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Comparison of real estate and forest equity properties as investment assets

Kiinteistöjen ja metsäkiinteistöjen ominaisuuksien vertailu sijoitus hyödykkeinä

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ABSTRACT

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This thesis studies the differences and similarities between real estate and forest equity as investment assets. The examination compares the intrinsic characteristics and the properties these characteristics impose to the assets as well as the asset structure and market dynamics. The study is executed as a literature review and qualitative comparison of findings based on literature review.

Real estate and forest equity are both real assets. As they belong within the same asset class, they share many common characteristics but also have major differences. Both assets have common intrinsic characteristics such as heterogeneity, non-transportability, localness, capital intensity, long investment horizon, lack of short selling opportunities, scarcity, and high investor managerial role. However, when examining these characteristics closely delicate differences divulge. These delicate differences impose diverging properties for the assets which also affect the markets of the asset.

Largest difference between the assets is created through the contemporaneous nature of the assets as both assets are simultaneously real investments and tradeable products. The underlying products of space commodity and timber, in real estate and forest equity respectfully, deviate substantially from each other by nature, markets, value, and cash flow. Space commodity is a necessity commodity sold on nearly perfect markets, whereas timber is a factor of production for lumber industry sold on oligopolistic markets featured by several structural shortcomings from perfect market model. Like the underlying products, the underlying value generation of the two assets diverges. Real estate is an investment into current income arising from trading rights to use space. Whereas forest equity is an investment into biological growth which generates large discreate returns through timber sale.

TIIVISTELMÄ

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Tämä tutkielma tutkii kiinteistöjen ja metsäkiinteistöjen eroavaisuuksia ja samankaltaisuuksia sijoitushyödykkeinä. Tutkielmassa vertailen näiden sijoitushyödykkeiden ominaisuuksia ja piireittä, joita ominaisuudet luovat, sekä sijoitushyödykkeiden rakennetta ja markkinoiden dynamiikkaa. Tutkielma on toteutettu kirjallisuuskatsauksena ja kvalitatiivisella vertailulla.

Kiinteistöt ja metsäkiinteistöt ovat molemmat reaalisijoituksia minkä myötä niillä on paljon yhteisiä ominaisuuksia, mutta myös merkittäviä eroja. Jaettuja ominaisuuksia on esimerkiksi heterogeenisyys, siirtämättömyys, paikallisuus, pääomaintensiivisyys, pitkä sijoitushorisontti, lyhyeksi-myynti-mahdollisuuksien puute, niukkuus ja sijoittajan aktiivinen rooli. Huolellinen ominaisuuksien vertailu paljastaa kuitenkin hienoisia eroja ominaisuuksissa. Hienoiset erot ominaisuuksissa luovat erkanevia piirteitä sijoitustuotteille sekä niiden markkinoille.

Suurin ero tuotteiden välillä syntyy tuotteiden kaksinaisesta roolista. Molemmat tuotteet ovat sekä sijoitushyödykkeitä että vaihdettavia hyödykkeitä. Vaikkakin sijoitushyödykkeiden erot ovat pieniä on kiinteistöjen hyödykkeen tilan ja metsäkiinteistöjen hyödykkeen puun välillä huomattavia eroja niin tuotteina, niiden markkinoissa kuin kassavirrassakin. Tila on välttämättömyyshyödyke, jota vaihdetaan lähes täydellisillä markkinoilla, kun taas puu on tuotannontekijä metsäteollisuuden yrityksille, jota vaihdetaan oligopolistisilla markkinoilla. Tuotteiden erojen myötä myös arvon luonnin pohja sijoitushyödykkeillä eroaa. Kiinteistösijoitus on sijoitus juoksevaan tuloon, jota kertyy tilan käyttöoikeuden myymisestä eli vuokraamisesta, kun taas sijoitus metsäkiinteistöön on sijoitus biologiseen kasvuun, joka tuottaa suuria diskreettejä tuloja puumyynnin kautta.

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1. INTRODUCTION

Reverse mortgage is a well-established financial product within the real estate market. However, reverse mortgage is the only reverse finance product accessible to consumers in any other asset class or market. Reverse finance allows borrowers to borrow capital against an unleveraged collateral with versatile withdrawal and amortisation plans (Huan et al. 2001). As will be illustrate in this thesis that an equity financial tool known as reverse mortgage can bring about financial benefits to forest owners that can further reduce some of the undesired properties of forest equity. This bachelor thesis will compare similarities and differences between real estate and forest equity and secondly discuss the possibilities of applying reverse mortgage into forestry business.

This transplant can be useful in evading some of the inherent undesirable properties of forest equity. Some of these structural adverse properties of forest equity are long investment horizon, large maturity mismatch between cash flows, strong emotional attraction, capital intensity, and illiquidity. Furthermore, forest accumulates value through biological growth and due to the nature of biological growth the accumulated value may not be economically vice to realize. For example, the case where the owner wants to realize the accumulated value, but the plot is not mature to harvest.

In the large picture the hypothesis is that the reverse mortgage product with small adjustments would be a competitive instrument to forest equity. However, there are several types of reverse mortgage products on the market that vary in maturity, termination clauses, behaviour of interest and cost and rights and obligations of the parties involved (Shao et al. 2015). To apply reverse mortgage to forest equity it is crucial to understand the similarities and differences of these asset classes. This thesis will focus to examine the similarities and differences between forest equity and real estate to provide the needed knowledge for applying reverse mortgage to forest equity.

Hence, this thesis will examine real estate and forest equity. The examination aims at divulging similarities and differences of these two assets. Both real estate assets and forest equity assets belong to the class of real estate assets. Thus, they will have many resemblances, but due to the very different nature of the assets it is expected that they also have some significant differences.

Real estate is defined in literature as interest, benefits, rights, and encumbrances included in an ownership of physical land included with all improvements affixed onto it (Pagourtzi, E. et al.2003). This definition of real estate includes both forest equity and real estate as both are tied on physical land. To increase the clarity and understandability of the thesis, real estate is defined as physical constructed property. Forest estate is defined as land which is in the use of forestry. Furthermore, in this study constructed property will be focused on residential property. This clarification is done to clarify the difference between forest equity and real estate equity.

1.1.Research subject and objectives

The aim of this bachelor's thesis is to carry out a qualitative comparison of real estate and forest equity assets. In the study a literature review will be conducted of both assets to discover characteristics and properties of both assets, their markets as well as risks involved in the investments. After this literature review a qualitative study will be conducted by comparing the findings made in the literature review. The objective of the literature review is to obtain an understanding of the similarities and differences between the assets. To fulfil this research objective two main research questions are studied. In order to address the main research questions following supporting research questions are posed.

- What are the similarities and differences between real estate and forest equity assets?
    - How does the asset structure differ between the assets?
    - Are there shared characteristics and properties between the assets?
    - Does the value generation differ between the assets?
    - What are the similarities and differences between the risks of these two assets?
- What are the similarities and differences in markets structure between the assets?
    - What are the market players and how do they differ or resemble each other?

1.2. Problem layout and limitations

This comparative study investigates assets in four different categories; the structure of the asset, intrinsic characteristics of the asset, markets of the asset and the risks involved in the asset. This approach excludes some genrally known determinants of assets like valuation, legislation and regulation, profitability, and any numerical comparison of the assets. However, these limitations

are applied in order to keep the scope of the study appropriate. The examination will be restricted within the Finnish real estate and forest equity markets. However, in some sections various sources which originate from Northern America, Asia and rest of the Europe are used. These sources which are not related to Finnish markets are used with careful consideration and only in geographically irrelevant contexts.

In addition, the properties of the assets are studied through economic framework and only through direct private ownership. This restraint is made to limit the scope of the work to comply that of the upcoming study. In addition, the examination of the assets is restricted to only certain subtypes of the assets. Forest equity is restricted to include only forestry land, excluding agricultural land, conservation land, wasteland, low productive forest land, and constructed estates. Whereas real estate is restricted only to residential real estate, excluding industrial, commercial, infrastructure and other public real estate.

1.3. Research methods

The study will be carried out as a literature review and qualitative analysis. The study starts with literature review. The literature review is divided into real estate and forest equity parts. The partition into two parts is made to enable a clear examination of both assets as they are complex in structure and in market. The division of the literature review also empowers the analysis of characteristics, properties imposed by the characteristics as well as the cooperative effects that the characteristics have in both assets.

In both parts of the literature review the main interest is in the Finnish markets. However, in both reviews international sources are used with careful consideration. The sources of the real estate literature review part contain more international sources than the forestry review. This is due firstly to closer resemblance of real estate sectors globally compared to forestry sectors resemblance. And secondly to the abundance of market specific literature of forestry versus real estate.

The timely dispersion of the sources is large. The oldest source utilized is from 1970’s which spans of the long and stable investment horizon of the real estate and forest equity assets. However, in utilizing the sources careful consideration of the publishing date is taken into

account. It is notable that both assets and their markets have changed very little over time and thus the utilization of older sources is acceptable.

The empirical part of the study consists of two parts. The first part deals with the development of forest market framework. The need to develop a forest market framework is raised from the finding that no comprehensive market model exists. The market model was designed to enhance the comparability of the real estate and forest equity markets. Thus, the forest equity market model was designed based on DiPasquale and Wheaton (1996) four-quadrant model of the real estate market. The second and main empirical research of the thesis is the comparison of the two assets. This comparison is executed as a qualitative comparison of characteristics and how they affect the assets. The objective of this comparison is to find and examine the similarities and differences of the assets.

1.4. Framework and structure of the study

The study is divided into three chapters. The study starts with literature review of real estate equity sector, followed by literature review of forest equity sector that is followed by the comparative part of the study. Each chapter is divided into three sections discussing the same dimensions of the assets. In the first section the structure of the asset is examined and a short introduction to market structure is introduced. The first section also includes the examination of intrinsic characteristics and properties these characteristics create to the assets. In the second section a market models are introduced. In the real estate part, the market model introduced is the four quadrant model (DiPasquale and Wheaton 1996) and in the forest equity market model a triangular market model is created. With the help of the market models the market structure, market forces, market players, submarkets and their interactions are studied. Lastly in the third section the risk involved with respected assets is examined. In the below figure the framework of the study is presented.

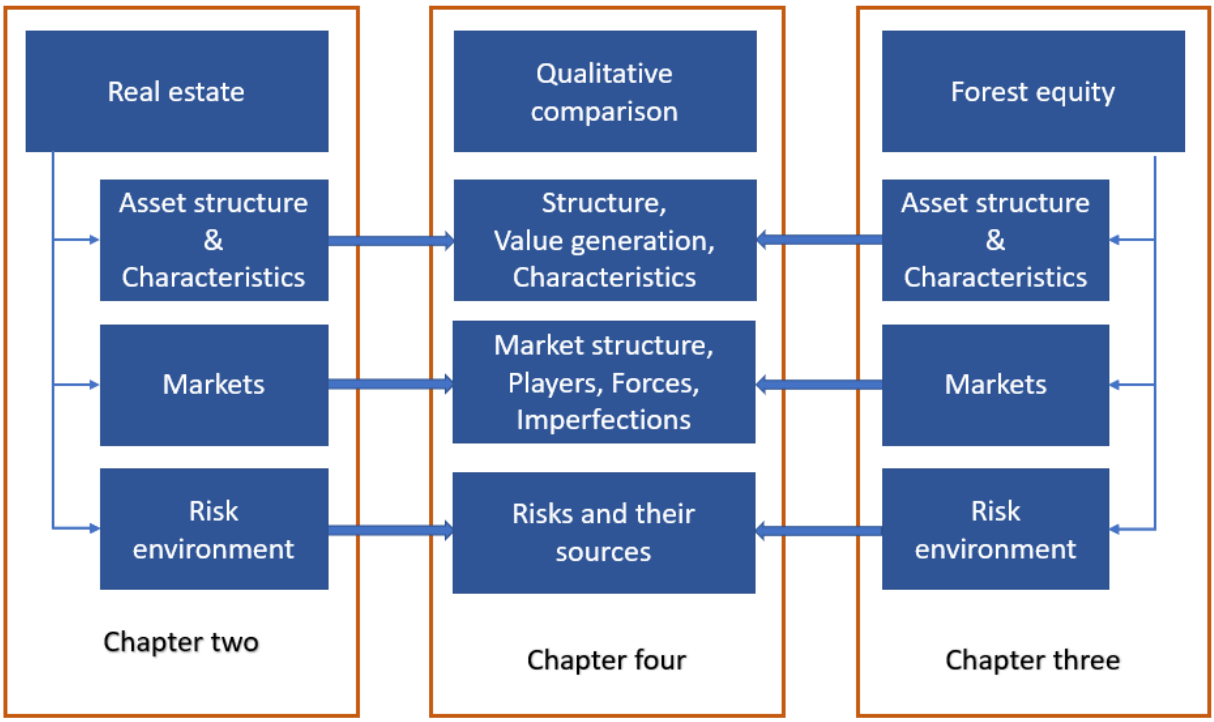

Figure 1 Framework of the thesis

2. REAL ESTATE EQUITY AS AN INVESTMENT ASSET

In this chapter real estate is studied in four parts. The chapter starts with the examination of real estate as an investment asset. The part consists of a short introduction to different markets involved in real estate and an examination of intrinsic characteristics of real estate. In the second part a real estate market model is introduced and each submarket within the real estate market is examined in depth. The market study focuses on market players, market equilibriums and the interrelations of the markets. Lastly, the focus turns to study the risk related to real estate.

2.1.Real estate as an investment asset

Pagourtzi et al. (2003) define real estate as physical constructed improvement, affixed on land, whose owner has the right to exploit the benefits of the ownership and has the burden to meet the costs of ownership. According to Fisher (1992) real estate differs from all major investment assets by its dual characteristic, which according to him is central to understand if one wants to have a complete understanding of real estate. He argues that real estate is simultaneously a commodity of space and an investment asset. Both of which have their own separate markets within the real estate market. (Fisher 1992) To complement with Pagourtzis et al. (2003) definition of real estate, the space market of real estate is the market where the rights of real estate are sold between real estate holders and occupiers. In the space market the real estate holder transacts the right to occupy the space to tenants against rent or interest. Tenants can be consumers, companies, or other space needing entities, and in this thesis all tenants are referred as occupiers. In the asset market of real estate, the physical properties or assets are transacted among investors. On the asset market property holders and construction entities supply the market whereas investors and owner-occupiers create the demand. (DiPasquale & Wheaton 1992)

Owner-occupiers are consumers or other entities who opt to both own, i.e., invest into the property, as well as to occupy the property. Investors on the other hand are consumers or other entities who opt to invest in real estate assets to gain profit by selling the rights of ownership. Both groups have varying motivations and behaviour in the market. (DiPasquale & Wheaton 1992) For investors real estate offers a fixed, semi-predictable and constant income in the form of rent as well as possible value appreciation of the property (Orava & Turunen 2013, 17-20).

