy of private information. These psychological biases cause asymmetric shifts in confidence of investors, which are drivers for unceasingly poor market timing and over- and underreaction of investors (Daniel, Hirshleifer, & Subrahmanyam, 1998). E.g. Veronesi (1999) found that, due to noise traders, in normal conditions stock prices overreact to bad news in good times and under- react to good news in bad times. This sentiment shifts over time. Together with biased self-attribution, this may drive investors to make incorrect assessments of fundamental values. As a consequence, price anomalies exist and stock markets may face disparity (Stambaugh, Yu, & Yuan, 2012). In addition, it is assumed that mispricing gets corrected as economic fundamentals are disclosed and sentiment declines.

Numerous studies have shown evidence that investor sentiment can cause non-fundamental movements of future stock returns in comparison to market efficiency. See e.g. Solt & Statman (1988), Fisher & Statman (2000), Brown & Cliff (2005) and Baker & Wurgler (2006). As investment returns are assumed to be in seamless balance with e.g. risk and pricing, it may be expected that investor sentiment causes irrational divergences of price levels from their fundamental values.

It is notable that in empirical studies regarding the ISH, investor sentiment is not measured by a general instrument or tool. Different methods are used to proxy for investor sentiment, which includes data from e.g. surveys, interviews or indices such as the Bearish- and Bullish Sentiment Index as used by e.g. Solt & Statman (1988) and Clarke & Statman (1998). However, in any case investor sentiment is defined as the investor's expectation of future stock price movements in a particular market. Three types of classifications are defined, namely: (1) bullish markets, in which investors expect the share prices to increase (2) bearish markets, in which investors expect the share prices to decrease, and (3) neutral markets, in which investors expect no significant price movement at all (John Wiley & Sons, 1996, p. 91)

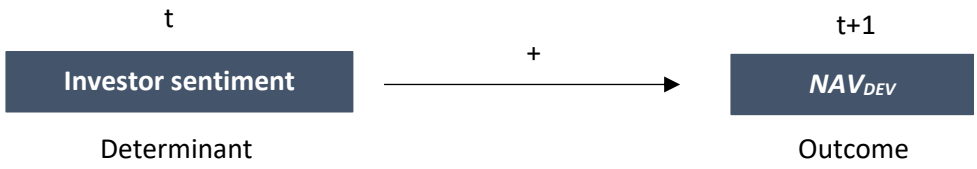
In different researches, such as De Long et al. (1990), Daniel et al. (1998), Baker & Wurgler (2007) and Stambaugh, Yu & Yuan (2012), it empirically proven that excessive optimism (pessimism) will lead to overvaluation (ondervaluation) of stocks. Meaning that negative (positive) new information makes investors increase (decrease) their discount on stock prices in order to bear the risk of higher future uncertainty. In addition lower (higher) price increases are seen in bearish (bullish) markets in case positive news is distributed. And lower (higher) price decreases in bullish (bearish) market in case negative news is spread into the market. Barberis et al (1998) explained this by the fact that investors pay too much focus on the strength of evidence instead of its statistical weight. And from this

assumption that investors underreact to earning announcements and similar events and overreact to consistent patterns of good or bad news.

Within the CEFP theory Lee et al. (1991) have made a significant contribution to the behavioral view. They came to the striking conclusion that CEF shares are primarily held by smaller investors (which are associated with noise traders) and thus subject to noise trader risk. Instead underlying assets to CEFs are primarily held by institutional investors (which are associated with rational investors). From this assumption it is supposed that CEF shares are more risky than holding the assets themselves and as such CEFs share prices are discounted to NAV to equally compensate for the higher noise trader risk premium. They also concluded that price discounts are mean reverting and relate this to investor sentiment fluctuations. E.g. Bodurtha et al. (1995) , Pontiff (1995), Pontiff (1997), Barkham and Ward (1999), Klibanoff et al.(1998), Flynn (2003), Lin et al. (2008) and Hwang (2011) validated the empirical findings of Lee et al. while using different proxies for investor sentiment in different investment markets across the UK and US and multiple periods of time.

Chen et al. (1993) criticized the approach of Lee et al. and debated that their approach regarding the small investor theory is does not fully explain the CEFP. Elton et al. (1998) also debated the smaller investor theory of Lee et al. and did not find empirical that changes in discounts to NAV, used as a proxy for investors sentiment, explain price deviations of e.g. passive and active OEF stock portfolios or a sample of stocks that are traded at the New York Stock Exchange (NYSE). Also outcomes of Abraham et al. (1993) do not fully support the ISH and the viewpoint of Lee et al. They researched 71 stock funds and 120 bond funds that are traded at the NYSE from 1985 to 1990 and found that the systematic risk is similar for both fund types, however that only stock funds trade at a discount.

Cherkes (2012) reflect the different viewpoints on the lack on an independent measure of investor sentiment as there are different proxies used. Therefore the outcomes of the studies are hard to compare and a compelling explanation for the ISH difficult. As there seems more profound evidence for the theory as explained by Lee et al. In this study, the following assumption is made:



H_6*: If disproportionate optimism or pessimism drives prices away from their intrinsic value, periods of high (low) investor sentiment should be followed by share prices above (below) their fundamental value and as such low (high) returns on the short run. Since sentiment (based on 'news' and 'events') is incorporated only slowly into the price level of shares, share prices will revert to their fundamental values in equilibrium on the long run.*

I. C Other explanations

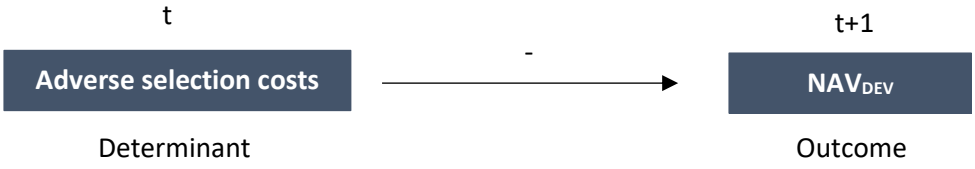
I. C1 Adverse selection costs

Investment markets are non-homogeneous, and generally funds have complex tax, legal and financing structures. Once one investor has greater material information available than another investor, the one investor (usually a seller) may take advantage over the other investor (usually a buyer). This information asymmetry is commonly called 'adverse selection' and is regularly assumed as a

systematic risk. Akerlof (1970) assumes information asymmetry between buyers and sellers to be evident, which results in uncertainty and price illiquidity premiums or discounts. Also Kelly & Ljungqvist (2012) concluded that information asymmetry is priced and linked to liquidity. They state that the more investors are uninformed, the larger the stock turnover varies and pay-off becomes uncertain. As a consequence that asset prices will fall. Clayton & MacKinnon (Clayton & MacKinnon, 2000) found that transaction costs of REIT trading increase when REIT prices are getting closer to NAV. Hence, the proportion of informed traders in the market is higher as the divergence between REIT prices and NAV narrows. And as such higher information costs needs to be incurred. This finding holds when they correct for trading volume and volatility changes. Fama (1970) related information availability to market efficiency as described in paragraph 2.3.2. In weak form market efficiency it may be expected that there is more information asymmetry among investors than in strong form market efficiency.

