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THE DYNAMIC RELATIONSHIP BETWEEN DIRECT AND INDIRECT REAL ESTATE

Cointegration in the U.S. office real estate markets

Master´s Thesis
in Economics

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1 INTRODUCTION

As a broad definition, real estate can be used to mean a piece of land and all the buildings situated on it. On the other hand it can also be used as a narrow definition to describe the documents and agreements which define the owner as a property investor. (Olkkonen, Kaleva & Land 1997, 11.) Consequently, direct real estate investment is by definition the direct ownership of real estate. These investments are bought and sold in the private property market that is characterised as having high transaction costs, no central trading, and inefficiencies in information creation and asset pricing. Direct real estate investments differ from traditional assets such as shares and bonds since they are characterised by large unit size, heterogeneity, indivisibility, and low liquidity. In addition, direct real estate investments demand large amounts of capital, and they amount only to a small portion of the publicly traded assets, making it harder for small investors to invest in them. In the scope of this study the terms private real estate or private property investments refer only to direct property investments (unless otherwise mentioned).

Despite the negative characteristics of direct real estate investments, they also encompass features that are appreciated and preferred by investors. Direct real estate assets are estimated to account for a significant amount of the world's total wealth[1] (see e.g. Brown & Matysiak 2000, 9−10; Chan, Erickson & Wang 2003, 5), and as a result real estate represents one of the three major asset classes together with shares and bonds, and offers investors the potential to diversify their asset portfolios more broadly (Geltner, Miller, Clayton & Eichholtz. 2007, 534). In addition, direct real estate present investors with relatively stable cash flow (Geltner [1989] in Ziering & McIntosh 1997, 16) and good inflation hedging capabilities (Chan et al. 2003, 214; Ziering & McIntosh 1997, 18−19).

The balancing act between the pros and cons of real estate investments has sparked new ways of investing in real estate. An alternative way of acquiring real estate assets is by investing in indirect real estate. Indirect real estate investments are securities that offer a claim on the cash flows and value increase of the security's underlying property assets. These securities are traded on the public asset markets and are generally characterised as having a small unit size, homogeneous claims on the underlying asset, and good liquidity.

The existence of indirect real estate investments is not a novelty, for example, the U.S. capital market has had publicly traded real estate securities on it since the 1960's.

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[1] The exact amount of real estate assets in the whole world is unknown but it is estimated that at least 40 to 50 per cent of the total wealth in the United States of America comprises of real estate (Chan, Erickson & Wang 2003, 5).

However, in recent decades the role of public real estate assets has changed, and due to the strong increase in asset securitisation real estate investments have become more accessible for small and medium size investors. A good indication of this is not only the huge increase in market capitalization of indirect real estate assets but also the increased amount of actors on the market (Chan et al. 2003, 19).

Since, indirect real estate investments are traded on the public market they have been considered as some type of hybrids that combine elements from both the general stock markets as well as from the private property market (Kaleva & Olkkonen 1996, 39). There is substantial evidence that direct and indirect real estate investments share a common real estate factor that influences their values (see e.g. Gilberto 1990; Newell & Chau 1996; Clayton & MacKinnon, 2001). This connection between the two types of real estate investments would suggest that investors could more easily invest in real estate via real estate securities.

Nevertheless, in order for the investors to benefit from the positive characteristics of direct real estate, the securitised real estate assets need to be able to work as good substitutes for direct property investments. As it were, this question on the substitutability of the assets has been a major question in the most recent relevant research. Previous research has recognised that contemporaneous correlations between direct and indirect real estate are weak (Mueller & Mueller 2003), and in short term indirect real estate is more closely related to the general stock market (Ling & Naranjo 1999, 484; Newell & Chau 1996, 9). However, when linkages between real estate investments are studied in inter-temporal context the existence of a common real estate component is confirmed (see e.g. Gilberto 1990; Newell & Chau 1996; Clayton & MacKinnon 2001).

Several studies have also confirmed a cointegrating relationship between direct and indirect real estate assets suggesting both assets are valued similarly in the long term (see e.g. Oikarinen, Hoesli & Serrano 2011; Boudry, Coulson, Kallberg & Liu 2011; Hoesli & Oikarinen 2012). In addition, the values of indirect real estate assets have been observed to lead the values of direct real estate assets suggesting that information flows from the public market to the private market (see e.g. Gyuorko & Keim 1992; Barkham & Geltner 1995; Yavas & Yldirim 2011). Both of these notions are also supported by economic theory. The majority of previous research concentrates on the aggregate level and less research has been conducted with sector level data. Nevertheless, some studies on sector level data have been conducted, but their results have been somewhat inconsistent, especially in the U.S. office real estate sector (Boudry et al. 2011; Hoesli & Oikarinen 2012).

Consequently, the aim of this thesis is to understand and clarify the structure and linkages between direct and indirect real estate investments together with their respective market environments, and shed more light on the possible cointegrating relationship of direct and indirect office real estates in the U.S. market. The main research question

for the thesis is that are the two different investment types valued differently on the markets respectively and what is their relationship in the long term. This is examined by studying economic theory on asset valuation and relevant researches, and by testing the cointegrating relationship between the direct and indirect real estate assets. In addition to this question, the thesis aims to clarify the difference between direct and indirect real estate investments and how investors can benefit from combining these investments into their wealth portfolio.

The empirical research on cointegration was conducted by employing a vector error correction model. Data used in the study encompassed two time series sourced from Thomson Reuters Datastream with the sample period of 1994:1Q-2012:4Q. Direct real estate investments were represented by NCREIF TBI office return index which is a transaction based total return index provided by the National Council of Real Estate Investment Fiduciaries (NCREIF). The series is quarterly based data from U.S. private office property market, and it presents the total return measure for a very large pool of direct real estate investments acquired only for investment purposes. The time series for indirect real estate investments was NAREIT Office REIT price index which is constructed by the National Association of Real Estate Investment Trusts (NAREIT). It is a transaction based price index that combines REITs that invest mainly on office space. Because of the short sample period the data is limited by fewer observations than appraisal based data. This is noteworthy because optimally research on long-term relationship and cointegration on the real estate market should incorporate much longer time periods. In addition, the two indices are not exact matches to each other; The NAREIT index incorporates the impact of leverage while NCREIF index is based on unleveraged real estate. Furthermore, the two indices do not necessarily incorporate exactly similar real estate portfolios and the active management of real estate's is only incorporated in the NAREIT office index.

The empirical research yielded results that were in line with the theoretical framework and some of the relevant studies. Results suggested that direct and indirect office real estate investments in the U.S. market do indeed share a long-term equilibrium towards which direct real estates' adjust. Granger causality test also confirmed that indirect real estate investments lead direct real estate investments. The fact that indirect real estate investments are observed to lead direct investments supports the theoretic notion that the public market is more efficient than the private market and therefore it reflects the changes in fundamentals and information faster than the private market, hence causing the private market to adjust to the long-term equilibrium path. Results confirm Oikarinen et al.'s (2011) findings on the cointegration between public and private real estate assets. It also resembles Hoesli's and Oikarinen's (2012) results from more a rigorous study, conducted with sector level data, in which they found that the public and private office real estate sector in the U.S. are cointegrated if a risk premium is included in

the model. However, estimation output does contradict the results presented in Boudry et al. (2011) as they do not observe cointegration between the direct and indirect office real estate markets in the U.S.

The thesis is structured as follows: The first two chapters work as an introduction to the overall environment of real estate assets. Chapter 2 defines and introduces direct real estate investment and the real estate asset markets. In addition, the unique features related to the investment and real estate markets are discussed together with market efficiency and duality. Chapter 3 aims to explain the process with which securitised investment products are created and clarify the connection to the underlying asset. It also introduces the most general and relevant indirect means of investing in real estate for the purpose of this thesis.

After the general introduction of different securitised real estate products the focus turns to the valuation of the assets and the theoretical and observed linkages between the markets. Chapter 4 defines the connection of risk and returns, and presents the basics of discounted cash flows method used to valuate different assets. In addition to presenting the basic method of asset valuation, chapter 4 explains how differentials in the pricing of the same asset can occur between different markets.

The theory of asset valuation is followed by relevant studies related to the linkages and dynamics between direct and indirect real estate investments. The aim of chapter 5 is to acquaint the reader with relevant research on the topic. Different studies include both contemporaneous and inter-temporal connections of different real estate assets, price creation within the two markets, and the long-term dynamics of public and private real estate investments. Discussion on how all of this relates to investors' portfolio choice is presented at the end of chapter 5. However, this thesis does not aim to give any recommendations on portfolio allocations. It simply tries to bring forth some portfolio considerations in regards to real estate investments role in a portfolio.

Chapter 6 presents the economic methods and data used in the research together with the actual statistical modelling and the results. Results from the estimations are compared to relevant studies presented in chapter 5 and summarised at the end of the chapter. Lastly, chapter 7 presents the conclusions of the thesis.

2 DEFINING DIRECT REAL ESTATE INVESTMENTS AND MARKET STRUCTURE

To understand the complexity and uniqueness of real estate markets it is first necessary to take a closer look at the actual unique features of direct real estate investments, as they have an impact on the real estate market. This chapter aims to define the unique features related to real estate investments and the markets on which they are traded. The efficiency of real estate asset markets is discussed along with the unique situation of two parallel asset markets for the same underlying asset.

2.1 Direct real estate investments

Direct real estate investments can either be investments in housing or commercial property, and both entitle the investor to the revenue created by the asset. For the purpose of this study, the focus is more on commercial property that is expected to create revenue by creating cash flow and/or maintain or increase in value. “After all, in acquiring an asset, the investors are purchasing a current or future income stream” (DiPasquale & Wheaton 1992, 187).

Olkkonen et al. (1997) divide the qualities of real estate into physical and economic features. Physical features include immobility, indestructibility, and heterogeneity. In addition, a large unit size and indivisibility can be referred to as the physical features. Economic features include scarcity, long investment horizon, adaptability, and the impact of location. (Olkkonen et al. 1997, 26−27.)

Immobility, indestructibility, and heterogeneity are related to the connection between land and property. Immobility refers to the locality of real estates and to the fact that they cannot be moved. Indestructibility in turn means that even if the original purpose of the property changes its value, which is defined by the location and other features of the property, remains. Hence, even if a building is demolished the actual land still has value. Heterogeneity implies that because of the differences in location, size, usability, architecture, etc. every property is unique and cannot be fully substituted. As a result real estates are not standardised products and thus their market structure is fragmented. (Olkkonen et al. 1997, 26−27.)

Because of their large unit size and indivisibility direct real estate investments usually demand considerable amounts of capital together with professional management. (Olkkonen et al. 1997. 28; MacKinnon & Al Zaman 2009, 143.) The aforementioned together with property investments illiquidity and high transaction costs related to their sale and purchase causes direct real estate investments to have a relatively long investment horizon. In addition, the cyclical nature of real estate market causes real estate

investments to be relatively safe in the long term rather than short term (Rehring & Sebastian 2011, 292).

As mentioned earlier, real estate investments are uniquely connected to the land and consequently to their location. One of the key features relating to this is the scarcity of land or a suitable property, which is mainly caused by heterogeneity. This means that due to urban structures and land capacity there is only a limited amount of space that can truly be used for building purposes. This may lead to a situation where sizeable areas could be used for construction but they do not meet the specific requirements set for the investment. In addition, changes in the surroundings, or on the actual real estate itself, may have positive or negative effects both on the real estate or the attractiveness of the location. (Olkkonen et al. 1997, 27.)

2.2 Market structure

Commercial real estates are traded in a private market place that can be divided into two sections: property markets and asset markets as shown on figure 1. This division is based on DiPasquale and Wheaton's (1992) quadrant model of the real estate markets.

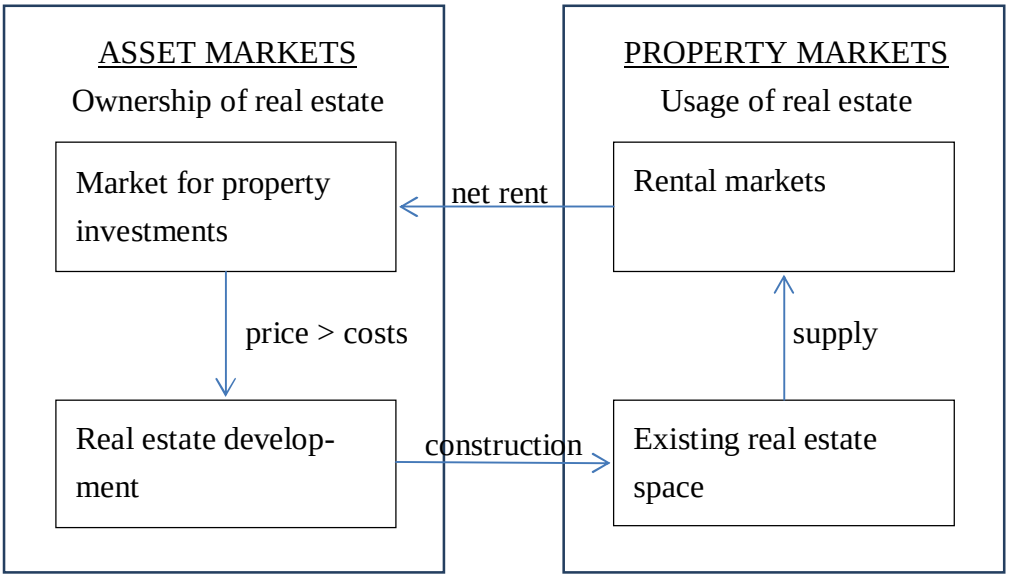

Figure 1. The division and connections of commercial real estate markets (adaptation from Olkkonen et al. 1997, 41)

Figure 1 has been slightly adapted from the original as it has been translated and some defining attributes for the markets have been added (ownership of real estate and usage of real estate). The main focus of this study is on the real estate asset market on which the ownership and value of direct real estate investments are determined. On the macro-

level the value of a property is determined by the overall demand for property ownership and supply of space on the asset market. (Olkkonen et al. 1997, 40.)

DiPasquale and Wheaton's (1992) quadrant model aims to explain the connections between the asset and property markets. As an example, the increased demand of property ownership affects the rate of construction, which in return has an effect on the property market either by increasing or decreasing existing space. Changes in existing space affect the supply of space on the property markets where also the demand for space usage is created by the occupants needs. Compensation for the usage of property, more commonly known as rent, is then defined on the rental markets. Optimal rent level is determined when the supply of space meets the occupants demand for space. From the property investor's (i.e. owners) perspective net rent is compensation for capital taking in to account the costs from usage and management. Hence, changes in the rent level impact the demand for the ownership of properties. As a conclusion changes on either asset or property side of the market have impacts on both sides of the real estate market, thus, both sides are closely interrelated. (Olkkonen et al. 1997, 40; DiPasquale & Wheaton 1992, 186−187.)

Since the focus of this study is on the real estate asset market, henceforth both *private real estate markets* and *private property markets* refer only to the asset side of the direct real estate markets, where the actual purchases of real estate assets are made. For the purpose of this study the actual usage side of the real estate markets has had to be omitted due to the limitations of the study.

The unique features of real estate investments, such as large unit size and heterogeneity, have a profound impact on the market on which they are traded. Quan and Quigley (1989) in Brown and Matysiak (2000, 372) note that real estate markets encompass features that separate them from conventional Walrasian action markets, where prices are determined by various transactions between numerous market participants. This is supported by Geltner, Rodriguez and O'Connor (1995, 14) as they note that the private asset markets are "characterised by high transaction costs, illiquidity, and a relative lack of informational efficiency in asset pricing".

Illiquidity of real estate asset markets is partly caused by the large unit size of the real estate assets together with their indivisibility (Olkkonen et al. 1997, 28). One key element of illiquidity is believed to be low transaction frequency which is due to the relatively low number of buyers and sellers in the market. Transaction frequency in real estate markets has exhibited a relation to asset price movements, and it may vary from period to period and from one submarket to another. Transaction frequency has also been observed to positively correlate with the asset market cycle suggesting that in a bull market transaction frequency increases, thus improving the liquidity on the markets. Hence it can be used as an indicator on the overall condition of the markets. With better knowledge on market liquidity the investors are able to form improved market

expectations with which to evaluate prices. (Fisher, Gatzlaff, Geltner & Haurin 2004, 239−243.)

