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DEVELOPMENT OF HOUSING PRICES OUTSIDE AND AT THE VERTICES OF THE FINNISH GROWTH TRIANGLE

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TIIVISTELMÄ

Lappeenrannan-Lahden teknillinen yliopisto LUT
School of Business and Management
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Asuntojen hintojen kehittyminen Suomen kasvukolmion kärjissä ja niiden ulkopuolella

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Asumisen ja asuntojen hintojen kehityksen katsotaan eriytyvän Suomessa harvojen kasvukeskusten ja muiden alueiden välillä. Kaupungistumiskehityksen takia asuntojen hintojen erisuuntaisen kehityksen odotetaan jopa kiihtyvän tulevaisuudessa.

Tämän pro gradun tavoite on tarkastella asuntojen hintojen kehitystä niin kasvukolmion kärkien ulkopuolella kuin kolmion kärkien alueilla. Tätä tutkitaan asuntomarkkinoiden nelikenttä-mallin avulla. Tutkielman tarkoituksena on myös selvittää, selittääkö yleisen asumistuen kehitys asuntojen hintojen kehitystä. Tämän tutkimiseen on käytetty usean muuttujan regressiomallia. Lisäksi pyritään selvittämään, voidaanko asumistuen maksamisen kustannuksissa säästää yhteiskunnan varoja, jos se määräytyy kasvukolmion kärkien ulkopuolisten alueiden perusteella myös kasvukolmion kärjissä. Tutkielma pyrkii myös antamaan arvion säästön mahdollisesta suuruudesta. Aineistona käytetään Tilastokeskuksen ja Kelan tietokannoista koostettuja indeksejä vuosilta 2007-2019. Tutkielma koostuu asuntomarkkinoiden erityispiirteiden ja -hintateorian kuvailusta, aiemman asuntomarkkinatutkimuksen esittelystä sekä empiirisestä osuudesta.

Tutkimustulosten perusteella asuntojen hinnat ovat nousseet kaupungeissa, jotka muodostavat kasvukolmion kärjet. Muun Suomen alueella asuntojen hinnat ovat laskeneet tarkastellulla aikavälillä. Vuokrahinnat ovat kasvaneet molemmilla alueilla, joskin kasvukolmion kärjissä huomattavasti enemmän kuin muualla. Maksetun asumistuen kokonaismäärä on samalla aikavälillä molemmilla alueilla reilusti yli tuplaantunut. Kasvukolmion kärkien alueella keskimääräisen asumistuen määrä kotitaloutta kohti on huomattavasti suurempi kuin kasvukolmion kärkien ulkopuolisilla alueilla. Tästä huolimatta, tutkimuksessa toteutetun mallin mukaan asumistuki selittää asuntojen hintojen kehitystä vain kasvukolmion kärkien ulkopuolella. Yleisen asumistuen kokonaismenoista pystyttäisiin kuitenkin säästämään noin 12 prosenttia, mikäli maksetun tuen suuruus määräytyisi kolmion kärkien ulkopuolisten alueiden mukaan.

ABSTRACT

Lappeenranta-Lahti University of Technology LUT
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Development of housing prices outside and at the vertices of the Finnish growth triangle

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The development of housing prices in Finland is considered to be differentiated between a few growth centers and other regions. Due to urbanization, the divergent development of housing prices is even expected to accelerate in the future.

This master's thesis aims to look at the development of housing prices both outside the growth triangle's vertices and at of the triangle vertices. This is examined using the Four Quadrant Model of the housing market. The purpose of the research is to determine whether the development of the general housing allowance explains the development of housing prices. A multiple regression analysis has been used to investigate this. In addition, the aim is to find out whether the costs of general housing allowance can be reduced if it is determined based on the areas outside the vertices of the growth triangle also at the vertices of the growth triangle. The research also seeks to provide an estimate of the potential magnitude of the savings. The data used are indices compiled from Statistics Finland's and Kela's databases from 2007-2019. The thesis consists of a description of the special features and pricing theory of the housing market, a presentation of previous housing market research, and an empirical part.

Based on the research results, housing prices in the Finnish growth triangle vertices have increased and decreased in other regions over the period under review. Rental prices have risen in both areas, although at the vertices of the growth triangle, much more than elsewhere. The total amount of general housing allowance paid has more than doubled in both regions over the same period. In the area of the growth triangle's vertices, the average general housing allowance per household is considerably higher than in the areas outside the vertices. Nevertheless, according to the model implemented in the study, housing allowance explains housing prices only outside the vertices of the growth triangle. However, almost 12% of the total general housing allowance expenditure could be saved if the amount of allowance paid would be determined by the level of the areas outside the growth triangle vertices.

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Finally, I would like to dedicate this master's thesis to my family and especially thank my wife Kiira for her constant encouragement and strengthening of my self-belief in the midst of all the major life changes. You are a source of endless inspiration to me.

In Helsinki on December 6nd, 2020

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Four Quadrant Model: a model developed by Denise DiPasquale and William Wheaton in 1992. The model presents the changes of the housing market equilibrium in the long run

General housing allowance: in this thesis, general housing allowance means the total amount of public subsidy for rent paid within a year by Kela, the Social Insurance Institution of Finland

Growth triangle vertices: Helsinki Metropolitan area, Turku, and Tampere. Helsinki Metropolitan area is formed by the cities of Helsinki, Vantaa, Espoo, and Kauniainen

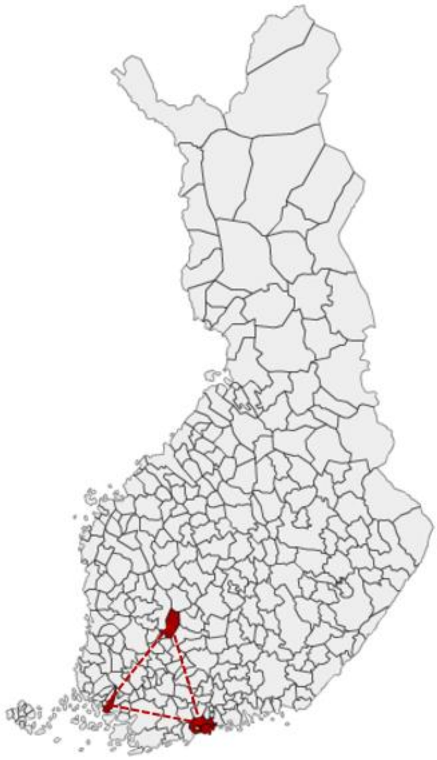

Figure 1. Cities forming the growth triangle vertices on the map (Kelasto 2020)

Kela: The Social Insurance Institution of Finland, a government agency that provides basic economic security for everyone living in Finland (Kela 2020a)

Statistics Finland: the only Finnish public authority specifically established for statistics. It produces the vast majority of Finnish official statistics and is a significant international actor in the field of statistics (Statistics Finland 2020e)

1. Introduction

The housing stock is generally one of the most significant assets that society has. Researchers of the housing markets have studied and emphasized the importance of the housing stock to society (DiPasquale 1999). The significance of the housing markets has traditionally been great also in Finland. Finnish households are relatively indebted, and most of the households' debt is mortgages. In other words, mortgage payback and additional loan expenses, and other living costs consume a large share of "every" working-age Finn's monthly income (PTT 2020). The housing stock is, therefore, an essential resource for the economy. Now we see a phenomenon where homes as properties are losing their value outside of few growth centers.

The above referred can be found from recent research as the decrease in housing prices has already extended to medium-sized cities. This kind of development has been verified by observing the period of 2015-2018 by Statistics Finland (2019). The only questions are: how much and at what pace is this trend advancing? The decline in housing prices might lead to society's problems as people get stuck with their houses as jobs and services move to cities. Which, in turn, could lead to housing prices declining even further.

Based on research conducted by Pellervo Economic Research Center (PTT 2020), the price difference between apartments in growth centers and other areas kept widening in 2019. It is a globally recognized fact that urbanization keeps changing our society at an accelerating pace. It means that the population, for example, in the Helsinki Metropolitan Area, Turku, Tampere, and a few other city areas, is rising rapidly. Still, in contrast, it will diminish at the same pace, basically in all other areas. However, research about housing prices development in Finland mostly compares average changes between the Helsinki Metropolitan Area and the rest of Finland. There have been surprisingly few academic studies conducted about housing price changes between, for example, different Finnish provinces.