The information asymmetry effect is partly reflected in the costs of obtaining accurate information. The higher the rate of non-transparency is, the higher the expected transaction- and information gathering costs. These higher information gathering costs are reflected is substantial lower market bid prices to compensate for access to relevant information. Information asymmetry may come in many forms. For example, Baum (2012) states that investing in foreign asset is more risky than in domestic asset as a result of information asymmetry between domestic and foreign investors. It is assumed that local operating investors know more about e.g. the market, legal and tax environments than foreign investors. This is e.g. supported by Chakravarty et al. (1998) and Chan et al. (2008), whom found a significant portion of cross-sectional variation in local- and foreign market investors on the Chinese stock markets. They found that the adverse selection component of the bid-ask spread between local- and foreign market shares explains a large portion of the price discounts. Instead, Clarke & Shastri (2001) found no evidence that adverse selection, reflected in bid-ask spread of CEFs, is directly related to discounts and premiums to NAV in a sample of 266 CEFs traded on the NYSE. Instead they found that the greater the part of CEFs is hold by large stock share owners (so called 'block holders'), the higher the discount to NAV. Hence, block holders commonly receive private monetary and non-monetary benefits, which will not accrue to other investors. Costs related to these private benefits being paid to block holders result in a larger adverse selection component of the bid-ask spread. Indirectly this will affect asset prices compared to their NAV.

As there seems more profound evidence for a negative relation between information gathering costs and price deviations to NAV, in this study the following assumption is made:



H_7: The higher information gathering costs are to obtain accurate information to compensate for adverse selection in the investment market, the higher the expected discount of its shares compared to its fundamental value.

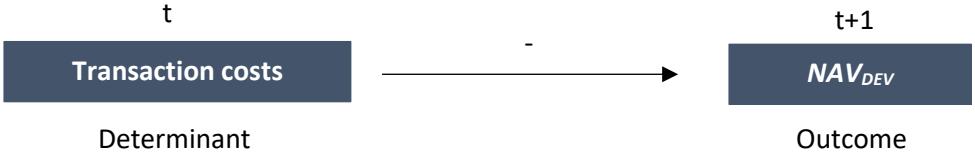
I. C2 Transaction costs

In direct real estate transactions and in setting-up real estate investment funds, investors need to take account of several transaction costs such as legal fees, due diligence costs and property taxes (e.g. stamp duty). These transactions costs are relatively high compared to other asset classes an may add

up to approximately 5-7% of the acquired property value. For example, for pan-European OEFs a 5% transaction cost level is assumed to be representative and may modify based on the level of gearing that is used (INREV & AREF, 2018). These acquisition costs are not sustained by investors that invest in e.g. REITs and OEFs that gain exposure to fully invested real estate portfolio's in which these are already incurred and amortized (Baum, 2012). In efficient markets one could therefore reason that these investment funds should equally trade at a premium to their NAV to compensate for these costs. As indicated in paragraph 2.5.1. also Roenfeldt & Tuttle (1973), Weiss (1989), Peavey (1990), and Cherkes (2012) concluded that on average a premium exists at CEF IPOs to compensate for start-up and underwriting costs.

In contrary, real estate investment funds that gain transaction cost exposure should trade at an equally fair discount to their NAV. Hence, at inception the transaction costs of these funds are relatively high compared to their total cash flow. Malkiel (1977) concluded that stock prices of CEFs with a high turnover leads to increased transaction costs (including higher taxes). Since there is no return compensation for these higher transaction costs, Malkiel concludes that this will lead to larger discounts to NAV. On the mid-long term this discount is expected to mean revert over time as transaction costs are amortized. Following INREV and AREF (2018) the amortization period is most effective as the period is adapted to the expected holding period of the fund vehicle, with a ten year time proxy for OEFs and a five year time period for CEFs. After the amortization period (and together with a potential leverage effect), real estate investment funds may outperform the direct real estate market on the mid-long run. The time varying performance of the decreasing performance on the short run and subsequent increasing performance on the mid-long run is the so called 'J-curve effect' (Baum, 2012).

As transaction costs are expected to be capitalized on market prices, an a-priori deviation between market prices and NAV can be expected between direct investments and publicly or non-publicly traded real estate fund shares. Therefore the following assumption is made:



H_8: The higher non-amortized transaction costs are in a real estate investment fund, the higher the expected discount of its shares compared to its fundamental value. As transaction costs are amortized over time, the discount is expected to mean revert on the mid long run.

I. C3 Leverage

In many company and fund structures a provision of leverage (or gearing) is included, which is usually expressed as the ratio of long term debt to total assets. Morri & Benedetto (2009) state that there is no straight forward relationship between leverage and price deviations from NAV as the effect can be considered both ways.

At the one side leverage may decrease agency costs and tie up free cash flow and therefore improve cash flow for investors (see appendix I. A1). Hence, debt facilities stimulate companies to become better organized so they are able to make timely interest- and principal payments. As lenders are monitoring their creditors carefully, the credit risk of the investment fund GPs is reduced and discounts to NAV are expect to be lower. See for example Jensen (1986) and Barber (1996).

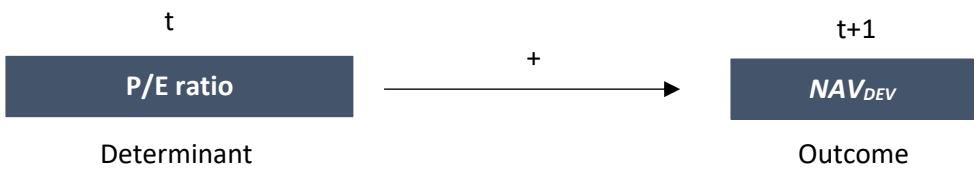
At the other side, a higher leverage provision may increase the risk of financial distress, which expectedly will result in a higher discount to NAV. Baum (2009) explains this more thoroughly and states that leverage makes the performance of investments funds more responsive to interest rates and the bond market, dependent on whether the interest rate is floating or fixed. Dependent on the cost of debt in comparison to the market rate, below of above market average, a discount or premium will be implemented. An expensive debt facility may drive REIT prices below NAV and vice versa. In addition, leverage makes cashflows more sensitive to interest rates and market conditions and increases earning volatility. And as such may decrease the investors income return. Therefore it can be argued that the risk on financial distress of a fund with high leverage is larger than a fund with low leverage. E.g. Barkham & Ward (1999) confirmed the positive relation between leverage of UK listed property companies and discounts to NAV, but found no significant effect between both factors over a 3 year time period (1993-1995) within the sample they used. E.g. Clayton and MacKinnon (2000), Bond and Shilling (2004) and Bounen & Ter Laak (2005) found significant evidence that leverage is positively related to discounts to NAV. Morri et. Al. (2005) and Morri & Benedetto (2009) also found a positive relationship between leverage and NAV discounts, but found that the influence of leverage on these discounts is biased by an accounting effect.

Reflecting on the above, the majority of studies support the theory that leverage is negatively related with price deviations to NAV, meaning that a higher leverage provisions will result in a discount to NAV. As explained in paragraph 2.5.1. CEFs can maintain higher levels of leverage compared to OEFs since these funds do not have to maintain large cash reserves to redeem shares. Generally value add and opportunistic funds, mostly CEFs, maintain maximum leverage levels of respectively 40-60% and over 60% (INREV, 2012). Therefore it is assumed that CEFs commonly may report higher discounts to NAV compared to OEFs.

H_9: The higher the leverage provision in a fund structure, the higher the expected discount of its shares compared to fundamental value as the risk for financial distress increases. Since CEFs can generally maintain higher levels of leverage compared to OEFs, it is expected that the discounts to fundamental value are larger for CEFs than for OEFs.