In addition to illiquidity, real estate markets are affected by the lengthy time spent by buyers and sellers in search of and purchasing suitable property. This is mainly due to the heterogeneity of properties and lack of information relating to the quality of an investment. Moreover, it is reflected in the costs that arise from long and complicated contract processes and taxation related to the actual sale and purchase of real estate. (Quan & Quigley (1989) in Brown & Matysiak 2000, 372; Olkkonen et al. 1997, 30.)

Lack of information, illiquidity, and heterogeneity of the assets lead to the absence of a centralised market place and force the buyers and sellers to negotiate prices privately. As real estate prices can be estimated as a relation between their current income and the capitalisation rate (i.e. cap rate), they are supposed to reflect information related to the income potential of the asset (Geltner et al. 2007, 14). In reality, the two-way negotiations between buyers and sellers may result in a market price that is influenced by factors not related to the actual income creating potential of the asset. Thus, the price formation on the property market is not always optimal (Olkkonen et al. 1997, 28.), and might lead to prices that in the short term may deviate from a price expected in a competitive market (Brown & Matysiak 2000, 372).

As there are a limited number of transactions and prices are established by negotiations, real estate valuations are mainly determined as appraisals based on the real estates' attributes together with past sales prices of similar properties (Chan, Erickson & Wang 2003, 198.). Hence, they are more or less approximations of the actual market price. As these approximations are based on past values the market values tend to be smoothed (Chan et al. 2003, 198) and, therefore, "they do not fully reflect current market information" (Brown & Matysiak 2000, 372). Smoothed values are autocorrelated with their past values, meaning that the current value incorporates information from the past values that may or may not be true. Carlson et al. (2010, 17) state that a more accurate estimations of real estate values can be produced by combining appraisal values with REIT and other stock market views. This would give a wider perspective on the factors relating to real estate valuation.

The efficiency of real estate markets is discussed more thoroughly in the next section, but there is still one market feature essential to this study that requires mentioning, as it is one of the most interesting features relating to real estate markets. This is the *duality* of real estate asset markets which refers to the existence of a parallel *public* market alongside the private real estate market. That is to say, in addition to direct real estate investments, real estate assets are traded also in the public market place as securitised products which have direct real estate assets as their underlying asset. This unique situation of parallel markets creates a fruitful opportunity for researchers to ex-

amine how well changes in the fundamentals of the underlying assets are reflected in the securitised products.

2.2.1 Efficiency of the real estate asset market

Market efficiency can be defined as allocational efficiency and operational efficiency. Allocational efficiency refers to the markets ability to allocate existing assets to most profitable investments. Operational efficiency, in turn, refers to the market's ability to implement market transactions smoothly and efficiently. (Pillbeam, 2005, 248.) The prevailing opinion is that property markets are less efficient than the conventional stock markets due to the unique features related to property investments. Indivisibility, illiquidity of the asset, and high transaction costs prevent the property market from being operationally efficient. Nevertheless, Brown and Matysiak (2000, 433) state that even if real estate markets are operationally inefficient it does not prevent prices from reflecting the relevant risk and return information.

The efficient market hypothesis (EMH) presented by Eugene Fama in the 1970's states that capital markets are efficient when (1) the prices reflect all the relevant market information and (2) arbitrage cannot be made. The first assertion is linked to the allocational efficiency since prices that accurately reflect the relevant market information are most efficient in optimal capital allocation (Brown & Matysiak 2000, 433). Three different stages of informational efficiency can be defined:

- ***weak-form***: market price of an asset contains only the historical information
- ***semi strong-form***: market price includes both the historical information and all the public information currently on the market
- ***and strong-form efficiency***: market prices reflect also the hidden information for example inside information

These three forms suggest that the relevant information embedded in the prices cannot be used to gain consistent excess returns for any given level of efficiency. That is to say that, if an investor operates on a market which is, for example semi strong-form efficient, he cannot consistently gain supernormal profits if he only uses the past public information available on the market. (Pillbeam 2005, 249.) The strong-form of information efficiency is more a theoretical benchmark for the efficiency of the markets than an actual representation of real asset markets (Fama 1970, 414).

The notion of arbitrage refers to the idea that if assets are mispriced on some markets due to market inefficiencies, sophisticated traders would eliminate the mispricing by buying the asset from the market on which it is cheaper, and selling it on the market where it is valued higher. This would eventually balance out the differences between the market prices. The unique features of properties pose restrictions on short selling, which

in turn restricts sophisticated traders from entering the market. This might cause the observed prices to deviate from the fundamental value of the asset. (Clayton, Ling & Naranjo 2009, 6.)

If market prices reflect new information directly and fully, and cannot be predicted, the prices are said to follow a random-walk process. This means that at any given point in time the price of an asset has the same probability to either increase or decrease. If prices follow a random-walk process it is impossible to predict future prices on the basis of the information embedded in current prices. (Pillbeam 2005, 249−250.)

Real estate markets have been observed to adjust slowly or only partially to new information suggesting some predictability in market price movements. As noted before with the help of a random-walk process, predictability is also an indication of market inefficiency. This market inefficiency is generally seen as a negative thing, but for some investors it might create opportunities. Individual investors with good knowledge about the assets may benefit from market timing. In other words, the relatively slow adaptation of prices to new information can help investors to buy cheap and sell when prices go up. (Geltner et al. 2007, 274.)

Mispricing and predictability in prices would suggest that real estate markets are grossly inefficient and investors could earn continuous supernormal profits. On the other hand, Brown and Matysiak (2000, 437) argue that on an individual property level real estate investments are efficiently priced and returns seem to follow random-walk. (Brown & Matysiak 2000, 437) This would suggest that gaining from market timing is much harder than it first seems. In addition, real estate markets are also characterised as having high transaction costs which in turn reduce the possible profits obtained by using asset predictability. (Geltner et al. 2007, 275) It is noteworthy that Brown and Matysiak (2000, 437) also observe that appraisals based on valuations that use past prices cause serial correlation on an index level thus implying some market inefficiency.

An important point to be made here is that if real estate markets were *grossly* inefficient supernormal profits would be available for *all* investors. This would lead to a situation where capital would flow to real estate markets bidding up the prices until no arbitrage could be made. (Geltner et al. 2007, 276; Brown & Matysiak 2000, 434.) Nevertheless, real estate markets slow adjustment to new information might cause the market prices to differ from their fundamental values (Geltner, MacGregor & Shwann 2003, 1047). In many respects the real estate market does not meet the requirements of a perfectly functioning Walrasian market. However, the real estate market may work either effective or ineffective within its own framework, and when a market operates effectively within its own framework, it will allocate resources in an optimal way. (Olkkonen et al. 1997, 30.) Hence, it can be argued that real estate market is not as grossly inefficient as it would first appear, but it is still prone to be somewhat inefficient.

2.2.2 Dual markets

As mentioned earlier, direct real estate investments are traded on the private market but other, indirect, real estate investments can be found on the public market. Consequently, these assets do not represent direct claims to property but they have real estate as their underlying asset. As they have a close connection to direct real estate, it can be argued that securitised real estate might share similar characteristics to direct property investments and, are therefore likely to be influenced by the same fundamental principles as them.

Table 1 describes different real estate investments in the context of the overall capital markets. In the context of this thesis private markets include only direct claims to the specified assets.

Table 1. Categorisation of capital markets and different real estate investments available (adaptation form Geltner et al. 2007, 11)

	Public Market	Private Market
Equity Markets	Real estate investment companies (e.g. Sponda Oyj, Citycon Oyj) REIT's = Real Estate Investment Trusts Real estate funds Publicly listed companies	Direct real estate investments (e.g. housing, commercial properties) Unlisted companies
Debt Markets	MBS = Mortgage Backed Securities Bonds	Whole mortgages Bank loans

In order to present a more thorough view on the capital markets, some examples have been added to the original table. As can be seen from table 1 the underlying real estate asset, traded on the private market, can be equity or debt based i.e. either direct real estate or mortgages. These assets are then securitised and traded on as either equity or debt based products on the public markets. In theory, also the private markets could include debt based investments such as whole mortgages but in reality they are rarely traded. (Geltner et al. 2007, 11−13.)

Public markets tend to be more efficient than private markets because they have a larger number of market participants, higher liquidity, lower transaction costs, and market prices have been observed to respond to new information more effectively. (Geltner et al. 2007, 11) The focus of this thesis is on the public equity market and more generally on the stock market where the shares of real estate investment companies and Real

Estate Investment Trusts (REITs) are traded. Therefore, few words about the market environment and its impact on the securitised real estate asset are relevant.

There is evidence that the general stock market is at least semi-strong efficient despite some puzzling anomalies that seem to be occurring annually, such as the January effect. Briefly, the January effect refers to a notable increase in stock returns every January and to the observation that especially small cap stocks seem to be outperforming the markets in the beginning of the year. This effect seems to be recurring and creates a possibility for arbitrage thus weakening the market efficiency. (Pilbeam 2005, 256, 266.)

As securitised real estates are traded on a more efficient market than direct real estate, their prices may offer some additional information to property appraisals. An important thing to remember is that, indirect real estates can only give some indication on the value of the direct real estate, but since they might encompass stock market information that has nothing to do with the underlying real estate asset, they should not be used as direct proxies. (Carlson, Titman & Tiu 2010, 2, 16.)

The existing empirical evidence on the different linkages between the direct and indirect property markets will be further discussed in chapter 5. The next section provides a discussion on how direct real estate assets can benefit investors

2.3 Direct real estate investments from an investor perspective

The beginning of chapter 2 introduced the unique features of real estate investments which have both strengths and weaknesses, but also create opportunities and threats for investors. The second part introduced the overall market structure and expanded the unique characteristics of direct property investments. In addition, the alternative way of investing in real estate through securitised claims was introduced. An interesting question at this point is that as there is different ways to invest in real estate, how is it possible to choose between them. Is one better than the other? This section aims to discuss the opportunities and threats investors face when investing in direct real estate. Securitised real estate assets are more thoroughly examined in the next chapter.

According to Geltner et al. (2007, 125) there is always an investment objective behind every investment decision, and it is defined by investors' preference for investment horizons and risk. Geltner et al. (2007) define two mutually exclusive investment objectives, growth objective and income objective, on which investors base their decisions. Although these objectives are mutually exclusive some investors might define both of them but for different parts of their wealth. Investors with growth objective concentrate more on assets that are used for savings purposes and have long time horizons. Thus, the growth oriented investors are indifferent to the cash flow and only care about the

investments ability to maintain or increase in value. Whereas, investors with an income objective look for investments that generate regular cash flow. In addition to their objectives, investors are also concerned with the risk, liquidity, and size of the investment together with the managerial expertise it requires. Investors are also constrained by the amount of time and money they can afford to put into the investment. (Geltner et al. 2007, 125)

As mentioned before, direct real estate investments are characterised as being illiquid and having high transaction costs. Therefore, it can be argued that they would be more suitable for investors with a relatively long investment horizon. (Geltner et al. 1995, 19.) This is in line with MacKinnon and Al Zaman's (2009, 143) notion that due to their indivisibility, demand for large amounts of capital, and professional management, direct real estates are not so suitable for small investors and short investment horizons. Pagliari, Scherer and Monopoli (2005, 152) also note that direct real estate investments seem to be favoured by large investors, such as pension funds, whereas small investors are prone to invest in indirect property.

Besides the threats, direct real estate investments also present their owners with substantial benefits compared to traditional assets such as shares. Real estate investments can help the investors to protect themselves against unexpected inflation. The hedging potential of real estate is at its most effective during times of relative market balance. (Chan et al. 2003, 214; Ziering & McIntosh 1997, 18−19.) Real estate investments have also been shown to produce a more stable cash flow than other investments (Geltner [1989] in Ziering & McIntosh 1997, 16). Even the need for professional management can be considered as an opportunity as it gives the investor more control over the asset (Carlson, Titman & Tiu 2010, 2). Consequently, when investors have more managerial control over the investment they can more easily control the risks through contracts. (Kaleva, Lahti & Miettilä 1995, 4) In addition, by managing and modifying the property it is possible for the investor to improve it, thus maximising its value (Ibbotson & Siegel 1984, 238).

In addition to these benefits above, direct real estate investments have also been observed to provide diversification benefit both within the property portfolio and in a mixed-asset portfolio (see e.g. Mueller&Mueller 2003, 199; Ibbotson & Siegel 1984, 238; Black 2004; Hoesli & Oikarinen 2012, 2). In addition, real estate investments have been observed to lower the risk levels of internationally diversified portfolios (Hoesli, Lekander & Witkiewicz 2004, 191). Diversification refers to the age old rule "don't but all of your eggs in one basket", and one of the most well-known financial theories quantifying this rule is the Modern Portfolio Theory (MPT) presented by Harry Markowitz in the early 1950's. Essentially the theory states that rational investors aim to diversify their wealth portfolio in order to reduce their overall risk or increase their returns on a given level of risk. According to the theory investors' are able to reduce their risk by

combining assets, which have correlation of less than 1.0 with each other, to their portfolio. Consequently, when price of some assets rises others fall, and by combining them to the same asset portfolio their price movements cancel each other out. Hence, the total risk of an asset portfolio is less than the combined sum of the individual assets risks. (Black 2004, 1−2; Ziering & McIntosh 1997, 16)

Real estate investments offer diversification benefit to a mixed-asset portfolio since their contemporaneous correlations with other assets are relatively low (Mueller & Mueller, 2003). In addition to the low correlation with other assets, direct real estate has also been observed to have lower return volatility than other assets (Ziering & McIntosh 1997, 16) meaning that the overall riskiness of the asset is smaller. However, investors that have a long investment horizon should not base their decisions solely on short-term volatility of direct real estate assets because it can vary between markets, even if long-term volatility might be the same (Rehring & Sebastian 2011, 313).

Despite their benefits, direct real estate investments still possess some negative features, such as demand for capital, need of professional management, and indivisibility, which cause restrictions especially for small and short-term investors. Since securitised property investments can mitigate these negative features they create a useful opportunity for small investors to invest in real estate. (MacKinnon & Al Zaman 2009, 143.) The next chapter will introduce the process of securitisation together with the most relevant real estate securities. At the end of the chapter a short discussion on the positives and negatives of indirect real estate investments is presented.

3 SECURITISATION AND INDIRECT REAL ESTATE INVESTMENTS

As mentioned in the previous chapter, indirect real estate investments offer claims to the cash flows and value increase generated by direct real estate investments. They help investors to diversify their wealth and release them from the professional management real estate requires. This chapter introduces the basic process of asset securitisation together with most relevant examples of indirect real estate investments. At the end of this chapter the pros and cons of investing in securitised real estate are discussed.

3.1 The securitisation process

Securitisation is a process where an asset generating cash flow is transferred into a more liquid and easily tradable form by creating publically traded securities. These securities are then sold to investors at a price that reflects the value of the underlying asset as well risks relating to the investment. Any asset class that is fairly stable and produces a steady cash flow can have potential for securitisation. (Kaleva et al. 1995, 17.)

The securitisation process is initiated by the initial investor who owns the asset. The process depicted in figure 2 originates with the grouping of the assets into homogenous units. After the grouping the initial investor sells the assets to a *Special Purpose Vehicle* (SPV) that is set up to manage the assets. After the assets have been pooled the SPV initiates an emission of different types of securities e.g. shares and bonds. These securities are then purchased (primary market) and traded (secondary market) by investors. (Kaleva et al. 1995, 19.)

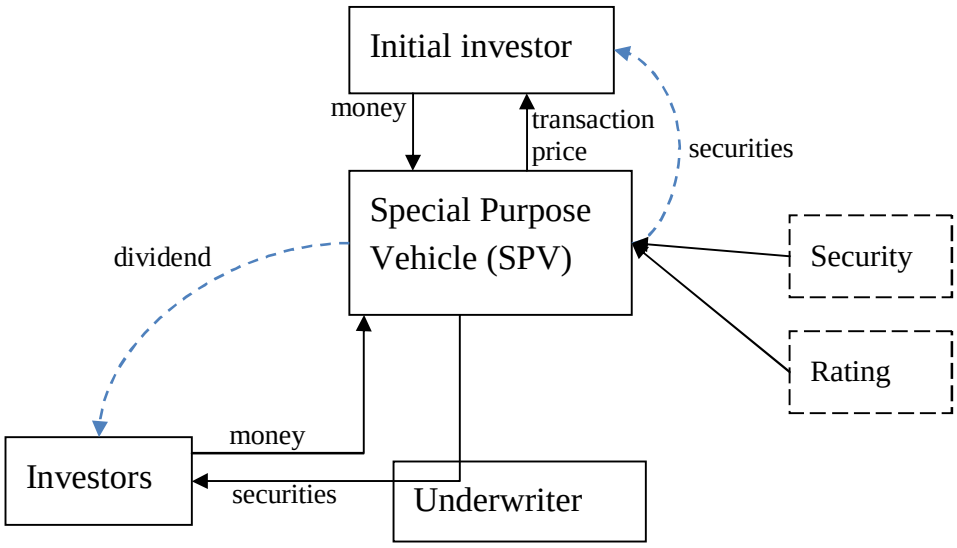

Figure 2. Securitisation process (adaptation from Kaleva et al 1995, 20)

Kaleva et al. (1995) have visualized the different cash flows form and to the original investor and SPV as well as transfer of the securities to the end investors. In addition to these it is important to also recognize that the initial investor might prefer shares in the SPV over cash and that the end investors are also entitled to dividend paid by the SPV. Thus, these flows of wealth have been added to the original figure.