The most significant feature of Finland's housing market, in addition to the differentiation of the housing prices, is the development of rental prices between growth centers and other areas. The spread seems to keep steepening year after year. Some parties actively following the housing market predict that in the future, the housing prices are increasing only in the region that is called the growth triangle of Finland. The vertices of this triangle are formed by the Helsinki Metropolitan Area, which includes the cities of Helsinki, Vantaa, Espoo and Kauniainen, and

Turku and Tampere. In this research, housing prices at the growth triangle's vertices and areas outside the vertices are compared.

As mentioned above, urbanization might be the most significant force directing the housing development in Finland. The reason behind this development is usually seen to be a collective desire to live closer to services and central locations. Obviously, in those areas where the population is increasing, the number of housing purchase transactions and housing prices will rise. According to Pellervo Economic Research Center (PTT 2020), in 2015-2019, this happened only in the areas forming the growth triangle's vertices and a couple of other cities with universities. However, it has been suggested that even the university's location in the city does not guarantee positive housing price development in the area.

1.1 Research background

It is challenging to find academic research specifically about the housing price development of different local regions in Finland. On the other hand, many studies were conducted about the Helsinki Metropolitan Area and Finland in general. This kind of research and statistics are also executed every year on behalf of different economic research institutes, such as Taloustutkimuskeskus, Bank of Finland, and the pre-mentioned Pellervo Economic Research center PTT.

As stated above, there has been a relatively profuse amount of studies about housing price development from various national scale perspectives. Historically, the housing market in Finland has been developing relatively similarly in different regions. As urbanization has progressed, the difference between cities' housing prices and rural areas has significantly differentiated in the 2010s. Thus, this is a comparatively recent phenomenon in Finland. As mentioned in the introduction section and based on general opinion and earlier studies, ditto development is estimated to accelerate in the future. One example of this kind of development is our Nordic neighbor Sweden, where the process is estimated to be 30 years ahead of the Finnish housing market. Even though the urbanization level (the level of how many people live in a population concentration center over 200 habitats) has developed to be almost the same within the last couple of decades, population density is totally different in Sweden than in Finland. As the urbanization levels are 87 and 84%, respectively, the population density in Sweden is over double compared to Finland. In Finland, the population density of conurbations is, on average, 680 people per square kilometer, in Sweden 1400. Another difference is the population's focus in the southern parts of the country in Sweden, meaning that about 80 percent of Swedes live further south than even the southernmost Finn. (EK 2016)

Based on numerous studies, a great deal of future housing price development can be explained by the region's population change. The population forecast by Tilastokeskus (2019) for the years 2019 to 2040 presents a few municipalities where the population increases by 2040. This would indicate that also the housing prices will decrease at the same pace as demand is disappearing. While housing prices increase in growth regions and decline in areas where the population is diminishing, it may become more difficult for individuals to follow jobs. However, studies about the topic cannot give any precise answers to the impact of housing depreciation on labor mobility (Ferreira et al. 2010; Brown & Matsa 2019).

1.2 Research objective, questions and delimitation

This study aims to find out how housing prices outside the growth triangle vertices have developed between 2007 and 2019 compared to the growth centers (i.e., cities) that form the Finnish growth triangle's vertices. This research also seeks to examine the relationship between the development of housing prices and the growth of public subsidy for rent. In the context of this study, this public subsidy of rent is only considered to be a general housing allowance, which means the total euro amount of housing support paid annually by Kela, the Social Insurance Institution of Finland. Kela is a government agency that provides basic economic security for everyone living in Finland (Kela 2020a).

The effect of housing subsidies has been studied worldwide and to some extent in Finland. According to a common phrase in the Finnish people's "language," greedy landlords always charge higher rents as more and more tenants finance their costs of living with a housing allowance. Based on studies of observations of data collected from different regions of Finland, it has been exposed that an increase in the rental price level increases the expenditure on general housing allowance, but this also seems to be true the other way around. In contrast, earlier studies on if the increase in housing allowance explains housing prices were not found based on online searches conducted for this thesis’s background research. Naturally, numerous other factors can also affect the development of housing prices, but this is what this study pursues to find out.

In addition, this study seeks to examine whether determining the amount of received general housing allowance based on regions with lower costs of living would potentially influence the development of housing allowance expenditure. Therefore, the research questions of this thesis are:

1. How have the housing prices developed outside the vertices of the Finnish growth triangle in comparison to the prices at the vertices?

2. Does general housing allowance explain the development of housing prices?

3. Can society's assets be spared, and if so, how much could potentially be saved if the general housing allowance would be paid determined by the level of the areas outside the vertices of the triangle?

As a research choice, students, conscripts, and pensioners have been excluded from general housing allowance statistics. Students form a significant group of beneficiaries of general housing allowance. Still, there are only a limited number of facilities providing education. The best universities, in particular, are located in growth centers, where the average monthly housing allowance seems to be automatically higher. Education often aims towards a better income level, i.e., the ability to pay taxes; i.e., at the state level, this must be seen as an investment. Conscription, on the other hand, is only a temporary phase, which, moreover, is not voluntary in terms of "equality" but impinges on only approximately half of each age group. On the other hand, retirees may no longer be able to influence their own income level by applying for employment, so it would not be reasonable to include them in the statistics.

In this study's regression models, housing prices have been described by explaining the prices of old housing shares, i.e., flats and terraced houses. The price development of old detached houses has been excluded from these statistics due to the large price volatility of different detached dwellings. The limitation condition has also been based on the information that the general housing allowance is paid in sporadic cases to detached house properties (Kela 2020b).

1.3 Frame of reference

The theoretical frame of reference for this thesis is based on the Four Quadrant Model of the housing market, developed by Denise DiPasquale and William Wheaton in 1992. The Four Quadrant Model presents the housing market equilibrium shifts in the long run (DiPasquale & Wheaton 1992). Alternatively, the general Stock-Flow Model, initially developed by Wynne Godley and James Tobin in the 1970s (Nikiforos & Zezza 2017), is used to explain the housing price developments in the short run. In the theory section, the Stock-Flow Model of housing markets is introduced, but it is not used in this research. In addition, the frame of reference includes housing market characteristics and unique features presented in the background section.

Of course, the framework is also relative for this time. Apart from the financial crisis occurring at the end of the 2000s, there have been no sudden changes in the Finnish housing market since the starting year of used observations selected for the study. Unemployment has not risen sharply over the period under review, and the level of immigration has remained relatively stable. As a result of domestic migration, rental price levels have been soaring in growth centers. Construction regulations and zoning by municipalities continue to be factors driving up housing prices. Mortgage loan rates have remained low for more than a decade now, increasing the owner-occupied housing demand. In addition to these above-mentioned demand and supply factors, general economic growth, interest rates, and subsidized housing production affect housing prices, thus rents, and further the general housing allowance.

The topic of this research is highly relevant in the context of recent and widely forecasted future development. In Finland, there are not too many academic researchers examining the field of housing markets. After all, housing market developments consequence on all of us living in some form of fixed housing.

1.4 Structure of this thesis

The following sections review the most common factors influencing housing development and the main theories applied in explaining housing prices. After this, the literature review, the study's implementation, and the findings are presented. In the final section, conclusions and observations are summarized.

Section two begins by reviewing the factors most commonly affecting housing prices, broken down into national and local factors. After this, two traditional models explain housing prices, the Four Quadrant Model and the Stock-Flow model, are assessed. The first model, the Four Quadrant Model, describes the long-term shift in the housing market's balance through four key variables. These variables are rental prices, housing prices, construction costs, and the number of stocks measured in square meters. In addition, the theory behind the formation of the multiple regression model is presented.

The third section is an overview of previous research and academic literature on the topic, i.e., the development of housing prices regionally and the impact of housing subsidies on housing prices. The most critical reviews in the section are the studies carried out on the Finnish observations. Or perhaps rather their lack or scarcity in relation to the extent to which the development of housing prices affect society.

The fourth section first describes the methodology used in this thesis and the variables selected as data and their formation. After this, it is proceeded to form the regression models and presenting their results. The last section reviews the results of the fourth part empirical study and the conclusions drawn from them.

2. Background: factors and theories affecting the housing markets

In this section, the most significant multiple factors affecting housing prices formation are presented. The factors have been divided according to the factors relevant when considered if they influence national or local levels. In this section, the most considered theories explaining housing prices in the long and short-run are also described. In the study conducted for this thesis, the concentration is on the development of housing prices at and outside of the Finnish growth triangle vertices. In addition, at the end of the section, the theory behind the multiple regression model is explained.