For owner-occupiers, the real estate offers utility through consumption of space as well as the possible value appreciation of the property (Shelton 1968). The utility of owner-occupiers consists of both economical utility and utility of mastery. The economical utility consists of the difference in cost of purchasing the right to occupy the estate though space markets and the cost of owning the property and its rights. The utility of mastery is the individual experience-based utility of owning the property which includes the right to master the property. The determination of utility is difficult and should be determined case by case. The difference in utility between owner-occupancy and occupancy can be positive or negative. (Shelton 1968)

The difficulty of determining the utility rises from heterogeneity of real estate asset and preferences of individuals. Real estate has a high degree of different properties which can differ from one another. (Kuosmanen 2002, 81) Thus the economical utility is hard to quantify due to lack of similar benchmarks. The determination of utility is hard also because each individual has their own preferences with respect to nearly endless degrees of heterogeneity in real estate. (Shelton 1968). The high degree of heterogeneity in real estate exposes real estate to further characteristics. According to Oikarinen (2007, 33-34) due to the heterogeneity of real estate there is no centralized marketplace for space or asset markets. The lack of a centralized marketplace hinders the transparency of price determination on the aggregate market, and on the individual trade level leads to asymmetric information between the buyers and sellers. These imperfections on the market make the real estate market highly imperfect. (Oikarinen 2007, 33-34) The heterogeneity of real estate implicates a special categorisation to real estate compared to other investment assets. Bonds are categorised and quoted on the markets by their issuer and coupon interest, stocks are categorised by company, whereas real estate are categorised by their usage. (Manganelli 2015, 8-9) This categorisation of real estate's creates technical submarkets. Each technical submarket has its own demand and supply which are somewhat separate from demand and supply of other submarkets. For example, the supply of single-unit apartments does not satisfy the demand of three-unit apartments. (Geltner et al. 2007, 4-5)

One key characteristic defining real estate is immobility which leads to further properties of real estate. Immobility makes real estate a local asset and commodity. This locality creates areal submarkets, which is one key characteristic of real estate. The areal submarkets can be further divided into macro and micro markets. Due to locality the price fluctuation as price per square meter on of a certain area can be assumed to be similar and to move in tandem, which increases

the price transparency. However, the areal submarkets also enhance the imperfections of the markets. (Manganelli 2015, 10) Locality causes the space market to be scarce, which leads to irrational pricing behaviour among investors and occupiers. The irrationality can be observed as inflated areal prices, which do not follow the assumption of rational consumer. (Hoesli & MacGregor 2000, 19–23) Strictly thinking real estate itself is not scarce as space is a producible item, but locality creates some restriction on production. Due to locality, one cannot build exact copies or in some cases not at all new space as the space on which real estate is placed is scarce. According to Hoesli & MacGregor (2000, 19–23) one of the most important properties that real estate has is its location. The infrastructure and services next to real estate affects greatly the value of real estate and price of space. They also point out that as the micro and macro location are major contributors to value and the investor can't affect the development of the surroundings the value generation is not fully controlled by the investor. (Hoesli & MacGregor 2000, 19–23)

Real estates have low liquidity compared to many other major asset classes. Low liquidity can be observed as long transaction times and low number of trades compared to market size. According to Oikarinen (2007, 33-34) the lack of centralized marketplace and locality of real estate contribute to long transaction times. Compared to other asset classes real estate's transaction cost are high which is caused by the heterogeneity, market imperfection and lack of centralised market palace, which increases the need for professional relaters. (Oikarinen 2007, 33-34) Part of the transaction cost is due to taxation. In Finland real estate has a two percent wealth transfer tax and mandatory fees caused by documents as well as other cost related to transaction.

Real estate is a high capital intensity investment, which means that the unit costs of real estate are high. Due to high capital intensity majority of the estate purchases are partly financed by borrowing and thus the usage of borrowed capital plays a large role in real estate market. (Hoesli & MacGregor 2000, 19–23) Some scholars argue that the real estate markets should include a third market besides space and capital markets. For example, Archer and Ling (1997) argue that the real estate market should be described by three separate markets space market, property market and capital market. The high unit costs of real estate are due to indivisibility of real estate, which means that one real estate is difficult to split or separate to two individual proportions. This is especially true to residential real estate. The indivisibility contributes partly to the liquidity as well as to the high capital intensity of real estate. The high capital intensity of real

estate is complicated by the lack of short selling opportunities of real estate, which rises the risks in real estate assets (Zheng et al. 2015, 426-427).

It is typical for real estate investment to have a long investment horizon. This is partly due to high transaction cost as well as low volatility and steady price development of real estate. (Hoesli & MacGregor 2000, 19–23). The long investment horizon of investment assets is also partly due to long business and development cycles of real estate. According to Hoesli and MacGregor (2000 19–23) real estate is an active investment compared to bonds or stock. Real estate investments require active managing, reinvestments to renovation, and include recurring responsibilities such as taxes and remunerations. According to Oikarinen (2007, 11-13) real estate is a durable commodity, which retains its value well. This is supported by real estate being a necessity commodity of space. This necessity makes both space and property markets of real estate very stable over time. (Oikarinen 2007, 11-13) However real estate's value degrades through wearing over time. Compared to other investment assets regulation has a larger role in real estate investments. Real estate is regulated through legislation and active governing through taxes, subsidies, and standards. This makes real estate investments sensitive to regulatory changes. (Hoesli and MacGregor 2000, 19–23)

2.2. Real estate markets in Finland

To study the real estate market structure and the market dynamics in a comprehensive way a model of real estate markets needs to be introduced. In this chapter real estate market is studied with the help of four submarkets and their relations. The market model consists of space market, property or asset market, capital market and construction market that are comprised into figure 2 (page 10). Each market displayed in the model has their own market equilibrium, noted below the market name in each box. The equilibrium of given market is determined by function of market variables of the market in question. These market variables are denoted on both sides of the scale figure in each box. The four separate markets define the real estate market through market mechanism which are most easily studied through the equilibriums and interactions of the markets. The interactions between the markets are denoted in the figure with yellow arrows.

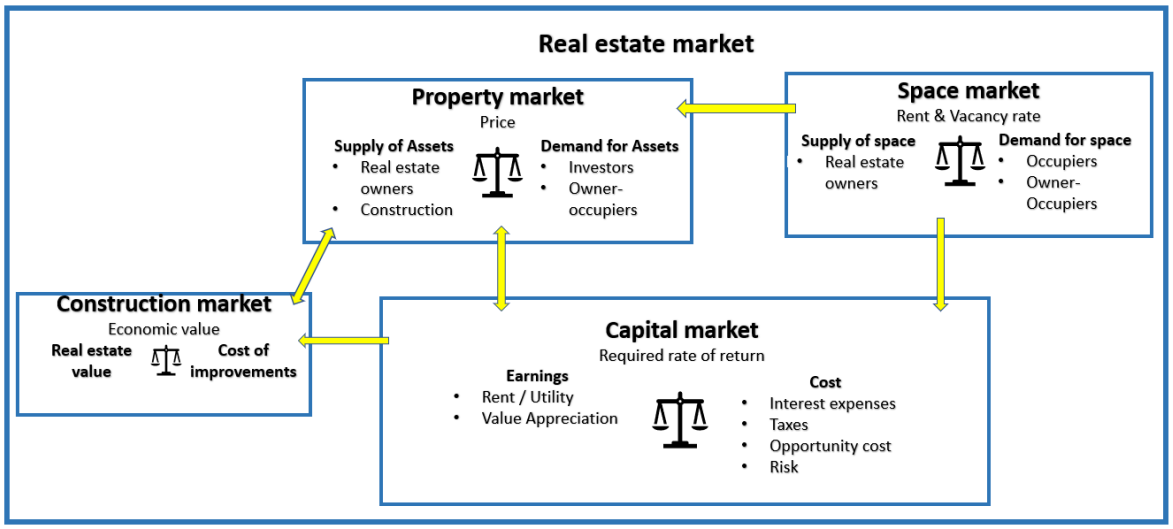

Figure 2 Construction of real estate market with the help of four market-model

This four-market model is constructed as a combination of works by DiPasquale and Wheaton (1992), Archer and Ling (1997), Fisher (1992) and Geltner et al. (2007). DiPasquale and Wheaton (1992) introduced the two-market model of space and property markets in which the construction market is included within the property market. Archer and Ling (1997) introduced the three-market model of space, capital and property market. Fisher (1992) studied the connection of space and capital market through risk and emphasised the importance the role of capital markets in real estate. Geltner et al. (2007) studied broadly real estate market structure and real estate investing. In the four-market model the four equilibriums are property price in property market, rent and vacancy rate in space market, required rate of return in capital market, and economic value in construction market. The equilibriums are not only determined by the market variables of given market but also by the equilibrium variables of other markets. Due to these inter connections the real estate market is a large dynamic system of separate markets. (DiPasquale & Wheaton 1992; Fisher 1992; Archer & Ling 1997)

To felicitate the study of the market interactions a four-quadrant model of space, property and construction market is introduced. This model is introduced by DiPasquale and Wheaton (1992) to represent the dependencies between markets. According to DiPasquale and Wheaton the right side of the diagram represents the space market and the left side the property market. In the diagram four main variables rent, property price per unit, amount of construction by unit and the total stock of constructed space are denoted in the axis. The equilibrium is derived by inputting the exogenous variables into the functions of each quadrant and the positive y axis and then

moving from quadrant to quadrant in counter clock vies to determine the rent, price, and amount of construction variables. (DiPasquale and Wheaton 1996) The four-quadrant model or DiPasquale and Wheaton model is a static representation of the relationships of the market and displays the long-term equilibrium state of the market. According to Pirounaksi (2013, 245) even though the model is static it suits well into studying how the changes of one market affects the equilibriums of other markets. In reality, the relationships between the quadrant are not linear, as presented, due to lags and elasticity of market variables (Pirounaksi 2013, 245). In real world the markets can occasionally have large deviations from long-term equilibriums. (Oikarinen 2007, 110) The model is created for the aggregate real estate market but with careful restraints the model can be also modified for areal as well as technical submarket study.

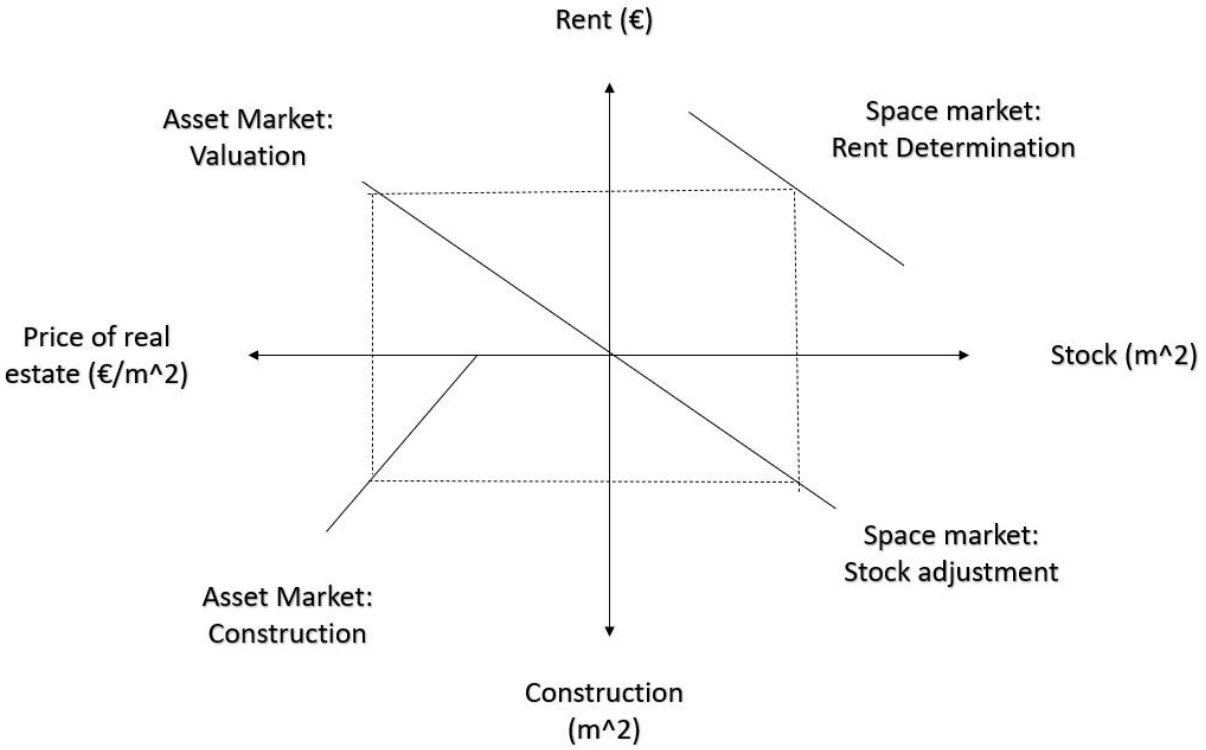

Figure 3 The inter links of space and asset markets (After DiPasquale and Wheaton 1992)

2.2.1. Retail space market

In the space market the real estate holders sell the right to occupy the real estate to tenants in exchange for rent. Thus, rent is the price of space commodity and also the equilibrium variable of the market. (DiPasquale & Wheaton 1996) According to Fisher (1992) rent determination on free markets is done very efficiently through supply and demand. This means that rent level is

determined in short and long term by the highest bid of demand side (Fisher, 1992). In the figure 3 the rent determination is located in the north-east quadrant. In the four- quadrant model the supply is assumed to match the stock of build space which is represented as positive y axis. The level of rent is determined by the demand function. According to DiPasquale and Wheaton the demand function is combination of exogenous factors. (DiPasquale and Wheaton 1996) Pirounaksi (2013, 242-244) points out that DiPasquale and Wheaton model assumes no vacancy, which in real economy is not observable, and that when the exogenous variables of demand function are assumed to be constant the rent is determined solely by the available space.

The exogenous factors can be divided into demographic, preferences, socioeconomic and political factors. According to Kivistö (2012) demographic factors are the most important factors in the long run. The most important factor being the areal and national population and its change. The role of areal migration from migration loss areas to migration gain areas changes the balance of space market radically in the long term. Besides the population and its changes also the age distribution and the amount of one person households affects the aggregate demand as well as the demand within submarkets. (Kivistö 2012) For an example according to Kivistö (2012) as the age distribution skews towards the elderly the demand for smaller and closer to services apartments rises.

Customer preferences are also an important factor of submarket demand. One trend according to Kivistö (2019) is the rise of demand for smaller units as consumers prefer more privacy and smaller household units. After 1990s 70 percent of the new households can be explained by increased number of household units and only 30 percent by increase of population. Preferences also highly determine the share of demand by each technical submarket. Kivistö (2019) Changes in consumer demand can occur quickly and the impact of preference changes can be observed quickly in the market, whereas demographical changes affect the market more gradually (Pirounaksi 2013, 205-209).

Socioeconomic factors play also a major role in the housing market. According to Oikarinen (2007, 106) the two most important socioeconomic factors are the amount of working people over the whole population and real earnings per household. The amount of financial resources and purchasing power per household correlates strongly with expenditure of housing. The rise of purchasing power also increases the subjective pricing of housing over the economic or rational

pricing. The amount of working people increases the housing prices not only through increased purchasing power but also as indicator of population gain, as areas with more job opportunities tend to have higher population gains. (Oikarinen 2007) Political factors are also a large contributor to demand curve of space markets as government grants several subsidies to support housing both directly to the consumers but also indirectly by creating arbitrarily cheap housing solutions as well as subsidies and tax benefits to certain entities. (Lindblad et al. 2019)

If the exogenous variables are considered, one can see that many of them are not constants by nature. The exogenous variables determining the demand curves of areal and technical sub-markets can change and these changes affect the market rent. Thus, a model with no-vacancy and constant exogenous variables does not determine market rent accurately. (Pirounakis 2013) According to DiPasquale and Wheaton (1996) the four-quadrant model works well in various market conditions even in markets which have a high owner-occupancy ratio. They argue that as the model is based on preferences and macro-economic factors, such as income level, the utility function of consumers does not affect the market equilibrium. In the long term and in perfect markets the utility between owner-occupancy and renting should be zero. (DiPasquale & Wheaton 1996).

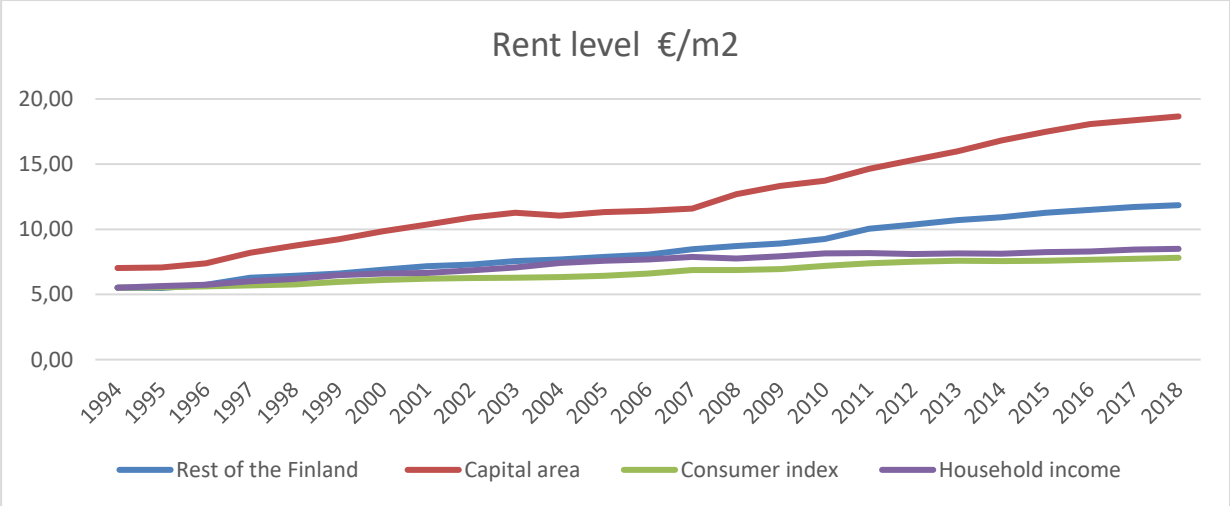

Figure 4 Rent level development in Helsinki area and in the rest of Finland (SVT a 2021)

Figure 4 illustrates the average rent level development per square meter. In the figure we can see that the average rent level has increased significantly, and that the growth rate surpasses both the average household income and the consumer price index. However, we can clearly see the price and price level change difference between the capital region and the rest of the country.