This process helps large investors to shift the professional real estate management to an intermediary that can specialise on it thus lowering the costs and risks related to it. It also induces new investors to the realm of property investments by servicing different types of investors. Real estate securities also help to connect the best features of property investments and shares: they offer the investors relatively competitive and stable cash flow with a moderate risk. They are also liquid and easily tradable securities. (Kaleva et al. 1995, 20−24.) The main point of real estate securitisation is to meet different investor sentiments and objectives by developing diverse ways of investing in real estate.

As mentioned before in section 2.3, there are two main categories of public real estate investments: debt securities and equity based securities. The next sections will describe the main characteristics of the most relevant real estate securities. For the purpose of this study is the main focus will be on equity based securities.

3.2 Mortgage backed securities

Debt securities i.e. mortgage backs securities (MBSs) are created by debtors pooling mortgages and selling them to a special purpose vehicle. The SPV then divides the mortgages into securities and sells them to the investors in the secondary market. This enables the debtor to segregate the mortgages from their balance sheet and create more opportunities for further lending. It also helps the debtor to eliminate and control the risks related to the mortgages such as interest rate risk. For investors MBSs offer new ways of diversifying their portfolio and they also offer higher coupon rates than similar securities (e.g. bonds) with steady cash flow and fixed interest payments. (Kaleva et al. 1995, 23, 32.)

There are several different types of MBSs that diverge from one another for example on the duration and ownership of the debt as well as transmission of the loan and interest payments. (Kaleva et al. 1995, 33−35) But one category of MBSs worth mentioning in the context of this thesis are the commercial mortgage backed securities (CMBSs) which are backed by mortgage pools linked to commercial property. The substantial growth of these securities in 1990's "helped to improve the liquidity and transparency of commercial real estate" as they enabled more efficient lending opportunities for investors buying commercial real estate (Geltner et al. 2007, 489).

3.3 Equity based real estate securities

Equity based real estate securities can be roughly divided into real estate companies, funds, and real estate investment trusts i.e. REITs. There are also different types of conglomerations and syndications but because they usually are not publically traded they are not considered to be relevant from the view point of this thesis.

Real estate investment companies, funds, and trusts focus on long-term property investments that are able to create steady cash flow and increase in value, thus making them possible substitutes for direct real estate investments. They offer more liquidity than direct investments, as their shares are comparable to other shares on the stock exchange. They also allow the investors to diversify their portfolio over several asset classes as well as inside the field of property investments.

3.3.1 Real estate companies and funds

Real estate companies can either be property developers or real estate investment companies. The main difference between these two is the strategy and purpose for which they acquire real estate. Traditionally property developers build or purchase real estate in order to (re)sell them for profit whereas real estate investment companies' core business is in professional real estate asset management. (Kaleva et al. 1995, 37.) Real estate investment companies are interested in creating steady cash flow and increase the value of their property pool by holding and actively managing their properties. Therefore property investment companies are interested in long-term growth (Newell & Chau 1993, 12.) and are a more suitable alternative for an investor looking to acquire indirect real estate (Kaleva et al. 1995, 37).

A significant difference between the two companies is the valuation of their shares. Property developers are usually valued similarly to other publicly traded companies, on price-to-earnings basis, whereas real estate investment companies are valued in relation to their net asset value (NAV). Essentially NAV is the overall current value of the real estate assets owned by the company, fund, or a trust. (Kaleva et al. 1995, 37; Liow 2003, 235.) This valuation is also used for the valuation of REITs, since they are basically special cases of real estate investment companies.

On the European markets securitised real estate investments are generally either closed- or open-end funds. Details of their legislation vary greatly between countries but there are some connective factors as well. Real estate funds are usually supervised by a banking authority and their activities are usually limited by restrictions on their capital structure and/or underlying real estate assets. Also in some cases the percentage of their

liquid assets as well as their dividend pay-out ratios are mandated by law. (Kaleva et al. 47–51.)

Major difference between open- and closed-end funds is in the extent of their capital base. The capital base of an open-end fund is not fixed therefore it can change according to investors' preferences towards its shares. Open-end funds can issue new shares and they also have an obligation to buy them back when the investors want to redeem them. Value of a share in an open-end fund is calculated by dividing the net asset value of the fund by the amount of share units. In comparison, close-end funds have a fixed capital base and fixed amount of share units which values are determined on the markets by the laws of supply and demand. Thus, it can be argued that real estate investment companies resemble more close-end than open-end funds. (Liow 2003, 254.)

In addition to real estate companies and funds there is also several different types of joint ventures for indirect real estate investments such as comingled funds, trusts, and real estate syndications. Their taxation and structures vary between countries but common for the is that they require larger capital inputs and are less liquid in comparison to property companies and funds. (Kaleva et al. 1995 40–47.) They are not of interest from the view point this study since they are not traded in the public market place.

3.3.2 Real estate investment trusts – REITs

From the perspective of this study the most relevant form of indirect real estate investments are the Real Estate Investment Trust i.e. REITs. A REIT is (usually) a publicly traded real estate company or a trust that works as a pass through entity for revenues created by property assets. There are two main types of REITs: mortgage REITs and equity REITs. The former holds mainly mortgages and gains its revenue from interest payments whereas the latter invests in direct properties and receives its revenue from rents. REIT's capital can also be a combination of both of those above. If this is the case the REIT is called a hybrid REIT. (Kaleva et al. 1995, 51, 53.) The vast majority, ca. 80 per cent, of all publicly traded REITs at the end of 1990's were equity REITs and they accounted for 95 per cent of the total REIT capitalization (Chan et al. 2003, 32) and still to this date it remains as the most popular form of REITs (US REIT Industry Equity Market Cap).

When REITs first were established in the US in the 1960's they were defined as close-end funds set up for the sole purpose of holding real estate assets and providing small investors an easier way to invest in real estate. Since then the REIT market has undergone many legislative changes and nowadays modern REITs can be said to resemble more actively operating companies than passive funds. (Chan et al. 2003, 32.)

Nevertheless, REITs are different from other real estate investment companies because of their unique tax position. REITs are not subject to double taxation since they are exempt from paying corporate tax and only the dividend of their shares is taxed. In order to qualify for this tax exemption REITs must follow distinctive restrictions placed on the ownership structure, type of assets they may hold and trade, or the type of income they can generate. They are also faced with restrictions on financial policies. (Geltner et al. 2007, 587; Chan et al. 2003, 37.)

Restrictions placed on ownership refer to the REIT's need to have at least 100 different shareholders, and to the "five-or-fewer" –rule which means that a maximum of 50 per cent of the shares can be owned by five or fewer investors. Restrictions on assets require that a specified percentage of REIT's total assets are property investments. The percentage and the type of property assets can vary between countries.[2] Similarly the income restriction requires that a specified percentage of REIT's annual income must be derived from primarily passive sources which are linked, either directly or indirectly, to properties (e.g. rent and mortgage payments, dividend from other REITs). The last restriction stipulates that a REIT must distribute majority (usually at least 90%) of its annual taxable net income (including capital gains) to shareholders as dividends. (Geltner et al. 2007, 587; Chan et al. 2003, 37.)

Because of the restrictions on financial policies and because REITs are seen as pass through entities, it could be argued that REITs are less able to retain assets for future investments. However, this is not always the case, even though the criterion on dividends payments clearly states that they must be paid from the taxable net income, REITs are can utilise generally accepted accounting principles and depreciate their property holdings i.e. treat them as expenses. Thus, they are able to lower the perceived cash flows and withhold more funds for future investments. (Geltner et al. 2007, 589.)

As REITs are able to reduce their perceived cash flows with depreciation the actual net income (or earnings) according to the REITs profit and loss account is not a true representation of the cash flow produced by REITs real estate assets. Another, more precise, measure for the actual cash flow available for dividends payments is REITs adjusted funds from operations (AFFO). Adjusted funds from operations measures the actual rents received from the property, and takes also into account the costs related to the up-keeping of the property. (Geltner et al. 2007, 593) This aspect relating to the measuring of REIT cash flows should be taken into consideration when calculating the

[2] E.g. in the US REIT's total assets must be *real estate, mortgages, cash* or *federal government securities* and their share of total assets hold by the REIT has to be at least 75%. (Geltner et al. 2007, 587) Whereas in Finland at least 80% of total assets have to be invested in *residental* real estate. (Finlex 2013)

value of the REIT. The valuation of indirect real estate assets will be discussed in the next chapter.

From their creation in 1960's to the beginning of 1990's the REIT market capitalisation in the US was relatively low. A collapse in property prices in the beginning of the 1990's gave a good prerequisite for new growth in the REIT market. This together with the exemption of the "five-or-fewer" –rule in regards to pension funds[3], led to a rapid increase in capitalization on the REIT market as pension funds were able to invest larger sums in individual REITs. (Chan et al. 2003, 30.)

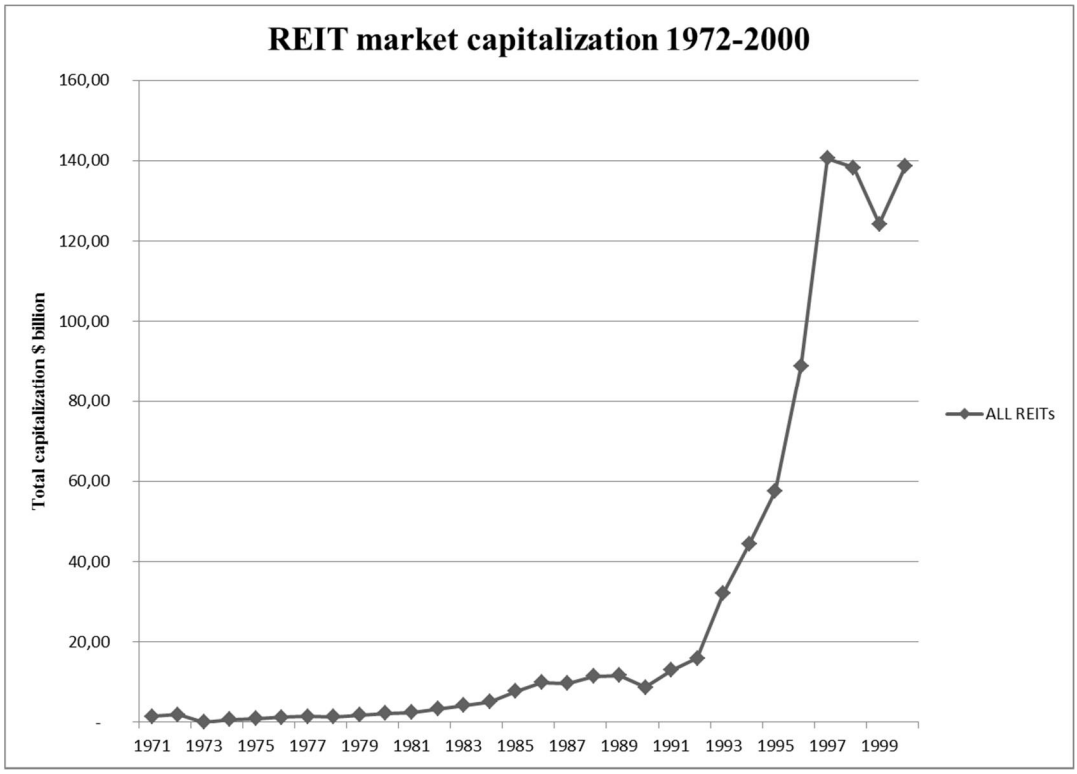

Figure 3. REIT market capitalization 1972-2000 (National Association of Real Estate Investment Trusts 2013a)

The rapid increase in REIT market capitalization is clearly visible from figure 3. Until the 1980's the REIT market capitalization had been almost non-existent. Even during the 1980's the growth of capitalization was moderate before it exploded in the early 1990's. Market capitalization was also boosted by the growing specialization within the REIT industry. Many of the new emerging REITs in the 1990's were focusing on spe-

[3] Since 1993 all the members of the pension fund's pension plan are considered as individual investors in the REIT and as a result large pension funds have been able to increase their ownership in individual REITs. (Chan et al. 2003, 30)

cific property types and emphasizing the need for specialist knowledge and professional management. This would have meant increased managerial efficiency and better profitability for the REITs. (Chan et al. 2003, 31.)

In addition to the exemption of the “five-or-fewer” –rule, REIT markets underwent other major legislative changes in the 1990’s. First of them was the creation of umbrella partnerships otherwise referred to as UPREITs. In this operating structure the UPREIT owns its properties via operating partnership that has more leeway in relation to buying and selling properties as well as actively managing them. The basic structure of an UPREIT concept is explained in figure 4. Before UPREITs, there were two basic ways of establishing the initial REIT portfolio; either by raising capital by issuing shares and using that capital for property purchases, or by converting corporate assets in order to form a REIT. The traditional way of converting corporate assets to REITs would have required a property transaction for which the company would have had to pay taxes. The creation of the UPREIT structure allowed companies to convert their property holdings into operating partnership units without actually selling the property, thus, avoiding the capital gains tax. (Chan et al. 2003, 30, 48−49.)

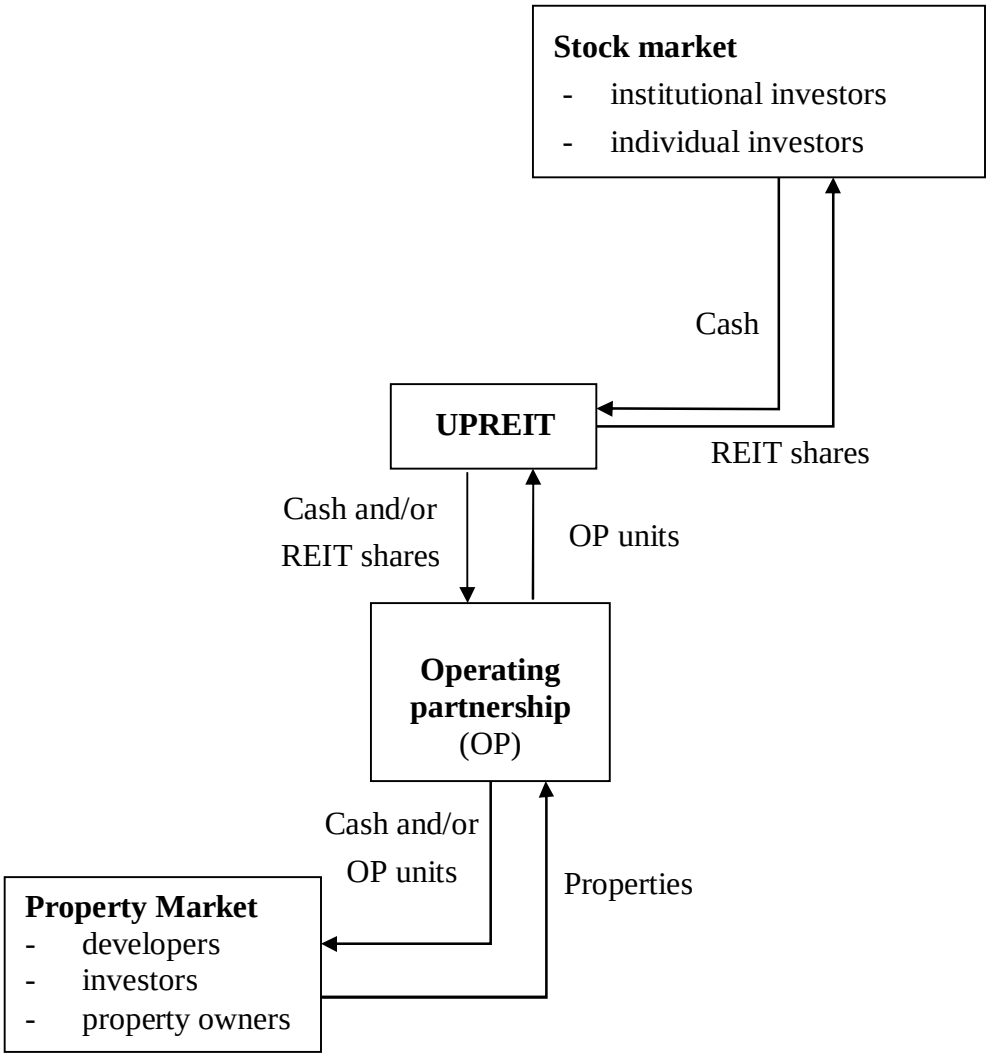

Figure 4. An illustration of the UPREIT concept (Chan et al. 2003, 49)

The operating partnership is owned and managed by the REIT and its equity consists of properties, cash, and REIT shares. The operating partnership units and the REIT shares have the same property portfolio as their underlying asset. However, the OP units are not the same as REIT shares and they do not enjoy the same tax benefits. Hence, the UPREIT structure offers two forms of ownership that have the same underlying asset but different benefits. Furthermore, operating partner units give their owner the option to convert them into REIT shares when they choose to do that, keeping in mind that this conversion is still subject to capital gains tax. The largest benefit from UPREITs is that it allows the operating partners to choose time of this conversion so that the tax benefits are at their greatest. Hence, the creation of UPREITs further facilitated the securitisation of real estate assets as it allowed the property sellers to postpone the payment of capital gains tax if they so choose to. (Chan et al. 2003, 30, 48−49.)