2.1 Special housing market characteristics

The housing markets are somehow different than other commodities. From the economic theory point of view, an apartment is a unique commodity, which is why the housing markets differentiate from other commodities markets (Kosonen 1995, 1). The housing markets are one changing ensemble affected by individual households' decisions and decisions concerning building and possessing real estate made by companies (Laakso & Loikkanen 2001, 39).

Initially, apartments and houses are a necessity, because we all need to live somewhere. This does not mean that individual households need to own the properties they are living in, but they can also rent it from somebody else. This aspect makes an apartment not only a commodity of consumption but also an asset, and thus an opportunity to be included as a significant part of households investing portfolio (Hasan 2009). Because of these factors, the demand for housing stock is two kinds. On the other hand, the owner-occupied housing and people living in a rental apartment consider the apartment a consumed commodity. The investors and the people living in an owner-occupied apartment consider it an investment (Laakso & Loikkanen 2001, 39). Indeed, an owner-occupied home's value often has a massive impact on household consumption and savings opportunities (Case et al. 2005, 14). Thus, they also affect socio-economic conditions and have an effect on national economic conditions as a whole.

There are several other unique features of the housing markets. For example, an apartment's price is commonly a specialty compared to other commodities (consumed or assets) because it is a massive and expensive purchase. This usually causes it to be a one-at-the-time acquisition.

In addition to the obvious that apartments have a fixed location, they are also commonly indivisible. Furthermore, the housing market is connected to multidimensional heterogeneity as an apartment consists of several structural, qualitative, and quantitative characteristics (Smith et al. 1988, 34 & Laakso 2000a, 4). Each apartment is a unique unit, differentiating from others in the sense of location, construction method, financing, etc. This uniqueness makes the housing markets often inflexible (Miles 1994, 7). In addition to the inflexibility, the pricing of the apartment is complicated. The uniqueness causes the target's information to be asymmetric as the buyer and the seller do not have the same knowledge about the same housing unit. This can lead to a situation where the other party of a transaction either over-or underprices the target (Laakso 2000a, 4).

It is also expected that the transaction costs are much higher in the housing market than in other markets (Oikarinen 2007, 34). Transaction costs are the costs that consist, i.e., from searching, removing, repairing, and broker costs (Mankiw & Taylor 2006, 197; Laakso 2000a, 4). Perhaps partially because of high costs, apartments and houses tend to be relatively long-lasting commodities for one owner (Kosonen 1995, 1). Due to this longevity, the existing housing stock is always much greater than the volume of building new residents. Therefore, most of the transactions are made between separate households, and the markets consist mostly of secondhand housing (Laakso 2000a, 4).

One major feature differing housing markets from others is that they are always local. More precisely expressed, national housing markets are always a combination of several different regional housing markets. The supply of apartments and houses is basically always connected to a location, which is the most important factor affecting the price. Distance to important places such as city centers, employment centers, and transport routes is essential (Smith et al. 1988, 38). It is also quite normal that the demand in the housing markets comes from the local people, even if the migration moves the population, especially to growth centers. Also, the housing markets' locality produces a situation where demand beyond supply needs to be fulfilled by building new premises (Salo 1990, 3; Laakso 2000a, 4).

The national and international factors affect local housing markets through general economic conditions and, more importantly, through financial markets. Even though these characteristics are concerning housing markets and other markets of different kinds of products, these aspects make the analysis of housing markets kind of challenging compared to others. (Laakso 2000a, 4-5)

2.2 Factors affecting housing prices on national level in Finland

It must be stated that many factors to be presented in the below chapters could be categorized to affect housing prices on a local level. However, some of the researchers think that national factors explain the housing price development entirely, i.e., the locality of a housing market is not relevant.

In this study, national factors affecting housing prices refer to factors that affect housing prices development throughout Finland. National factors are either raising or lowering housing prices almost simultaneously, regardless of region. Several different housing market researchers have found that interest rates, inflation, and construction costs significantly impact housing price volatility (e.g., Abraham & Hendershott 1996; Hort 1998; Malpezzi 1999; Oikarinen 2007). Other national factors influencing the development of house prices include, for example, household borrowing, the price effect of the housing concentration on the whole country, and state tax subsidies (e.g., Oikarinen 2009a; Kuosmanen 2002; Berg 2002). These factors are key factors influencing housing prices also in the Finnish housing market.

There is a clear two-way interaction between housing prices and the economy. The national economy's general state has a significant impact on housing prices, and changes in housing prices have a far-reaching impact on the macroeconomy (Hou 2010). Macroeconomic factors affecting housing prices are the factors that affect the demand, for example, interest rates, construction costs, expected changes in housing prices, household income, and changes in the housing price index. A large proportion of housing market researchers believe that housing prices are mainly explained by macroeconomic factors.

Oikarinen (2007, 103-104) has identified three important channels through which housing prices change affect economic activity. The first is the wealth impact of housing. As dwellings make up most of the households' wealth, housing prices significantly impact household's consumption. In other words, an increase (or decrease) in housing prices leads to an increase (or decrease) in consumption precisely through this wealth effect.

The Finnish state uses tax subsidies to support owner-occupied housing and make owner-occupied housing possible for households that do not easily access it. The government has provided homeowners with the right to deduct tax on mortgage interest, which has increased the popularity of owner-occupied housing. However, this right has been significantly reduced in recent years. In 2015, the right of interest rates deduction on mortgages was 65%, while in 2020, it was decreased to a level of 15%. These deductions are typically made from capital income. Still, if a mortgage borrower does not have any or has less of the value of the deduction, 30% of the resulting deduction can also be made from income taxes. (Tax 2020) In addition, the Finnish state aims to make it easier to buy a first home with a free transfer tax and a housing savings account (ASP) (Savolainen 2009). This tax benefit is 2% if the transaction object is an apartment in the form of a housing company and 4% if the object is real estate (Tax 2013). The housing savings account includes various (changing) incentives that make it easier to accumulate the first apartment purchase's required capital and loan guarantee. All such forms of subsidies increase, or at least are expected to increase, the demand for housing. This growth in demand, in turn, generally raises housing prices and rents, which in turn may fuel the need for new construction.

The construction industry is undoubtedly one of the major factors and second channel identified by Oikarinen (2007), affecting housing prices. The fall in housing prices has a negative effect on the supply of housing, which leads to a decline in the construction industry and thus to a decrease in both total output and employment. The availability of land for housing construction, zoning of the areas, and building legislation also influence housing prices at the national level. However, the first two can vary significantly from region to region. The Finnish housing market has been very cyclical in terms of housing prices and construction. The housing market has been active since the early 2000s, as interest rates have been very low, and loan terms have been flexible (Viitanen et al. 2003). In the Finnish housing market, demand is strongly limited to certain growth centers, where significantly more housing is built than elsewhere in Finland. Still, the volume of new housing stock under construction is not enough to stop or even slow down the rise in housing prices. The best examples of such growth centers are the cities forming the growth triangle's vertices: Helsinki Metropolitan area, Turku, and Tampere.

The financial sector is the third channel that was identified by Oikarinen (2007). Changes in housing prices have been found to have a significant impact on bank lending (Goodhart & Hofmann, 2008). The higher housing prices are, the more money banks lend. This was also observed by Oikarinen himself (2007) when studying housing data in Helsinki and noting the two-way effect between housing prices and household borrowing. Increased household mortgage borrowing pushed up housing prices. The rise in housing prices, in turn, accelerated mortgage lending, which pushed up housing prices even further. There was a similar connection as housing prices fell. This is a good thing for consumption but a significant risk factor for the financial sector's sustainability. If housing prices fall suddenly, mortgage debtors could face real distress, forcing banks to bear heavy credit losses, which would negatively impact the economy as a whole. In Finland, the mortgage's interest rate consists of the European Central Bank’s interest rate and the bank’s margin. The interest rate of the European Central Bank is the same for all mortgage holders, but the bank’s margin varies depending on the borrower’s personal factors (Savolainen 2009). In 2020, the mortgage for owner-occupied housing is usually 70-85% of the apartment's price.

In Finland, the acquisition of owner-occupied housing, housing construction, and the occupancy itself is supported by the state. Housing supply subsidies refer to subsidies that affect housing production; for example, the transfer of constructible land to constructors at a reduced price. Demand subsidies, on the other hand, are various direct income transfers between households. The most relevant of these housing demand subsidies for this thesis is the general housing allowance, which in this context means the total amount of euros paid to the households. The amount of supply subsidies has fallen sharply in recent years, but at the same time, the amount of demand subsidies is growing considerably. However, it is difficult to determine the share of income transfer in the national economy to support housing. Especially in the case of supply subsidies, because, for example, the above-mentioned land transfers at a lower price are only a calculated loss of income in municipal budgets. They do not really appear anywhere (Eerola & Saarimaa 2016). However, in the housing market, rising housing prices are expected to affect demand and supply and thus on the rental prices and the amount of housing support expenditure. If housing prices are not flexible, which is often the case in the housing market, there will be flexibility on housing subsidies. This means that an increasing amount of euros in housing subsidies is being transferred to rental landlords. In this way, housing subsidies are still being passed on to housing prices, and the effectiveness of housing subsidies is weakening, and their growth is accelerating further.