I. C4 Price-earnings ratio

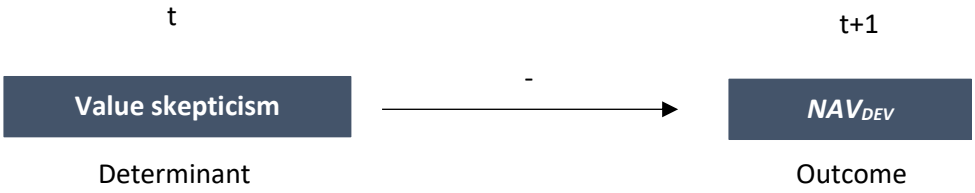
As already substantiated in paragraph 2.4.1.6 stock price valuations, and price-to -earnings ratios, may be subject to investor bias based on their future earnings growth projections. This may irrationally diverge stock prices from the fundamental value of the underlying asset holdings. It is expected that value stocks (stocks with a low P/E ratio or share-to-book value ratio) have higher risk adjusted returns than growth stocks (stocks with a high P/E ratio or share-to-book value ratio). Since in general investors are overconfident in their earnings growth projections, they tend to overpay for growth stocks and vice versa. As such, in this research the following assumption is made:



H_{10}: The higher the price-earnings (P/E) or share-to-book value ratio of an investment fund, the higher the tendency that investors overpay for the shares and thus the higher the premium of its shares compared to its fundamental value.

I. C5 Valuation skepticism

Another frequently reported factor that relates to valuation in comparison to price deviations from fundamental value is the accounting-based stock price theory or 'valuation skepticism'. See e.g. Malkiel (1977) and Caroll et al. (2003). This theory assumes that the reported NAV may be different from the market conform NAV due to accounting guidelines. As Barkham & Ward (1999) and Morri (2009) set out, some property companies hold trading stock on their balance that is designated for trading purposes. Following International Accounting Standards, the fair value of this stock should be reported against the lowest value of either the market or cost value. Trading stock will therefore never be reported above the market value. This approach is also referred to as 'skepticism' of fair value. This conservative accounting approach, may cease investors to discount on share prices since the NAV may be lower than is rationally assumed in the market. And additionally, harder to value shares are expected to be associated with larger discounts to NAV. In many researches valuation skepticism is proxied by non-actively traded securities such as trading or letter stock. Morri et al. (2005) could not confirm the relation between both variables, looking at UK listed property companies over the period 1999-2004. However e.g. Barkham & Ward (1999) and Brounen & ter Laak (2005) concluded on a significant negative relation between trading stocks and discounts to NAV for respectively listed UK property companies over period 1993-1995 and European property shares of CEFs in 2002. Cullinan and Zheng (2014) studied valuation skepticism amongst 567 CEFs and e.g. concluded that valuation skepticism (measured by a higher degree of subjective variables to determine fair value) has a significant relation with funds that trade at a discount. Referring to the above, in this research the following assumption is made:



H_{11}: The higher the share of trading stocks on the balance sheet of an investment fund, the higher risk that the reported NAV is lower than is assumed in the market, and thus the higher the expected discount of shares compared to their NAV.

I. C6 Size

As already elaborated on in paragraph 2.4.1.5. market capitalization (or size) of portfolios may have effect on asset price returns. Though the relation between size and price deviations of fundamental value is not straightforward.

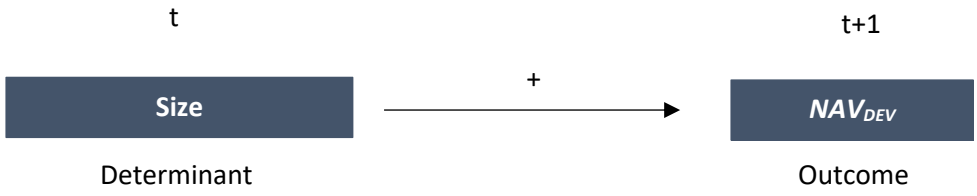
At the one side, a general explanation of the so called size effect is that smaller firms may face higher specific company risks in comparison to large firms and as such should be compensated for extra risk and thus report larger discounts to NAV. Brounen and ter Laak (2005) found a significant negative relation between firm size and share discounts for listed UK property companies. Additionally they found that the largest firms in their sample reported the lowest discounts to NAV. They argued that this effect might be explained by a higher transparency rate of larger firms and higher popularity

amongst investors for larger firms. Capozza & Lee (1995) assumed premiums and discounts from net asset value for publicly traded REITs. Based on a sample of 75 REITs, they concluded that small REITs trade at a significant discount to NAV and large REITs at a premium. They argue that smaller REITs are less leveraged, less diversified (more focused) and have higher overhead expenses compared to large REITs. Also Clayton & Mackinnon (2001) researched changes to premiums on NAV in REIT pricing. They assumed 104 REITs over the period 1996-1999 and concluded that larger REITs trade at a lower discount to NAV than smaller REITs and argued that larger REITs seem to have a larger liquidity premiums and therefore higher prices relatively to NAV. Adams & Venmore-Rowland (1989) concluded that large size companies commonly have better access to capital and consequently a better chance to acquire high value properties and earn above average returns. And as such this should lower the discount to NAV. Also Anderson et al. (2001) came to similar conclusions and reported a significant negative relationship between size and discounts to NAV. They argued that higher liquidity of large firms, better access to capital markets and economies of scale explain this relationship.

Contrary there exists the assumption that larger companies have higher illiquidity risk and therefore report larger discounts to NAV. Barkham & Ward (1999) argued that in case companies are forced to sell their stock (in case of e.g. a bankruptcy), they generally should sell properties against lower prices than the estimated market values. Both Barkham & Ward (1999) and Bond & Shilling (2004) found a positive relation between size and discounts to NAV. However, they found no significant effect between both variables. Also Barker et al. (2018) found a positive relationship. They explained this by the fact that larger funds tend to be more complex for buyers in the market to understand as they involve generally more assets, different property classes and more geographical variation. Because of this more complex structure, or larger fund size, it is more difficult to form expectations on e.g. performance and dividend yield distributions. This higher uncertainty is reflected in the share price.

Last, different studies indicate that one has to be cautious about the explanatory level of size in relation to share price differences from fundamental value. Banz (1981) for example concluded that the size effect is not influenced by the fact that larger firms are better able to diversify portfolios. However, he could not exclude other factors influence the direction and magnitude of size as an explanatory factor and remarks that size also might be a proxy for unknown factors that are correlated with size.

Following the above, the predominant view is that larger firms trade at a lower discount to NAV than smaller firm and thus a negative relation exists between both variables. Therefore we assume:



H_{12}: The larger the firm size of an investment fund, the lower the expected price discount (or larger the premium) of shares compared to their NAV.

Appendix II. Overview variables, measurement scales and proxy codes

Dependent variable (DV)	Code	Scale	Outcome	Item/ dummy description	Applicable predictions
Pricing deviation (premium or discount) from NAV	NAV_{DEV}	Ratio	Quantitative	Premiums ($NAV_{DEV} > 0$) and discounts ($NAV_{DEV} < 0$) to NAV of non-listed real estate secondary trades	H_1, H_2, H_4, H_6, H_9 and H_{12}