The second wave of major legislative changes came at the end of 1990's with the introduction of REIT simplification (REITSA) act and REIT modernization act (RMA). Both REITSA and RMA gave REITs more control over their lease agreements and the services they could provide to the tenants without disqualifying the rents from the favourable taxation. They also made changes to the income and asset restrictions, e.g. after 1999 the earnings distribution requirement was lowered from 95 per cent to 90 per cent. (Chan et al. 2003, 31−32.)

All of these changes led to a significant increase in investor attention for REITs, thus, improving the liquidity and informational efficiency of the REIT market. As the changes radically shaped the overall market environment, the 1990's became generally known as the beginning of "the new REIT era". (Chan et al. 2003, 32.) According to some studies, after the legislative changes in 1990's, REIT returns have begun to reflect their fundamental values more efficiently (Oikarinen et al. 2011, 86).

REITs are interesting and very important as they are prominently used in academic research of indirect real estate. Many of the researches presented in chapter 5 use REIT data collected from the U.S. REIT markets as a proxy for indirect real estate. Good reason for this is the relative maturity of REIT legislation and the REIT markets in the U.S. in addition to the good availability of the data. A more thorough introduction to the REIT market index is given in chapter 6 when the data obtained for this research is presented.

3.4 Indirect real estate investments from an investor perspective

Indirect real estate investments are considered to be liquid, information on them is easily available, and they do not incorporate as high transaction costs as direct real estate investments. Hence, securitised real estate assets are more easily traded, by both small and large investors, than direct real estate. (Kaleva et al. 1995, 37; Geltner et al. 2007, 132.) Small investors also benefit from the greater transparency and lower debt levels related to indirect real estate investments (Chan et al. 2003, 32).

In addition to better liquidity indirect real estate investments incorporate other attributes that might make them preferable to some investors. Kaleva et al. (1995, 37–38) note that real estate companies can benefit from gearing i.e. use different ways of financing their activities. By varying their equity-debt ratio they can influence the relative attractiveness of their share. Kaleva et al. (1995) also argue that investors are able to more easily diversify their real estate portfolio by investing in different property investment companies, and that real estate investment companies relieve the investors from the burden of professional property management.

As traditional real estate has been observed to work as hedge against unexpected inflation, naturally a question arises whether securitised real estate can convey this good attribute. Chan et al. (2003, 214−215) note that in the short run REITs cannot protect investors from inflation. As a matter of fact they quoted that some studies had shown REITs to be perverse inflation hedges meaning that their returns were actually lower when inflation was higher.

Indirect real estate investments are said to be influenced by movements in the general stock and bond market (Ling and Naranjo 1999; Geltner et al. 2007, 620) but also by the private property market (Gilberto 1990; Chan et al. 2003, 196). Despite the observed linkage with the general asset market indirect real estate has been observed to offer diversification benefit in a mixed-asset portfolio on the higher return levels (Mueller & Mueller 2003, 199).

As indirect real estate assets are also observed to be connected with direct real estate assets they could arguably work as substitutes in a portfolio. However, the effectiveness of securitised property investments to work as a substitute for the direct real estate investments would depend on their ability to reflect real estate returns (MacKinnon & Al Zaman 2009, 143). Indeed, according to Oikarinen et al. (2011) direct and indirect real estate returns share a long-term cointegrating relationship and can be considered as substitutes in a mixed-asset portfolio. Nevertheless, since direct and indirect real estate returns tend to differ from each other in the short run, indirect real estate assets could also effectively provide diversification benefit for shorter investment periods. More discussion on how direct and indirect real estate investments should be considered in a mixed-asset portfolio is offered at the end of chapter 5.

4 PROPERTY ASSET VALUATION

As both direct and indirect real estate are assets that are expected to create cash flow and/or increase in value, and since they both are traded in the broad capital markets, similar methods can be used in their valuation. This chapter explains how real estate returns can be defined and quantified, together with the basic valuation method for real estate assets. In the last section the possible differences in the valuation of real estate assets are discussed.

4.1 Defining real estate return and risk

Real estate returns can be measured either as periodic returns or multiperiod returns. For the purpose of this study periodic returns are more of interest since they can be averaged across time and are more comparable with returns from other conventional assets, such as shares and bonds. Periodic returns are particularly useful because they enable investors to measure changes in asset returns over time. Hence, they can be used to assess assets return volatility and co-movements between different asset classes. (Geltner et al. 2007, 175.) Real estate returns could also be measured by using the internal rate of return (IRR). IRR is a micro-level approach on returns and it measures the returns of the capital invested in the property for the duration of the investment. IRR does not tell us at what point in time during the investment horizon the return is actually formed thus, it is not suitable for computing statistics on the co-movements of different real estate assets. (Geltner et al. 2007, 192.) Therefore, within the scope of this study periodic returns are seen to be more relevant and more focus is placed on them.

The total return of an asset comprises of net income return (yield) and capital return (growth), and it can be written out as a sum of these components, $r_t = y_t + g_t$. These two components are linked to the basic investor sentiments of income and growth mentioned in subchapter 2.3. Net income return or the current yield (y_t) is calculated by dividing the net cash flow received during the period t with the asset value in the beginning of the period. It is relevant for investors with income objective as it shows the share of the total return which is created by the cash flows. The capital return of the asset denotes the growth (g_t) in asset value during period *t*. And it is calculated by dividing the change in asset value with the assets value in the beginning of the period. Consequently, capital return is more relevant for investors with a growth objective as it shows the share of assets total return crated by changes in asset value. (Kaleva et al. 1995, 93−94; Geltner et al. 2007, 176−177.)

In other words, periodic returns for real estate assets can be written as follows:

$$r_t = y_t + g_t = \frac{CF_t}{P_{t-1}} + \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{CF_t + P_t - P_{t-1}}{P_{t-1}} \quad (4.1)$$

Where r_t is the total return of the asset, CF_t is the cash flow generated by the investment at the end of the period, P_t is the price of the property at the end of the period and P_{t-1} is the value of the property in the beginning of the period.

Periodic returns expect the investor to know the value of the asset both in the beginning and at the end of periods. Therefore, frequent appraisals or other ways of measuring real estate's value are required. (Geltner et al. 2007, 178−179.) However, as already mentioned is subsection 2.2., a good thing to remember is that the usage of appraised values cause smoothing in the real estate values and understates the risk related to the returns (Ibbotson & Siegel 1984, 222).

Consequently, from investors' perspective the attractiveness of expected return is dependent on the risk the investment holds together with the returns' possible co-movements with other asset returns. Hence, it is important that the relationship between risk and return can be quantified so that investors are able to compare different asset classes and also test their possible correlations. Risk can be defined as the probability that the ex-post (observed) return differs from the ex-ante (expected) return, and it can be quantified by calculating the standard deviation for the probability distribution of the expected returns. This risk measurement is also referred to as volatility of the investment. Periodic returns enable the investors to measure the historical volatility of the asset and use that to compare the historical riskiness of the real estate asset to other assets. As investors are assumed to be risk averse they expect a higher level of return for higher level of risk. (Geltner et al. 2007, 183, 186.)

Simply put the relationship between risk and return can be stated as follows:

$$E[r_t] = r_f + E[RP_t] \quad (4.2)$$

Where $E[r_t]$ is the expected rate of return for the asset during period *t*, r_f denotes the risk free return, and $E[RP_t]$ is the expected risk premium for the asset during period *t*. As equation 4.2 shows, expected rate of return can be explained as a combination of risk free return and the expected risk premium related to the asset. Risk free return represents the return investor could earn if they invested in a riskless asset thus, it compensates the investor for the time value of the money i.e. letting somebody else to use the money. T-bills or other government bonds are usually used as proxies for the risk free rate of return (see e.g. Pillbeam 2005, 160). Risk premium on the other hand is the compensation the investor expects to receive in addition to the risk free rate when choosing to invest in the specific asset. (Geltner et al. 2007, 186−187.)

Risk of an asset consists of unsystematic and systematic (market) risk. According to Markowitz's Modern Portfolio Theory (MPT), the unsystematic risk can be eliminated

by combining enough assets into a well-diversified portfolio. A good example of this type of portfolio that does not include unsystematic risk is the market portfolio which combines all assets available on a particular market. Return for this market portfolio can be written as r_m. Since market portfolio does not include any unsystematic risk, only the systematic risk of the markets can be quantified to represent the overall riskiness related to market return. This systematic risk that cannot be eliminated by diversification is called market risk premium and it can be defined as return on the market minus the return on a risk free investment ($[r_m - r_f]$). (Ling & Naranjo 1998, 14−15.)

Systematic risk of an individual asset essentially describes the assets sensitivity to the changes in market fundamentals i.e. changes in the market risk premium. Hence, the systematic risk of an individual asset is the risk that an asset contributes to a well-diversified portfolio. It can be measured with the covariance between asset returns and market returns. If this covariance is further divided with the market volatility, a measure for the assets sensitivity towards market returns (r_m), otherwise known as beta coefficient (β_a), is retained. (Ling & Naranjo 1998,14−15.) Using this definition the expected return of an asset can now be written as follows:

$$E[r_a] = r_f + \beta_a(E[r_m - r_f]) \tag{4.3}$$

Equation 5 shows that the expected return of an asset reflects the assets sensitivity towards the changes in the market fundamentals in the form of the beta coefficient. This is especially important notion since it highlights the connection between the expected return of an asset and the expected return of the market on which it is traded. Hence, the expected rate of return on the market has a profound impact on the expected rate of return of the asset.

4.2 Valuation of property assets

Both direct and indirect real estate investments can be valued by using the discounted cash flow valuation otherwise known as the DCF -model. However, differences in the expected level of cash flows or the expected rate of returns between the direct and indirect market may cause the valuation different types of real estate assets to differentiate from one another (Geltner et al. 2007, 280). More discussion relating to the differentials is presented in the next subchapter. The DCF -model can be found in almost any basic finance books (see e.g. Pilbeam 2005, 224), but notation for this one was taken from Geltner et al. (2007, 203, 594). In equation form discounted cash flows are presented as follows:

$$V = \frac{E_0[CF_1]}{1+E_0[r]} + \frac{E_0[CF_2]}{(1+E_0[r])^2} + \cdots + \frac{E_0[CF_{T-1}]}{(1+E_0[r])^{T-1}} + \frac{E_0[CF_T]}{(1+E_0[r])^T} \quad (4.4)$$

Where Vequals the present value of the investment, $E_0[CF_t]$ is the expected cash flow in period *t*, $E_0[r]$ denotes the discount rate i.e. the expected average rate of return, and T is the terminal period of the expected investment holding period. Note that CF_t also includes the resale price of the asset in addition to the periodical cash flow.

The expected cash flows ($E_0[CF_t]$) of investments are determined by the future income produced by the investment. In the case of direct real estate this means the future net rents, and for indirect real estate the future income is the dividends paid out by the company. DCF can be used to calculate either the whole value of a real estate firm's equity or just the price of one share. The difference between the two is as to what measure to use for the cash flows: either the divided per share, which represents the cash flow per one share, or the *adjusted funds from operations* which represents the cash flow for the whole company. Adjusted funds from operations take into consideration the actual rents received from the property minus the costs related to the up-keeping of the property, thus it reflects the actual money the real estate company is able to pay out as dividends. (Geltner et al. 2007, 161, 593–595.)

Discount rate for a given investment is determined by investor's perception on the expected rate of return for the asset. As already mentioned in section 4.1 the expected rate of return is influenced by investor's perception on the riskiness of an asset together with their comparison to other possible investment opportunities. Thus the expected rate of return is considered to be the opportunity cost of capital for other investment products on the market. (Geltner et al. 2007, 249−251.) The opportunity cost of capital for individual direct real estate investment is defined on the private real estate asset market where as the OCC for securitised real estate investments is defined in the broader public asset markets.

If the cash flows (either rents or dividends) are expected to continue indefinitely and expected to grow at a constant rate (g) the DCF formula can be simplified to a more simplified formula called *Gordon's growth model*. (see e.g. Geltner et al. 2007, 161, 595; Pilbeam 2005, 224; Brown & Matysiak 2000, 36)

$$V = \frac{CF_1}{r-g} \quad (4.5)$$

In equation 4.5, CF_1 is either the net rent or the dividend depending on which assets valuation is in question and r is the expected rate of return for the same asset. Fundamentally, assets value is defined by investor's required rate of return (r) and the markets growth expectations. (Geltner et al .2007, 602.)

There are other ways of calculating both direct property values and the value of real estate securities, but despite its flaws DCF is particularly useful as it can be used for

both direct and indirect real estate and it takes into account the cash flows from multiple periods. As both types of real estate investments can be valued by using the same model it would be intuitive to assume that the both public and private markets would value the same asset similarly.

One way of examining if the values of direct and indirect property investments are similar in a specific point in time is by comparing the value of a real estate security to the value of its underlying assets. This can be done for example by calculating the net asset value (NAV) of a real estate security and comparing that to the share price. The NAV can be attempted to be quantified by evaluating real estate investment company's property holdings according to how they would be valued in the private market. After the evaluation, this value is compared with the company's share price on the market, and consequently a *premium* or *discount* to NAV can be compounded. If there is difference in the share price and the value of the underlying assets, it could suggest some type of differential in asset valuation between the private and public market. Nevertheless, it is important to bear in mind that differential in company level does not automatically lead to differential on the market level valuations. In order for there to be differential on market level valuations, factors causing the differential would have to be widespread and not only related to few real estate investment companies. (Geltner et al. 2007, 277, 605−607.) The next section will take closer look at the possible reasons behind the potential differential in real estate asset valuation.

4.3 The dilemma of differential in asset valuation

An important thing to remember when comparing real estate company's share prices to their net asset values is the fact that they are essentially two quite different measures. Share price includes the markets perception on the company's growth opportunities whereas NAV prices are based on a static property portfolio owned by the company. (Geltner et al. 2007, 278.) A more accurate indicator for differential in valuation between direct and indirect real estate markets would be real estate investment companies' possibility to indulge in market arbitrage. Arbitrage could be obtained if these companies were be able to increase the value of their share merely by buying direct properties form the private markets. In order for this to be possible the investment value[4] of the specific property would have to be more beneficial for a particular company compared to other real estate companies on the market. (Geltner et al. 2007, 280.) In other words,

[4] Investment value merely describes the value of an investment to an investor if they were to hold it for a very long time. It too can be calculated with DCF method. (Geltner et al. 2007, 265 & 280.)

this would also suggest that the property would be worth more if it were owned by a real estate company, not by a private owner. How or why could this be possible? Why would the price of an asset change just because it moved from one market to another?

As property investments are valued by using DCF method, the possible differential in valuation could be assumed to stem from markets perceptions relating to the components of the model. That is to say that there might be a fundamental difference between the direct and indirect market in regards to their perception on the expected level of cash flows or average expected returns i.e. opportunity cost of capital. (Geltner et al. 2007, 280.)