2.3 Local factors affecting on housing prices

Another side of housing market research possesses the opinion that it does not make sense to study the housing market nationally, as the housing market can vary considerably within the country (e.g., Goodman 1998; De Vries 2005; Oikarinen 2009). For example, there may be very little land available for construction in some areas, which costs a lot due to inadequate supply. This is usually the case in growth centers. There is typically a lot of demand because the population is increasingly moving into the area, and the average household's income level is considerably higher.

The development of housing prices in each housing concentration center can be strongly reflected in other housing concentrations in the country and from there on to the provinces. A study conducted by Oikarinen in 2004 showed that the development of housing prices in Finland is driven by Finland's largest economic concentration, i.e., the Helsinki metropolitan area, one of the vertices of the growth triangle. Changes in its prices spread to other regional centers, such as the other vertices of the growth triangle, i.e., Tampere and Turku, but also to Jyväskylä and Oulu. It is assumed that as housing prices in the provincial center rise, so will housing prices in the whole province. In 2009, however, Oikarinen found that the Finnish local housing market might be worth examining in more detail separately. The regional housing market can be considered a completely separate commodity, but it can correlate with other regional markets. Local housing markets can be non-linear, and geographically combined local observations can yield misleading results (Goodman 1998).

The Finnish housing market operates mainly according to the market economy rules, in which case purchase prices are formed according to supply and demand. In the short term, real estate supply is inflexible because housing completion is slow and does not meet demand in real-time. In this case, prices will rise rapidly, as has happened, for example, in the Helsinki metropolitan area and other growth centers. Increasing supply, in particular by improving the zoning process for plot properties, would rebalance the market in the longer term. (Jokinen 2004, 2-4)

However, the most significant regional factors influencing housing prices are probably demographic factors. It has been found that the demand for housing is greatly influenced by the average income of the inhabitants of different areas. Thus, the price elasticity of the demand for housing varies considerably due to local market preferences. The demographic structure, i.e., the population's age, the distribution of minorities and ethnic composition, and the uneven migration movement often vary from region to region (Reichert 1990; Goodman 1998). The total population of the area and the average unemployment rate also significantly affect housing prices (Rechert 1990). Naturally, these factors also significantly impact the development of housing prices in different regions of Finland, as Finland is a large and thus long-distanced country with a highly varying population structure between the south and north and between the east and west.

In addition to demographic factors, the number of construction companies, i.e., the number of operators influencing housing supply, varies greatly from region to region. In Finland, for example, there are very few large construction companies, and only a few of them act as producers nationally. This leaves room for regional construction companies outside the growth centers. Because locally-based construction companies have knowledge of the local housing market and demand, they have an advantage when constructible land zones are allocated. Thus, construction companies can be segmented according to the local area, which means that the quality of construction and houses' types to be built may vary. Such segmentation can, in turn, increase oligopolistic or monopoly pricing (Goodman 1998).

2.4 Theories behind the pricing of housing markets

Two fundamental theories explain changes in housing prices. The formation of housing prices, in the long run, has been theoretically examined to a large extent with DiPasquale’s and Wheaton’s Four Quadrant Model, which gives a reduced theoretical description of the determination of the price of housing. A model presented in this section is a simplified Four Quadrant Model of the housing market that illustrates how the housing stock, production, consumption, and housing prices and rents interact.

The short-term approach differs from the long-term approach due to the characteristics of the housing market. This is because the supply of housing in the short term is inflexible, whereas the production is considered flexible in the long run. In other words, adaptation to changes in supply and demand is relatively slow. Building a new home is a long-term project, and construction decisions also take their own time. Also, adjusting the production to weakening demand is slow, as housing depreciation takes several years.

The Four Quadrant Model presented is a static model used to understand the interaction between variables and describe long-term equilibrium. However, it cannot describe how the housing market's new balance will be reached and how long it will take. When analyzing short-term changes, a more dynamic model, the so-called Stock-Flow Model, is needed. The Four Quadrant Model presented in the next chapter is developed by DiPasquale and Wheaton (1992) and extended here by Laakso & Loikkanen (2004).

2.4.1 The Four Quadrant Model of the housing market

In the long run, the most popular macroeconomic model of the housing market is commonly considered to be the Four Quadrant Model (also known as DiPasquale-Wheaton Model and Fisher-DiPasquale-Wheaton Model) developed by DiPasquale and Wheaton in 1992. The Four Quadrant Model (DiPasquale & Wheaton 1992) provides a simple and well-known theoretical framework for looking at house prices' formation over the long term. It is a four-variable model that divides the housing market into two based on the housing stock demand. The sections on the right represent the housing consumption market in the figures to be presented, while the sections on the left represent the housing capital market. The model outlines how the housing stock, housing production, and housing consumption, as well as housing prices and rents, interact. (DeSalvo 2017)

First, the housing stock can be considered as an asset, in which case it is subject to a demand for ownership. This demand for ownership arises from two factors. Since housing capital generates a return to its owner in the same way as other capital, part of the demand for ownership is generated by investors. At the same time, housing capital provides housing services to households, which gives rise to another set of ownership demand, owner-occupied housing. On the other hand, the housing stock can be thought of as providing only housing services to households, subject to consumer demand. Consumer demand is generated by both rental and owner-occupied living. (Laakso & Loikkanen 2004, 267)

The division into ownership and consumption demand is evident, especially in rental dwellings, when dwellings' ownership and consumption are separated. In the case of owner-occupied housing, it is plausible that the household rents a dwelling and receives rental payments for it, which corresponds to the care and maintenance costs of the dwelling and the capital costs arising from ownership. Capital expenditure refers to the imputed return on a dwelling, which describes the lost return on an alternative investment when deciding to buy an apartment instead of rental housing. (Laakso & Loikkanen 2004, 267) However, the division into ownership and consumption demand seems to be a justified and clear solution (DiPasquale & Wheaton 1992, 181).

Figure 2 shows a simplified Four Quadrant Model that illustrates how the housing stock, construction, housing prices, and rents interact. The upper vertical axis describes the rent level (€/m^2), the lower vertical axis the volume of construction (m^2), the left-hand horizontal axis the price level of dwellings (€/m^2), and the right-hand horizontal axis the size of the housing stock (m^2). The right half of the figure represents the housing consumption market, and the left half the housing ownership market. The rectangle reflects the long-term equilibrium of the housing market. (Laakso & Loikkanen 2001, 41) Next, the model's determination of rents, housing prices, construction, and housing stock is observed.