Independent variables (IV)	Code	Scale	Outcome	Item & dummy description	Bivariate analysis	Applicable predictions
Fund age	AGE	Ratio	Quantitative	Year fraction between registered trade date ($YEAR_{TRADE}$) and the fund's year of first closing ($YEAR_{CLOSING}$)	Pearson correlation coefficient	H_1
Vehicle structure	VEH	Nominal (Dich.)	Qualitative	• OEF • CEF	T-test	H_2
Investment style	STYLE	Ordinal	Qualitative	• Core (d$STYLE_C$) • Value Add (d$STYLE_{VA}$) • Opportunistic (d$STYLE_{OPP}$)	Spearman's rank correlation coefficient	H_4
Sector allocation	SECT	Nominal (Dich.)	Qualitative	• Single-sector • Multi-sector	T-test	H_4
Target sector	TSECT	Nominal	Qualitative	• Healthcare (d$TSECT_{HEALTH}$) • Leisure (d$TSECT_{LS}$) • Logistics (d$TSECT_{LOG}$) • Offices (d$TSECT_{OFF}$) • Residential (d$TSECT_{RES}$) • Retail (d$TSECT_{RET}$) • Student Housing (d$TSECT_{STUDENT}$) • Multi-sector (d$TSECT_{MULTI}$)	Anova	H_4
Country allocation	COUNTRY	Nominal (Dich.)	Qualitative	• Single-country • Multi-country	T-test	H_4
Target country	TCOUNTRY	Nominal	Qualitative	• France (d$TCOUNTRY_{FR}$) • Germany (d$TCOUNTRY_{GER}$) • Ireland (d$TCOUNTRY_{IR}$) • The Netherlands (d$TCOUNTRY_{NL}$) • United Kingdom (d$TCOUNTRY_{UK}$) • Multi Country (d$TCOUNTRY_{MULTI}$)	Anova	H_4
Investor sentiment	$SENT^{\perp}$	Ratio	Quantitative	Orthogonalized sentiment Index	Pearson correlation coefficient	H_6
Leverage	LEV	Interval	Quantitative	• 0-25% ($dLEV_{LOW}$) • 25-50% ($dLEV_{MED}$) • > 50% ($dLEV_{HIGH}$)	Spearman's rank correlation coefficient	H_9
Size	SIZE	Interval	Quantitative	• €0-2 Billion ($dSIZE_{SMALL}$) • €2-5 Billion ($dSIZE_{MID}$) • > €5 Billion ($dSIZE_{LARGE}$)	Spearman's rank correlation coefficient	H_{12}

Appendix III. Orthogonalized Sentiment Index

The orthogonalized sentiment index (SENTIMENTt⊥ or SENT⊥) originates from Baker & Wurgler (2006) and is based on first principal (time- series) components of five (standardized) sentiment proxies which all have been orthogonalized with a set of six macro-economic indicators. The sentiment proxies include the closed end fund discount (CEFD), the NYSE share turnover (TURN), The number of initial public offerings (NIPO), the average first- day returns on initial public offerings (RIPO), the share of equity issues in total equity and debt issues (S) and the value weighted dividend premium (PD-ND).

SENT⊥ is a composite index, meaning that each sentiment proxy is likely to include a sentiment component as well as a non-sentiment (idiosyncratic) component. Each individual proxy has an expected correlation sign regarding its contribution the index. Common components are excluded and all proxies have been orthogonalized with respect to a set of macroeconomic conditions (business cycle variations) to reduce the connection with systematic risk and exclude extreme values. The index takes into account the relative timing component of the proxies, making this a lagged sentiment index (expressed by ⊥**)**. The proxies are time- series conditioning variables. Baker & Wurgler state that proxies that contain supply responses (S and NIPO) can be expected to lag behind proxies that are based directly on investor demand or investor behavior (RIPO, PD-ND, TURN and CEFD).

Both the SENT⊥ formula and a short description of the proxy variables are presented below. Any further directions and sources of the components can be found at Baker & Wurgler (2006):

$$SENT^{\perp} = -0.241\, CEFD_{t^{\perp}} + 0.242\, TURN_{t-1} + 0.253\, NIPO_{t^{\perp}} + 0.257\, RIPO_{t-1^{\perp}} + 0.112 S_{t^{\perp}} - 0.283\, P_{t-1}^{D-ND^{\perp}}$$

CEFD*:* The closed end fund (CEF) discount. This variable is defined by the equally weighted average difference between the net asset values (NAV) of CEF stock shares and their market prices.

TURN*: Share turnover of the NYSE.* The ratio of reported share volume to average shares listed in the Fact Book of *NYSE.*

NIPO*:* The number of IPO's. Calculated by counting all IPO's on a monthly basis. Regulation A- offerings (small issues, raising less than $1.5 million during the 1980's), real estate investment trusts (REITs) and CEFs are excluded.

RIPO: Average first-day return on IPO's. The average first day returns are calculated as the percentual difference between the offering price to the end-of-the-first-day bid price, without adjusting for market movements. The RIPO variable is then constructed by taking an equally-weighted average (based on NIPOs) of the initial returns of all the offerings over the prior twelve months to smooth noise.

S: The share of equity in new issues. This value is measured through the total volume of equity issues (annual totals, common and preferred) over the prior twelve months divided by the total volume of equity and long-term debt issuance (public and private) over the prior twelve months from Federal Reserve Bulletin. The data series are gross totals of equity and debt issues and do not subtract out repurchases or debt retirements.

PD-ND: Value weighted dividend premium. This is a measure based on uniformed demand for dividend paying shares at the stock market. The dividend premium is defined by the log difference of the average market-to-book ratios of payers and nonpayers over a the prior twelve months.

Appendix IV. Descriptive statistics

IV.I Quantitative Variables

Stata command: *summarize NAV_DEV AGE SENT*

Before correction of outliers

Variable	Obs	Mean	Std. Dev.	Min	Max
NAV_DEV	1,350	-.0013852	.0440559	-.55	.21
AGE	1,350	23.32	15.56306	1	51
SENT	1,350	-.0500464	.175446	-.8939431	.3841878

After correction for outliers

Variable	Obs	Mean	Std. Dev.	Min	Max
NAV_DEV	1,324	.0008384	.0357489	-.1	.08
AGE	1,350	23.32	15.56306	1	51
SENT	1,315	-.0323775	.1386092	-.3917551	.3841878

IV.I A. Confidence Intervals

STATA command: *ci NAV_DEV AGE SENT*

Before correction of outliers

Variable	Obs	Mean	Std. Err.	[95% Conf.	Interval]
NAV_DEV	1,350	-.0013852	.0011991	-.0037374	.000967
AGE	1,350	23.32	.4235729	22.48907	24.15093
SENT	1,350	-.0500464	.004775	-.0594137	-.0406791

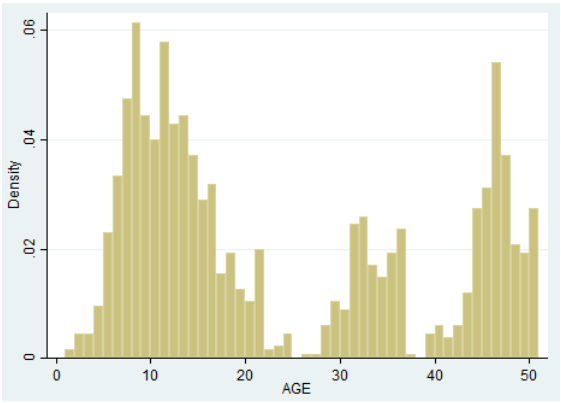
After correction for outliers

Variable	Obs	Mean	Std. Err.	[95% Conf.	Interval]
NAV_DEV	1,324	.0008384	.0009825	-.001089	.0027657
AGE	1,350	23.32	.4235729	22.48907	24.15093
SENT	1,315	-.0323775	.0038223	-.039876	-.0248789