4.3.1 Difference in expected cash flows

There are several ways how an individual real estate investment company or a trust could be able to obtain greater future cash flows than a regular private investor. The company might benefit from professional management, economies of scale, or maybe even branding. However, in order for this to affect the valuation differential on the market level the differential in cash flows would have to be wide spread and factors causing it would have to be systematic across companies and property types. (Geltner et al. 2007, 281.)

Let us assume that the private property markets perception on the future cash flows of the property is lower than that of the public market. This would suggest that there is genuine differential in the expected cash flows across the two markets. Furthermore, it would suggest that the value of the property on the private market would be different from the value on the public market. This differential in valuation can be assumed to be only momentary. This is due to the fact that if it were possible for real estate companies to obtain higher future cash flows they would end up buying all the properties that presented that opportunity. Consequently, all the properties that were able to produce higher expected cash flows in private ownership would now be in public ownership and all investors would have similar perception on their future expected cash flows. Thus, the once existing differential would have seized to exist. Consequently, different expectations regarding future cash flows can cause genuine differential in valuation between direct and indirect markets, but only temporarily. (Geltner et al. 2007, 281.)

In theory return differentials could also be caused by the cost structure related to different real estate investments. Pagliari et al. (2005) note that private real estate investments may be burdened with managerial costs and transaction fees. This cost differential could affect the size of cash flows and influencing real estate returns. However, they also note that the size of cost differential would need to be quite large in order to create

substantial differential in the returns, and consequently, in the valuation. (Pagliari et al. 2005, 173.)

4.3.2 Difference in opportunity cost of capital

As mentioned earlier opportunity cost of capital is the expected average return investor is expected to receive if they invest in other assets with similar risk to that of the subject investment. It is constructed in a similar manner to expected return; OCC consists of the risk-free rate and the risk premium. (Geltner et al. 2007, 249−251.) According to some, opportunity cost of capital is the only potential source of valuation differential (Geltner et al. 2007, 283). This is in line with Carlson et al.'s (2010) statement that direct and indirect real estate assets share a common cash flow component, which in turn suggest that the observed differences in prices are due to differences in their required rate of returns i.e. opportunity cost of capitals (Carlson et al. 2010, 12).

As public asset markets are known to exhibit noise and excess volatility in the short run, real estate securities traded on these markets are expected to reflect these attributes (Geltner et al. 1995, 18) in addition to markets perception on their future opportunities and underlying real estate assets (Geltner et al. 2007, 132). Consequently, indirect real estate investments are subject to a greater systematic risk than direct real estate investments. In other words the combination of real estate characteristics and public markets fundamentals means additional risks for investors. (Geltner et al. 1995, 18.) Hence, opportunity cost of capital of public markets can differ from that of private markets.

Carlson et al. (2010) state that these differences in market defined rate of returns causes indirect real estate values to differ from the fundamental values of their underlying real estate assets. That is to say, when the opportunity cost of capital is different between the general stock market and real estate market, shares of real estate securities are trading either at a premium or discount to their net asset value. (Carlson et al. 2010, 16.) Carlson et al (2010, 10−14) also demonstrate that changes in REIT prices can be used to estimate direct real estate prices.

Despite the different factors causing differential in the valuation of real estate assets, the fundamental economic theory suggests that if two markets price the same asset, there is a tendency for the markets to move towards a mutual equilibrium. This cointegrating relationship between markets prevents price levels in private and public market from permanently deviating from each another. (Geltner et al. 2003, 1058.) Hence, the possible differentials in asset values can be assumed to be only short-term deviations from the long-term equilibrium.

4.3.3 Impact of information efficiency

In addition to the two previous explanations for valuation differential, the difference between the share price of an indirect real estate investment and its NAV might be caused either by trading noise on the market or new information. Trading noise refers to investors' irrational pessimism or optimism towards the asset, in other words the difference in values is caused by change in investor sentiment. However, disparities in efficiency between the dual markets might also lead to differences in valuation. If indeed the public market is more informationally efficient than the private market, new information relating to property investments should be reflected first on the securitised real estates. (Clayton & MacKinnon 2001 according to Yavas & Yilidrim 2011, 7.)

This difference in informational efficiency between the markets might cause temporal differential in asset valuation, but it does not cause fundamental differences. That is to say, in principle both of the markets agree on how the new information affects the value of the asset but the public market is merely more efficient in communicating this change. (Geltner et al. 2007, 284.) From this we can conclude that changes in valuation due to informational efficiencies may occur, but are short lived.

The next chapter presents the historical linkages between direct and indirect real estates by examining relevant studies. Real estate assets' connection to the surrounding capital markets is also discussed together with the informational efficiency of the dual markets in the form of price creation. Chapter 5 also discusses the long-term dynamics between direct and indirect real estate and makes some conclusions on how the linkages between different real estate assets reflect on their role in a mixed-asset portfolio.

5 LINKAGES BETWEEN REAL ESTATE INVESTMENTS

Based on the previous chapter we can conclude that short lived differentials in asset valuation can be caused by wide spread valuation differential in cash flows or in the opportunity cost of capitals between the dual markets. In addition to these sources of fundamental differential, the informational efficiency of the markets also has an impact on how new information, related to similar assets traded on different markets, is reflected on their values. However, even if there are differences between real estate asset valuation between the public and private markets, as long as capital can freely move between the markets, they tend to agree on the value in the long term (Geltner et al. 2003, 1058; Geltner et al. 2007, 285, 605). Hence, it is reasonable to assume that even tough differentials can exist in short term, in the long term the dual markets tend to agree on the value of the real estate asset.

In recent decades the correlation and co-movements of different types of real estate investments have been researched to a great extent. Studies have yielded mixed results depending on the methods used and data available. This chapter aims to present a variety of studies that examine these relationships between real estate investments and other asset types. Focus of the chapter is to bring forth the relevant observations related to the linkages between direct and indirect markets together with their connection to the general capital markets. Some discussion on the quality of data is also presented. First two sections present simple contemporaneous correlation studies and factor models. Third section studies the inter-temporal linkages and dynamics between real estate assets more thoroughly, and at the end of the chapter some discussion on investors' portfolio considerations is provided.

5.1 Contemporaneous connections between real estate investments and other assets

As mentioned earlier in subsection 2.2.2, indirect real estate assets are traded on the general stock market together with shares and other financial assets, hence, they might incorporate stock market information that has nothing to do with the underlying real estate asset. Consequently, some early studies show that indirect real estate returns are very much affected by the general stock market returns implying that these two are closely related (Ling & Naranjo 1999, 484; Newell & Chau 1996, 9) and have little correlation with the direct real estate market (Mueller & Mueller 2003). However, other studies have found that indirect real estate investments are affected by changes in both stock markets and direct real estate markets (Gilberto 1990; Newell & Chau 1996; Clayton & MacKinnon, 2001).

By examining the distributional and time series properties Myer and Webb (1993, 106) note that equity REITs appear to be closer to common shares and closed-end funds. In their study on the Hong Kong real estate markets Newell and Chau (1996, 16) observed that simple correlations between indirect real estate assets and stock markets suggested a close relationship between the two assets.

A similar positive relationship between indirect real estate assets and stock markets was observed by Ling and Naranjo (1999) in their research on REITs integration with the overall stock market. By analysing the factors influencing REIT and stock market returns they found that commercial REIT markets are integrated with the general stock market. This integration would suggest that both markets value macro-economic risks similarly. No similar integration was found between the direct commercial property market and stock markets. (Ling & Naranjo 1999, 484 & 502−505)

According to Mueller and Mueller (2003) direct and indirect real estate investments have very low quarterly correlations with each other. However, despite the low correlations they argue that combining both direct and indirect real estate assets into a mixed-asset portfolio helps to generate more efficient portfolio frontiers. Their results suggest that direct and indirect real estate investments help to diversify the portfolio for different levels of expected risks: direct real estate helps to lower the risk at the lower return levels while indirect real estate provides best diversification benefit for higher return levels. (Mueller & Mueller 2003, 199, 202.) MacKinnon and Al Zaman (2009, 119) contradict this view by stating that the correlation between direct and indirect real estates' increase with longer horizons making the indirect real estate redundant if direct real estate investments are available for the investors.

The lack of positive correlation along with the missing linkage between the dual markets may be due to the heterogeneity of the examined underlying real estate assets. The effects of data smoothing and deployment of appraisal based data instead of transaction based data might also obscure the results. (Mueller & Mueller, 2003; Ling & Naranjo 1999.) However, despite the fact that appraisal based data is to some extent affected by appraisal smoothing, on the whole direct real estate markets functions with an efficiency that allows appraisal based indexes to incorporate enough relevant information for them to be useful in terms of research (Geltner et al. 2003, 1049). On the other hand, according to Geltner et al. (1995, 19−20) low correlations may also be due to the return statistics. They argue that the positive relation of different real estate assets would be more easily detected if longer-interval returns were used, say five-year returns instead of quarterly or annual returns. (Geltner et al. 1995, 19−20.)

Nevertheless, when the sample period is extended and data used in studies is based on transactions rather than appraisals more encouraging results on simple correlations have been obtained. This was presented in a more recent study by Boudry, Coulson, Kallberg and Liu (2011). They observed, by examining transaction based direct proper-

ty returns[5] and REIT returns, that correlations between public and private real estate returns increased over time. This observation held true on both aggregate level and property type level data. (Boudry et al. 2011, 236−237.)

On the whole the absence of contemporaneous correlation is not contrary to the theory presented in the previous chapter even if it would seem counter intuitive for the two real estate assets not to correlate since the underlying assets are similar. The previous chapter clearly stated that differentials in asset valuation can be expected in the short run but in the long term markets are expected to value similar assets in a similar way. Furthermore, researches on simple correlations only give an idea of how the different assets co-vary in one specific point in time instead of fully explaining if and how the assets are connected to each other and if the connections change over time. Therefore, it is important to take a closer look at the dynamics of the dual markets. (Newell & Chau 1996, 16.)

5.2 Evidence on a pure real estate factor

While financial assets movements have been observed to influence indirect real estate returns, eliminating their effects has yielded interesting results. Gilberto (1990) presented that when the effects of general bond and stock markets are removed a positive correlation between public and private real estate is observed, and a presence of a *pure* real estate factor can be detected. In addition, the lagged values of equity REIT residuals have been found to help explain direct real estate residuals. (Gilberto 1990.)

The existence of a pure real estate factor that reflects only the fundamentals of real estate markets and is not shared with the overall capital markets, is supported by several other studies (see e.g. Newell & Chau 1996; Clayton & MacKinnon 2001) As mentioned in the last section Newell and Chau (1996) observed a relationship between indirect real estate assets and the stock market, but in a more thorough investigation they also discovered correlations in the return residuals of property companies and a direct real estate index. This result suggested that direct and indirect real estate investments shared a common real estate factor that influenced both assets. This was true on both appraisal and transaction based data. (Newell & Chau 1996, 21−22, 28.)

Clayton and MacKinnon (2001) also found results confirming the presence of a real estate factor when they studied the correlations between securitised and un-securitised real estate assets together with other asset classes. By utilizing a multi-factor model es-

[5] As the data for direct real estate investment Boudry et al. 2011 used the MIT TBI indexes that are based on property transactions and are available both as aggregate and sub-index levels.

timated with quarterly data between the years 1978-1998, they found that full sample correlations suggested REIT market returns to be highly correlated with both bonds and shares, including both large and small cap shares, but uncorrelated with direct real estate returns. However, as the factors (large cap stocks, small cap stocks, government bonds, and a direct real estate index) were allowed to vary over time, by using the flexible least squares method, a significant positive relationship between direct real estate and REIT returns was observed. In addition, the influence of large cap shares on REITs diminished. However, the connection between small cap shares and REITs seemed to prevail over longer time periods. Relationship between REITs and small cap shares also exhibited cyclical tendencies with REIT returns being more responsive to small cap returns during bear markets. (Clayton & MacKinnon 2001, 49−50, 52.) The positive connection between direct and indirect real estate investments is in line with Gilberto's (1990) and Newell and Chau's (1996) results.

This short review is in line with the notion, that while some strong linkages between direct and indirect property markets have been observed, they seem to be inter-temporal rather than contemporaneous (Geltner et al. 2003, 1058). The next section will focus on the price discovery and long-term dynamics of real estate returns.

5.3 Price creation and linkages within the dual markets

In an inter-temporal context real estate securities are said to resemble more private real estate investments than other stock market products (Myer & Webb 1993, 106). The evidence on pure real estate factor has prompted researchers to examine the information flow and linkages between the dual markets. Information flow between the two markets can be investigated through price discovery: a process of information aggregation, by which asset market prices are formed. Price discovery of the pure real estate factor can occur either on the public or private market from which it is then transmitted to the other side of the dual markets. The market on which the price is first discovered is said to lead the market to which the information is later transmitted. (Barkham & Geltner 1995, 21.)

The linkages between markets can be examined for example by deploying a granger causality test. Granger causality implies either uni- or bidirectional causality from one variable to another. For the simple example of two variables x and y, it means that the current values of x are correlated with the past values of y and/or vice versa. Hence, values of one variable can be used to predict the values of another. If both variables are correlated with each other's past values then causality is said to be bidirectional, suggesting that there is feedback between the two variables. However, because granger

causality is an examination of correlations it is not a representation of cause and effect. (Brooks & Tsolacos 2010, 348−349; Myer & Webb 1993, 97.)

Price discovery is said to occur in the public real estate market if there is unidirectional causality between the past values of securitised property investments and direct real estate. This would suggest that the public real estate market informationally leads the private real estate markets. (Yavas & Yildirim 2011, 7.) An early study by Gyuorko and Keim (1992) found that lagged values of indirect real estate investments could be used to forecast the future values of direct real estate, suggesting a lead-lag relationship between the markets. This was later supported by Barkham and Geltner (1995) who found that price discovery of the common real estate factor occurred first in the public markets, suggesting that new information related with property valuation was reflected faster on the public rather than the private real estate market. Their examination of both the U.S. and U.K. real estate asset markets showed significant non-contemporaneous cross-correlations between direct and indirect real estate as well as evidence of granger causality from the direction of public markets. (Barkaham & Geltner 1995, 34–39.) The informational flow from public to private is also supported by Newell and Chau (1996) who observed a lead-lag relationship between the public and private commercial real estate markets in Hong Kong. They found that price changes in property companies led the private markets by one quarter. (Newell & Chau 1996, 18–20.)

Research on granger causality has also yielded mixed results; Newell, Chau, Wong and McKinnel (2005) studied the linkages of the direct and indirect real estate investments on the Chinese market. In their examination of several local stock and office markets they found evidence of granger causality only from one local market to another. They found no significant evidence that real estate companies on the examined stock markets would correlate with their respective office markets. However, the lack of observed granger causality in the Chinese market may be due to several factors: the Chinese stock market is still maturing and many of the real estate companies on the markets are owned by the state and focused on development rather than on actual real estate investing. Many of the companies also trade in other fields of business than just real estate. Therefore, the revenue of the companies is affected by other business activities in addition to real estate investment revenues. (Newell et al. 2005, 265–270, 276.)

Yavas and Yildirim's (2011) research also yielded similar results to those of Barkham and Geltner (1995) with public real estate markets leading private markets. They used firm level data on different REIT returns and their corresponding NAV returns. Price discovery was examined by constructing an error correction model (ECM) with which the past REIT returns effects on current NAV returns could be hypothesised. Their results suggested that there is a unidirectional causality between the two markets with REITs generally leading the public property investments. (Yavas & Yldirim 2011.)

Since real estate is characterised by heterogeneity it is plausible that the dynamics between direct and indirect real estates' vary across property types (Boudry et al. 2011, 232). This was also noted by Yavas and Yildirim's (2011) in their further research examining the dynamic relationships between the two real estate markets. By utilizing a dynamic conditional correlation GARCH test, that measures the current correlation between the assets as well as the time-varying correlations of past values, they found that correlations between REITs and their NAVs varied in time, and from REIT type to another. Consequently, some of observed REIT returns had stronger influence on private property returns than others. (Yavas & Yldirim 2011, 27.)