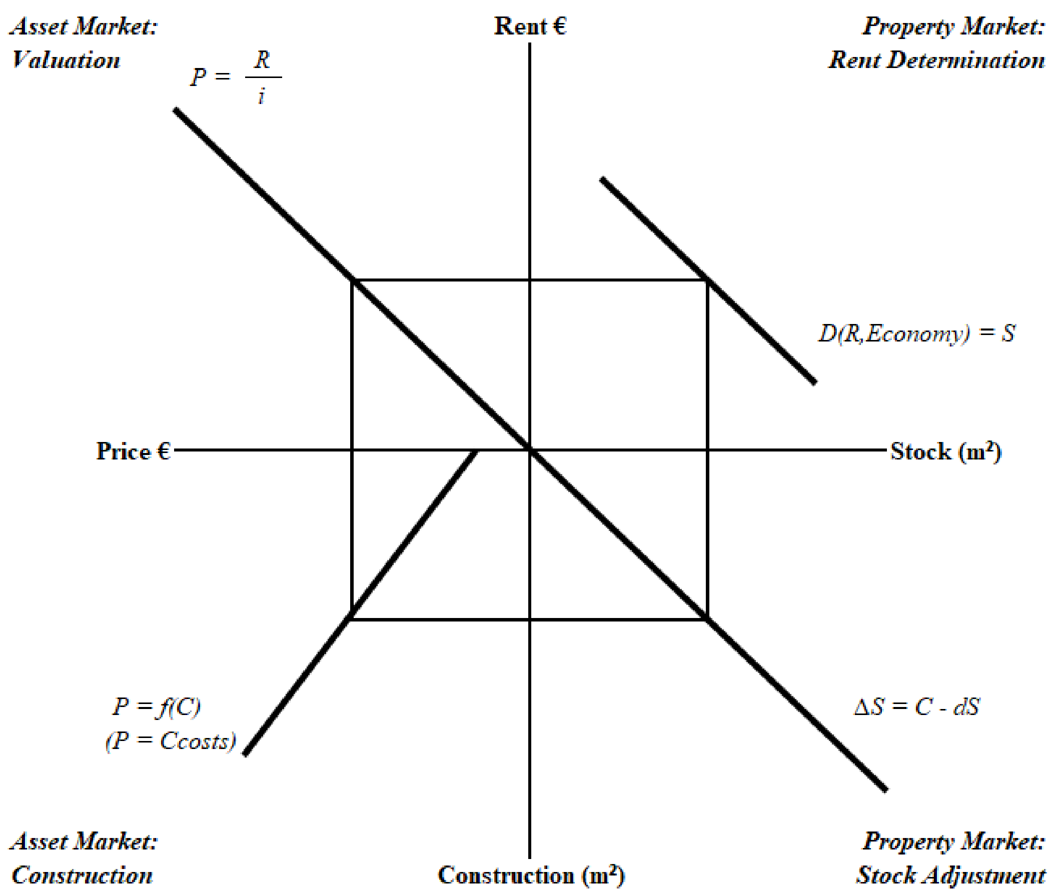

Figure 2. The Four Quadrant Model – The Property and Asset Markets (DiPasquale & Wheaton, 1992)

The upper right corner of *Figure 2* depicts the relationship between rent levels and housing consumption. The vertical axis represents the rent level (€/m²), and the horizontal axis the housing stock (m²). Rents are determined by the balance between supply and demand for housing consumption. The line down to the right depicts the relationship between the demand for housing and the rental level if other economic factors are unchanged. The supply of housing is very inelastic, which is why the strengthening of demand may lead to an increase in rents in the short term. In the long run, the housing stock supply will adjust, and the housing market will return to balance. (Laakso & Loikkanen 2001, 41)

The upper left corner of the figure depicts the determination of housing prices in the asset market. The vertical axis represents the rental level of dwellings (€ / m²), and the horizontal axis, the price level (€/m²). The straight line rising from the origin to the left depicts the relationship between the rent and the price level, i.e., the amount of risk-free net rental flow *R* per year that property owners have to receive in order to hold *P* square meters of dwellings. It is conceivable that rents and prices are in balance when the discounted present value of future rents per square meter of housing is equal to housing prices per square meter. (DiPasquale & Wheaton 1992, 187–188)

There is an equilibrium condition between the price per square meter and the net rent; the price of housing capital is the present value of future net rents when interest rate level *i* is used as the discount factor. I.e., the return on the alternative investment per year. $P = R/i$ = (gross rent - current expenses - taxes) / interest rate, i.e. the housing price should correspond to the discounted present value of the rental flow. The level of rent corresponding to the balance determines the price level of dwellings. The price level corresponding to the equilibrium is determined by the rent level and the intersection of the *R/i* curve. The equilibrium price is located at the intersection of the vertical line and the horizontal price axis. (Laakso & Loikkanen 2001, 42)

The lower-left corner of the figure depicts the volume of new housing construction in the property market. The straight line, i.e., the production cost curve $(P = f(C))$ falling to the left of the origin, describes the unit costs of construction per new dwelling. Unit costs are assumed to be a growing function of construction volume, i.e., the intensity of construction is assumed to affect the land price and the wage costs in the construction sector. Also, it is essential to understand that the production-cost curve does not start at the origin. This is since house prices require a certain minimum level at which new production will be implemented. The intersection of the production cost curve and the horizontal price axis describes the minimum price level of dwellings at which new production occurs in general. The volume of new housing production corresponding to the equilibrium is determined based on the housing price level through the production cost curve. In equilibrium, the volume of new production is at a level at which house prices correspond to the total cost of new production, i.e., $P = f(C)$. (DiPasquale & Wheaton 1992, 188–189)

The lower right corner of the figure illustrates the housing stock change in the housing consumption market. Here, the annual flow of new production is converted into the long-term housing stock. The change in the housing stock (ΔS) is equal to the amount of new production (C) minus depreciation (dS). The straight-line slope from the origin to the right thus describes the relative share of the depreciation in the existing housing stock. In a long-term equilibrium, the annual volume of construction must cover depreciation. The size of the housing stock remains constant when other factors in the economy remain unchanged. (Laakso & Loikkanen 2001, 43) However, it should be noted that the above-mentioned long-term balance will only be maintained if the same level of construction continues indefinitely. This assumption is not very realistic in the prevailing housing market (DiPasquale & Wheaton 1992, 189).

In summary, the starting point is an approximately fixed housing stock in the short term. This housing stock determines the level of rental housing consumption in the market based on supply and demand. In contrast, the rental level determines the prices of housing in the property market. In turn, housing prices generate new housing production, which, together with depreciation, determines the housing stock's size in the housing consumption market. The combined housing consumption and housing ownership market is in balance when the total housing stock in the initial situation, and the final situation is the same. If the starting level exceeds the decision level, rents, prices, and construction must rise in order for the market to be in balance. If, on the other hand, the starting level is below the decision level, rents, prices, and construction must be lowered to strike a balance. However, it is imperative to remember that this Four Quadrant Model can only describe long-term equilibrium and thus does not work as well when describing short-term changes. (DiPasquale & Wheaton 1992, 190)

2.4.2 Readjustments of the housing markets

The housing market faces changes on the demand and supply side, which are not, in fact, one-off and permanent. The housing market is not initially in a stable equilibrium state (Laakso & Loikkanen 2001, 46). The Four Quadrant Model makes it possible to observe how the housing market reacts to various shocks caused by external factors. Such external factors may include, for instance, changes in the macroeconomy, such as an increase in income, production or the number of households, short- or long-term interest rates, the tax treatment of real estate markets, and the availability of financing for construction. The Four Quadrant Model illustrates how the shock caused by the change in an external factor is initially applied to a quadrilateral of the model. And also how it is transmitted from there to other parts of the model (DiPasquale and Wheaton 1992, 190). Next, more detailed effects of shocks and its transmission in the Four Quadrant Model is presented.

The growth in housing demand may be due to economic growth, which is reflected in society, among other things, as changes in employment, rising household income levels, and an increase in the number of households as a result of migration. This will cause the demand for housing consumption in the area under review to rise permanently to a new level. From the housing market perspective, this is a demand shock, which appears in *Figure 3.* As a shift in the demand curve for housing consumption to the right, as indicated by the arrows. As the housing stock is almost fixed in the short term, rents will rise. Rising rents, in sequence, are causing housing prices to rise in the property market. Higher housing prices will increase the profits of construction companies, which will increase construction output. New construction will eventually increase the housing stock and supply housing services, which will push down the rental level.

Thus, a new equilibrium in the housing market is finally found, defined in *Figure 3* as a rectangle drawn outside the original rectangle. As can be seen from the figure, the rectangle drawn with a dashed line, i.e., the new market equilibrium, is larger in each direction than the previous market equilibrium. In other words, the level of rents, housing prices, construction, and housing stock have increased compared to the starting level. Similarly, a contraction in demand causes the demand curve to shift inward and lead to a new equilibrium through the adjustment process. The rent and price level will be lower, and construction will be lower, and eventually, the housing stock will be smaller. (Laakso & Loikkanen 2001, 46; DiPasquale & Wheaton 1992, 191-192)