2.2.2. Property market

On the property market investors acquire real estate assets from real estate holders or construction sector as an investment. The demand side consists of investors who can be either investors or owner-occupiers. The supply side consists of both real estate holders who are divesting and construction market players who are building new assets. (DiPasquale & Wheaton 1996) Construction market dynamic will be studied later in this part. The case of investor through the four-quadrants model and then apply the model to also account owner-occupiers. According to DiPasquale and Wheaton (1996) real estate investors acquire real estate to obtain a current income stream. According to Fisher (1992) the price per unit, which is the equilibrium of property market, is determined on the property market by investors pricing the risk of the future income. According to him the price is determined by supply and demand and as the there is more demand than supply the highest bid determines the equilibrium price. (Fisher 1992)

DiPasquale and Wheaton (1996) argue that investors price the properties with the help of capitalisation rate. Capitalization rate is the operating net income divided by the price of the real estate asset. This capitalisation rate can be seen in the north west quadrant emitting from the origin. This is the current yield required by the investors, which is determined by long-term interest, expected growth of rent, risk concerned in the investment and tax burden by the state. (DiPasquale and Wheaton 1996) When this is to be compared to Fisher's (1992) price determination one can see that when the investors required rate of return lower the asset prices grow i.e., the investors who are willing to take the most risk determine the price on markets. The determination of required rate of return will be looked more closely in the capital market part.

In DiPasquale's and Wheaton's model the property market and space market are in relationship through rent. In their model the house price is determined with rent and capitalisation rate ratio, which is the required rate of return. Capitalisation rate is the combination of opportunity cost, risk, long term interest, and expected growth of rent. In the figure z the capitalisation rate can be seen in the upper right quadrant as a ray from origin. (DiPasquale and Wheaton 1996) Disagreeing with DiPasquale and Wheaton (1996), Fisher (1992) argues that real estate assets can also have option values. These option values can affect the pricing of real estate increasing the price on market (Fisher 1992). According to Geltner et al. (2004, 275) the real estate asset market is also affected by subjective pricing of owner-occupiers, which can increase the

equilibrium price. This subjective pricing comes from owner-occupiers whose capitalisation rate consists of economical utility and utility of mastery. The individual specific utility of mastery and consumer preferences on characteristics make the owner-occupiers to bid irrationally.

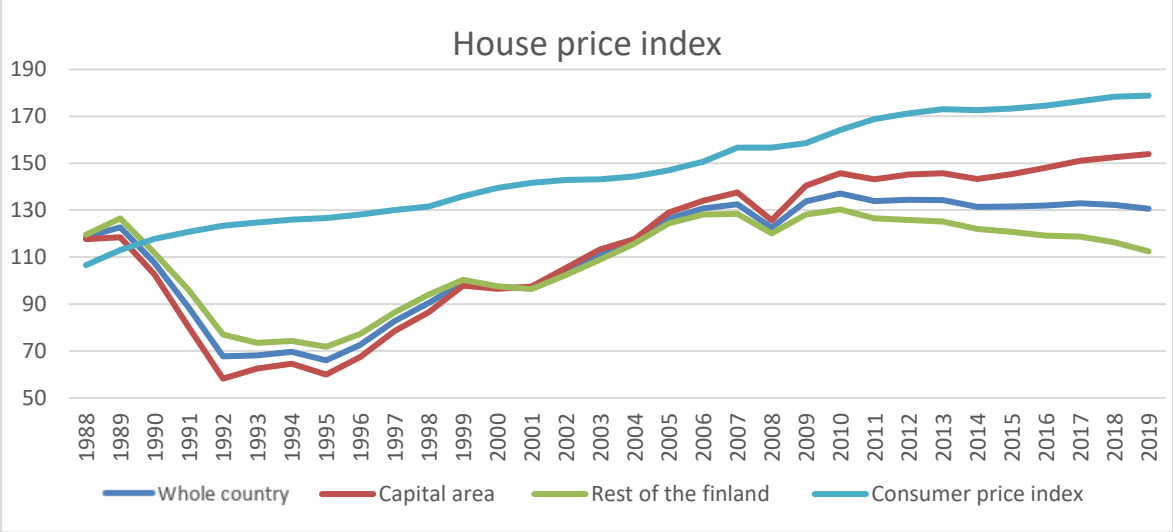

Figure 5 Housing price index and consumer price index (SVT a 2021; SVT b 2021)

Figure 5 illustrates the housing price index development on aggregate markets in hole Finland, capital area and rest of Finland. From the figure we can observe the large price correction of 1990s depression and two smaller price corrections during 2000 and 2008 depressions. On average however the housing price index has risen steadily with small volatility since the 1990s crash. Another interesting finding is the divergence of areal submarket prices on macro level since 2008.

2.2.3. Construction market

The construction market consists of both renovation and construction. Renovation increases the existing quality of space stock or deforms existing stock from one functional submarket to another and construction sector builds new space to space stock (DiPasquale 1999). In DiPasquale and Wheaton's model the construction market is part of both the space market and the property market. The amount of construction, square meters of new space, is determined in the lower left quadrant by price per unit of real estate asset and the construction cost function. (DiPasquale & Wheaton 1996) Line C is a function of exogenous building costs which determine the amount of construction for given price per unit. These costs are cost of materials, cost of

labour and value of land, among others. In DiPasquale and Wheaton's (1996) model the equilibrium the price of properties is equal to the replacement cost of space on the long term. Thus, the construction sector will start construction only when the value of new construction projects exceeds the expected value of the projects. As the amount of construction is determined by the cost and value of land the equilibrium of construction sector is economic value which in the long term is zero. (DiPasquale & Wheaton 1996)

In reality the prices and amount of construction can vary greatly in the short term. There is also areal deviation from this equilibrium such as city centres where the market prices are significantly higher than replacement cost. For this deviation DiPasquale and Wheaton (1992) present a second equilibrium price of land. In this equilibrium the amount of construction increases to the point where the value of bare land matches the value of constructed land. To study the effect of added space to building stock the amount of construction is added to the existing building stock in the south-east quadrant. (DiPasquale and Wheaton 1996)

In real economy however the addition of new space through construction does not accumulate space instantly due to lag of construction. The lag between the demand and supply of new space introduces elasticity to the supply of properties and space. Thus, in real property markets the supply is fixed in the short term and has significant eliasticity in the long-term. (Huovari et al. 2002, 21) The elasticity is further amplified by regulatory authorities who restrict the amount of construction through permits. DiPasquale (1999) also points out the role of renovation which increases the rent and property values through increased quality. This increase in quality transfers construction costs into the property and space markets. (DiPasquale 1999)

2.2.4. Capital market

The role of capital markets in real estate market modelling is versatile with different views. In DiPasquale and Wheaton's (1996) model the capital market is seen as an exogenous force and modelled by variables of capitalisation rate. Fisher (1992) on the other hand argues that there are no separate property market and capital market, but they are the same market. In Archers and Lings (1997) model capital market is its own market along-side property and space markets. Compared to the clear distinction of space and property markets, capital market does not have a clear place inside the framework of real estate.

Nevertheless, all scholars agree that capitalisation rate plays a central role in real estate asset pricing and in each model the capitalisation rate reflects the relationship between space market and property market. Both DiPasquale and Wheaton (1992) as well as Fisher (1996) agree that the capitalisation rate is determined by risk, expectations of future rent, opportunity cost, inflation, and taxes. DiPasquale and Wheaton's (1992) model approaches the capitalisation rate very mechanically and distances the role of capital markets in their work to exogenous variables. Whereas Fisher (1996) recognises in his paper the nature of capital markets as a risk pricing machine.

Archer and Lings (1997) examined capital markets through risk pricing. They argue that capital markets determine the required rate of return to capital. The required rate of return is determined by risk free interest and risk premium of aggregate capital markets. This required rate of return for capital markets serves as a benchmark and as the minimum return of capital which must be fulfilled if the capital is to be invested into the real estate market. To this required rate of return the real estate specific risk is priced by adding investment specific risk factor into the discount rate. With these investments specific rates, the capital is allocated within the property market. Thus, the role of property market is to allocate dedicated capital within the market between competing investments. In this three-market model the capital market determines the systematic risk of the investor and the idiosyncratic risk of the space market separate of the property market. This means that the property market is a competitive market where the highest bid wins i.e., the lowest discount rate wins. (Archer and Ling 1997)

2.3. Risks concerning real estate

In this part of the chapter the risks related to real estate investments are explored. The risks of real estate investments can be divided to three levels market, submarket, and investment level risks. Market risk, also known as systematic risk, is a risk that affects the whole property market and space market. The submarket and investment risk, also known as idiosyncratic risk, affect only restricted part of the property and space markets (Shao et al. 2015). According to Orava and Turunen (2013, 197) the risk characteristics of real estate diverges from other investment assets due to high level of heterogeneity and the investors right to mastery of property. The heterogeneity and right to mastery the property transforms the riskiness of individual

investments, very investment and investor specific as the investor's knowledge and experience as well as investments properties affect the level of potential risks. This is not the case in many other investments asserts as many other investments have low investor responsibility. (Orava & Turunen 2013, 197)

Due to the high degree of heterogeneity and strong price determination within sub-markets, whose price determination is not well connected to other sub-markets, the literature is not managed to define the amount of systematic risk and idiosyncratic risk. The systematic risk also known as beta risk can be found to vary greatly between different sub-markets. The amount of idiosyncratic risk varies greatly between submarkets, where some submarkets can respond positively and some submarkets negatively to changes. This variability in risk pricing between submarkets makes the real estate risk examination difficult. (Shao et al. 2015) The examination of risk is made difficult also through the interconnection of different risk and their cooperative effect to multiple values. This is due to complexity of real estate market structure which has several market equilibriums and interconnections. As one risk can simultaneously affect multiple market equilibriums the consequences of realised risk are difficult to predict. Thus, in this chapter the study of real estate risk is not examined through the market model parse. The risks are studied with the help of a two-by-two matrix where the risks are placed. The categories of this matrix are internal and external business risks and the source systematic or idiosyncratic. On top of these categories real estate has environmental risk. In the below table the risks studied in this part of the chapter are summarised.

Table 1 Summary of risk involved in real estate

Business risk \ Source	Systematic	Idiosyncratic
Internal • Strategic • Operational		• Building infrastructure • Risk of renting (empty months and tenant risk) • Rumination risk • Renovation risk
External	• Long term demand risk (demographic, national economy, income level) • Interest risk • Inflation risk • Opportunity cost	• Political risk • Rent level risk • Price risk (aggregate price risk and base risk) • Liquidity risk • Bank risk
Environmental risk	• Natural hazards	

The risks of real estate affect the value of property or the net operating income that the property generates. The examination of risk starts from internal risk, followed by external risk and environmental risks. All the internal risks are idiosyncratic meaning that they are related to internal processes or individual assets. The internal business risks can be divided into strategic and operational risks. According to Orava and Turunen (2017, 252) the risks involved in renting are operational business risks which affect the rental income of the investor or the value of the property. Rental risk can be divided into two risk, risk of empty months and tenant risk. The risk of empty months is the risk that the investor cannot find a willing tenant how fulfils the required rate of return of the investor. In these cases, the investors NOI is negative as the revenue component is zero while the responsibilities of the investor remains at the same level (Orava & Turunen 2017, 252). The tenant risk is comprised of solvency risk of the tenant and moral hazard risk of the tenant. If the tenant is insolvent to pay rent the investors revenues are either postponed or permanently lost which affects the NOI of the investor. Tenants can also bear also moral hazard risk. Tenants can mistreat the property which can affect the value and rentability of the property and can cause costs to the investor. (Kaleva & Olkkonen 1996, 12)

The strategic business risks are risks involved with the long-term profitability of the investment in the form of rising costs (Orava & Turunen 2013, 257). The risk affecting the cost are

rumination risk and renovation risk. The renovation cost and ruminations of real estate are well predictable for short time frame, but in long term they can bear significant uncertainty. This uncertainty is caused by the risk that the building infrastructure or regulation changes which can decrease the investors returns. (Orava & Turunen 2013, 108 & 257) Renovation risk and building infrastructure risk can also realise in the form of empty months.

The external idiosyncratic business risks are risk which affect a given submarket of real estate or a specific asset. It is commonly agreed that these risks consist of rent level risk, price risk, liquidity risk, bank risk, and political risk. According to Orava and Turunen (2013, 205-207) the rent level is under rent level risk. Rent level risk is the risk that the rental levels on aggregate market drop due to changes in the market forces. (Orava & Turunen 2013, 205-207) These market forces can be for example, increase in space supply, decrease in property prices, decrease in required rate of return of investors, or changes in consumer preferences. The rent level risk can be realising also through some systematic risks realising. These risks can be demographic changes which affects demand or drop in consumer income which decreases the purchasing power of consumers.

The price risk is the risk of sudden price correction on property markets (Leväinen 2013 209). Even though the value of real estate is on theoretically tied to the rental level and the required rate of return of investors there can be price disturbances. These market disturbances can alter the long-term equilibrium price greatly, which exposes the investor to price risk. The price risk can also realise through demand and supply shocks or sudden fall in required rate of return or in rent level. (Kiander 2001, 23) House prices as any investment commodity follows long term business cycles (Quan & Titman 1997, 22). Orava and Turunen (2016, 247) however remind that price risk is realised only if the investor is seeking to sell the property or trying to leverage the property. They also point out that a very leveraged investor could face financiers covenants difficult in market price corrections if they are highly leveraged. (Orava & Turunen 2013, 210) The determination of price risk is difficult due to heterogeneity and submarkets. According to Leväinen (2013, 209) price risk is heavily dependent on areal and technical submarket. The price risk can be divided into aggregate price risk and base risk. The aggregate price risk refers to a drop in aggregate housing prices or submarket prices, whereas base risk is the risk that the price of single investment diverges for the aggregate price development.

Liquidity risk is the risk that the investor cannot easily convert the investment into cash, which exposes the investor market conditions longer than the investor wants. (Kallunki et al. 2002, 108) Bank risk, according to Orava and Turunen (2013, 210), has a very low probability to realise but when realised it can have serious implications to real estate investment. Bank risk in its most serious form is bankruptcy of bank, call back or renegotiation of loan conditions and with its less serious form the denial of new capital (Orava & Turunen 2013, 210). Naturally if the investment is not leveraged the investor does not carry bank risk.

Political risks concern taxation, legislative, regulatory and subsidies changes which affect the market dynamics, hinder new investments, or affects the net operative income variables such as aggregate rent level or cost side. Market level political risk concern taxation, interest taxation, consumer leverage restrictions, housing and tenant subsidies, land taxation, property taxation, tax alike payables, housing and building regulation. On local level political risk can be zoning decision, accessibility to public services, and infrastructure investments. (Levänen 2013, 209; Orava & Turunen 2013, 209-211; Kaarto 2015, 29)

The external systematic business risks are risk which affect the long-term demand or profitability. These risks are democratic or national economic changes, interest rate risk, inflation risk and opportunity cost of the investor. Long-term market risks relates to national and local economical and demographical factors which determine the long-term market development of both space and property markets. Large demographic changes or sudden drop in consumer purchasing power can decrease the demand decreasing the rent and thus decreasing the value of property. The interest rate risk affects real estate investment in several ways. Interest rate affects the investors required rate of return, profit of renting as well as demand and supply in the property market through the amount of capital entering and leaving property market. As discussed earlier real estate investments are financed heavily through leveraging up to 70-80 percent. An increase in interest rates increases the interest expenses of the investment which can make the investment unprofitable. Interests' effect on profitability is calculated more as a capital market risk than space market risk as the rise in interest affects the required rate of return and not the net operating income, which is a before capital expenders in income statement. (Orava & Turunen 250-251) Thus, according to DiPasquale and Wheaton's (1996) model interest rates do not affect the price of property through the discounting factor. This increase of discount factor decreases the present value of future cash flows which then decreases the house prices (Fisher 1992).