Since lead-lag relationship between the two markets suggests predictability in pricing, it also implies a long-term dynamic relationship where one market adjusts to the other. In their research on the direct and indirect real estate markets in the U.S. from 1977 to 2008, Oikarinen, Hoesli and Serrano (2011) observed a long-term cointegrating relationship between public and private real estate returns with public property leading the private. In other words, the direct property market was observed to adjust to this long-term relation between the markets. They also found that prior to the "new REIT era" in the 1990's, when REIT legislation underwent some major changes the direct market seemed to lead the indirect property markets. They argued this was due to the fact that during that period REIT markets suffered from low maturation and that their strong connection with the general stock markets enabled the direct real estate investments to reflected property market fundamentals more efficiently. (Oikarinen et al. 2011, 84–94.)

A recent study by Boudry et al. (2011) also utilised the cointegration framework and found direct and indirect real estate assets to be related, and that they share a long-term equilibrium path on both aggregate and property type level data. Their study included both aggregate and sector level data from the U.S. real estate markets. Sample period extended from the second quarter of 1994 to the fourth quarter of 2009. While they did not find any lead-lag relationship, with one market leading the other, they found that both real estate markets follow the same long-term equilibrium path as other financial assets and they both adjust to each other and to the overall financial markets. This was true on all the sectors examined except the U.S. office real estate sector, for which they did not find a cointegrating relationship. (Boudry et al. 2011, 242–247.) This is in contradiction to Oikarinen et al.'s research (2011) where they did not find a connection between real estate assets and the overall stock market, quite the opposite. Based on their findings Oikarinen et al. (2011, 89) stated that there is no long-term cointegrating relationship between stocks and direct or indirect real estate. Consequently, both real estate investments could help to diversify a broad stock portfolio for a long investment horizon.

The researches presented so far have yielded similar but non-conclusive results on the linkages between the direct and indirect real estate assets. There is strong evidence of public real estate assets behaving like direct real estate in the long run but some studies in short-term dynamics still connect indirect real estate closely to the general stock markets. Hoesli and Oikarinen (2012) state that these inconclusive evidence are due to selected methods used in the researches as well as data limitations (aggregate level data, sample periods, asset matching of the data, leverage used in indirect real estate, etc.) in the selected markets. In order to tackle these issues they conducted an examination on the sector level data in the U.S. and the U.K. (and on overall level in Australia).

Hoesli and Oikarinen (2012) set out to study both the short- and long-term dynamics between direct and indirect real estate markets and the stock markets. They also examined the influence of economic fundamentals such as, economic growth, inflation, and short-term interest rates together with the term structure, by adding them to the estimated model. The addition of economic fundamentals to the model helped to reveal the true effects the individual assets have on each other. In order to make the direct real estate data more comparable with indirect real estate and stocks, leverage was added to the direct real estate indices. This was justified by the fact that many investors take on debt in order to purchase real estates. (Hoesli & Oikarinen 2012, 5–6, 8–9.)

In their research Hoesli and Oikarinen (2012) found robust evidence of cointegration between direct and indirect real estate on five of the seven markets examined. The cointergrating relationship between the assets was tested with Johansen Trace test of cointegration and vector error correction model (VECM) was constructed. The results of the trace test suggested a long-term relation between direct and indirect property markets, towards which the direct real estate market was observed to adjust. However, Hoesli and Oikarinen failed to find a pairwise cointegration between the direct and indirect office real estates in the U.S., but after a risk premium was added to the model a cointegration between the variables was detected. The observed cointegrations between the assets together with the examined variance decompositions implied that movements in the private property returns could be somewhat predicted by the movements in the public real estate markets. (Hoesli & Oikarinen 2012, 9–11, 16.)

On the whole, many of the subject studies seem to verify the proposition presented by the theory; in the short run direct and indirect real estate values might differ from one another but in the long run both markets tend to converge towards a shared long-term equilibrium. Also the higher informational efficiency expected from the public market seems to hold true since the price discovery is observed to move from the public market to private market. All in all the results have implication on the optimal portfolio choice of investors which will be discussed in the next section.

5.4 Some portfolio considerations

As there is evidence of indirect real estate behaving both like shares as well as direct property investments it is wise to say few words regarding some considerations about real estates' role in a mixed-asset portfolio.

The portfolio choice of an investor is generally assumed to be based on the risk relating to the expected return. These risk-return characteristics are evaluated in one-period-analysis for the purpose of creating an optimal portfolio. The length of the period is related to the preferred investment horizon of the investor. If the asset returns are independently and identically distributed, all investors (despite the differences in the length of their horizon) are presumed to have the same optimal portfolio. In case the asset returns are not i.i.d. and there is predictability in the returns, the optimal asset allocations might differ between portfolios with different investment-horizons. (MacKinnon & Al Zaman 2009, 119-120.)

In order for investors to be able to diversify their portfolio in the long term the returns of different assets should not be cointegrated. If there is cointegration between different assets, diversification benefits between them will be lost in the long run because the markets tend to revert towards the same long-term equilibrium path and bring similar return and risk characteristics to the portfolio (Brooks & Tsolacos 2010, 384). This notion is one of the key points when studying different real estate investments and their substitutability.

Early researches found little correlation between the dual markets and suggested that securitised real estate investments behaved more like traditional securities (Mueller & Mueller 2003; Ling & Naranjo 1999.) Many researchers have also shown that securitised real estate returns are greatly influenced by other financial asset movements (see e.g. Gilberto 1990). However, more recent studies have shown that these connections between securitized real estate assets and general stock markets are short-term, and that there is substantial evidence of indirect real estate performing like direct real estate in the long run. (see e.g. Oikarinen et al. 2011; Yavas and Yildirim 2011)

Furthermore, Hoesli and Oikarinen (2012) examined the long-term dynamic relationship by conducting an impulse response analysis. They argued that if REITs and direct real estate investments would work as good substitutes to one another as long-term investments, their long-term reactions to shocks should be similar. Indeed their hypothesis was validated; their general conclusion from the impulse response analysis was that on five of the seven markets analysed there were robust evidence that in a long-term investment portfolio REITs would work as better substitutes to direct real estate assets than for shares. (Hoesli & Oikarinen 2012, 19−22.)

Based on these results it can be concluded that direct and indirect real estate investments can substitute each other, and that the diversification benefit between them is lost

in the long term. However, in the short term, investors can hope to gain diversification benefit also between different real estate investments because of the strong connection between the indirect real estate investments and the general stock market.

Investors should also consider the lead-lag relationship between the assets when reallocating their assets from one assets group to another. For example, if market values of securitised real estates' seem to plummet it might not be the best option to materialize potential losses by moving the wealth to direct real estate investments. This can be argued because research suggests that direct real estate values are likely to be influenced by the shocks in the indirect real estate market, suggesting a forthcoming fall in the direct market as well. (Hoesli & Oikarinen 2012, 25.)

6 EMPIRICAL STUDY

Based on the theoretical discussion in chapter 4 and literary review on chapter 5 a hypothesis on the long-term dynamics of direct and indirect real estate investments is formed. The prevailing hypothesis of this thesis is that direct and indirect office real estate investments in the U.S. markets share a long-term equilibrium path towards which direct real estate tends to adjust. This chapter presents the econometric methods used for testing the hypothesis and results yielded by the tests. Data for the research was sourced from Thomson Reuters Datastream, and it was analysed by using EViews. More detailed description of the data is presented in section 6.1.3.

6.1 Methods and data

In order to study long-term dynamics between the chosen real estate time series a multivariate time series regression model is constructed. The proposed model also incorporates the possibility of cointegrating relationship between the time series which allows the variables to adjust to a possible long-term equilibrium path. If cointegration on the basis of total return indices is observed in the long run it would imply similar pricing of the assets, similar shifts in their cap rates and similar impact on their capital growth. (Brooks & Tsolacos 2010, 384). In this chapter a method for detecting the supposed cointegration is presented, but before that few words on the construction of basic multivariate systems regression model is in order.

6.1.1 Vector auto regressive model

Vector auto regressive model i.e. VAR model is a systems regression model with two or more variables whose current values are dependent on the different combinations of current and prior *k* values of all variables, and their error terms. The simplest of the models is constructed by using two variables y_t and z_t and the lag length is unity i.e. k=1. This bivariate system called *a first-order vector autoregression* is depicted in equations 6.1 and 6.2 and it is called a structural VAR. (Brooks & Tsolacos 2010, 337-338; Enders 2004, 264−265.)

$$y_t = b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon_{yt} \quad (6.1)$$

$$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{1t-1} + \gamma_{22}z_{t-1} + \varepsilon_{zt} \quad (6.2)$$

It is assumed that y_t and z_t are stationary and that ε_{yt} and ε_{zt} are uncorrelated white-noise disturbance terms with standard deviations of σ_y and σ_z respectively. The model is called the first-order VAR because of the longest lag length is unity. As the values of y_t are allowed to affect the values of z_t, and vice versa, the model incorporates feedback between the variables. If parameters b_{12} and b_{21} are not equal to zero, some form of feedback is expected to exists and variables y_t and z_t are expected to correlated with each other's error terms ε_{1t} and ε_{2t}. As standard estimation techniques require the regressors to be uncorrelated with the error term, equations 6.1 and 6.2 cannot be estimated as such. Hence, another presentation of VAR is required. Equation 6.3 represents the standard form of VAR which can be used for estimating the model. (Enders 2004, 264−265, 271; Brooks & Tsolacos 2010, 342−343.)

$$x_t = A_0 + A_1 x_{t-1} + e_t \tag{6.3}$$

Here A_0 is vector $[a_{i0}, \cdots, a_{n0}]$ for i, A_1 is a matrix for the parameter estimates of the lags and e_t is the vector for error terms. The structural form of VAR can be estimated, equation by equation, using ordinary least squares (OLS) technique (Brooks & Tsolacos 2010, 343). The reduced form of VAR (equations 6.4 and 6.5) depicts these equations.

$$y_t = a_{10} + a_{11} y_{t-1} + a_{12} z_{t-1} + e_{1t} \tag{6.4}$$
$$z_t = a_{20} + a_{21} y_{1t-1} + a_{22} z_{t-1} + e_{2t} \tag{6.5}$$

Since the error terms e_{1t} and e_{2t} are composites of shock terms ε_{yt} and ε_{zt} they are expected to have zero means, constant variances, and no autocorrelation. On the other hand within the model the error terms are expected to be correlated with each other, except in the special case when parameters b_{12} and b_{21} are zero and there is no contemporaneous relationship between y_t and z_t. (Enders 2004, 265−266.)

Despite the fact that VAR assumes y_t and z_t to be stationary, in the estimation of multivariate processes it is also possible that two non-stationary variables can produce a linear combination that is stationary. This connection between the variables is called cointegration and it suggests that the two variables share a long-term equilibrium path, hence, variables cannot move independently from one another. (Enders 2004, 319.) If economic theory and evidence from the data suggest that the variables are cointegrated instead of using VAR the usage of a vector error correction model (VECM) is in order.

6.1.2 Cointergation and vector error correction model

If it is established that two variables share a long-term relationship, it is important to study the dynamics of this relationship since it may have implications regarding similar pricing between markets (Brooks & Tsolacos 2010, 384), predictability of asset prices, and choosing the optimal portfolio allocation (Oikarinen 2007, 65). From this we can conclude that more detailed knowledge on the dynamics of the relationship between the direct and indirect assets, could help investors to make more informed decisions on real estate assets ability to substitute one another in a mixed-asset portfolio in the long run. It is also important to take in to consideration that if cointegration is overlooked in the econometric modelling of the data, some relevant information maybe be left unobserved (Oikarinen 2007, 65).

As noted previously, cointegration suggests that variables share a long-term equilibrium path. Algebraically this long-term equilibrium can be stated as follows (Enders 2004, 320−321.):

$$\beta_1 x_{1t} + \beta_2 x_{2t} + \cdots + \beta_n x_{nt} = 0 \qquad (6.6)$$

Or as a combination of vectors $\beta x_t=0$ where β is $\beta_1, \beta_2,\ldots, \beta_n$ and x_t is $x_{1t}, x_{2t}, \ldots, x_{nt}$. As variables are expected deviate from this equilibrium due to shock in the markets, an equilibrium error of $e_t= \beta x_t$ is defined. In order for the equilibrium to be meaningful the process for the equilibrium error needs to be stationary. (Enders 2004, 322.)

In order for the variables of interest (i.e. components of vector x_t) to be cointegrated of order (d, b) two requirements must be met. Firstly, all variables are integrated of order d. Secondly, there exists a cointegrating vector β for which there is a linear combination (with the vector x_t) that is integrated of order (d−b) where b > 0. (Enders 2004, 322.) In other words, if two variables are cointegrated of order (1,1) both of the variables are non-stationary i.e. integrated of order I(1) and their linear combination β is a stationary process i.e. integrated of order I(0).

Cointegration can be tested by using for example the Engle-Granger method or the Johansen technique. In the scope of this study the Johansen technique is employed since it allows for more than one cointegrating relationship to exist between the variables and for the hypothesis testing on the actual cointegrating relationship (Brooks & Tsolacos 2010, 403).

In order to achieve the long-term equilibrium after a shock in the system, either one or more of the variables need to adjust towards the equilibrium path. This adjustment implies a dynamic relationship between the variables. Error correction model can be constructed to demonstrate this adjustment towards the equilibrium. Consider the following bivariate system with error correction:

$$\Delta y_t = a_{10} + \alpha_y(z_{t-1} - \beta y_{t-1}) + \sum a_{11}(i)\Delta y_{t-i} + \sum a_{12}(i) z_{t-i} + \varepsilon_{yt} \quad (6.7)$$

$$\Delta z_t = a_{20} - \alpha_z(z_{t-1} - \beta y_{t-1}) + \sum a_{21}(i)\Delta y_{t-i} + \sum a_{22}(i) z_{t-i} + \varepsilon_{zt} \quad (6.8)$$

This vector error correction model (VECM) is really similar to the VAR model introduced in the previous section, since it introduces the lagged changes of both variables into both equations. It deviates from VAR as it is in first difference and it has restrictions on cointegration built into the specification of the model. Cointegration restrictions are in the form of error correction terms $\alpha_y(z_{t-1} - \beta y_{t-1})$ and $-\alpha_z(z_{t-1} - \beta y_{t-1})$. (Enders 2004, 328−329.)

In more generalised form the VECM can be presented in matrix form (similar to equation 6.3) as follows (Boydry et al. 2010, 239; Oikarinen et al. 2011, 83):

$$\Delta x_t = v + \alpha\beta' x_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-1} + \varepsilon_t \quad (6.9)$$

Where x is a vector of variables y and z, v is a two-dimensional vector of parameters presenting a deterministic drift term, α is the vector describing the adjustment speed of the variable towards the equilibrium path and β' is the cointegrating vector. Γ_i is a matrix of coefficients for the lagged differences for the subject time series and p is the maximum lag length for the model. (Boydy et al. 2010, 239; Oikarinen et al. 2011, 83.)

6.1.3 Data

Data used for this study was sourced from Thomson Reuters Datastream. Two time series were chosen for the study: one for direct real estate investments and another for indirect real estate investments. Both of the series are based on quarterly data from the U.S. office markets between 1994:1Q-2012:4Q.

The time series for direct real estate investments was produced by the National Council of Real Estate Investment Fiduciaries (NCREIF). The chosen time series NCREIF TBI office return index is a transaction based total return index which is composed of office real estates noted in NCREIF property index and were sold during the quarter. The series is based on quarterly data and it presents the total return measure for a very large pool of direct real estate investments acquired for investment purposes only. Data contained by the indexes is collected from the U.S. private property market. (National Council of Real Estate Investment Fiduciaries, 2013.)

The time series selected to represent indirect real estate is produced by the National Association of Real Estate Investment Trusts (NAREIT). NAREIT Office REIT price index is a transaction based price index that combines REITs that invest mainly on office space. (National Association of Real Estate Investment Trusts 2013b.)

Before moving on to the estimation of the model few words on the quality of the data are in order. Even though it is preferable to use transaction based data over appraisal based data, it is not without its flaws. The transaction based indices for direct real estate investments have only been around form the beginning of 1990's. Therefore, the data is limited by fewer observations than appraisal based data. This is particularly important to note because optimally research on long-term relationship and cointegration in the real estate market should incorporate much longer time periods (Brooks & Tsolacos 2010, 384).

In addition, the two indices are not exact matches to each other in few ways. The NAREIT index incorporates the impact of leverage while NCREIF index is based on unleveraged real estate. Leverage affects the mean and volatility of the NAREIT series, and it might also distort the results explaining the long-term relation between the two series. (Oikarinen et al. 2011, 79; Hoesli & Oikarinen 2012, 8.) In addition, the two indices do not necessarily incorporate exactly similar real estate portfolios. Furthermore, NAREIT office index incorporates the active management of REITs. (Oikarinen et al. 2011, 79.)