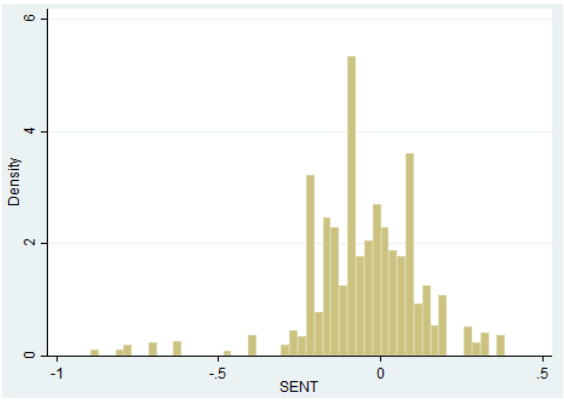
IV.I B. Outlier analysis

IV.I B1 Histograms of quantitative variables

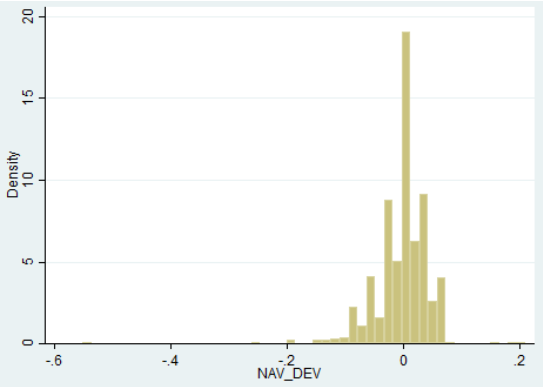
AGE



SENT



NAV_{DEV}



IV.I B2 Z-score analysis

STATA Command: egen std[VARIABLE] = std([VARIABLE] | summarize stdNAV_DEV stdAGE stdSENT

Before correction of outliers

Variable	Obs	Mean	Std. Dev.	Min	Max
stdNAV_DEV	1,350	-3.39e-09	1	-12.45269	4.798108
stdAGE	1,350	1.03e-09	1	-1.434165	1.77857
stdSENT	1,350	-3.86e-09	1	-4.810007	2.47503

After correction of outliers

Variable	Obs	Mean	Std. Dev.	Min	Max
stdNAV_DEV	1,324	-2.37e-09	1	-2.820743	2.214382
stdAGE	1,350	1.03e-09	1	-1.434165	1.77857
stdSENT	1,315	-4.20e-10	1	-2.59274	3.005322

IV.II Quantitative Variables

IV.II A. Nominal Dichotomous

Stata command tab1 VEH SECT TSECT COUNTRY TCOUNTRY

VEH	Freq.	Percent	Cum.
Open-end	1,059	78.44	78.44
Closed-end	291	21.56	100.00
Total	1,350	100.00	

SECT	Freq.	Percent	Cum.
Single-sector	581	43.04	43.04
Multi-sector	769	56.96	100.00
Total	1,350	100.00	

TSECT	Freq.	Percent	Cum.
Health care	6	0.44	0.44
Leisure	14	1.04	1.48
Logistics	91	6.74	8.22
Offices	125	9.26	17.48
Residential	5	0.37	17.85
Retail	234	17.33	35.19
Student Housing	106	7.85	43.04
Multi-sector	769	56.96	100.00
Total	1,350	100.00	

COUNTRY	Freq.	Percent	Cum.
Single-country	1,280	94.81	94.81
Multi-country	70	5.19	100.00
Total	1,350	100.00	

TCOUNTRY	Freq.	Percent	Cum.
France	2	0.15	0.15
Germany	1	0.07	0.22
Ireland	3	0.22	0.44
Multi-country	70	5.19	5.63
Netherlands	19	1.41	7.04
United Kingdom	1,255	92.96	100.00
Total	1,350	100.00	

IV.II B. Multi-item

STATA command: tab1 STYLE SIZE_INT LEV_INT YEAR

STYLE	Freq.	Percent	Cum.
Core	1,095	81.11	81.11
Value-add	253	18.74	99.85
Opportunistic	2	0.15	100.00
Total	1,350	100.00	

RECODE of SIZE	Freq.	Percent	Cum.
€0-2 Billion	767	57.15	57.15
€2-5 Billion	553	41.21	98.36
>€5 Billion	22	1.64	100.00
Total	1,342	100.00	

LEV_INT	Freq.	Percent	Cum.
0-25%	976	72.62	72.62
25-50%	277	20.61	93.23
>50%	91	6.77	100.00
Total	1,344	100.00	

YEAR	Freq.	Percent	Cum.
2010	58	4.30	4.30
2011	120	8.89	13.19
2012	141	10.44	23.63
2013	218	16.15	39.78
2014	192	14.22	54.00
2015	159	11.78	65.78
2016	164	12.15	77.93
2017	140	10.37	88.30
2018	158	11.70	100.00
Total	1,350	100.00	

Appendix V. Bivariate Analysis

V.I T-test

V.I A. *VEH – NAV_{DEV}*

STATA Command: ttest NAV_DEV , by(VEH) unequal

```
Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Closed-e	277	-.0195307	.0025141	.0418433	-.02448	-.0145814
Open-end	1,047	.0062273	.0009848	.0318667	.0042948	.0081598
combined	1,324	.0008384	.0009825	.0357489	-.001089	.0027657
diff		-.025758	.0027001		-.0310678	-.0204482

```
    diff = mean(Closed-e) - mean(Open-end)                        t =  -9.5395
Ho: diff = 0                     Satterthwaite's degrees of freedom =  364.933

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

V.I B. *SECT – NAV_{DEV}*

STATA Command: ttest NAV_DEV , by(SECT) unequal

```
Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Multi-se	760	.0100789	.0010377	.0286084	.0080418	.0121161
Single-s	564	-.0116135	.0016996	.0403632	-.0149518	-.0082752
combined	1,324	.0008384	.0009825	.0357489	-.001089	.0027657
diff		.0216924	.0019914		.0177845	.0256003

```
    diff = mean(Multi-se) - mean(Single-s)                        t =  10.8933
Ho: diff = 0                     Satterthwaite's degrees of freedom =  961.864

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

V.I C. *COUNTRY – NAV_{DEV}*

STATA Command: ttest NAV_DEV, by(COUNTRY) unequal

```
Two-sample t test with unequal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Multi-co	67	.008209	.0040066	.0327953	.0002096	.0162084
Single-c	1,257	.0004455	.0010117	.035869	-.0015393	.0024303
combined	1,324	.0008384	.0009825	.0357489	-.001089	.0027657
diff		.0077635	.0041323		-.0004692	.0159961

```
    diff = mean(Multi-co) - mean(Single-c)                        t =   1.8787
Ho: diff = 0                     Satterthwaite's degrees of freedom =  74.6688