Rising interest also increases the opportunity cost as the returns on bonds increase. This increase of opportunity cost added with lower leverage percentages, due to higher interest expenses, can decrease the amount of capital flowing into property market and increase the capital withdrawn from the markets. Interest markets are also tightly tied together with inflation, as rising interest rates tend to increase the inflation. However real estate has been found to perform well under moderately high inflation compared to other investment assets. (Benjamin et al. 2001; Hamelink & Hoesli 1994; Glascock & Davidson 1995)

According to Orava and Turunen (2013, 210) the risk of natural hazards and technical building infrastructure failure are a serious risk to consider in real estate investments. These risks can derogate the value of a property greatly with one sudden random event. Luckily, these risks are random events which means that they are insurable. (Orava & Turunen 2013, 210)

3. FOREST EQUITY AS AN ASSET

Forest equity is part of the real estate equity family and is defined in similar terms than real estate equity. Forest equity is defined as the interest, benefits, rights, and encumbrances included in an ownership of physical land included with all improvements which are affixed on the property into it (Pagourtzi, E. et al.2003). Forest equity holding can be in the form of direct ownership of hole or a proportion of estate, or indirectly through establishments which hold forest estates. In case of Finland forest estate is defined in real estate formation law 2.1 § (Kiinteistönmuodostamislaki 554/1995) as "independent unit of land ownership, which is by real estate register law (Kiinteistörekisterlilaki 392/85) or by other register unit marked in real estate register as a separate unit. Real estate comprises of area, share of common areas and common benefits as well as easements and private specific benefits belonging to the real estate." In this thesis forest equity is studied only through direct ownership of forest estates and forest estate is used only to refer only forest land. Thus, forest equity, forest estate and plot are used interchangeably for forest estate defined in real estate formation law.

Forest equity has wide array of physical and abstract properties. These properties create unique characteristics and values to forest estates. (Airaksinen 2008, 9) According to Gregersen et al. (1995) the value of forest can be divided into direct, indirectly, and passive value, which are either sharable or non-sharable. Due to versatile characteristics and multidimensional values of forest there are multiple different players with varying interests to possess forest. But as the thesis the discussion is focused on forest financing and thus a natural restriction is to study forest equity through forestry. Due to this restriction forest estates examined are considered to lack constructed improvements and fulfil the requirements of forest cultivation. In literature the requirements for an estate to be suitable to forest cultivation is a uniform area of two hectares of timberland (Ärölä et al. 2019, 82-83). Thus, the thesis limits the examination to estates over two hectares.

This chapter starts with the examination of the physical and abstract composition of forest estates and what characteristics these properties create to forest as an investment asset. The examination also includes an examination of the rights and obligations of the forest estate owner and the markets of forest estates and timber. The examination of forest as an investment asset is followed by a study of different valuation methods used to value forest estates. Lastly the risks involved in forest investing is studied.

3.1.Forest equity as an investment asset

The main physical properties forest estates are size measured in hectares, shape and location of estate, timber and other plants growing on the ground, and forest ground composition. Location of forest can vary by proximity to population centres and the geographical location. Geographical location is measured in heat sum, which is the average mean day temperature of days which are over 5 degrees (Ärölä et al. 2019, 15). The timber is measured by classes and volume in cubic meters. The classes are classified mainly by the species and quality. The three main timber species in Finland are pine, spruce and birch and the quality classes are log, small log, pulpwood and energy wood according to the size and other features. (Hakala et al. 1998, 87). Forrest ground is classified by soil composition, rockiness, and wetness of the ground. Because forests are not generally uniform within an estate the estate can be divided into stands which are smallest economical units of forest composing of homogeneous timber, soil composition and silviculture measures. (Hakala et al. 1998, 152)

Due to the versatile physical properties of forest and ground forest estates are very heterogenic assets. The heterogeneity is due to the different properties of stans composing the estates, which can vary significantly within and between estates. Naturally, the heterogeneity is not stable over time as timber grows through its turnover-time which changes the physical properties between stands and estates. (Linna 2012, 29-30; Airaksinen 2008, 19) The heterogeneity of forest is empathised by the scarcity of forest estates (Linna 2012, 27-32). The scarcity of forest estates is due to fixed location of the estate which makes the asset local, non-transportable, non-producible. (Virtanen 1992; Linna 2012, 27-32; Airaksinen 2008, 19). However, the estates are dividable as the estate can be separate to smaller estates which can be sold separately (Linna 2012 27-32). Due to the localness of estates the forest equity market is also local restricting the number of buyers and sellers making the forest estate market illiquid (Virtanen 1992). According to Virtanen (1992) the heterogeneity of estates further empathises the illiquidity of the markets.

Forest estate as investment asset differs from other investment assets greatly as forest is simultaneously factor production, means of production and product by itself (Airaksinen 2008, 19). Forest produces direct value each year through biological growth in the form of trees, berries, and other eatables as well as other plants which can be harvested (Sinclair 2013; Liljeroos 2009, 156). The result of direct value production can be thought as factor of production and the

biological growth as the means of production (Gregersen et al. 1995). On top direct value forest generates indirect value when the forest is used to produce services such as conservation, tourism, and hunting. The indirect value of forest entity can be means of production or the product itself depending on if the forest used as means of service or as the service itself. Lastly the forest has passive value which is the share value of existing including the option values imbedded in the preservation of forest. When considering the passive value, the forest is the product itself. (Gregersen et al. 1995).

These values can coexist into some degree, but fundamentally they are conflicting values which the owner must value when making decision. (Gregersen et al. 1995) Forest investment with its many uses, and values creates also strong emotional feelings among forest holders. Part of this emotional tie to forest can be explained by cultural phenomenon but also by forest ownership structure. Forest ownership has historically been very family citric as 47 percentage of forest owners have inherited their forest (Hänninen 2020, 36). Majority of the forest is also co-owned between family members and only 34 percent of forest owners own at least one estate entirely (Hänninen 2020, 35-36). On top of this approximately 38 percentage of forest estates hold a residential building and one third of forest owners are in fact owner occupiers. One fifth of the estates hold a vocational property. (Hänninen 2020, 69) One can easily see that the different values endorsed by different owners influences the "role" of forest plays on the markets.

In forestry indirect and passive values of forest are widely considered as secondary values and handled as excess value to the owner or wider public. The amount of excess value is very individual specific and hard to price or capitalize in monetary amounts. Therefore, they are usually sided in valuation and profitability calculations in forestry. (Holopainen & Viitanen 2009) This is because the main value generation of forest equity is the biological growth which differentiates forest equity from most investment assets. By investing in forest equity, one invests in means of production, the biological growth, which grows value in the form of timber, a factor of production which can be sold. (Sinclair 2013, 30; Linna 2012, 27-32; Caulfield 1998; Paananen et al. 2009).

The biological growth as value generator provides forest some interesting characteristics as investment asset. Biological growth rate is compounding and predictable to a reasonable degree. In other words, the returns of forest investments are predictable to reasonable degree and

compounding. In forest equity the value generation method is not tied into global economy and grows in value even in economical down turns. (Linna 2012, 27-32). However, there are natural restrictions on biological growth which can be seen as down sides of forest assets. The growth rate can be enhanced only to some degree by cultivation and forest management, but it has natural limits imposed by growth factors such as species, soil composition, location of the forest and water economy on the estate. The amount of growth has also a natural maximum limit per given hectare, which are restricted by the space, growth factors, forest management as well as the natural decaying of trees. (Mielikäinen 2018; Puttonen 2018; Airaksinen 2008, 19)

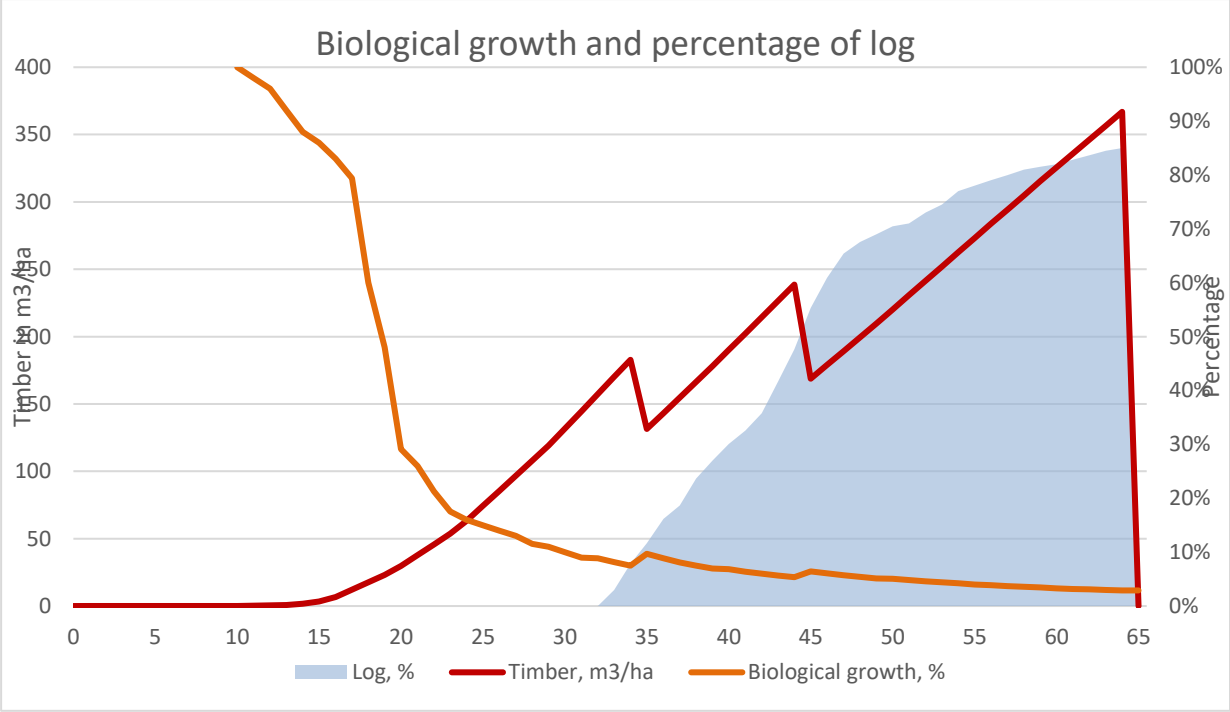

Figure 6 The biological growth rate, amount of timber in cubic meters per hectare and percentage of log over one turnover-time. The figure is based on MOTTI-simulation of uniform spruce forest, forested with traditional turnover method in southern Finland (After Ärölä 2018)

From figure 6. we can see the biological growth over one turnover-time. Forest turnover-time is the time from forest restock, when the forest has been planted to terminal logging, where the majority of cash flow from the forest is realised (Mielikäinen 2018). The length of forest turnover is a function of biological growth rate determined by growth factors, investors required rate of return and decisions on silviculture implementation. In Finland, the turnover-time is between 60-90 years depending heavy on the spices and geographical location (Pukkala 1997). The forest

owner can speed up the turnovertime up to 20-30 years compared to natural forest by optimizing the silviculture operations (Korhonen 2018).

Ruotsalainen (2005, 9) agrees with the importance of silviculture for both the biological growth rate and the return on investment. He defines silviculture as maintaining the vitality of the estate and careful optimisation of forest growth. The four main steps of silviculture operations are restocking including forest groundwork, plantation by seeding, natural seeding or planting saplings; sapling nurture including hay work and sapling clearing; thinning; and terminal logging. (Ruotsalainen 2005, 9) During one turnover the forest goes through one to three thinning, depending on the growth factors and forest management strategy. In each thinning 30-40 % of timber is logged, which generate almost a third of the revenues of forestry. Thinning increases also the terminal logging revenue as it prepones terminal logging and increases the timber quality by increasing the proportion of log timber in terminal harvest. (Huuskonen et al. 2018,148)

The role of silviculture in forestry is undeniably important to the value generation as well as cash flows. On top of this silviculture decisions give a lot of decision power to the forest owner, which is not the case in many other investment assets. The forest owner has a large selection of options in disposal to manage and optimise the estate. With these options the forest owner can determine the time and the amount of cash flows. (Linna 2012, 27-32; Airaksinen 2008, 19) The generalised MOTTI-simulation presented above was managed by equally-aged turnover model which is one of the several forest management strategies. In Finland the two main silviculture strategies in forestry are the equally-aged forest, which has been the principal silviculture strategy in Finland, and continuously-growing forest, where the forest has several age groups of timber from which only the aged threes are harvested at logging. (Puttonen 2018)

Currently there is a very vivid debate in Finnish forestry over the ecology, sustainability, and economics of different silvicultural approaches. One reason for the debate is the revoke of restrictive regulation on forest management in 2014. Before the 2014 forest law reform the terminal logging was allowed only after the timber had grown to certain sturdiness. This imposed the forest owners to adopt single-egged forest management as the main silviculture strategy. The regulatory change has given the forest owners a lot more decision-making power over the estate management. (Äijälä 2014; Metsälaki 1093/1996; Laki metsälain muuttamisesta 1085/013; Liljeroos 2017). Deregulation has also led to new thinking in turnover-time and cash flow

optimisation in forestry. Previously the turnover-time was determined by biological growth, which determines the time to required sturdiness, whereas now the turnover-time is determined by value growth and investors required rate of return (Äijälä 2014; Liljeroos 2017).

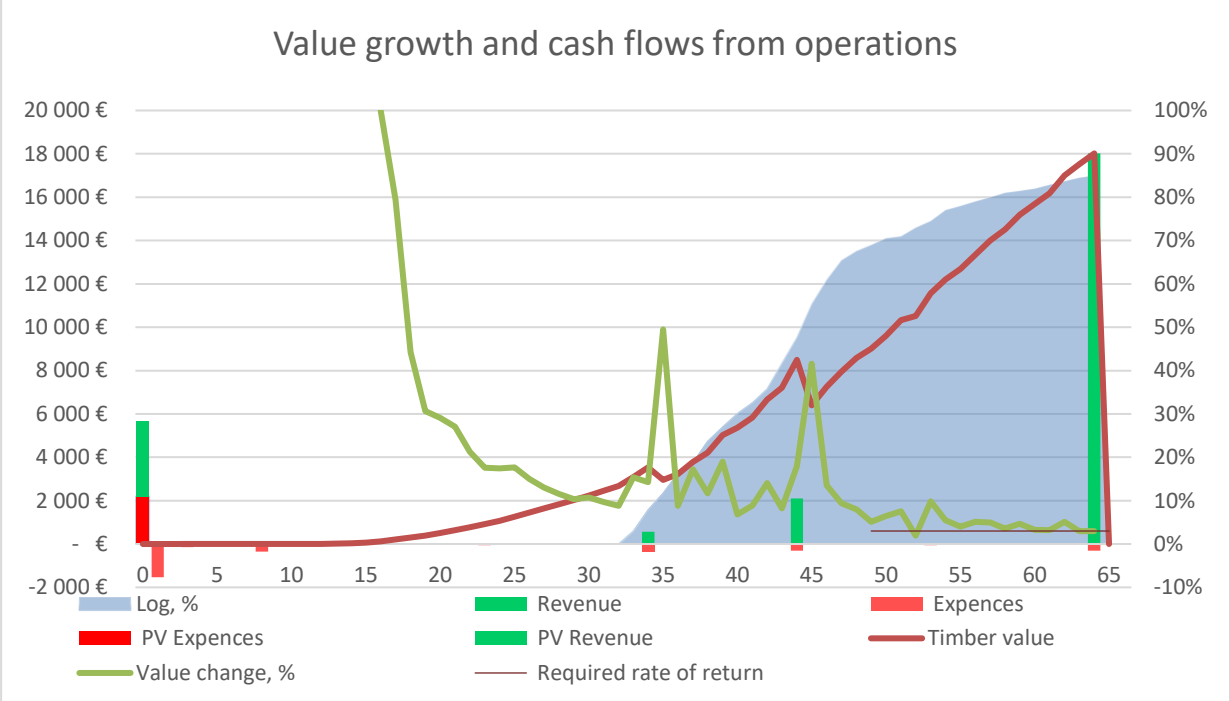

Figure 7 The value and value growth rate of timber as well as log percentage and cash flows of equally-egged forest over one turnover. Cash flows at year zero are present value cash flows staked. The required rate of return which is also used as discounting factor is 3 percent

In above figure is presented the value of timber and the value change in percentage, and the cash flows of silviculture and harvests. At year zero the nominal cash flows are presented as present value of cash flows which are stacked. From the figure, first important observation is the timing of terminal harvest, which is scheduled to the point where the decreasing annual growth rate of value is equal to the required rate of return. This is in line with Äijälä's (2014) and Liljeroose's (2017) statement. Second important finding is the large difference of net present value of cash flows and the nominal cash flow. This difference is more due to long maturity than high discounting rate as the discounting rate was in nominal terms 3 percent which can be held moderate. Third note is the difference between the growth rate of timber, the biological growth rate from figure 7, versus the growth rate of value.