6.2 Estimating the model

Estimating the vector error correction model begins by identifying the appropriate variables identified by the economic theory. In this research, variables y_t and z_t are the time series presented in the previous section: NCREIF TBI office index and NAREIT office index. As the aim of this study is to examine relationships between the two different real estate investment indices, no other variables are required. Natural logarithms of the two series are used throughout the estimation.

The estimation follows roughly the four step procedure used in Boudry et al. (2010, 239). Estimation begins with establishing the non-stationarity of the subject time series followed with the estimation of the optimal lag length. After estimating the optimal lag length the number cointegrating vectors is established. Since there are only two subject variables only one long-term relationship is assumed. The number of cointegrating vectors is verified with trace and maximum eigenvalue tests. Lastly the VECM is estimated and innovation accounting in conducted.

6.2.1 Testing for unit root

Establishing the non-stationarity of the subject time series unit root tests are required. Unit root can be tested by employing an augmented Dickey−Fuller -test (ADF) or a

Phillips−Perron -test (PP). Both ADF and PP -tests are conducted by employing the following regression and comparing the values of the test statistics to the critical values presented in table 2.

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + u_t \quad (6.10)$$

The possible autocorrelation in the dependent variable is noted by incorporating the lagged values into the regression. The suitable lag length for the regression can be chosen based on the frequency of the data (quarterly data = four lags) or information criteria. In ADF -test the residuals (u_t) are expected not to be autocorrelated. The PP –test on the contrary takes into consideration the autocorrelation in the residuals and incorporates an automatic correction to the ADF process. (Brooks & Tsolacos 2010, 378-380.)

The null hypothesis for both the ADF and PP tests states that a time series is non-stationary i.e. contains a unit root. Hence, if the test statistics are significant the null hypothesis can be rejected and series is assumed to be stationary. (Boudry et al. 2010, 239; Brooks & Tsolacos 2010, 378.)

The initial review of the series with the help of graphs and correlograms suggest that the two series are non-stationary and appear to include an upwards trend in them. Unit root testing for the two subject time series is done by using augmented Dickey−Fuller test. The amount of lags is chosen automatically based on Schwarz's Bayesian information criterion. Table 3 presents the test statistics for both series. The test is performed on both levels and first differences.

Table 3. Test results for augmented Dickey−Fuller unit root tests

Variable	**Levels** (lags) [p-value]	**1st differences** (lags) [p-value]
NAREIT	-1.801 (2) [0.377]	-6.879 (1) [0.000]
NCREIF (tbi)	-1.586 (0) [0.484]	-3.524 (2) [0.010]
Critical values for 1% and 5% significance levels are -3,52 and -2,90, when a constant is included in the test.		

Test statistics for both subject time series suggest that null hypothesis cannot be rejected for levels but can be rejected for first differences, therefore, both time series are expected to be integrated of order 1 i.e. non-stationary. Since both subject time series present an upward sloping trend, a constant is included in the unit root testing (Oikarinen et al. 2011, 84).

6.2.2 Choosing the optimal lag length

In the case of both the VAR and VECM much thought has to be placed on the choosing of optimal lag length for the model. Since real estate theory does not provide much clues regarding to the optimal lag length, other methods are used to reach a decision. These methods include the usage of cross-equation restrictions and information criteria. One of the problems with cross-equation restrictions is that they are based on the assumption that the errors from each equation are normally distributed, which is usually not the case in real estate data. Hence, for real estate data the use of information criteria is more relevant. (Brooks & Tsolacos 2010, 340−342.)

Three most popular information criteria for a model are Aikake's information criterion (6.11), Schwarz's Bayesian information criterion (6.12), and Hannan−Quinn information criterion (6.13) all of which are here presented in their multivariate forms Brooks & Tsolacos 2010, 243, 342).

$$MAIC = \log\left|\hat{\Sigma}\right| + 2k'/T \quad (6.11)$$

$$MSBIC = \log\left|\hat{\Sigma}\right| + \frac{k'}{T}\log(T) \quad (6.12)$$

$$MHQIC = \log\left|\hat{\Sigma}\right| + \frac{2k'}{T}\log(\log(T)) \quad (6.13)$$

For all equations $\hat{\Sigma}$ is the variance-covariance matrix of residuals, T is the number of observations, and k' is the number of regressors in all equations of the system. Information criteria take into consideration that by adding parameters the model becomes more precisely defined but also loses in the degrees of freedom. Consequently, each criterion embodies two factors: one representing the variance-covariance matrix of residuals and another that considers the loss in the degrees of freedom i.e. *a penalty term*. The three criteria differ from each other with respect to the stiffness of their penalty term. In the selection of the optimal lag length information criteria is used as follows: Values for different information criteria are put together for different number of lags and the number of lags that minimises the chosen information criterion is chosen for the model. (Brooks & Tsolacos 2010, 243, 342.)

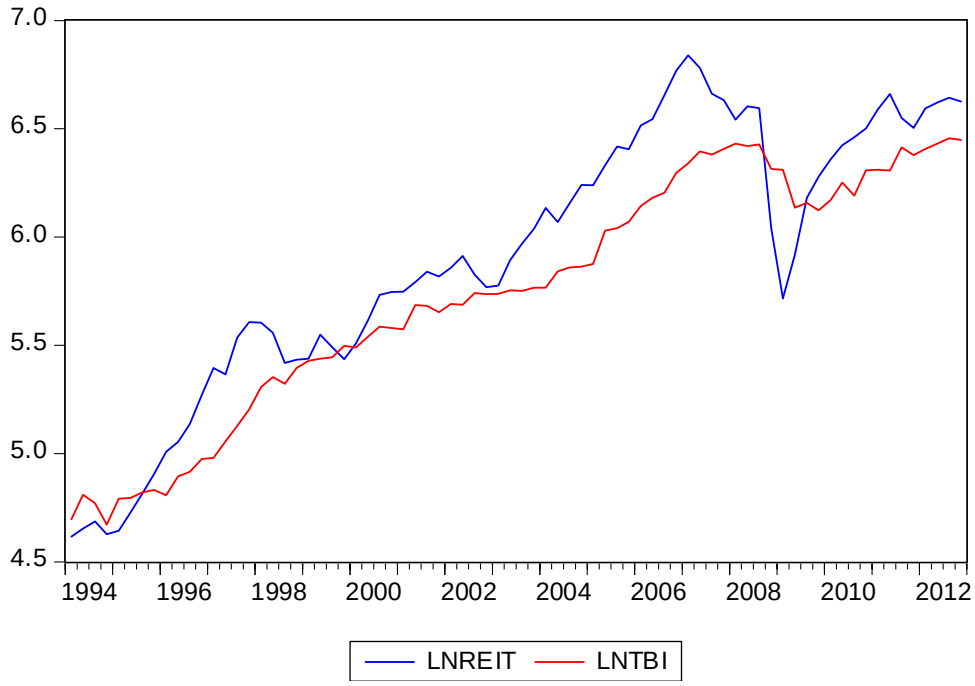

Figure 5. Direct and indirect office real estate logarithmic return indices in the US market 1994:Q1-2012:Q4

Based on the graphic description of the subject time series presented in figure 5, office REIT returns seem to be leading the direct office real estate returns by one or two years. Hence, the testing for lag lengths can begin from eight lags. This should be enough time to capture the possible relations between the variables. The optimal lag length for the VECM is done by first estimating a VAR and comparing the different lag lengths with the help of the information criteria. Lag length for the estimation is chosen with the help of both Schwarz's information criterion and Hannan−Quinn information criterion. Based on the results VECM is estimated with the lag length of two.

6.2.3 Estimating the vector error correction model

Since both NAREIT Office and NCREIF Office TBI appear to be non-stationary, and both theory and previous research suggest a cointegrating relationship between the series, two tests on the presence of cointegration are implemented. Table 4 summarizes the results of trace and maximum eigenvalue tests. The number of cointegration vectors is represented by *r*.

Table 4. Cointegration tests

Null hypothesis: No cointegration, $r = 0$		
	Trace test	**Maximum eigenvalue test**
Eigenvalue	0.424	0.424
Trace statistic	43.685	
Max-Eigen statistic		40.305
Critical value (5% significance)	15.494	14.264
p-value	0.000	0.000
Null hypothesis: At most one cointegration relation, $r \leq 1$		
	Trace test	**Maximum eigenvalue test**
Eigenvalue	0.045	0.045
Trace statistic	3.379	
Max-Eigen statistic		3.379
Critical value (5% significance)	3.841	3.841
p-value	0.066	0.066

The maximum eigenvalue test confirms the existence of at least one cointegrating vector for critical value of 5%. However, noteworthy is that for a larger critical value the null hypothesis on $r \leq 1$ would have been rejected. This possibility of rejection can be present due to the quality of the data.

Nevertheless, based on the theoretical assumptions, previous studies and cointegration tests the two subject series can be deduced to be cointegrated of order I(1) and a VECM is estimated by using the Johansen method. In other words the estimation is done by estimating equation 6.9 by applying OLS to equations 6.7 and 6.8. Lag length for the estimation is two as mentioned in the previous section.

6.3 Results

This chapter summarizes the results of the estimated VECM and some procedures that are implemented in order to study the dynamic relationship between the variables. Different diagnostic checks are conducted so as to verify the stability and quality of the estimated model. Both Portmanteau autocorrelation test and autocorrelation LM test, with 12 lags, were employed in order to study the residuals of the VECM. Test results indicated that residuals do not incorporate any serial autocorrelation. In addition, diag-

nostic checking of the inverse unit roots affirmed that the estimated VECM is stable. As mentioned in before, natural logarithms of the original time series are used throughout the estimation, and consequently, LNTBI denotes the natural logarithm of the direct real estate index and LNREIT denotes the similar index for the indirect real estates. The estimation output of the VECM is reported in table 5. As mentioned before the lag length for the estimation was chosen to be two. Consequently, the different lags for each variable are presented on the left hand side of the table and noted with the corresponding number on the parenthesis.

Table 5. VECM estimation output

	NCREIF off_tbi	***p-value***	**NAREIT off**	*p-value*
Estimated long-term relation, *β* (stand. error)	1.00		-0.888 (0.023)	
Speed of adjustment parameter, *α* (stand. error)	-0.301 (0.04800)	0.000	0.053 (0.121)	0.663
Parameter estimates for VECM (stand. dev) [t-Statistic]	ΔNCREIF tbi office		ΔNAREIT office	
ΔLNTBI(-1)	-0.441 (0.099) [-4.463]	0.000	0.183 (0.251) [0.732]	0.465
ΔLNTBI(-2)	-0.278 (0.102) [-2.737]	0.007	-0.126 (0.258) [-0.488]	0.626
ΔLNREIT(-1)	-0.056 (0.0495) [-1.141]	0.256	0.486 (0.126) [3.873]	0.000
ΔLNREIT(-2)	-0.020 (0.055) [-0.371]	0.711	-0.315 (0.139) [-2.257]	0.025
C = constant	0.042 (0.006) [6.410]	0.000	0.021 (0.016) [1.263]	0.209

The estimation output in table 5 suggests that LNREIT is weakly exogenous (see e.g. Enders 2004, 368) and the VECM is estimated again with the restriction posed on LNREIT. The estimation output of the new VECM is reported in table 6.

Table 6. VECM estimation output, LNREIT restricted as weakly exogenous

	NCREIF off_tbi	***p-value***	**NAREIT off**	*p-value*
Estimated long-term relation, *β* (stand. error)	-10.482		9.283	
Speed of adjustment parameter, *α* (stand. error)	0.028 (0.0045)	0.000	0.0047 (0.012)	0.683
Parameter estimates for VECM (stand. dev) [t-Statistic]	ΔNCREIF tbi office		ΔNAREIT office	
ΔLNTBI(-1)	-0.441 (0.099) [-4.471]	0.000	0.181 (0.251) [0.721]	0.472
ΔLNTBI(-2)	-0.278 (0.101) [-2.747]	0.0068	-0.129 (0.258) [-0.502]	0.616
ΔLNREIT(-1)	-0.057 (0.049) [-1.155]	0.250	0.485 (0.126) [3.859]	0.000
ΔLNREIT(-2)	-0.021 (0.055) [-0.381]	0.704	-0.317 (0.139) [-2.271]	0.025
C = constant	0.042 (0.006) [6.425]	0.000	0.021 (0.016) [1.277]	0.204

The estimation output suggests that there is a cointegrating relationship between the two assets towards which only NCREIF TBI office index adjusts to. This result is in line with the theoretical framework and confirms that direct and indirect office real estate investments share a long-run equilibrium. It is also in line with the notion that the public market is more efficient and therefore it reflects the changes in fundamentals and information faster that the private market, hence causing the private market to adjust to

the long-term equilibrium path. Noteworthy is that the speed of adjustment parameter is rather small suggesting that the NCREIF TBI index is somewhat slow in its adjustment towards the equilibrium.

In comparison to previous studies the results confirm Oikarinen et al.'s (2011) findings on the cointegration between public and private real estate assets. It also resembles Hoesli's and Oikarinen's (2012) results from more a rigorous study, conducted with sector level data, in which they found that the public and private office real estate sector in the U.S. is cointegrated if a risk premium is included in the model. However, estimation output does contradict the results presented in Boudry et al. (2011) as they do not observe cointegration between the direct and indirect office real estate markets in the U.S.

In the light of theory and previous research the results are encouraging. However, the quality of the data needs to be addressed and taken in to consideration in the evaluation of the results. Firstly, even though the data for direct real estate investments is transaction based, it is not without its flaws. The TBI index is collected from the beginning of 1990's and thus it is limited by few observations. In optimal circumstances research on long-term relationship and cointegration should incorporate much longer time periods. Secondly, the two indices are not exact matches; indirect real estate index incorporate the impact of leverage and professional management of REITs while the direct real estate index is leverage free and does not incorporate effects of professional management. And thirdly, the real estate portfolios on which the indexes are based on are not necessarily exact matches. These data restrictions can be compared to those of other studies to reveal possible reasons behind the differing results.

In their study Oikarinen et al. (2011) use mainly appraisal base aggregate level data and even though, a short sample of transaction based data is added to the observations, their results are arguably more comparable on the aggregate level not the real estate office sector. Boudry et al. (2011) also use aggregate data but they also conduct a more thorough examination on the sector level. Nevertheless, they fail to observe a similar connection between the direct and indirect office real estates which was observed both in this empirical research and Hoesli's and Oikarinen's (2012) research. This might be due to differences on the sample periods and leverage in the data. Bourdy et al. (2011) do not control for the possible leverage in the indirect real estate data whereas Hoesli and Oikarinen (2012) add leverage to the direct real estate series in order to make it more comparable with indirect real estates. In the empirical research of this study leverage was not controlled fore but the sample period of the study was slightly longer than that of Bourdy et al.'s (2011) resulting in opposing results. Arguably, if the effects of leverage were taken into consideration in this study the results could have been even closer to those of Hoesli and Oikarinen (2012).

6.3.1 Testing for Granger causality

As already mentioned in chapter 5.3 the feedback between variables can be examined via Granger causality test. The actual testing is done by imposing restrictions on the lags of a particular variable. For example in order to study whether or not the lagged values of y_t granger cause the current value of z_t, all lagged values of y_t are restricted to zero. After imposing the restrictions, both set of equations (unrestricted and restricted VARs/VECMs) are estimated by using OLS and compared with each other with F-test framework. (Brooks & Tsolacos 2010, 347−348.)

Granger causality -test is conducted by estimating a VAR with same lag length as the estimate VECM. Then a granger causality test is implemented in order to check if the lagged values of one series have an effect on the current value of another. Test results affirm that NAREIT office indeed granger-causes NCREIF TBI office, meaning that the values of NAREIT office has prediction power over the values of NCREIF TBI office. This result is in line with Gyuorko and Keim's (1992), Barkham and Geltner's (1995) and Yavas and Yilidrim's (2011) notion that indirect real estate returns informationally lead the returns of direct real estate.

The estimated VECM system incorporates unidirectional feedback only via the cointegrating vector, from which it is evident that the current values of NAREIT influence the current values of NCREIF. However, the changes of TBI index do not seem to be influenced by the changes (i.e. lagged differences) of the NAREIT office index, suggesting that previous changes in NAREIT do not affect the current values of NCREIF. It seems that NCREIF TBI office values are only affected by its own changes and the constant C, whereas NAREIT values are only affected by its own lagged differences.