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9679         Pr(|T| > |t|) = 0.0642          Pr(T > t) = 0.0321
```

V.II ANOVA

V.II A. *TSECT – NAV_{DEV}*

STATA Command: oneway NAV_DEV TSECT_n, bonferroni tabulate

TSECT	Summary of NAV_DEV Mean	Std. Dev.	Freq.
Health ca	-.005	.05089204	6
Leisure	-.00857143	.0416685	14
Logistics	.00340909	.03698047	88
Multi-sec	.00196026	.03525389	755
Offices	-.00178862	.03392452	123
Residenti	.002	.01923538	5
Retail	-.00166667	.03856265	228
Student H	.00066667	.03317398	105
Total	.00083837	.03574887	1,324

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	.005265397	7	.0007522	0.59	0.7667
Within groups	1.68550399	1316	.001280778		
Total	1.69076939	1323	.001277981		

Comparison of NAV_DEV by TSECT
(Bonferroni)

Row Mean-Col Mean	Health c	Leisure	Logistic	Multi-se	Offices	Resident
Leisure	-.003571 1.000					
Logistic	.008409 1.000	.011981 1.000				
Multi-se	.00696 1.000	.010532 1.000	-.001449 1.000			
Offices	.003211 1.000	.006783 1.000	-.005198 1.000	-.003749 1.000		
Resident	.007 1.000	.010571 1.000	-.001409 1.000	.00004 1.000	.003789 1.000	
Retail	.003333 1.000	.006905 1.000	-.005076 1.000	-.003627 1.000	.000122 1.000	-.003667 1.000
Student	.005667 1.000	.009238 1.000	-.002742 1.000	-.001294 1.000	.002455 1.000	-.001333 1.000

Row Mean-Col Mean	Retail
Student	.002333 1.000

V.II B. *TCOUNTRY – NAV_{DEV}*

STATA Command: oneway NAV_DEV TCOUNTRY_n, bonferroni tabulate

TCOUNTRY	Summary of NAV_DEV Mean	Std. Dev.	Freq.
France	-.035	.03535534	2
Germany	-.1	0	1
Ireland	.00333333	.04041452	3
Multi-cou	.005	.03791192	68
Netherlan	.01315789	.02925988	19
United Ki	.0005524	.03558597	1,231
Total	.00083837	.03574887	1,324

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	.016917848	5	.00338357	2.66	0.0210
Within groups	1.67385154	1318	.001269994		
Total	1.69076939	1323	.001277981		

Comparison of NAV_DEV by TCOUNTRY
(Bonferroni)

Row Mean-Col Mean	France	Germany	Ireland	Multi-co	Netherla
Germany	-.065 1.000				
Ireland	.038333 1.000	.103333 0.182			
Multi-co	.04 1.000	.105 0.053	.001667 1.000		
Netherla	.048158 1.000	.113158 0.030	.009825 1.000	.008158 1.000	
United K	.035552 1.000	.100552 0.073	-.002781 1.000	-.004448 1.000	-.012605 1.000

V. III Pearson correlation coefficient

NAV_{DEV} - AGE – SENT

STATA Command: pwcorr NAV_DEV AGE SENT, sig star (0.05)

(obs=1317)

	NAV_DEV	AGE	SENT
NAV_DEV	1.0000		
AGE	0.2032*	1.0000	
	0.0000		
SENT	-0.0575*	-0.0100	1.0000
	0.0392	0.7182	

** Means significant at a 5% significance level*

V. IV Spearman rank correlation coefficient

NAV_{DEV} – STYLE – YEAR – LEV_INT – SIZE_INT

STATA Command: spearman NAV_DEV STYLE_n LEV_INT_n SIZE_INT, stats (rho p) star (0.05)

(obs=1317)

	NAV_DEV	STYLE_n	LEV_IN~n	SIZE_INT
NAV_DEV	1.0000			
STYLE_n	-0.1113*	1.0000		
	0.0001			
LEV_INT_n	-0.3365*	0.3946*	1.0000	
	0.0000	0.0000		
SIZE_INT	0.1304*	-0.0149	-0.0545*	1.0000
	0.0000	0.5885	0.0478	

Appendix VI. Confidence intervals

A confidence interval provides an indication of the quality of estimates. For statements about confidence intervals in this report, a 95% confidence level has been used. The following example shows a calculation of the variable NAV_{DEV} before correction for outliers. This elaboration applies to a ll other variables for which a confidence interval has been calculated.

The factor 'σx' is unknown in the calculation of the confidence interval for NAV_{DEV}, so the following in terval estimation formula is used:

$\bar{X} \pm t_{n-1,\alpha/2} \frac{S}{\sqrt{n}}$, where the estimated standard deviation of the sample is $S = \sqrt{\frac{\sum(x_i-\bar{X})^2}{n-1}}$

For NAV_{DEV} the following numbers apply:

Sample size	(n)	= 1.350
Variance	($\Sigma (x_{i-X})^2$)	= 59.43
Sample mean	($\bar{X}$)	= -0.00139
Conf. Level	(α)	= 0,05

The 95%- confidence interval for NAV_{DEV} is calculated as follows:

The standard deviation of the sample is:

$$S = \sqrt{\frac{59.43}{1349}} = 0{,}21$$

And the standard error of the sample:

$$-0.00139 \pm t_{1349-0{,}025} * \frac{0{,}21}{\sqrt{1350}}$$

$$-0.00139 \pm 1{,}96 * \frac{0{,}21}{36{,}74} = 0{,}011$$

After the calculation, the interval ranges from [-0.037374, 0.00967]. So the widt of this interval is 0.0470. On a scale of 0 to 1, this interval can be assumed narrow. This indicates a high accuracy and r eliability of the estimate.

Appendix VII. T-test

Below one find a step-by-step approach of a two-sample T-test (van Dalen & de Leede, 2009, pp. 320-329). As an example the relationship of the variables *VEH* and NAV_{DEV} is tested. Before the T-test can be applied, an F-test will first be performed to test the equality of the variances from the different subpopulations of *VEH* and NAV_{DEV}.

1. ***Formulate null and alternative hypothesis***

H_0: $\sigma_1^2 = \sigma_2^2$ $(\leftrightarrow H_0 : \frac{\sigma_1^2}{\sigma_2^2} = 1)$

H_1: $\sigma_1^2 \neq \sigma_2^2$ $(\leftrightarrow H_1 : \frac{\sigma_1^2}{\sigma_2^2} \neq 1)$

2. ***Choose test statistic***

$$F = \frac{S_1^2}{S_2^2}$$

A two sided test is performed. Hence, the test should make clear whether or not the manipulation has an effect on the dependent variables. The test is not meant to investigate the nature of the effect.

3. ***Define distribution of test statistic***

H0 = $F \sim F_{(n1-1,n2-1)}$

Where n_1 indicates the sample size of the first group (OEFs) and n_2 of the second group (CEFs). For the analysis of *VEH* (see also appendix IV) n_1 = 1047 en n_2 = 277. This results in in F ~ (1046,276)

4. ***Critical rejection area***

$S_1^2 \ll S_2^2 \cup S_1^2 \gg S_2^2$

On the level of the test statistic this corresponds with:

$$F_{obs} \ll 0 \cup F_{obs} \gg 0$$

5. ***Determine level of significance***

α = 0,05

6. ***Determine critical value***

Based on table B.5 (van Dalen & de Leede, 2009, p. 583)

The rejection area is derived from:

$F_{n_1-1,n_2-1,1-\alpha/2}$, where $F_{1046;276;0,975}$ applies to the critical value at the left side of the

distribution and $F_{n_1-1,n_2-1,\alpha/2}$, waarbij $F_{1046;276;0,025}$ applies to the right side of the distribution.

The critical value at the right side of the distribution can be obtained from table B.5. However, the critical value at the left side cannot be obtained since the table is only drawn up for exceedance probabilities at the right sight. This can be solved by the following formula:

$$\frac{1}{F_{n_2-1,n_1-1,\alpha/2}} = F_{276;1046;0,25}$$

Critical value right side: 1.2129
Critical value left side: 1.2004

All values smaller than 1.2004 and larger than 1.2129 will lead to a rejecting of the assumption that the variances are equal to each other.

7. ***Compare observed value with critical value.***

The observed F-value equals to:

$$F_{obs} = \frac{S_1^2}{S_2^2} = \frac{0.0025141}{0.0009848} = 2.5529$$

The observed value falls outside the critical values. Therefore H_0, which assumes that the variances of OEFs and CEFs are equal to each other, can be rejected. As a consequence for the t-test unequal variances are assumed.

T-test (T_p)

8. ***Formulate null and alternative hypothesis***

$$H_0: \mu_1 = \mu_2 \ (\leftrightarrow \ H_0: \mu_1 - \mu_2 = 0\ )$$
$$H_1: \mu_1 \neq \mu_2 \ (\leftrightarrow \ H_1: \mu_1 - \mu_2 \neq 0\ )$$

9. ***Choose test statistic***
Since the variances for the two groups are not equal, the following formula is used in which the standard error for each group is taken separately.

$$T_p = \frac{\bar{Y}_{1-}\bar{Y}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

10. ***Define distribution of test statistic***

H0: $T_s \sim t\ (n_1 + n_2 - 2) = t\ (n - 2)$

Where n_1 equals 1046 en n_2 equals 276.

11. ***Critical rejection area***

$$\bar{Y}_1 \ll \bar{Y}_2 \cup \bar{Y}_1 \gg \bar{Y}_2$$

On the level of the test statistic this corresponds with:

$$T_{s,obs} \ll 0 \cup T_{s,obs} \gg 0$$

12. ***Determine level of significance***

α = 0,05

13. ***Determine critical value***

Based on table B.2 (van Dalen & de Leede, 2009, p. 579)

$$\pm t_{n1+n2-2,\alpha/2} = \pm t_{1322;0,025} = \pm 2.244$$

14. ***Compare observed value with critical value.***

The difference between the sample means and the estimated standard errors are respectively -0.025758 and 0.0027001. With these values the observed value $T_{s,\,obs}$ can be calculated:

$$T_{s,obs} = \frac{-0.025758}{0.0027001} = -9.5395$$

$$T_{s,obs} = -9.5395 < -2.244$$