From the findings some characteristics describing forest assets can be withdrawn. Forest has a long turnover-time, which leads to long maturity mismatch between cash flows (Ärölä & Paananen 2018; Liljeroos 2017, 27-32; Airaksinen 2008, 19). The long maturity mismatch forces the investor to hold the investment for long periods to realise the accumulated value. (Bodie et al. 2008, 321) The large accumulated value which is tied to the estate poses forest investor to tie a lot of capital making forest investments capital intensive investments. (Airaksinen 2008, 19, Liljeroos 2017, 27-29)

Even though there is a large maturity mismatch the cash flows them self are realised based on silviculture action. This means that the investor has the power to determine the amount and timing of cash flows in the short term, which makes the cash flows predictable. (Liljeroos 2017, 27-29) Penttinen and Laustin (2004, 393) emphasise that the statistical biological growth gives predictable long term revenue promise to forest investments. In the other hand the long term the cash flows are limited by the biological growth rate. This characteristic of long-term predictable revenue and ability to determine the maturity of cumulated capital is not common for many investment assets. (Liljeroos 2017, 27-29) The third observation points out the difference of value growth and biological growth, which is caused by the timber growing sturdier from pulp wood to log timber. The value growth between pulp and log is a significant value driver which is caused by higher market prices of log compared to pulp wood. (Hakala et al. 1998, 87)

The examination of forest value generation has so far been focused into the value growth of timber on plot, however this is not the only value driver of the. According to Caulfied (1998) and Uotila (2011) revenue of forest equity can be divided into three parts the biological growth of the timber, the price development of timber and the value appreciation of the plot. In Caulfield's study he states that the biological growth of timer generates 60,5 percent of the value growth, the price development of timber generates 33,3 percent and the appreciation of the estate generates the rest 6,2 percent (Caulfield 1998). Uotila (2011) and Liljeroos (2017, 27-32) both agree with the order and magnitude of Caulfield's study. Both of them list additional value drivers on top of the three main value drivers such as sectioning waterfront plots, soil material sales such as sand and compost, building space and natural products and services sales. (Uotila 2011)

Mei, Clutter and Harris (2013) argue that the most significant value driver, biological growth, conflicts with traditional assumption that the expected returns of investment, which is built on

top of systematic risk. This is due to the underlying value generation mechanism, growth of volume of biomass. The growth of the biomass happens “from thin air” and thus it is not connected to the financial markets and systematic risk. (Mei et al. 2013) One characteristic of biomass growth is non-negative growth, with the assumption that no risks realise. (Caulfield 1998) Yaon, Chengin and Men (2016) have shown that the forest equity revenues diverge from market revenue and conclude the underlying factor for this phenomenon to be biological growth.

In Caulfield’s (1998) study the biological growth proportion of the value growth was measured under Ceteris Paribus. One could argue that this assumption would not be a realistic assumption to have in real markets. However, Casio and Clutter (2008) have pointed that the price fluctuation of timber does not have an influence on the revenue in the long term because the maturity of harvest can be extended and thus the holder of forest equity can wait for favourable market prices without significant costs or loss of revenue. Thus, even if the price of timber is under systematic risk the effect of this risk realising is limited.

Forest returns have also been found to retain value against inflation (Lungren 2005). Lungren (2005) argues that timber prices have a high coefficient of 1,44. This means that as inflation goes up by 1 percent forest equity revenues go up by 1,44 percent. (Lungren 2005) Implicitly as the forest value consist mostly of the volume of timber on the plot and the future value growth of the timber the value of forest equity retains its value against inflation. Healey et al. (2005) and Wan et al. (2013) states the same in their studies respectfully, that the real revenue and forest equity value stays unchanged in times of real, expected and surprise interest.

Lastly, when assessing the value of forest ground there is two schools of thought. One school argues that the value of the forest ground is the main driver of forest estate value. Representatives of this view argue that as trees cannot exist without the forest ground the expected value of timber growth is inherited from the forest ground. The other school of demonstrates the opposite that the main value driver of forest estate is the timber on the forest ground and the expected value of the value growth of the timber. This thesis agrees with the later school of thought. The value development of forest ground is explained by scarcity which creates biases in the demand and supply of forest ground creating a monetary value to it. The biases raise the price of forest ground as all demand cannot be fulfilled with scarce resource (Linna 2012).

3.2. Forest equity markets in Finland

In Finland there is approximately 30,5 million hectares of land of which 26,2 million hectares are available to forest economy, excluding urban and conservation areas. After deduction waste land only 20,3 million hectares of forestry land is suitable to forestry and of this land only 91 percent, 18,5 million hectares, is used in forestry. The largest forest owner group is private individuals who consist of 630 thousand forest owners owning 60 percentage, 26 percent is owned by the government, 8 percent owned by companies and the rest owned by municipalities and other entities. To understand the forest equity market a forest economical framework of the industry must be created. Regardless of the school of thought, forest investment is simultaneous investment into means of production, biological growth, and into factor of production, the present amount of timber on the forest estate. (Luke 2021)

Due to this dual characteristic of being simultaneously factor of production and means of production the forest equity market can be divided, similarly to real estate, into two markets. The forestry market consists of markets for forest estates and markets for timber, which are heavily linked into the global markets of timber products. To comply with the market model constructed for analysis of real estate market this market model is added with capital markets. In the figure 8 below presents this multi market model of forest equity. Each market has their own market equilibrium, noted in the figure below the market name. Each market equilibrium is determined by function of market variables of market in question. The main market variables are denoted in the figure on both sides of the scale figure. Similarly, to real estate market model, each market and market equilibrium is related to other markets. These interactions are denoted with yellow arrows.

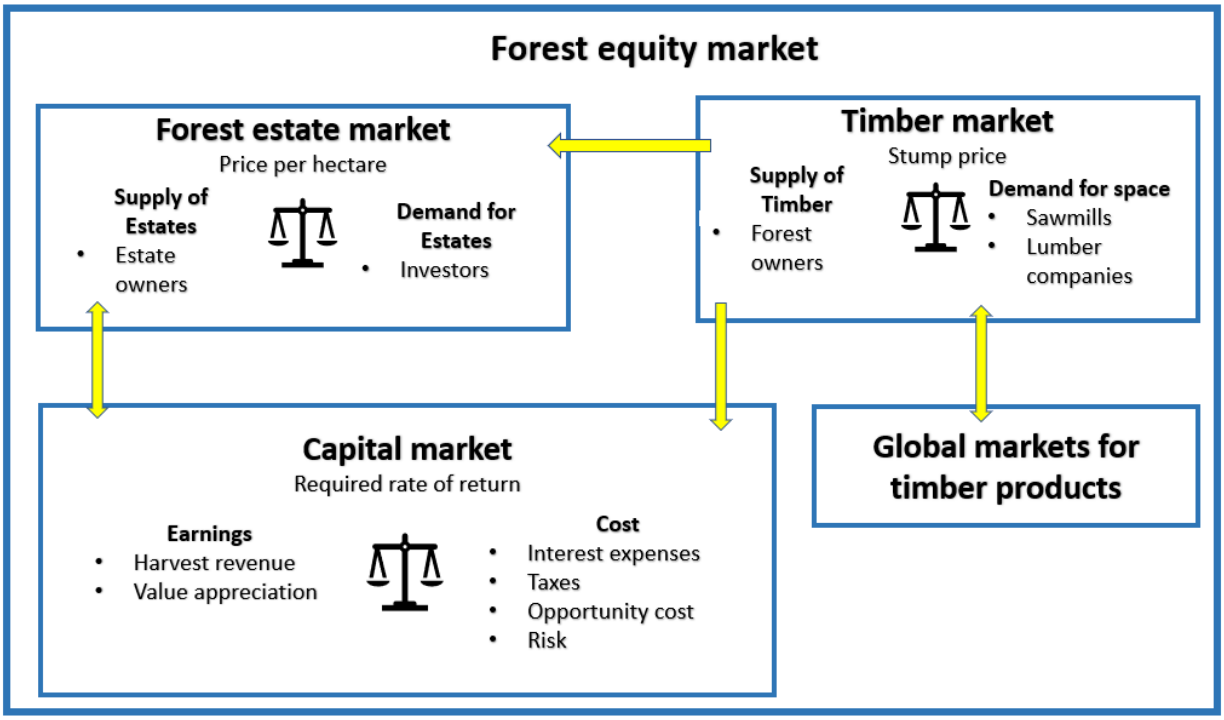

Figure 8 Forest equity market model

In order to explore these submarkets and their interactions a three-quadrant model of forest equity is applied. The three- quadrant model of forestry is presented in below figure 8. The three-quadrant model consists of three quadrant which describe the long-term equilibriums, price of hectare in the forest equity market, stump price and harvest quantity in the timber market, and the timber stock of the forest land. The model is a static model to study the long-term equilibriums of areal sub-market. The equilibriums are determined starting from the south-east- quadrant of timber stock and moving in counter clock vice direction. The model can, similarly to DiPasquale and Wheaton model (pages 10 and 11), be used to study market disruptions and short-term deviations from the long-term market equilibrium. The three- quadrant model is a simplified expression of the relationship of different markets within the forest equity market. In reality some of the relationships are elastic and embed lags which are not taken into consideration in the model presented in figure 9. The model relies on the forest interest theorem of normal forest.

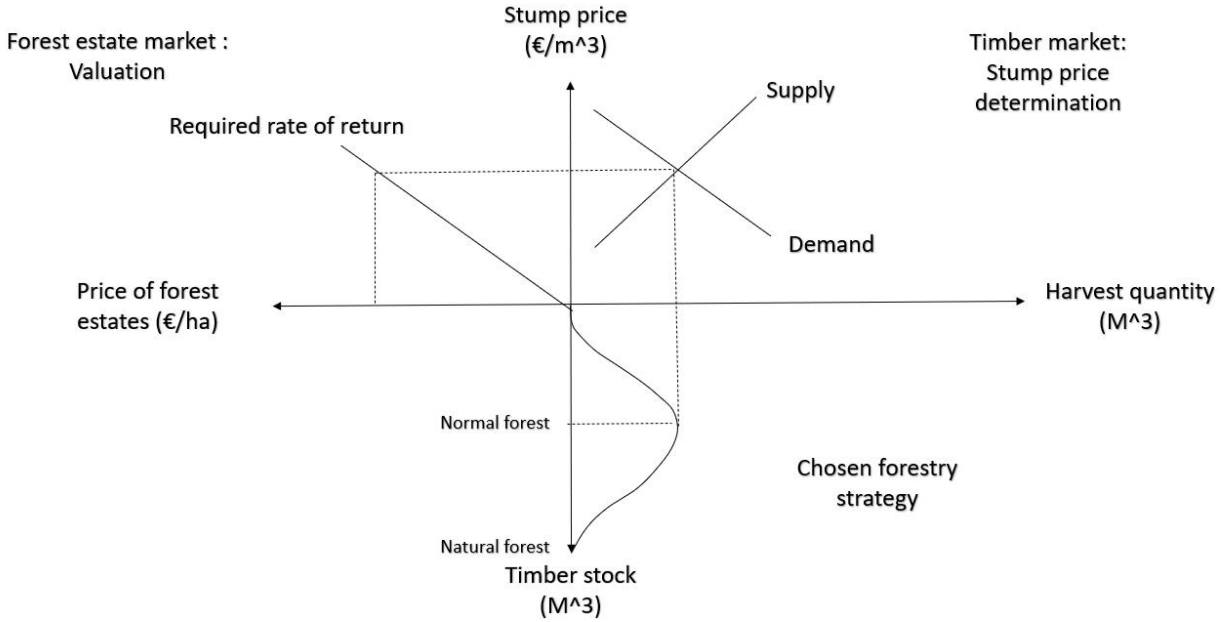

Figure 9 Three-quadrant model of forest equity market

3.2.1. Timber markets

The forest in Finland grows approximately 110 million cubic meters of timer per year. Of this growth 65 million cubic meters are harvested, and the rest is lost through naturally or left to forest unused. During the past fifty years the forest biological growth has increased by half due to systematic forest management, cultivating enhancements such as diching wetlands and improvements in forest management practises. The majority of 62 million cubic meters of annual harvest is harvested by private owners. One half of the harvest is pulp wood, one thirds log wood, and the rest are energy wood. The annual turnover of timber sales was 2,3 billion euros whereas the expenses of forestry 235 were million euros and forest management costs 65 million euros. (Luke 2021)

Timber in Finland is sold in 10-15 commodity classes with respect to each species, which in Finland are mainly spruce, pine and birch. Due to the scope of this thesis only four main products are separated which are log, small log, pulp wood and energy wood. The main difference between the products is diameter of the trunk. Log is on average over 16 centimetres of diameter on average, small log is over 10-13 centimetres, and pulp is over six centimetres. Anything smaller or in other metrics not acceptable to the three previous products is energy wood. The stumps, crowns and branches can also be sold as energy wood. On top of size restrictions spruce pulp wood has a spoilage time of 1-2 weeks and pine pulp wood 8 weeks. (Melkas 2018)

The timber trade is done in two ways either by vertical-trade or acquisition trade. In vertical trade the purchaser is responsible of harvesting and logistics, which ensures the forest owner with least effort in trade. The price quote used in vertical trade is called stump-price, which is the timber price deducted with the cost of harvesting and logistics of the purchaser. The stump price is determined separately for each product category, for thinning and terminal harvest, for winter and summer stands, and for different stands according to the difficulty of harvest posed by the forest ground. (Horne 2018)

As the purchaser is responsible for the harvesting the vertical-trade is practically a contract over the right to harvest the estate. This means that the forest serves as a living stock for the purchaser, which ensures a steady supply of timber for the lumber industry. It is typical that the purchaser pays a proportion of estimated contract price in forehand and the rest at the end of the harvest when the actual contract price is settled with the real harvest quantities. In acquisition trade the seller is responsible for the harvest and logistics to agreed location at an agreed time. In acquisition trade the contract typically includes a quantity spread which the seller must fulfil. Vertical trades consist on average 83 percent of timber sales in Finland. (Horne 2018)

Timber is a factor of production which is supplied by forest owners and limited by the biological growth. In the southeast quadrant of the model the timber stock is determined by line Q which is a function long-term average annual harvest quantity, biological growth and natural decay with respect to the state of the forest as well as the chosen forestry strategy. The supply of timber i.e., long term average harvest quantity is determined by the chosen forestry strategy (Patolahti 2018, 4). The demand is created by the demand of end products produced by lumber industry. The price of timber is determined by the demand and supply on free markets. (Patolahti 2018, 4)

According to Airaksinen (2008, 361) there are on average 120 thousand timber trades annually in a normal year. The supply side of timber markets consists of more than 600 thousand private individual sellers, roughly 5 000 common forests and companies, several municipalities, and the Forest Agency (Metsähallitus). The private sellers create most of the supply and the largest single seller is Forest Agency, which manages governments forest and privately owned forest though forest management contracts. The purchase side consists of sawmills, lumber giants, and energy companies. In pulp wood market the demand has consolidated into three big buyers, Stora Enso,

UPM and Metsä Board, which control the entire demand. (Ariaksinen 2008; Horne 2018) In log timber the demand side is bit more balanced. According to Finnish sawmill association there are 30 small-to-medium size sawmills (Sahateollisuus 2021). On top of the sawmill association members Airaksinen (2008, 361) counts about 300 small saw entrepreneurs. Additionally, to the small and medium players the three big wood lumber giants work in the sawmill sector with few larger and medium sized sawmills. The three lumber giants also momentarily substitute pulp wood by log timber in pulp and mass production in market disruptions (Ariaksinen 2008; Väkevä 2018) In the energy wood market there are few heating as well as combined heating and power stations which use energy wood as input providing areal demand. (Horne 332)

The supply side of timber is affected in short time by seasonality, storms, and stub prices, and in the long term by the price of harvesting, forest management cost and imports of timber. The harvests of certain stands depend on seasons due to ground frost, which enables harvests in wet and swamp lands during winter. This seasonality in normal years does not affect the supply of timber, but in bad winters when the ground frost does not from the supply can be decrease during winter. This affect can be seen as increased timber prices on the markets. (Airaksinen 2008; Horne 2018) According to Airaksinen (2008) the short-term supply, or the amount of willing forest owners to sign harvesting rights, increases sharply when the there is a sudden increase in stub prices. Short-term supply-side shocks can also be generated by storms, which create sudden excess supply due to fallen trees. The supply shocks are experienced more in log markets as pulp wood has a spoil period. (Viiri et al. 2011)