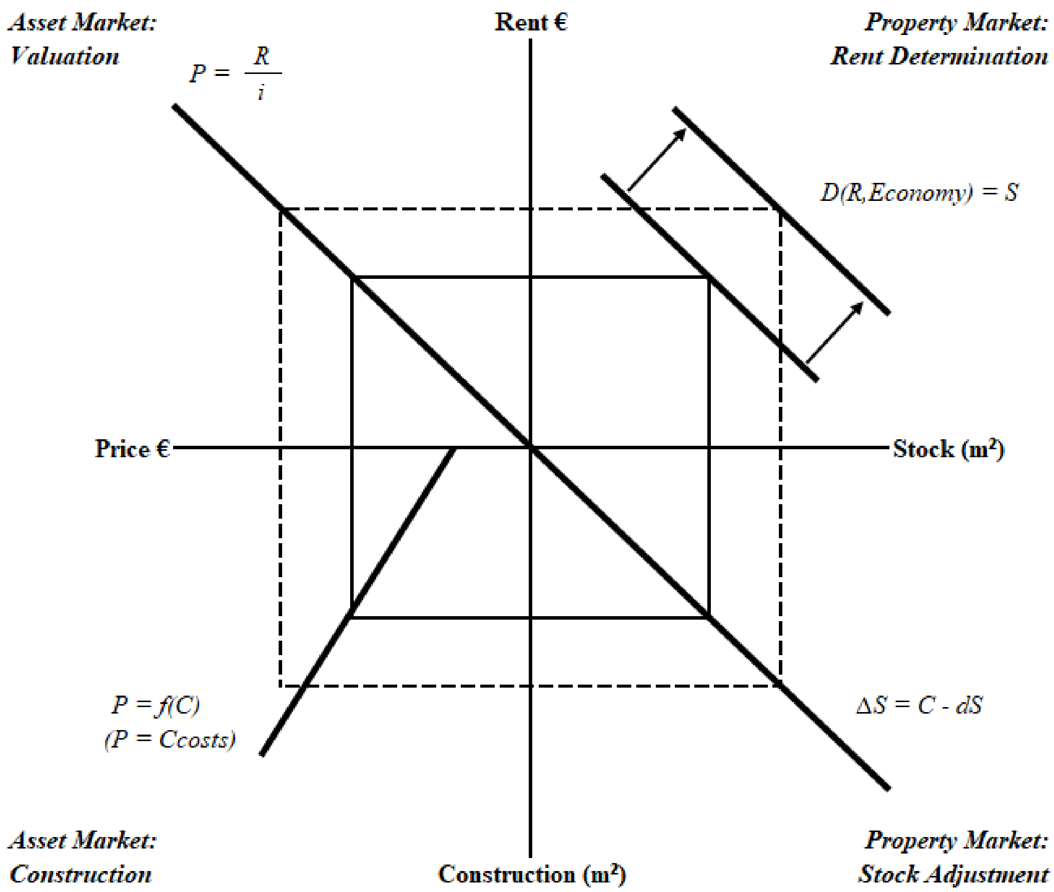

Figure 3. The Property and Asset Markets: Property Demand Shifts (DiPasquale & Wheaton 1992, 191)

The magnitude of the changes depends on the steepness of the slope actions of the lines in the figure. For example, if construction were flexible relative to house prices, then the new levels of housing prices and rents would be only slightly above the baseline, while the housing stock and construction would grow very strongly. (DiPasquale & Wheaton 1992, 191-192)

Adapting to a one-time but permanent change in demand growth may take five to ten years, during which time the real price level is off the long-term level. Even after the adjustment phase, the level of rents and prices will no longer recover permanently, as the average price level in an area with a growing population is higher, partly because, for example, the best-located housing will become relatively scarcer. (Laakso & Loikkanen 2001, 46)

There may also be changes in supply factors that affect the housing market. For example, an increase in interest rates or tax regulations changes will change the housing investors' return requirements, which will be reflected in housing prices and further in housing production, the housing stock, and the rent level. Housing production's cost factors may also change, reflected in the construction and further in the housing stock, rents, and price levels. (DiPasquale & Wheaton 1992, 194)

The housing reserve, i.e., the reserve of vacant dwellings, plays a significant role in price and supply-side reactions. The large stock of housing as a source of supply is why, instead of constant fluctuations in production and housing prices, the rises and falls in prices and output in the housing market are long after the breakpoints than in many other markets. (Laakso & Loikkanen 2001, 46)

Changes in demand in the property market affect the housing market quite differently from the recently examined change in demand in the housing consumption market. Changes in demand in the ownership market can be due to many reasons. If interest rates fall, the return on alternative investments will fall, and homeownership return will increase. Then households prefer to invest their assets in housing. Correspondingly, as interest rates rise, alternative investment targets become more attractive. (DiPasquale & Wheaton 1992, 192)

Another example is the effects of long interest rates and tax changes related to real estate in the Four Quadrant Model. A reduction in interest rates or a favorable tax reform reduces the investor’s risk level and reduces the capital required for the investment. Such a shock, such as a change in homeowners' yield requirements, is evident in *Figure 4* by turning the line counterclockwise from the origin. Similarly, higher interest rates, a higher level of risk, and weak tax reforms for the property buyer will turn clockwise. (DiPasquale and Wheaton, 1992, 193) Expectations of a continued rise in rent levels in the future can be interpreted as lowering the yield requirement and increasing housing price. The opposite expectation, in turn, reduces housing prices. As housing prices rise, the volume of construction increases, as demonstrated in *Figure 4*. Eventually, this will increase the housing stock, leading to lower rental levels in the housing consumption market. The new equilibrium is reached when the initially expected rent level and the final rent level are equal. A dashed rectangle indicates the new equilibrium of the housing market in *Figure 4*. As will be seen, the new balance is lower than the original balance. (Laakso & Loikkanen 2001, 42)

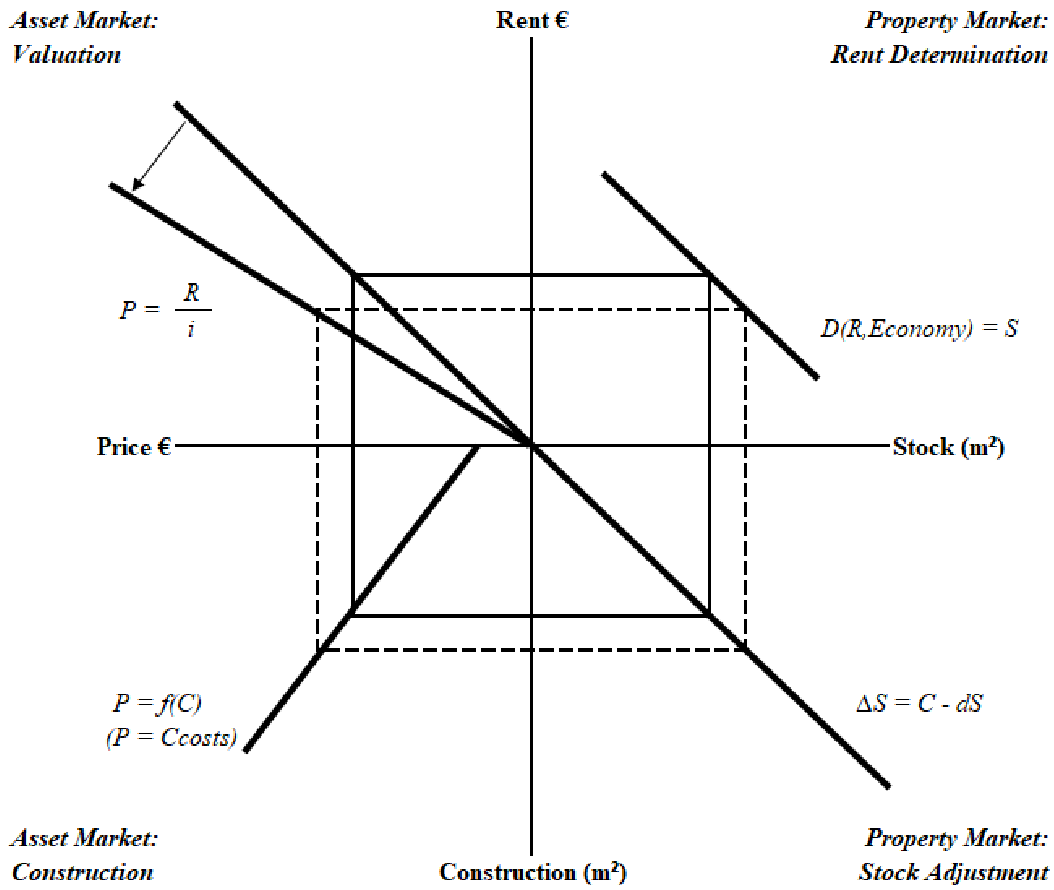

Figure 4. The Property and Asset Markets: Asset Demand Shifts (DiPasquale & Wheaton 1992, 193)

In the new balance, housing prices will be higher and the rent level lower, while the housing stock and the construction that supports it will be higher. DiPasquale and Wheaton (1992, 192-193) note that in addition to the prevailing return expectation (i.e., risk level), the tax treatment of rental income affects how much gross rent is required for the above equilibrium condition to apply.