The observed value falls outside the critical values. Therefore H_0 is rejected at a significance level of 5%, meaning that there is no empirical support that the vehicle structure (OEF or CEF) of an investment fund involved in a secondary trade shows no significant difference in the share price deviations to NAV. Based on the STATA output an average price discount to NAV of -2.0% is found for CEFs and a premium of 0.6% for OEFs. Since H_1 is accepted, it can be assumed with a reliability level of 95% that there is a significant difference between OEFs and CEFs and share price deviations to NAV.

Appendix VIII. ANOVA

Below one find a step-by-step approach of a one-way Anova (van Dalen & de Leede, 2009, pp. 349-356). As an example the relationship of the variables *TSECT* and NAV_{DEV} is tested.

1. *Formulate null and alternative hypothesis*

   H_0: $\mu_1 = \mu_2 = \cdots = \mu_8 = \mu$ ($\leftrightarrow H_0: \alpha_1 = \alpha_2 = \cdots = \mu_8 = 0$)
   H_1: Not all μ_i are equal to μ ($\leftrightarrow$ H1: not all α_i equal to 0).

2. ***Choose test statistic***

   $$F = \frac{MSB}{MSW}$$

   Under the null hypothesis MSB is the estimator for the population variation based on the between-group variance and MSW is the estimator for the population variation based on the within-group variance.

3. ***Define distribution of test statistic***

   H_0: *F ~ F (a – 1, n – a)*

   In the distribution *n* represents the sample size and *a* the possible number of outcomes of the variable that divides the population. The total sample size of *TSECT* is *n* = 1324. There are eight possible sector type options for the variable, so *a* = 8. This leads to *F ~ F(7, 1316)*.

4. ***Critical rejection area***

   H_0 is rejected when F_{obs} >> 1
   The F-test is one-side per construction since the outcome of step 2 is always positive

5. ***Determine level of significance***

   α = 0,05

   Determine critical value

6. Based on table B.5 (van Dalen & de Leede, 2009, p. 583)

   $$F_{7;1316,0,05} = 2{,}02$$

7. ***Compare observed value with critical value.***
   For the expected difference between the target sectors of an investment fund involved in a secondary trade and price deviation to NAV, F_{obs} appears to be 0.59. $\boldsymbol{F_{obs}}$ is lower than the critical value (F) of 2.02, meaning that H_0 holds at a 5% significance level. Therefore it can be concluded that there is no significant difference in price deviation to NAV between the target sectors an investment fund involved in a secondary trade.

Appendix IX. Pearson's Correlation coefficient

Below a step-by-step approach of a Pearson's correlation coefficient is worked out (van Dalen & de Leede, 2009). As an example the relationship of the variables $SENT_{\perp}$ and NAV_{DEV} is tested.

1. ***Formulate null and alternative hypothesis***

   H0: $\rho_{SENT_{\perp}} > 0$
   H1: $\rho_{SENT_{\perp}} < 0$

2. ***Choose test statistic***

$$T_{obs} = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} \sim t\,(n-2)$$

   In which:

$$r = \frac{COV(x,y)}{s(x)s(y)} = \frac{\sum((x_i - \bar{x})(y_i - \bar{y})\,/(n-1)}{s(x)s(y)}$$

   In this equation $\sum$ represents sum, x_i and y_i the means of the observations, $\bar{x}$ and $\bar{y}$ the means of the samples, *s(x)* and *s(y)* the standard deviation of the samples and *n* the sample size.

3. ***Define distribution of test statistic***

   H_0: *T ~ t (n – 2)*
   In the distribution *n* represents the sample size, so *T ~ t (1324)*

4. ***Critical rejection area***

   H_0 is rejected when $r_{SENT_{\perp}} << 0\ and\ r_{SENT_{\perp}} = 0$
   On the level of the test statistic this corresponds with: T << 0 and T = 0.

5. ***Determine level of significance***

   α = 0,05

6. ***Determine critical value***
   Based on table B.2 (van Dalen & de Leede, 2009, p. 579)

$$t_{1324,0,05} = 1.646$$

   Calculate observed value

7. $T_{obs} = \frac{-0,0575}{\sqrt{\frac{1-(-0.0575)^2}{1324-2}}} \sim$ *-2.1261*

8. ***Compare observed value with critical value.***
   The observed value $T_{s,obs} = -2.1261$ and is lower than the critical value *(t)* of 1.646. H_0 is rejected at a significance level of 5%. There is a significant negative relationship between investors sentiment *(*$SENT_{\perp}$*)* and the price deviation to NAV (*NAV_{DEV}*).*

Appendix X. Simple regression analysis

Stata command: regres NAV_DEV [variable], own redaction

Considerations: t(1323), F (1,1322), P > |t| and P > |F| ≤ 5%

Variable / Dummy	β (est.)	Std. err.	t- value	P > |t|	Conf. interval (95%)	α (est.)	F-value	P > |F|	R^2
AGE	0.0004666	0.0000618	7.55	0.000)	[0.0003453 : 0.0005879]	-0.100731	56.93	0.0000	0.0413
VEH	0.25758	0.0023102	11.15	0.0000	[0.21226 : 0.3029]	-0.452887	124.32	0.0000	0.0860
STYLE	-0.0050278	0.0012476	-4.03	0.0000	[-0.0074753 : -0.0025802]	0.0077724	16.24	0.0001	0.0121
$dSTYLE_{C}$	0.0102495	0.0024877	4.12	0.0000	[0.0053692 : 0.0151298]	-0.0074603	16.97	0.0000	0.0127
$dSTYLE_{VA}$	-0.0098109	0.0024968	-3.93	0.0000	[-0.147089 : 0.0049128]	0.0026909	15.44	0.0001	0.0115
$dSTYLE_{OPP}$	-0.0509153	0.0252682	-2.01	0.044	[-0.1004854 : -0.0013452]	0.0009153	4.06	0.0441	0.0031
SECT	-0.0216924	0.0018959	-11.44	0.0000	[-0.0254118 : -0.0179731]	0.0317714	130.91	0.0000	0.0901
TSECT	-0.0006197	0.0006365	-0.97	0.330	[-0.0018685 : 0.000629]	0.0038336	0.95	0.3304	0.0007
$dTSECT_{HEALTH}$	-0.0058649	0.0146322	-0.4	0.689	[-0.0345699 : 0.02284]	0.0008649	0.16	0.6686	0.0001
$dTSECT_{LS}$	-0.0095104	0.0096053	-0.99	0.322	[-0.0283536 : 0.0093329]	0.0009389	0.98	0.4853	0.0007
$dTSECT_{LOG}$	0.0027538	0.0039449	0.70	0.485	[-0.0049853 : 0.0104928]	0.0006553	0.49	0.4853	0.0004
$dTSECT_{OFF}$	-0.002896	0.0033847	-0.86	0.392	[-0.0095361 : 0.003744]	0.0011074	0.73	0.3924	0.0006
$dTSECT_{RES}$	0.001166	0.0160237	0.07	0.942	[-0.0302686 : 0.0326006]	0.000834	0.01	0.942	0.0000
$dTSECT_{RET}$	-0.0030262	0.0026018	-1.16	0.245	[-0.0081303 : 0.002078]	0.0013595	1.35	0.245	0.0010
$dTSECT_{STUDENT}$	-0.0001865	0.0036373	-0.05	0.959	[-0.0073219 : 0.0069489]	0.0008532	0.00	0.9591	0.0000
$dTSECT_{MULTI}$	0.0026105	0.0019841	1.32	0.188	[-0.0012817 : 0.0065028]	-0.0006503	1.73	0.1885	0.0013
COUNTRY	-0.0077635	0.0044789	-1.73	0.083	[-0.01655 : 0.0010231]	0.0159724	3.00	0.0833	-0.0023
TCOUNTRY	-0.0001688	0.0018847	-0.09	0.929	[-0.003866 : 0.0035285]	0.0018283	0.01	0.9287	0.0000
$dTCOUNTRY_{FR}$	-0.0358926	0.025877	-1.42	0.156	[-0.085501 : 0.0137158]	0.0008926	2.01	0.156	0.0015
$dTCOUNTRY_{GER}$	-0.01009146	0.0356681	-2.83	0.005	[-0.1708868 : -0.0309424]	0.0009146	8.00	0.0047	0.0060
$dTCOUNTRY_{IR}$	0.0025006	0.0206707	0.12	0.904	[-0.0380504 : 0.0430517]	0.0008327	0.01	0.9037	0.0000
$dTCOUNTRY_{NL}$	0.0124989	0.0082568	1.51	0.13	[-0.003699 : 0.0286968]	0.000659	2.29	0.1303	0.0017
$dTCOUNTRY_{UK}$	-0.0040713	0.0038443	-1.06	0.29	[-0.0116128 : 0.0034703]	0.0046237	1.12	0.2898	0.0008
$dTCOUNTRY_{MULTI}$	0.0043869	0.004451	0.99	0.325	[-0.0043449 : 0.0131188]	0.0006131	0.97	0.3245	0.0007
$SENT_{-1}$	-0.0147819	0.0071595	-2.06	0.039	[-0.0288274 : -0.0007363]	-0.0003836	4.26	0.0392	0.0033
LEV	-0.218378	0.0015295	-14.28	0.0000	[-0.0248383 : -0.0188372]	0.0299388	203.85	0.0000	0.1338
$dLEV_{LOW}$	0.0272469	0.0020779	13.11	0.0000	[0.0231705 : 0.313233]	-0.019	171.94	0.0000	0.1151
$dLEV_{MED}$	-0.196165	0.0023789	-8.25	0.0000	[--0.0242833 : -0.0149496]	0.0048387	68.00	0.0000	0.0489
$dLEV_{HIGH}$	-0.0372944	0.00381	-9.79	0.0000	[-0.0447687 : -0.0298201]	0.0033172	95.82	0.0000	0.0676
SIZE	0.0105218	0.0018377	5.73	0.0000	[0.0069167 : 0.0141269]	-0.0144364	32.78	0.0000	0.0243
$dSIZE_{SMALL}$	-0.0101803	0.0019618	-5.19	0.0000	[-0.0140289 : -0.0063317]	0.0065744	26.93	0.0000	0.0200
$dSIZE_{MID}$	0.0084492	0.0019803	4.27	0.0000	[0.0045643 : 0.0123341]	-0.0026779	18.2	0.0000	0.0136
$dSIZE_{LARGE}$	0.0276962	0.0078297	3.54	0.0000	[0.0123362 : 0.0430561]	0.0003991	12.51	0.0004	0.0094

Appendix XI. Multiple regression analysis

XI. I Multiple regression managerial performance

Stata command: regres NAV_DEV AGE VEH_n

Considerations: t(1321), F (1,1321), P > |t| and P > |F| ≤ 5%

Source	SS	df	MS		
				Number of obs	= 1,324
				F(2, 1321)	= 67.89
Model	.157591779	2	.07879589	Prob > F	= 0.0000
Residual	1.53317761	1,321	.001160619	R-squared	= 0.0932
				Adj R-squared	= 0.0918
Total	1.69076939	1,323	.001277981	Root MSE	= .03407

NAV_DEV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	.0002167	.0000667	3.25	0.001	.0000859	.0003475
VEH_n	.022185	.0025509	8.70	0.000	.0171808	.0271893
_cons	-.0439577	.0042469	-10.35	0.000	-.0522891	-.0356263