The demand side is controlled by the global economy, currency rates, competitor country cost structure, price level of timber and the demand of end products on global markets. (Horne 2018) The most important of these being the demand of pulp and wood products on global markets as most of the production goes to exports (Airaksinen 2008). In Finland there is 15 chemical pulp factories and 15 mechanical press pulp factories, 19 paper or cardboard factories, 77 industrial sized saw mils and 14 wood panel factories as of 2018. (Saarinen et al.2018) In 2019 the annual demand was 71 million cubic meters which was split approximately 40 percent to wood products consuming log timber and 60 percent to pulp production consuming pulp wood, of which 60 percent was paper and cardboard production and the rest pulp mass. Of the annual 2019 demand 85 percent was satisfied with domestic supply and 15 percent by imports of which the majority originates from Russia. (Luke 2021) The price of import timber is approximately on the same

level as domestic supply. The biggest imported timber classes have been birch pulp wood and wood chip, which do not pose a large competition risk to domestic production as the majority of domestic production is spring and pine. (Horne 2018) The annual value of exports has been around 12 billion euros annually during the 21st century. (Luke 2021)

Recently there has been a vivid debate on the profitability of Finnish pulp and paper sector, which has risen from several digester closures. However, there are some global megatrends which are estimated to increase the demand of pulp and wood products in the long term. In Tapion taskukirja the megatrends concerning forestry are the global growth of population which increase the global demand, the rise of bio- and circular-economy trends in which timber products fit in well as they are recyclable and compostable. There are also big promises in innovation in the field of new timber and timber refinement products containing the highest expectations such as intermediate chemistry products, petrochemicals, animal feed products and textile fabrics. (Horne 2018; Väkevä 2018)

Even though timber market is a free market the market it is far from perfect competition, due to market structures and timber properties. The timber market is very sewed, as there are far more sellers than buyers, especially in pulp wood markets. This skewness gives the buyers more power in the markets. The market power of the buyers is further enhanced with the well-established vertical trade transaction custom, which introduces price eliasticity for the demand side. The properties of timber such as low value to weight ratio and spoilage duration of pulp wood shape the market of timber to be local, which increase the skewness and market power of purchases. One could argue that the Finnish timber market could be divided into geographical submarkets according to timber buyers. Airaksinen (2008) argues that especially in pulp markets the market power of purchasers is so large that they have the ability to alter market prices to some extent. The locality of markets can be seen well in pulp wood according to Skyttä (2018), as there are only four lumber factories in Lapland all of them in Kemi. The lack of pulp wood demand has decreased the pulp wood prices well below aggregate market prices. Skyttä (2018) also argues that the lack of pulp wood demand will affect the market far in the future as the timber reserves increase which can lead to decrease of future biological growth and low-quality timber as the optimal forest management is not performed. (Skyttä 2018) The price deviation between Lapland and the aggregate prices, seen below, is as large as 15 percent in pine and 20 percent spruce in log timber and 5 percent in pine and 20 percent spruce in pulp wood. (Luke 2021) Heikinheimo

et al. (1969) argues that the locality of prices of timber is also due to local harvest difficulty posed by forest ground and timber harvests per hectare. This supports the price difference between Lapland and aggregate market as there is less timber per hectare and the harvesting circumstances are on average more difficult in Lapland than in the rest of the country.

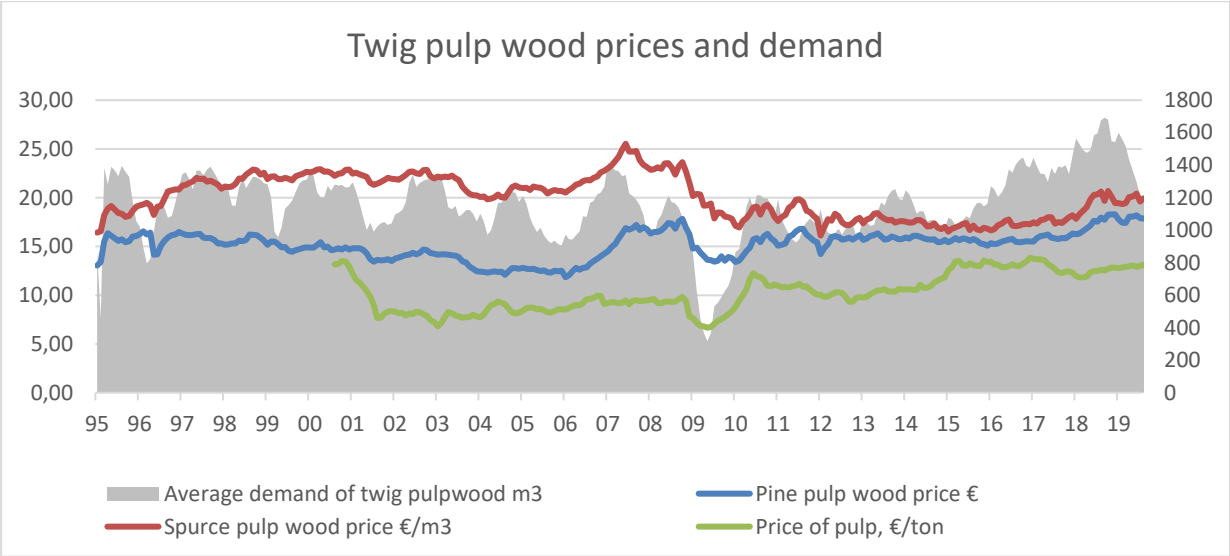

Figure 10 Twig pulp demand and pulpwood prices on aggregate level in Finland and pulp mass price in North Sea ports (Luke 2021; Index Mundi (a) 2020)

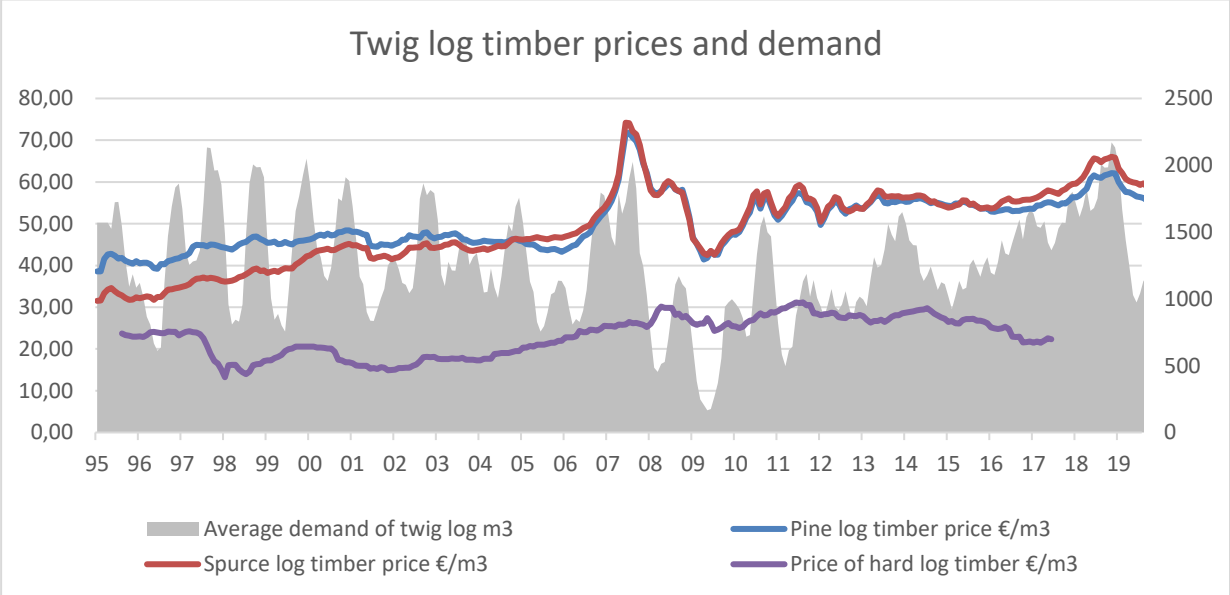

Figure 11 Twig log timber demand and prices on aggregate level in Finland and the global prices of hard log wood (Luke 2021; Index mundi (a) 2022; Index Mundi (b) 2020)

According to Airaksinen (2008) the price of timber in Finland is determined solely be the demand of timber, which is derived demand of production capacity and global demand. From the figures 10 and 11 the nationwide aggregate stub-price and demand of both log timber and pulp wood respectfully. For price correlation the aggregate Baltic sea harbour price of pulp mass by metric ton and the global hard wood log timber price by sawed timber per cubic meter are plotted (Index Muini (a) 2020; Index Muini (b) 2020). As the timber price is measured with stub-price it reflects better the real value of timber. This is because stub-price includes harvesting, restocking, and logistical costs. Uotila (2011) argues that by displaying stub price a more accurate picture can be drawn of the value development of timber and the revenue. In the long run the stub prices have partially increased due to decreasing costs of harvest. The decreased is due to automation and mechanisation of harvesting. On the short-term stub-prices have large price variation which is due to seasonality and market disruptions. In the long term however the stub-prices can be shown to be very stable compared to many other prices. According to the forest statistics yearbook the real stub-prices have stayed stable on the long run from 1872 to present day. (Metsätilastollinen vuosikirja 2011)

The price development of log and pulp can be seen to follow each other and the prices of end products such as pulp mass and the price of hard wood saw timber. According to Viitanen and Mutanen (2018) the price development of pulp mass has greater impact to both log timber and pulp wood than saw timber prices. They also argue that the price and quantity of imported timber has a great affect to the price of timber in Finland, but not as much as the global demand of end products. (Viitanen & Mutanen 2018) The price development of pulp wood has typically been more volatile than that of log timber. The reason for this is larger elasticity of prices and short spoil duration, which keeps the demand more stable. The demand of timber has been relatively stable and as one can see the seasonal demand swings have decreased after the financial crises of 2008. The reason for decrease of seasonality can be explained by technical advances in harvesters which enable less ground frost reliant harvest. The demand between the timber classes has stayed stable from 1990 to present day with the exception of pine and birch pulp, both of which have increased little over 40 percent. This increase of demand can be seen also in pine and birch prices.

The price of energy wood is not displayed. The reason for this is the exceptionally high price variation inside Finland, which makes it less ideal to be presented as aggregate price. The price difference of vertical trade and acquisition trade in energy wood is also extensionally large,

approximately 6-fold, which is due to subrationally larger harvesting cost per cubic meter. (Horne 2018) The price of birch is also not displayed as it is a less important lumber product. The demand of birch is less than one fifth of spring wood. It is important to recognise also that nearly half of the birch is also important to remember that nearly half of the demand of industrially processed birch wood is imported, which affects greatly the price of domestic birch stub-prices. (Luke 2021)

3.2.2. Forest equity markets

In 2017 nearly half a million hectares where transacted in 62 700 transactions adding up to 1,2 billion euros in turnover. Of this turnover only 3 670 transactions were representative with a value of 240 million euros. Compared to the hole real estate market the representative forest equity transactions are 6,2 percent in volume and 2,9 percent in turnover. (Ärölä 2019, 43) The large non-representative proportion of trades is explained by family centricity, as majority of forest is inherited or purchased from a relative (Ärölä 2019, 43-44) According to Hänninens (2020, 36) study 46 percent of forest owners have inherited forest, 7 percent has got the estate as a gift, and 28 percent of estates are purchased from a relative or family member. The numbers are the same magnitude with Airaksinen study (2008). In the past 20 years the representative trades have increased by 60 percent, which speaks of change in the markets and the upcoming reorganisation of forest ownership. The low representative volume of forest estates is partly due to the localness of forest markets which affects the demand and supply locally (Ärölä 2019, 85-86)

Locally the demand of forest estates has been higher than the supply. The skewness of demand and supply as well as sacredness of vendable estates has historically increased with the forest estate prices. (Airaksinen 2008; Linna 2012, 29-30) The locality of forest equity markets is also facing a change according to Ärölä (2018, 86). The exploitation of internet in forest equity trade has increased marketing and amount of available information. This has led to increase in demand increasing the competition on the markets which has led to higher prices. This trend is endorsed by the simultaneous introduction of specialised intermediaries in the market who prepare independent assessments of vendible estates. (Ärölä 2019, 86) Even there is skewness between supply and demand in forest estates it is relatively low compared to other real estate classes, however the long transaction times make forest equity illiquid. (Virtanen 1992)

The liquidity of forest estates is expected to be eased in the medium to long term as the forest ownership is going through its largest change after the land reform of independence (Ärölä 2017, 82-85). This ownership change in forest estates is supported by big trends such as aging forest owners, increasing interest toward forest as investment asset, decrease of proportion of farmers and on estate occupants. (Hänninen etal. 2018; Ärölä 2017, 83-84) In thirty years, the amount of senior forest owners has risen from 30 percent to 50 percent. At the same time there has been a decrease of 60 percent in forest and agricultural entrepreneurship and the amount of owner occupancy has decreased from 50 percent to 35 percent. This change can be seen also in the increase of remote-ownership and urban owners. (Hänninen 2020, 37-38; Hänninen et al. 2018) Other factors that increase the liquidity is the introduction of forest hedge funds which have increased the demand especially for the large estates. The spike that investment seekers has introduced demand and increased the prices of forest estates especially for the large estates. (Ärölä 2019, 88) The trend of forest becoming a noteworthy investment asset and diversification tool to portfolios has increases the demand also in the small and medium sized estates through individual investors. (Tilli et al. 2008)

Airaksinen (2008) argues that the liquidity of small and medium sized forest estates is not as dependent on the characteristics of estate compared to other real estate classes. The historical management and the quality of the forest has not been shown to have an effect to the liquidity. However he argues that the amount of harvest mature timber on the estate has a positive effect on the liquidity and price of the estate. He argues that this is due to the smaller risk and uncertainty of future cash flows. (Airaksinen 2008) Furthermore, Airaksinen (2008) and Ärlöä (2019, 87) point out that there are large differences in trade times and liquidity between the local markets as Lapland stands to be less liquid than southern Finland. (Airaksinen 2008; Ärölä 2019, 87) According to transaction data from land survey institute (Maanmittauslaitos 2020) southern Finland has three times more transactions than in northern Finland.

Like liquidity the price of forest land variates greatly inside Finland. Below we have a figure showing the price development of average forest prices per hectare in four forest areas in nominal terms and the national aggregated price both in nominal and real terms. The forest areas are constructed alongside county borders with uniform heat sum. (Ärölä 2019, 88) The price discussed is the market price of the plot, paid in the free markets, thus the price includes the price

of timber and the price of forest ground at the given moment excluded with taxes and transaction cost. In our three-quadrants model the price of hectare is determined by the required rate of return line which describes the price of hectare as a function of long-term interest rates, expected future harvest revenues and risk. Similarly, to timber prices the price of forest land varies across Finland which supports the idea of areal sub-market of forestry.