In addition to changes in demand, supply may also fluctuate. For example, an increase in short-term interest rates would increase construction costs, which would be reflected in a decrease in construction. Such negative changes in supply are shown as a shift of the production cost curve to the left, as shown in *Figure 5*. With housing prices remaining the same, an increase in costs would lead to a contraction in construction and, ultimately, a smaller housing stock size. This, in turn, will lead to an increase in rental levels, which will be reflected in rising property prices in the property market. (DiPasquale & Wheaton 1992, 194)

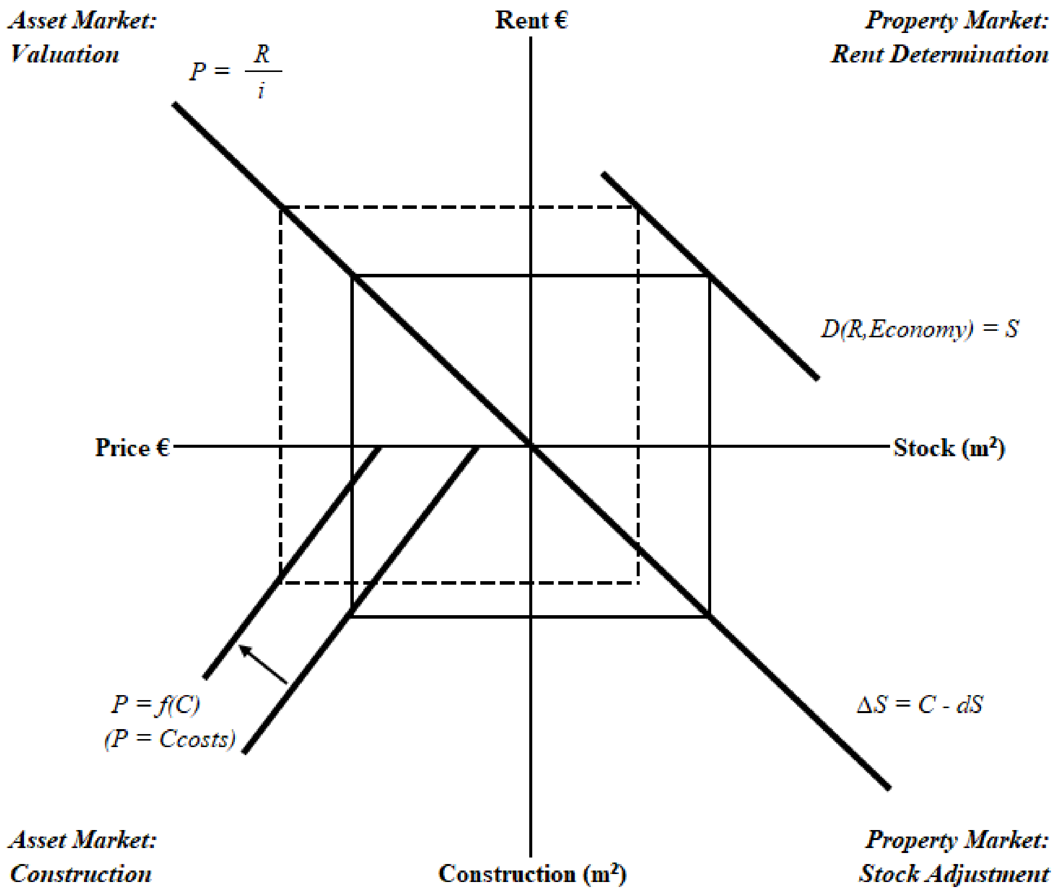

Figure 5. The Property and Asset Markets: Asset Cost Shifts (DiPasquale & Wheaton 1992, 196)

A negative supply shock causes the production cost curve to shift to the left, leading to increased costs and a decrease in construction. The decline in construction will drive the housing stock to shrink, causing rents to rise. Eventually, rising rents will continue to raise house prices. The result is a rectangle drawn in broken line in *Figure 5*, which has moved up to the left compared to the previous equilibrium state. In the new balance, housing prices and rents have risen, while construction and the housing stock have declined. According to DiPasquale and Wheaton (1992, 194), similar negative factors influencing supply include tightening local building regulations or other construction regulations.

Finally, it is good to note that the Four Quadrant Model only works for long-term consideration. In the short term, the housing supply will be very inflexible, i.e., housing supply will change very little as prices change. It is also important to note that examining the above adjustment processes assumes that the market is in equilibrium before a shock occurs. (Laakso and Loikkanen 2004, 273) However, according to Laakso and Loikkanen (2004, 273), the changes in supply and demand experienced by the housing market are not one-off and permanent, and the market is thus not initially in a stable equilibrium state. Changes are continually happening, and they are fluctuating in housing prices and housing production. However, the processes described above play a role in the background. An interesting observation is that output increases and decreases are longer in the housing market after breakpoints than in many other markets. This can be explained by the large size of the housing stock, which acts as a constant supply source and prevents continuous production and price movement back and forth.

2.4.3 The Stock-Flow Model as formalized by DiPasquale & Wheaton (1996)

The Stock-Flow Model assumes that housing prices can be determined by the current variables selected for the model at any given time. Instead, the housing stock's size is determined by the same variables' historical values, as the housing stock is highly sustainable and changes very slowly. The model can be thought of as being divided into two parts, where housing prices demonstrate the flow rate and the size of the housing stock represents the reserve size. The formation is based on a publication by DiPasquale & Wheaton (1996, 243-246), supplemented with a few modifications by Oikarinen (2007, 20-24).

Due to the simplification of the model, the demand for dwellings (D_t) is assumed to be determined in period *t* only based on the number of households (H_t) and the cost of owning a dwelling (U_t). This relation is shown in *Equation 1*. The parameter α_0 can describe the number of homeowners if ownership would not incur any costs, and α_1 represents the sensitivity of demand response to housing cost changes. It is good to note that housing demand refers specifically to the demand for homeownership in the model. (Oikarinen 2007, 20)

$$(1) \quad D_t = H_t(\alpha_0 - \alpha_1 U_t)$$

The cost of owning an apartment (U_t) is naturally affected by the current purchase price (P_t) of the apartment. Also, the costs are affected by the prevailing after-tax housing loan interest rate (R_t), housing maintenance costs (M_t), and expectations for future appreciation (I_t). The relationship between these variables is shown in *Equation 2*. Examining the equation shows that the higher the cost of housing purchase, the higher the housing prices, interest rates, and maintenance costs. Maintenance costs include property taxes and depreciation, which must be offset by maintenance and repair costs. In contrast, positive expectations of house price developments have a dampening effect on the cost of ownership.

$$(2) \quad U_t = P_t\,(R_t + M_t - I_t)$$

The Stock-Flow Model assumes that house prices adjust so that the demand for dwellings (D_t) is equal to the number of dwellings available (S_t):

$$(3) \quad D_t = S_t$$

By placing *Equations 2* and *3* in *Equation 1*, *Equation 4* describing house prices is obtained. According to the model, *Equation 4* holds for each period, i.e., the current size of house prices depends on the ratio between the housing stock and the number of households, the mortgage interest rate, maintenance costs, and return expectations. A low ratio between the housing stock and the number of households, low mortgage interest rates, low maintenance costs, and the best possible expectations for appreciation would favor a high current housing price.

$$(4) \quad P_t = \frac{\alpha_0 - S_t / H_t}{\alpha_1 (R_t + M_t - I_t)}$$

Next, the supply side of the housing market and a steady-state equilibrium is observed. According to *Equation 5*, the housing stock's growth is equal to the new construction volume (C_t) minus the depreciation of the housing stock in the previous period (δS_{t-1}). The housing stock is said to be in a steady-state equilibrium when the housing stock's size remains unchanged, i.e., the right-hand side of *Equation 5* is zero. The housing stock is said to be in a stable state balance when the housing stock's size does not change, i.e., the amount of new construction is barely enough to cover the amount of depreciation.

$$(5) \quad S_t - S_{t-1} = C_t - \delta S_{t-1}$$

There are other factors involved in the formation of supply. Housing prices and the overall size of the housing stock affect the supply of housing through construction. Rising house prices give rise to new construction, but only if the value-added from construction (the price of the dwelling less the cost of construction) is greater than the vacant land value.