Even though granger causality helps to determine which variables have statistically significant effects on the other variables in the model, it does not give any clues on the direction of the effect. Nevertheless, the results on the direction of Granger causality are useful in a more profound analysis the interaction between the variables (Brooks & Tsolacos 2010, 352.). The effects of shocks in the variables can be examined via impulse response analysis and variance decompositions which will be presented in the next two sections.

6.3.2 Impulse response analysis and variance decompositions

In order to study the direction and intensity of the effect caused by one variable to another, impulse response functions need to be traced out. Impulse response functions depict the reaction each variable exhibits after a shock in the system is introduced. This is done by applying a unit shock to the error terms of the equations, and noting the ef-

fects of the shocks on the system over time. (Brooks & Tsolacos 2010, 352, 354.) If the subject time series are truly bound by same fundamentals their reactions on shocks should after a while resemble each other (Hoesli & Oikarinen 2012, 19).

Impulse responses for the two subject series are presented in figure 6. The Cholesky ordering (LNREIT – LNTBI) in the tracing of the responses is based on the results of pairwise Granger causality test on the levels. As the VECM estimation suggested that direct real estate is the only one adjusting to the long-run relation NAREIT office is assumed to weakly exogenous (see e.g. Enders 2004, 368). Both NAREIT office and NCREIF TBI office series react to a shock in the NAREIT office series, implying that new information affecting office REITs affects both direct and indirect office investments.

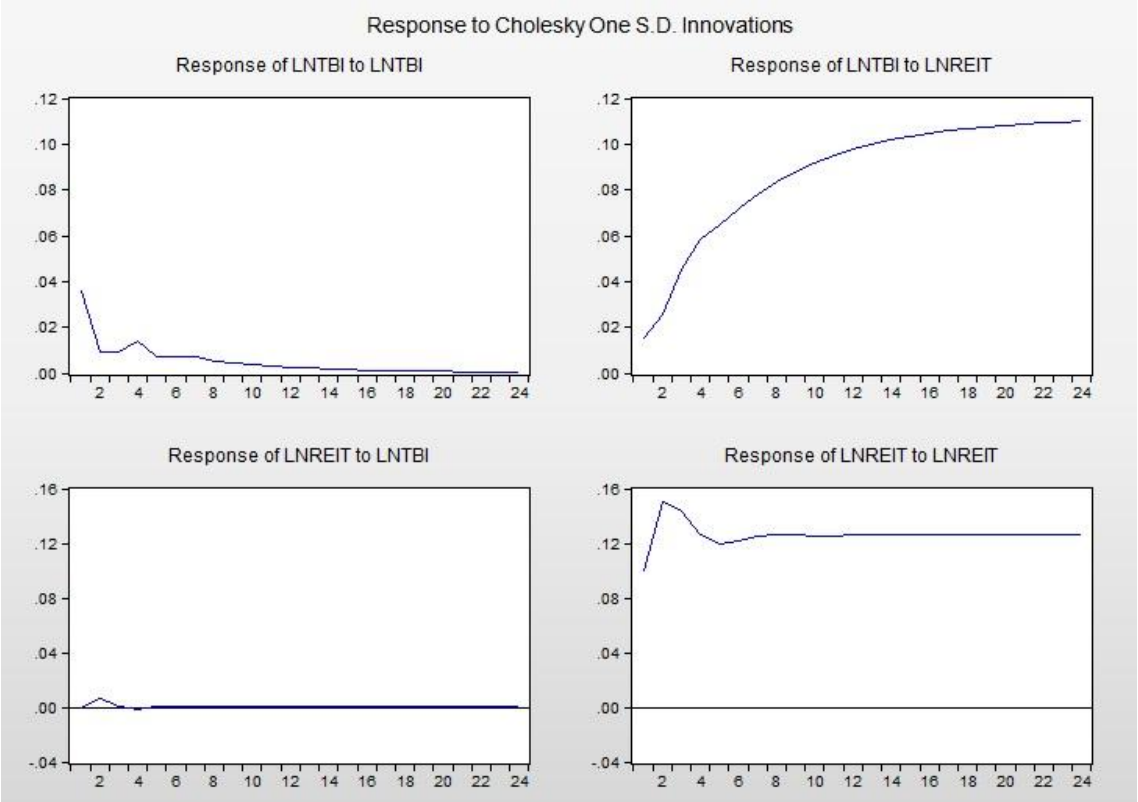

Figure 6. Impulse responses for shocks in both NCREIF TBI office and NAREIT Office indecies

A shock in the indirect real estate series (NAREIT) causes itself to react quite rapidly and intensely. However, the shock seems to be short lived. The NCREIF series for direct real estate investments reacts to the shock in the indirect real estate markets more sluggishly, but it steadily adjusts towards the same value. Similarly to previous re-

searches[6] the impulse response functions confirm the results that the direct real estate series adjusts towards the values of indirect real estate, and that shocks on the direct real estate markets affect only its own values not the values of indirect real estate.

Another way to study the dynamics between the variables is by tracing out variance decompositions. This method helps to determine how much the movements of the dependent variable are due to its own shocks as opposed to shocks in other variables. (Enders 2004, 280; Brooks & Tsolacos 2010, 354.) The variance decompositions for NAREIT office and NCREIF TBI office are presented in figure 7. Cholesky ordering in the first four frames is LNREIT – LNTBI in the latter four frames the opposite.

[6] Oikarinen et al. (2011), Hoesli & Oikarinen (2012)

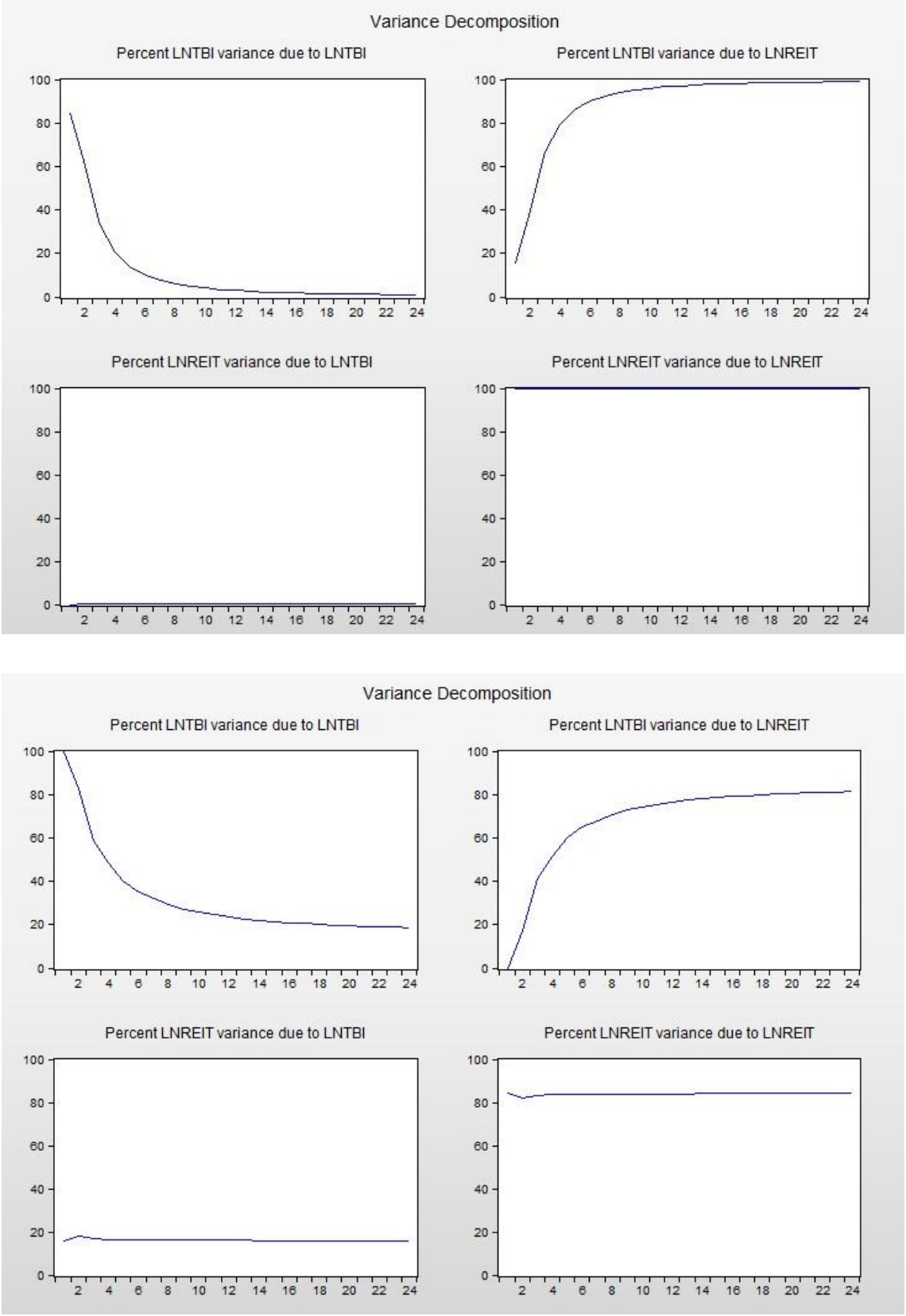

Figure 7. Variance decompositions for NCREIF TBI office and NAREIT Office indecies

Variance decompositions indicate that the shocks on the direct office real estate markets (NCREIF TBI office) do not influence the movements of the indirect office markets (NAREIT office series). However, shocks on the indirect market account for some of the movement on the direct office market. The results suggest that the effect of shocks in NAREIT office has on the values of NCREIF TBI office increase overtime. In other words a shock on the indirect real estate markets causes the values in direct real estate markets to change and move towards the equilibrium, and as time passes more and more of this movement is due to the original shock on the indirect markets.

In summary, the results obtained from the estimation and the diagnostic checking suggest that changes in real estate asset values are first discovered in the public office markets from which they are either transmitted to (or independently rediscovered in) the private office markets. The observed cointegrating relationship between the direct and indirect office real estates' is in line with the theoretical assumptions that real estate assets share a long-run equilibrium.

7 CONCLUSONS

The purpose of this study was to study if and how direct and indirect real estate investments are valued differently and what is their relationship in the long term. Connections between direct and indirect real estate assets were discussed by presenting their characteristics and methods for their valuation, together with relevant previous research. In addition, an empirical study on the U.S. office real estate markets was conducted in order to examine and clarify the connections and linkages between direct and indirect office real estates, and also study their long-term dynamics, with the help of econometric methods. The long-term dynamics were studied by estimating a vector error correction model for two office real estate indices.

Direct real estate assets encompass several features that differentiate them from other assets. They are by nature very heterogenic and highly connected to their location causing their markets to be fragmented. Furthermore, the purchase and sale of direct real estate is saturated with transaction costs and requires large amounts of capital, thus making the asset illiquid in comparison to traditional assets such as shares and bonds. In addition, the literature on real estate markets concludes that in many regards the real estate markets do not meet the requirements of a perfectly functioning Walrasian market. Nevertheless, real estate market can be argued to work efficiently in its own framework, but this does not eliminate the reality that it is arguably less efficient than the public market on which other conventional assets are traded.

Real estate market is also characterised by its duality; the existence of parallel public market for another type of property investments described as indirect real estate investments. Indirect real estate investments are essentially real estate securities that have real estate as their underlying asset. They are trader on the more efficient public asset markets and could be considered as hybrids that combine elements from both the general stock markets and from the direct property markets. As such they could be considered to be a good alternative for traditional direct property investments.

Based on the literature it was argued that securitised real estate could help to mitigate the negative features of direct real estate assets, such as illiquidity, informational inefficiencies, heterogeneity, transaction costs, etc. Hence, they were argued to be a good alternative for direct real estate, especially from the perspective of small investors. However, investors would also have to give up the benefits of inflation hedging and having control over the management of the real estate. Furthermore, indirect real estates' ability to convey direct real estates' diversification benefits to investors' portfolios was still debated.

As was shown in chapter 4, both real estate assets could be valued by using discounted cash flows -method where the future cash flows and the potential value increase of the asset are converted to present moment by dividing them with the expected rate of

return of the asset. Furthermore, economic theory suggests that if two markets price the same asset, their values should not permanently deviate from one another, as there is a tendency for the markets to move towards a mutual equilibrium. However, temporary deviations from the long-term equilibrium state can result from differentials either in the expected cash flows or in the expected rate of return of the assets. Short lived differentials in valuation can also occur because of differences in the informational efficiency of the markets. In principle both of the markets agree on how the new information affects the value of the asset but the public market is more efficient in communicating this change. Nevertheless, these differentials in the real estate asset valuation were redeemed to be only temporary because as long as capital can freely move between public and private markets, they tend to agree on the value in the long term.

A long-term equilibrium path between the assets is a result of cointegration between assets. Cointegration results in similar pricing, similar shifts in the cap rate, and similar impact on capital growth suggesting that diversification benefits between the assets are lost in the long term. Hence, in the long run assets would bring similar return and risk characteristics to the portfolio. However, since deviations from this equilibrium path are possible, various trends could be observed in the short run.

Most of the relevant research presented in this thesis, confirm the above mentioned theoretical assumptions. Many of the observed contemporaneous correlations between direct and indirect real estate are weak suggesting a differential in the valuation of real estate assets. However, when the linkages between real estate investments were studied in inter-temporal context, the presence of a pure real estate factor and a cointegrating relationship between direct and indirect real estate assets was found, implying that the assets are valued similarly in the long term.

Despite the fact that there is substantial theoretical and empirical evidence that direct and indirect real estate assets are cointergated in the long run, some studies failed to find a long-term connection between the two assets. This could arguably be mainly due to their research methods or the quality of their data. A study by Boudry et al. (2011) found robust evidence on cointergration between the assets on an aggregate level but failed to find similar relationship for the office real estate sector. Also a study by Hoesli and Oikarinen (2012) found that office markets in the U.S. were cointegrated only if a risk premium was included in the model.

The empirical research of this thesis set out to test the hypothesis that direct and indirect office real estate assets in the U.S. market are cointegrated and thus share a long-run equilibrium path. Cointegration between the assets was studied by constructing and estimating a vector error correction model. Data for the study was collected from Thomson Reuters Datastream and estimation and diagnostic checking was done with EViews.

Results from the estimated model suggested that direct and indirect office real estate investments in the U.S. market indeed share a long-term equilibrium towards which

direct real estates' adjust. Granger causality test also confirmed that indirect real estate investments lead direct real estate investments. On the whole the results yielded by the estimation, impulse responses and variance decompositions were in line with many of the previous researches and the theoretical base of the study. The theoretical framework was verified as differentials in valuation were observed but they seem to be short lived since one of the variables adjusts to the long-term equilibrium level. As public market is arguably more efficient than the private market it incorporates the effects of fundamental changes and new information earlier causing asset values to change, however, since capital can move between the markets the differential in asset values balances out in the long run.

Even though the results were in line with the theoretical framework some caution should be used in their assessment. The data used in the research was not flawless hence its quality needs to be taken into to account. The transaction based index used to represent the direct real estate investments is collected from the beginning of 1990's and thus it is limited by few observations. This is not optimal since cointegration should preferably be studied with much longer time periods. In addition, the two indices used in the study incorporated different features in regards to the underlying real estate portfolio, leverage and professional management.

Nevertheless, from an investor's perspective the results would suggest that in the long run investors will lose any diversification benefit they might gain by combining both direct and indirect office real estate assets in their wealth portfolio. In other words direct and indirect real estate assets can work as substitutes in the long run. For smaller investors this would be a positive opportunity since indirect real estate assets can be purchased with smaller amounts of capital and do not require knowledge on real estate management. The results is also of use for larger investors since they can either choose to diversify their real estate wealth by investing in professionally managed indirect real estates or they can benefit from the positive properties of direct real estate assets while remaining in total control over the assets, all the while knowing that in the long run they could expect to gain similar average return for their investment. However, all investors should keep in mind that in the short term the values and returns on real estate assets might differ a lot.

To this date relevant research on the cointegration has been conducted both on aggregate level and sector level data. Nevertheless, more research on this subject is needed especially on more immature markets. Interesting field of studies could be the European and Finnish real estate markets and how well their solutions for indirect real estate investments reflect the real estate market fundaments in the long term. These types of studies however are faced with the inevitable problem of scarcity of good quality data. When more time passes and more good quality data is at hand also the accuracy in real estate research could arguably improve.

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