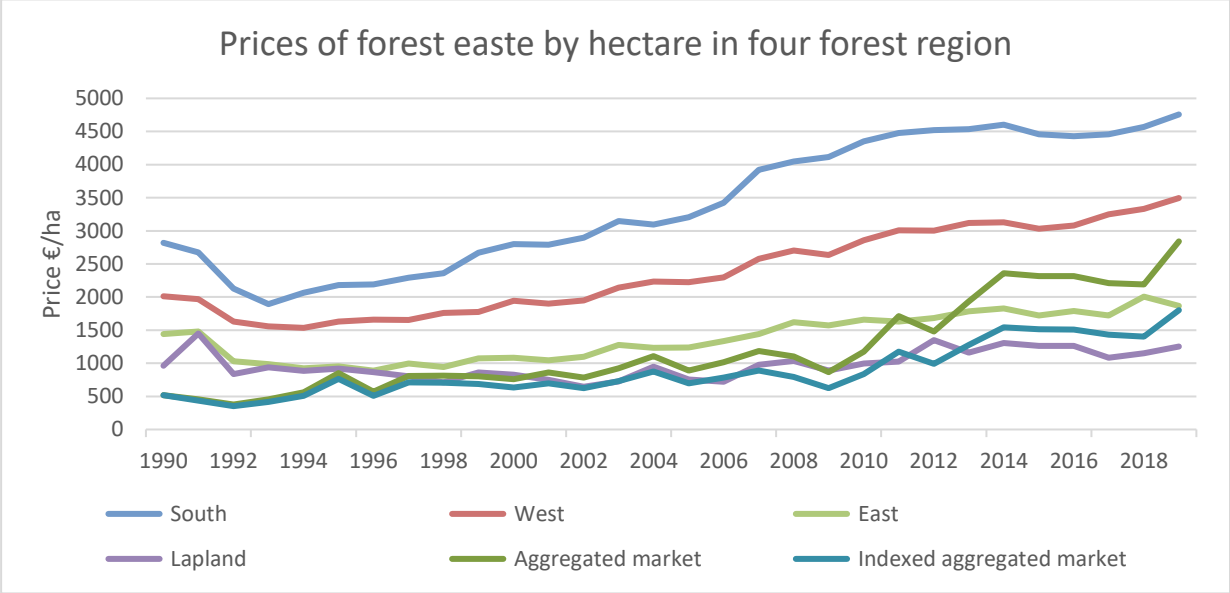

Figure 12 Forest estate prices per hectare in four forest areas in nominal terms and the aggregated forest estate price in Finland in nominal and real terms (Luke 2021, SVT b)

The large price differences can partially be explained by the difference of timber on the estate at the time of transaction and the quality of the soil. These two characteristics vary on the aggregate level between forest areas. For example, in the Lapland 40 percent of the forest ground is swamp compared to South-Finland were the respective percentage is only 26 (Luke 2021). In general, the forest ground in Lapland is less productive in terms of forestry. One reason for this is soil composition and the heat sum, which decreased on average by one degree per kilometre in transition from north to south. Heat sum describes the length of growth season and the higher the heat sum the longer the growth season and thus the biological growth per year. These two factors combined describe the majority of biological growth rate which in the other hand determines the return of forest estate. Thus, the price in the southern part of Finland is higher than in the northern part. There is also a difference in average size in estates in northern and southern Finland, which in part decreases the relative hectare prices in northern Finland. This is because the prices of

larger estates are lower than in small and medium sizes estates due to different market of buyers and sellers. (Ärölä 2019, 88-92)

There is also a clear difference in amount of timber present on the estate at the time of transaction. In South-Finland there is on average two times more timber and in central-Finland almost 70 percent more timber compared to Lapland at the time of the transaction. (Ärölä 2019, 91) The amount of timber increases the prices through the amount of accumulated value transferred in the transaction. The amount of timber also reduces risk and increases the price as the cash flows are closer. (Ariaksinen 2008) The amount of timber at the time of transaction is not due to difference in customs, but according to Hakala et al. (1998, 87) the difference is naturally due to more verdant growth location. The difference can be also seen in the aggregate harvest quantities between southern and northern Finland (Hakala et al.1998, 87). The difference in biological growth also allows several tree generations to exist side by side in south which increases the difference. In southern-Finland the timber quality and log percentage of harvest is also higher which increase the average price of timber on estate and the thus the market price of the plots. Part of the price difference is also explained by the population density, as forest closer to urban areas is more expensive. This increases the prices in southern Finland and decreases the price in eastern or northern Finland on aggregate level as southern and western Finland have higher population density. Population density also increases the number of buyers on localised markets, which can influence market prices. (Ärölä 2019, 88-91)

The value of timber, and its expected future value, is a great part of the price of forest estate value. But by comparing the price of forest estates and price of timber, figures 10 and 11 above, there is no clear sign of correlation of forest estate value and the price of timber. Airaksinen (2008) however argues based on his study a sharp decrease in timber prices affect the forest estate market price immediately and the increase of timber prices affects the forest estate prices with a one-to-three-year lag. He points out that the correlation of timber prices and forest estates has decreased in the 21st century. (Airaksinen 2008) By some scholars the price variation of forest estates due to price variation of timber is though negatable. Tilli et al. (2008) argues that the price variation should not be acted upon as the capitalization of such strategy would prove difficult to small correlation and illiquidity of forest estates.

The price of forest estates has clearly increased over time. According to Ärolä (2019, 91-92) part of this increase in prices is due to increased amount of timber at the transaction time. On average the amount of timber on estate has increased by over 25 percent in 2016 compared to 2007. This argument is backed with the fact that nearly the hole increase of timber in transaction came from southern and western Finland. (Ärölä 2019, 91) Tilli et al. (2008) explains the rise in market prices with low interest rates which increases the expected future value of harvest, decreases the required rate of return and new investors who seek new investments goods. As we can see the price of forest estates has risen proportionally more in southern and western Finland than in the northern and eastern. The price of timber has also increased from 1990's to present day adding to the price growth of forest estates. However, by comparing the price development of different regions to inflation, measured by the cost-of-living index reported by Finnish statistics bureau (SVT b, 2021), we can see that only the southern and western areas have beaten inflation in a thirty year period. This finding conflicts with the academic findings.

The small volatility of market prices is due to lack of supply in the markets, which decreases the business cycle trading according to Tilli et al.(2008) Forest is seen as a long term investment. The reasons for this Tilli et al. (2008) argues is the long turnover-time and slow growth of timber. On top of this he lists transaction costs which are high compared to other investment assets. The transaction costs of forest estates consist of 4 percent wealth transferee tax, land registration cost, notary costs, cost of legal documents, real estate reward, and the cost of forest mapping, valuation and forest planning. These costs and the nature of forest as an investment asset it is not profitable to hold forest less than ten years.(Tilli et al. 2008) On average forest estates are sold every 22 years (Hänninen et al. 2011, 40)

The aggregate forest estate market is far from perfect competition. In a perfect competition there is a lot of sellers and buyers, commodities are homogenic, there is free access to markets, and all players have perfect knowledge. In forest estate markets there is limited amount of buyers and sellers, commodity is very heterogenic, and there is asymmetric information as well as lack of knowledge between market players. (Virtanen 1992, 19)

3.2.3. Capital markets

The role of capital markets in forest equity market serves the same role as in real estate. The capital market determines the required rate of return to capital with risk free interest and risk premium of aggregate capital markets. This required rate of return is used to price risk of forest investments to allocate capital into forest estate market and works as the minimum return required by forest investments. On the estate markets a investment specific risk premium is added. The role of estate markets is to allocate the capital within the individual estate investments. Thus, the role of capital markets is to price the systematic risk of forest equity investments, whereas the role of estate market is to allocate the dedicated capital within the forest estate market.

3.3. Risk concerning forest investments

The risk of forest investments can be divided into systematic and unsystematic risk. Systematic risk is the risk concerning the entire market and it cannot be managed by diversification. Systematic risk is an external risk which is unpredictable and difficult or even impossible to avoid. Non-systematic risk is unique to given industry or entity and thus it is diversifiable. Non-systematic risk of forest can be further categorised to business risk and environmental risk. Business risks are taken consciously to make revenue of investment and they can be divided into internal and external risks. (Suominen 2001, 11) Environmental risks are external risks which are posed by practicing business and they cause operating loss without the possibility of profit. (Suominen 2001, 11) The examination of these risks will start first by examining the systematic risk and then by the examination of non-systematic risk. Lastly the focus will be on ways to control forest risk. The risk involved in forest equity are summarised in the below table.

Table 2 Summary of risks related to forestry

Business risk \ Source	Systematic	Idiosyncratic
Internal • Strategic • Operational		• Risk related to acquiring • Risk related to forest management decisions • Risks related to forest management execution
External	• Long term demand risk (competitor country relative competitiveness and global demand) • Interest risk • Inflation risk • Opportunity cost	• Political risk • Stump price risk • Timber mix risk • Liquidity risk • Bank risk • Third party risk • Areal demand risk
Environmental risk	• Natural hazards: Wildfires, snow burden, storms, insects, animals, fungi	

Mei, Clutter and Harris (2013) stated earlier that forest has a small systematic risk. Systematic risk is the probability of loss associated with the industry or the entire market. The loss is caused by events affecting factors determining either revenue or cost attributes of operations. As studied earlier the revenue of forest investment is realised either by harvesting or selling the forest estate. In both transactions the main determinant of revenue is the volume of timber and the price of timber. As the volume of timber is determined by the biological growth of trees the only determinant which carries systematic risk is the price of timber. Compared to other investment assets this feature of non-negative guarantied value growth, with the assumption that no non-systematic risks realise, creates low systematic risk to forest investments revenue side. Newellin and Ecesin (2009) argue in their study of forest risk and return, that the risk of forest investments is smaller than stocks but higher than other real estate. The higher risk compared to other real estate is explained by price fluctuations of timber prices which is systematic risk (Newellin & Ecesin 2009).

The systematic risk conserving the price of timber is created by factors affecting the stub price of timber. As the stub price of timber is driven by demand and supply, and the cost structure of

forestry and logistical cost, these attributes bear systematic risk. As the demand of timber is driven demand of end products, the main systematic risk concerning price of timber concerns the demand of forestry end products. The risk could realise in events such as sudden drop in purchasing power or a building recession. On the cost side the main risk is the increase of harvest, cultivation, and logistical costs. The main risk in the cost side attributes is sudden and unexpected rise in inflation. But as noted earlier by Laugren (2005) forest investments are highly resilient to inflation. Thus, the systematic risk of forest investments is low compared to many other investments and the main systematic risk of forestry is events affecting the demand of end products. The low systematic risk of forest investments brings interesting characteristics to forest.

Healey (2005) argues that forest equity offers an excellent diversification to a portfolio due to small correlation with stock and bonds, which is due to small volatility and low systematic risk of forest equity revenue. Caulfield (2018) argues that forest investments are an exceptional diversification tool as forest can be sued to diversify systematic risk in the long run. Milsin and Hoover (1982) argue that even forest investment shares a rather small internal rate of return, but the diversification utility of forest is large for a portfolio containing a large risk. Forest equity is found also to be an excellent inflation hedging asset in portfolios. (Penttinen ja Laustin 2004; Wasburnin & binkley 1993; Lagren 2005) However Viitala (2008, 43) points out that the risk of any portfolio containing only one asset is large, also in the case of forest.

When forest has a small systematic risk there is other risk's which are greater. Next in the examination is non-systematic risk of forest investments starting with business risk and then environmental risk. Business risk can be caused by external or internal factors which can have either positive or negative impact the revenue. (Suominen 2001, 11) Thus business risk is related to the return on investment. The nature of business risk is described as uncertainty over outcome and thus as the outcome can be either positive or negative the risk is speculative. Business risk cannot be fully avoided as it is the condition to obtain profit and thus they are consciously taken. The business risk can be divided into Strategic, operative, industry, legislative and key person risks. (Suominen 2001, 10- 11; Rantala & Pentikäinen 2009, 57)

Strategical risk is risk related to internal processes of forest management and forest estate acquiring. These strategic risks can realise for example in the form of poor harvest timing with respect to growth rate or price of timber, acquiring of estates from areas which face lumber

factory closures in future, both of which decrease the future revenues (Suominen 2003, 68). The industry risk is an external risk which can realise as changes in market structure and mechanism as well as demand of timber, the overall lumber industry cost structure and demand of end products. These risks can realise for example as introduction of a substitutes to forestry products, risen fuel costs, decreased competitiveness of Finnish lumber industry due to globalization, or decreasing revenue. (Nielsen 2004, 30-31; Suominen 2003, 68-69; Arikaksinen 2008, 17)

Operative risk is risk relate to harvesting, cultivation, and valuation. A poorly executed harvest or cultivation can lead to destruction of value in form of destroyed saplings or storm vulnerable stands. The main operative risks however is valuation risk as Ahonen (1970) noted the majority of profit made in forestry is done at the time of purchase of forest estate. The operative risk in valuation is related to the accuracy and execution of initial data gathering, forest calculations and simulations. The risk realises as increased scale of uncertainty or systematic error in valuation or forest management planning, which can lead to low return on investment or affect the value growth through miss timing of forestry operations. (Holopainen & Viitanen 2009, 136-138) Airaksinen (2008, 20) points out that the risk of sub optimally timed forest operations or risks involved in forest revenue are small compared to other risk. In the junction of operative and strategic risk is liquidity risk. Liquidity risk rises from the maturity mismatch of revenue and cost which can create problems to fund forestry investments (Nielsen 2004, 43). The liquidity risk is emphasised by poor liquidity of timber and estates (Linna 2012, 29-30).

The legislative risk relates to taxation, government assistance, and regulation. Changes in taxation or government assistance can negatively affect the expenses and revenue of conducting forestry. The regulation of forest management can create new encumbrances to forest owners which can negatively affect the value or increase cost of forestry. New regulation or changes in existing regulation can also change the market structure in timber or lumber markets which can affect the competition power of market players. Regulatory risk is related also to forest management and harvests as there are restrictions on the harvested amount on certain plots. For example, there are limitations on harvest close to water bodies. If these kinds of restrictions get harder or there comes new restrictions, they can affect the return of forest investments. Close to legislative risk is the third-party risk, which refers to third parties' interest and expectations on forest assets, which can affect negatively to the value or value generation of a plot. The worst-case example is that a third party drives a conservation of an estate, which can lead to forced

redemption of an estate. (Linna 2012, 29-30) In the larger picture commitments of Finnish government to nature conservation and climate change through several platforms like EU and IPCC can impose now restrictive regulation to forestry. The key person risk refers to lost capabilities due to employee leaving. In forestry the key person risk can realise also as the loss of a subcontractor.

The main distinction between environmental risks and business risk is that environmental risks incidence rate and the severity of realised risk can be estimated and that the effect of environmental risks is always negative, and the cause of environmental risk is always external. (Suominen 2001, 11) These characteristics of environmental risk make environmental risk impossible avoid but make it possible to prepare and prevent them. The characteristics also enable the selling of the risk further i.e., insuring against the risk. (Rantala & Pentikäinen 2009, 56) Environmental risk include natural hazards like pest, swells, fires, draughtiness, storms and snow burden and other natural phenomenon that can affect the value or value generation of a plot. (Linna 2012, 29-30) Several of these natural hazards can be worsen or prevented to some degree with efficient forest management and some of them are more severe than others. Lindberg et al. (2011, 13-15) argues that forest fires and fallen threes due to storm are not a major risk in Finland. He argues that the prevention and extinction of fires limit the damaged area efficiently and that on average storms have negatable effect on the aggregate timber production. However, he acknowledges that either one of these risks if realised can lead to destruction of whole estate, in which case an undiversified investor could face drastic loss. (Linberg et al. 2011, 13-15) On average, there are severe storms like the Astra storm, which destroyed the equivalent of 15 % of yearly harvest quantity in 2010 (Viiri et al. 2011, 221).

According to Nielsen (2004, 47) the destruction of snow is by far the largest cause of lost value. Snow does not absolutely destroy the forest but can severely affect the value by decreasing the quality of timber from log to pulpwood. He points out that with appropriate and timed forest management action forest owners can protect themselves quite efficiently against snow destructions and storms. (Nilesen 2004, 47) Among the less easily influenceable natural hazards are moles, moose's, insects, and fungi. Of these hazards the destruction of mooses is covered by the state. (Anila 1999, 171-177) For insects and fungi the only effective prevention is clearing of fallen trunks (Viiri et al. 2011)

Of the natural hazards the risk of wildfires, snow burden especially in northern and eastern parts of Finland, storms, fungi, and insects are estimated to raise in amount of incidence as well as in severity in the upcoming decades due to global warming. (Lyytikäinen-Saarenmaa & Tomppo 2002; Annila 1999 171-177) In wildfires and storms the pulp wood damaged can generally not be used in pulp production due to quality issues, however in both the trees can be used as log timber to some degree. The worst-case scenario is snow destruction which can lead to permanent harvesting and restocking of the hole estate. (Viiri et al. 2011, 224)

The effect of natural hazards can be decreased by areal diversification of forest estate portfolio and well timed and execution of forest management. The risk can also be minimised through insurance policy. (Vughan 1996, 30) Approximately 30 % of Finnish forest is insured and the proportion of insured forest has increased steadily from 90's. Most of the insurance policies cover storms, wildfires, snow, insect, fungi destruction, and animal excluding moos which enjoys government subsidies. The insurance premiums are charged based on hectares and location of the estate, which tends to change the markets of insurance policies towards old growth forests and harvest mature forests. The compensation of damages is to full extent of the damages subtracted with a deductible amount or percentage. However, some policies have a maximum compensation per hectare in storm and snow destructions. The most frequent and largest in monetary terms is the usage of forest insurance is storm settlements. (Rantala 2018)

4. COMPARISON OF REAL ESTATE AND FOREST EQUITY

In this chapter real estate and forest equity are compared against each other. The aim of this comparison is to find similarities and dissimilarities in characteristics between the two assets. Findings of this comparison will be used in the construction of a reverse finance product for forest equity in future works. The comparison starts with examination of the assets as investment assets. This comparison includes an assessment of fundamental structure of the assets, the value generation of the assets, the characteristics and what kind of properties these characteristics create the asset respectfully. After this the focus turns to compare markets of both assets. Lastly the examination shifts to evaluate risks of the given assets.