```
Number of gaps in sample:  26

Durbin-Watson d-statistic(  3,  1324) =  1.698394
```

XI. II Multiple regression market diversification

Stata command: regres NAV_DEV COUNTRY_n SECT_n dSTYLE_C dSTYLE_VA VEH_n

Considerations: t(1321), F (1,1321), P > |t| and P > |F| ≤ 10%

Source	SS	df	MS		
				Number of obs	= 1,324
				F(5, 1318)	= 34.57
Model	.196025652	5	.03920513	Prob > F	= 0.0000
Residual	1.49474374	1,318	.0011341	R-squared	= 0.1159
				Adj R-squared	= 0.1126
Total	1.69076939	1,323	.001277981	Root MSE	= .03368

NAV_DEV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
COUNTRY_n	-.007077	.0042924	-1.65	0.099	-.0154977	.0013437
SECT_n	-.013496	.0031183	-4.33	0.000	-.0196134	-.0073786
dSTYLE_C	.0510535	.0243971	2.09	0.037	.0031921	.0989149
dSTYLE_VA	.049679	.0248251	2.00	0.046	.000978	.09838
VEH_n	.0159202	.0032365	4.92	0.000	.0095708	.0222695
_cons	-.0453472	.0248919	-1.82	0.069	-.0941793	.0034849

```
Number of gaps in sample:  26

Durbin-Watson d-statistic(  6,  1324) =  1.742265
```

XI. III Multiple regression leverage

Stata command: regres NAV_DEV dLEV_MED dLEV_HIGH VEH_n

Considerations: t(1321), F (1,1321), P > |t| and P > |F| ≤ 5%

Source	SS	df	MS	Number of obs	=	1,324
				F(3, 1320)	=	89.88
Model	.286793823	3	.095597941	Prob > F	=	0.0000
Residual	1.40397557	1,320	.001063618	R-squared	=	0.1696
				Adj R-squared	=	0.1677
Total	1.69076939	1,323	.001277981	Root MSE	=	.03261

NAV_DEV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dLEV_MED	-.0223438	.0022477	-9.94	0.000	-.0267532	-.0179344
dLEV_HIGH	-.0291029	.004041	-7.20	0.000	-.0370305	-.0211754
VEH_n	.0183296	.0024524	7.47	0.000	.0135186	.0231406
_cons	-.0254951	.0046515	-5.48	0.000	-.0346202	-.01637

Number of gaps in sample: 26

Durbin-Watson d-statistic(4, 1324) = 1.721027

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