4.1. Similarities and differences as investment assets

Forest equity and real estate resemble each other and share some important properties. Both are real investment assets. Furthermore, both have a dual characteristic of being simultaneously an investment asset and a product. On a fundamental level real estate is simultaneously an investment asset and a commodity of space whilst forest equity is an investment asset and factor of production. When investing in real estate one invests in a necessity commodity which rights one can sell or use them-selves. Whereas forest equity is an investment into means of production, which is biological growth, and into timber present on the estate, which is a factor of production for multiple industries. For both investments, the asset and the underlying product are transacted on different markets. The assets are transacted in property market and in forest estate market, whereas the underlying products are transacted in space market and timber market respectfully. Importantly, in both cases the asset market and product market are connected through the price of the underlying product. Furhtermore, value of both investments is driven from the value of future cash flows generated by the underlying product.

However, beneith these fundamental similarities there exist important differences. The cash flow is generated differently due to the difference in how the value is generated. The commodity of space generates periodic continuous cash flows in the form of rent or interest, whereas timber generates large discreate cash flows in the form of harvest revenue. This means that real estate investment is an investment to current income whereas forest investment is an investment to future income.

In addition to the maturity of the cash flows the generation of value differs. Real estate generates its value through usage of the commodity of space which is non-shareable and non-wearing. This means that the value is the present value of net rent, which is determined by demand and supply of the space market. The value of forest estate is the present value of future net harvest revenue. As forest equity is an investment to means of production, the value generation comes from biological growth and the price of the timber. Thus, the value grows with compounding interest, or the amount of timber does, and the price of the value growth is on the timber market by demand and supply. As a factor of production, the demand of timber is derived demand of the end products.

The differences in underlying value generation generate particular properties for both assets. Real estate generates semi-predictable cash flows and retains its value well. However, in long time span the value of real estate decreases due to wearing of the asset, which decreases the receivable rent. To maintain positive cash flow real estate needs continuous managing and periodic maintenance. Forest equity on the other hand, generates well predictable cash flows and the value of forest equity increases with compounding interest. In other words, the creation of value can be deposited in the asset for long time periods without any cost. This means that unlike real estate owner, the forest owner can decide when to realise the value. The value generation of forest also holds a promise of non-negative development, with the assumption that natural hazards do not create havoc of the forest property.

The value of forest equity drops significantly with harvests. Furthermore, forest investment, in contrast to real estate property, needs diminutive periodic management and maintenance and neglecting forest management does not generate negative cash flow like real estate. Nevertheless, poor management can decrease value growth of the forest equity for the entire turnover-time whereas the poor management in real estate seldomly affect the future revenues. In both investments the owner can increase the value by proper management to certain extent, but in both assets the upside is limited by restrictions. In both assets the volatility is low due to the characteristics of markets and underlying product.

Some intrinsic characteristics that real estate and forest equity share are heterogeneity, non-transportability, capital intensity and long investment horizon. Despite these commonly shared characteristics a more detailed observation reveals that these properties have some underlying differences. Namely, despite the obvious heterogenity, real estate is exposed to a larger variety of heterogeneity than forest equity. Real estate heterogeneity consists of macro and micro location, both of which can have numerous features; the ownership form which each have their own features of heterogeneity, and the property itself which has a myriad of physical and abstract features.

Forest estate heterogeneity is created through macro location, harvestability, shape of estate, soil composition, timber quantity and quality, common benefits, and encumbrances. The differences in heterogeneity can be observed on the markets *by* technical submarkets. In real estate sector technical submarkets are created with respect to the usage of the property, whereas in forest estates some vague technical submarkets can be observed with respect to timber type and growth location. However, the technical submarkets of forestry are not as clearly exposed within the market as in real estate. A key difference in heterogeneity between the assets is the fact that real estate heterogeneity is quite stable, whereas the heterogeneity of forest equity is unstable.

A common characterstics of both assets is that they are non-transportable, which makes both assets local and scarce. The locality also creates areal submarkets for both assets. Forest equity is less tied to its location as the product itself can be transported, however the low value to weight and volume as well as the spoilage time creates some areal restrictions to product markets. Real estate however is strictly tied to its location and has also greater variance in properties and value both in macro and micro location. Forest equity on the other had does not have a sensible micro location property. The differences in locality make real estate much more dependent on the development of surrounding area, which is not influenceable by the investor. However, the locality of real estate makes the price determination of real estate easier due to high correlation of areal prices. Locality makes both assets scarce. However, forest estates are truly scarce as forest equity is non-producible. Real estate is producible, but the amount of extra production is restricted by the locality of real estate. This means that in some areas the amount of space is scarcs and due to long production time, the amount of space can be though to be scarce also in short time.

If value is examined within a wider framework, forest equity has a more versatile set of values than real estate. On top of direct value, forest has indirect value and passive value. If these values are compared to real estate's comparable values, there is surprising similarities. The indirect value of forest equity can be capitalised by using or renting the forest as factor of production or product. Examples of these are the non-sharable values like professional tourism and hunting. If these are compared to real estate the value generation of selling right to use space one can see the resemblance. Passive value refers to option value and value of existence. Real estate has also option value but compared to forests option value the real estate option value can be estimated with greater accuracy. However, the share value of existence can be found only in some cases in real estate, for example in historically or culturally important constructions.

Both assets are described in literature as capital intensive. This capital intensity rises from large unit costs and missing short selling options. However, of the two assets real estate is more capital intensive than forest equity. The unit prices of real estate are on average much higher than that of forest equity. On top of this forest estates are dividable whereas real estate is much harder or impossible to divide into smaller units. The difference in capital intensity can be also seen in dept financing as real estate is much more leveraged asset than forest investments. In long investment time horizon, the assets are similar, but the reasons for the long investment horizon are different. In forest estates the long investment horizon is due to biological growth and value accumulation which happens during decades. In real estate the long investment horizon is determined by long business and market cycles. On average one could say that the investment horizon of real estate is shorter. Other reasons for long investment horizon are transaction costs, low volatility and steady price development. In these forest equity has higher transaction cost and lower liquidity.

Table 3 Summary of characteristics of real estate and forest equity

Real estate	Forest Investment
Investment asset & commodity of space	Investment asset & factor of production (means of production and product itself)
Direct value	Direct & Indirect & Passive value
Economic value and utility if commodity is used by owner	Economic value (utility if used as service)
Continuous periodic cash flow from rent	Large discreate cash flow from harvest
Value appreciation tied to space market demand and supply	Value appreciation tied to biological growth and timber market supply and demand
Retains well value, but in the long term destroys value	Non-negative value growth which is compounding and storable
Value can be enhanced by management to some extent	Value can be enhanced by management to some extent
Value can be destroyed by poor management	Value growth can be only hindered by poor management
Semi predictable cash flows	Very predictable cash flows
Small volatility	Even smaller volatility
High transaction cost	Even higher transaction cost
Highly heterogenity; creates distinguishable technical submarkets	Heterogenity; creates wage technical submarkets
Constant heterogeneity	Non-constant heterogeneity
Non-transportable	Non-transportable
Local, creates very distinguishable micro and macro areal submarkets	Local (timber is mobile to some extent) , creates distinguishable macro areal submarkets
Scarce in some sense	Scarce
Producible	Non-producible
Very capital intensive	Capital intensive
Non dividable	Dividable
No short selling opportunities	No short selling opportunities
Dept financing used extensively	Dept financing
Very active investment	Active investment
Investor has a large decision power	Investor has very large decision power
Long investment horizon due to long business and development cycles, transaction costs, and steady price development	Very long investment horizon due to biological growth which creates long business cycles, transaction costs, and steady price development

In the above table a summary of the similarities and differences of the two assets is presented. From the table we can observe the characteristics and their relative strength between the assets.

4.2. Similarities and differences of markets

The market structures forest equity and real estate have some similarities, but yet comprise major differences. In literature the market structure of real estate is studied through four-quadrant model presented in figure two and three (see pages 16 and 17), whereas in the forest equity literature no similar static models are not used. This thesis presented a static model in figures eight and nine (see pages 39 and 40). When the two static models are compared the real estate market and forest equity market seam to resemble each other well. Both market models share same type of submarkets, similar market players and market forces. However due to the nature of the products there are some large differences.

In product market the two assets differ the most. The space market of real estate resembles more the models of perfect competition whereas within timber markets exist oligopolistic agents that dominate the marketplaces. The space market can be though to consist of constant or very elastic stock which restricts the total amount of supply. The supply itself as well as the demand have a low-price elasticity. The demand is affected by the nature of space being necessity commodity which makes aggregate demand very stable. The supply side of space market is affected by the risk of negative cash flow, which decreases the pricing power drastically.

The timber market on the contrary has very few entities creating demand and large pool of entities creating supply. Compared to the real estate market the supply and demand are very price elastic. In the supply side forest owners can store wealth and wait for prices changes. The concentration of demand gives the demand side grate pricing power on the markets which is amplified by vertical-trade custom of timber markets which acts like a buffer to prices. The demand and supply of timber markets is also subject to shocks. Demand of timber is derived demand of end products that directly correlates with the development trends of the global economy. The supply side is under weather restraints which can create positive and negative supply shocks. In addition, the price determination and price transparency are low due to transaction customs, large amount of tradable classes as well as the nature of the trade which includes contractors and large uncertain cost components. Both markets lack a centralized marketplace, which is due to the locality and heterogeneity of the products.

Intrestingly asset markets resemble each other more than the product markets. Both real estate and forest estate markets are imperfect, lack a centralized marketplace, bear large transaction cost, have skewness between demand and supply, and have low liquidity. Of these characteristics forest equity has higher transaction costs, larger skewness, and lower liquidity. However real estate market can still be though to be more unperfect because real estate market has much lower price transparency and price determination as well as large asymmetric information between the parties.

In both assets the demand is larger than that of supply. Even though this skewness is larger in forest estates the skewness of demand is seen as a larger problem in real estate. This is due to necessity of the commodity and the utility function of owner occupiers which results in irrational pricing of real estate. However, this same effect can not be observed in forest estate market. The markets also differ greatly by ownership structure and transaction customs. Forest estates are most often transacted within families whereas the real estate is transacted typically between non-related parties. Due to this forest has a very low liquidity compared to real estate. The transaction times of forest estate are also higher than that of real estate.

4.3.Similarities and differences in risks

The examination starts from environmental risk, which is restricted to include only natural hazards. After this the risks are examined by two-by-two matrix introduced earlier, internal, and external risks versus systematic and non-systematic. In general, the risks concerning both assets are very investment and investor specific as in both investments investor has a great decision power. Real estate can be though to have a larger investment and investor specific than forest estates. This difference is caused by the larger managerial role which the real estate investor has as well as larger heterogeneity.

Both assets face risks of natural hazards or catastrophies. In both assets the risk of natural hazards is insurable and into some degree preventable by good management. Because natural hazards are insurable the environmental risk is in both assets is equal, if insured. Forest estates are under larger number of different risks which have a higher incidence rate. However, there are fewer clauses in forest insurances than in real estate, which makes the natural hazards riskier to the real estate holder. If the tenant violates the clauses of insurance company and is doomed to be liable

and the tenant is insolvent the risk can realise for the investor. Forest investors have also greater possibility in the prevention of natural hazards through good management than real estate owners.

Furtermore, both investments products are subjected to systematic risks, such as opportunity cost, interest rate risk, inflation risk, cost attributes, and risk conserving the global and national economic. Opportunity cost is shared equally between both assets. The interest risk is slightly larger with real estate due to larger typical leverages used in the industry. In addition, both assets are described in literature as good inflation hedges, but forest equity literature has a larger consensus on the inflation resistance of forest investments. Due to this consensus forest equity could be seen to have a better protection against inflation, even though forest profits are much more reliant on cost attributes than real estate. The largest cost attributes of forestry are fuel and labour costs. The systematic risk of forest is much more related to the trends of global economy whereas the real estate is more tied to the national economy. Real estate is also sensitive to other systematic risks on national level like large demographic changes. However, both assets bear very little systematic risk compared to many other investment assets.

The internal business risk can be divided into strategical and operational, which differ a lot due to very different products and operations related to the assets. Between the assets the strategical business risks resemble each other more than the internal business risks. In both assets there are inherent risks in acquiring which relates to pricing risk and business process related risks, process risk and human error. On top of this risk both assets have risk related to long term profitability loos which could occur due to strategic decisions. In forestry these are strategic decision on forestry which affect the long-term biological growth and thus the long-term value growth. In real estate the risk is related to renovation risk, remuneration risk and building infrastructure risk. The strategic risk of real estate is partly environmental risk, like failure of building infrastructure, but also risks which are bought like renovation risk. The strategic risks are grater in real estate than in forest equity as they affect more the profitability and value of the asset.

The internal operational risk differs greatly between the assets, which is due to differences of underlying products. The operational risks of real estate are risks related to renting which are risk of empty months and tenant risk which consist of solvency risk and moral hazard. Compared to forest estate where the operation risk consists of risk involved in forestry. The affect of

operational risks realising in real estate bear relatively small cost and short duration, whereas in forestry the cost is can be very high and can affect the profitability of the forest for an entire turnover-time.

Both assets share a common set of external business risks. These risks consists of liquidity risk, price risk, political risk, areal submarket risk, and market risks which can be divided into market structure and demand risk. If the asset is leveraged there is also bank risk. In addition, real estate has rent level risk and forestry has a cost level risk. In real estate the market structure risk consists of preference changes which affects both rental level risk and price risk through demand risk. If the preferences of consumers change the demand of given property can decrease which will decrease the rent, which will then decrease the price of the property. In forestry a comparable risk could be timber demand risk which can realise through timber company shutdowns or wrong timber mix. Similar risk is also the price level risk which is the risk of national or areal drop in relative competitiveness which decreases the demand. Price risk in both consists of aggregate price risk and base risk. In real estate the base risk is significant compared to aggregate price risk, whereas the opposite is true in forest estates. The political risk consists of changes in regulation, legislation, taxes, tax like payables and subsidies. The risk of subsidies and tax changes is large in both asset classes as they play a large role in the markets of both assets. In forestry however the effect of subsidies changes is felt immediately by the forest owners, whereas in real estate the subsidies changes come through market structure changes. The legislative and regulatory risk is far larger in the real estate market.

In the end the risk profile of forest equity and real estate has some surprising similarities and some large differences. It is difficult to say which asset class has a larger overall or aggregate risk without numerical examination. But by comparing the severity of certain shared risk and common risk we can conclude that the risk profile of both assets resembles each other well.

5. CONCLUSIONS

The intrinsic characteristics of real estate and forest equity resemble to a large degree. In some intrinsic characteristics some differences can be found like producibility, scarcity and heterogeneity. The main difference of the assets raises from the asset structure which creates large difference in the value generation and market structure. Despite of the differences forest equity and real estate resemble each other, compared to many other investment classes such as comparing bonds and stock with each other.

The difference in asset structure is conditioned by the nature of underlying product, space commodity and biological growth that is a particlar property of forest equity. The difference of underlying product can be seen the product market and the value generation. Forest equity creates value through biological growth which is realised in large discreate cash flows. Whereas in real estate business value is generated by selling rights to a necessity commodity which realises small periodic payments. If these two cash flows are compared one can see that they could not differ more from each other. Thus, also as an investment commodity the assets fulfil very different needs as real estate is a current income and forest equity is a future income product.

The nature of the product creates also very different markets. Real estate has nearly perfect competition, good price determination and steady demand and supply in space market. Whereas forest property markets are oligopolistic with significant structural price elasticity and volatility on both demand and supply. In the property and estate market the relation is opposite as the forest equity market is closer to prefect competition than property market due to asymmetric information and poor price transparency and determination as well as irrational pricing.

Even though the underlying products, market structure and value generation differences the risk environment consists of very similar risk with resembling severity. The largest difference in risk can be found in the risk source. The risks of forest equity are related to global economy and the macro areal submarket of the estate. Whereas the risk concerning real estate relate to national and macro areal economy, demographic and preferential changes of domestic population and micro areal changes.

The findings off this comparison where well aligned with the initial expectations. However, the complexity of the asset structure and differences caused by it is a valuable finding for future study. Based on this comparison the two assets do not differ from each other too much to dilute the further study of reverse forest finance. Base on the comparison reverse mortgage could be applicable to forest equity with careful consideration of the differences and similarities found in this work.

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