Next, it is considered how these two effects can be regarded as on the supply side. The long-term balance of the housing stock is denoted by the abbreviation ES_t. At this stage, for simplicity, it is assumed that the dwellings will not be depreciated. Thus, if the housing stock's size is in its long-term equilibrium $S_t = ES_t$, no new dwellings will be built. However, if the growth in demand for housing raises housing prices, the added value of construction will also increase. Due to increased construction, the size of the housing stock is increasing. The increased number of housing stocks leads to an increase in the demand and value of vacant land. The balance is restored when the value-added from construction is equal to the value of the free land. This interaction is evident at the following *Equations 6* and *7*:

$$(6) \quad ES_t = -\beta_0 + \beta_1 P_t$$

$$(7) \quad C_t = \tau (ES_{t-1} - S_{t-1})$$

The parameter β_0 is included in *Equation 6* because the land has an agricultural value even if it is not built at all. On the other hand, it also considers the high construction costs of housing. Thus, high construction costs lead to a higher value of the parameter β_0. The parameter β_1 describes the sensitivity of free land construction to rising house prices. The more limited the free land supply, the smaller the parameter β_1. Most of the areas that have become growth centers get a small value of the β_1 parameter because the land is scarce. This will cause housing prices in growth centers to rise faster than in other areas if the housing stock is to be increased to a certain point. In Finland, an excellent example of this is the Helsinki metropolitan area. In its basic form, the model assumes a constant housing height. In reality, of course, the heights of dwellings vary, which means that changes can also occur in the housing stock without using new land.

The parameter τ in *Equation 7* describes how quickly construction reacts to deviate from the housing stock's long-term equilibrium. It is noteworthy that the equation's explanatory variables are delayed by one period, i.e., the delay between the construction decision and the completion of a new dwelling is one period.

In a dynamic model like the Stock-Flow Model, in which part of the housing stock disappears each period, the housing stock's size must decrease if no new dwellings are built. It follows that the size of the housing stock must be smaller than the long-term equilibrium for new housing to be built. In this case, *Equation 8* describing the change in the price level of housing and the housing stock is obtained by placing *Equations 6* and *7* in *Equation 5*. Otherwise, dwellings are not built, and the *Equation* shrinks to form *9*.

$$(8) \quad S_t - S_{t-1} = \tau(-\beta_0 + \beta_1 P_{t-1} - S_{t-1}) - \delta S_{t-1} \qquad when\ ES_{t-1} > S_{t-1}$$

$$(9) \quad S_t - S_{t-1} = -\delta S_{t-1} \qquad when\ ES_{t-1} \leq S_{t-1}$$

The steady-state equilibrium S^* of the housing stock is obtained by placing $S_t = S_{t-1}$ in *Equation 8*.

$$(10) \quad S^* = \frac{\tau(-\beta_0 + \beta_1 P_{t-1})}{\delta + \tau}$$

As can be seen from *Equation 10*, the price level determines the size of the housing stock. However, the functionality of the model requires that this price level remain unchanged. The steady-state equilibrium of the current reserve model also includes an equation that can determine the steady-state equilibrium price. Placing $S_t = S^*$ in *Equation 4* gives:

$$(11) \quad P^* = \frac{\alpha_0 - S^*/H_t}{\alpha_1(R_t + M_t - I_t)}$$

By combining *Equations 10* and *11*, the steady-state equilibrium price P^* can now be represented in the following form:

$$(12) \quad P^* = \frac{\alpha_0 H_t(\delta + \tau) + \tau\beta_0}{H_t(\delta + \tau)\alpha_1(R_t + M_t + I_t) + \tau\beta_1}$$

According to the definition of steady-state balance, both house prices and the housing stock size are expected to remain unchanged. It follows that the variable I_t, which describes the expectations for future appreciation, is in fact zero in *Equation 12*. According to *Equation 12*, the higher the household equilibrium price, the higher the number of households, the lower the mortgage rates, and the more inflexible the housing supply. It is also noteworthy in the equation that the housing stock's size is no longer an explanatory variable but is assumed to affect the equilibrium balance implicitly through other variables.

It is important to note that the effect of income is not taken into account when determining the steady-state equilibrium price. In other words, *Equation 12* has, in principle, no income-taking variables. Analyzing the Four Quadrant Model, a possible increase in income will strengthen demand and raise housing prices' long-term equilibrium. Income should, therefore, also be considered when examining short-term dynamics. For example, in the q-theory of housing investment, household income is one of the variables explaining housing demand and prices, even in the short-run. (Sörensen & Whitta-Jacobsen 2005, 450-456; Oikarinen 2007, 23)

However, the absence of a variable describing income is not a significant drawback of the Stock-Flow Model because the parameters α_0 and α_1 can be thought to describe the effect of inputs indirectly. As income levels increase, the number of potential homeowners α_0 increases, and demand no longer reacts strongly to building costs α_1. It can be seen from *Equation 12* that the overall effect of the change in these two parameters is an increase in house prices, i.e., an increase in household income raises house prices, as assumed in the long-term model.

2.5 Multiple regression analysis

In this research, single and multiple regression analysis is used. Thus, its formation is presented here. Regression analysis is probably the most used tool in economic research. Regression analysis describes and evaluates the relationship between two, or in the case of multivariate regression analysis, more than two variables. Thus, the model has one explained variable and one or more explanatory variables (Maddala 1992, 59-60). Regression analysis is possibly the most important statistical multivariate method because other multivariate techniques can be derived in one way or another from the regression analysis (Liski & Puntanen 1976, 1).

The regression equation's compatibility and the observations are described by the sum of squares and the degree of explanation. The statistical significance of the degree of explanation assesses whether the x-variables can be used to explain the variations of the y-variable statistically. Suppose the variables involved correlate too strongly with each other. In that case, it can result that the estimation of the model parameters is disturbed, and one of the explanatory variables can be explained almost entirely by other explanatory variables. This is called multicollinearity. At the same time, it also affects the variances and covariances of the regression coefficient estimates. In the model, the correlation coefficient may indicate that the two variables are related to each other. Still, it does not give any idea of how the variables are related to each other. The model is not expected to show any specific relationship between the two variables. (Dougherty 2002, 48) When the explanatory variables' correlations are more than 90%, the selected variables should not be used as explanatory variables (Laininen 2004, 85-120). In examining the correlation coefficient, the rule can be considered that the absolute value of the correlation should be greater than two divided by the square root of the sample size *n* in order to show a strong linear correlation between the variables (Newbold et al. 2006, 519).

The regression line's dependence between the variables to be explained is described in both simple and multiple regression models. The regression line is determined by the method of least squares (MLS). The regression line determined by the least-squares’ method is included in the set of observations. There may be observations above and below the line. The distances of the observations are raised to the second power, and the squares are added together. The regression line slope is adjusted so that the squares' sum is obtained as small as possible. (Maddala 1992, 69)

The parameters to be estimated in the multivariate regression model (*Betas*) are the explanatory variables' regression coefficients, which tell the relationship between them and the variable to be explained. Important in the coefficients' interpretation is that in the case of one explanatory variable, the variable's regression coefficient directly indicates how large the change in the explanatory variable is when the explanatory variable changes by one unit. (Stock & Watson 2007, 193) The t-test tests the goodness of the beta coefficient by dividing the regression coefficient by its variance. Suppose the Beta coefficient's value is about two or higher, and the p-value corresponding to the t-value, i.e., the significance, is 0.05 or less. In that case, the variable is significant at the 95% confidence level (Metsämuuronen 2006, 683). The expectation value's confidence interval describes the uncertainty associated with estimating the expected value calculated based on the sample. The narrower the confidence interval, the more reliably the expectation value's true magnitude is known (Nummenmaa et al. 2014, 166).

The F-test examines the significance of the whole model when there are one or more explanatory variables. If at least one of the variables in the model is significant, the null hypothesis is rejected. The F-test indicates whether the ratio of the model's squares to the sum of the squares of the error terms is large enough to reject the null hypothesis. The t-test value only explains the significance of each individual explanatory variable. (Hill et al. 2018, 263-266)

R^2 or adjusted R^2 is called the explanatory coefficient or explanatory intensity of the model. In general, it is this value that is under observation in regression analysis. The explanatory coefficient is used to measure the model's performance, but it must be remembered that R^2 is only one available measurement. (Liski et al. 1976, 32-33) The main goal of regression analysis is to explain the variable's behavior (Dougherty 2002, 66). In regression analysis, R^2 measures the explanation level, thus telling how much the explanatory factors describe the explained factor's variation. The highest value of R^2 is one. If there is no relationship between the variable to be explained and those explaining it, then R^2 is close to zero (Dougherty 2002, 66).

In this study, backward elimination of explanatory variables to improve the significance of multiple regression analysis has been used. The backward elimination of variables is based on first constructing a model containing all explanatory variables and dropping out one worst explanator at a time based on its significance limit, i.e., trying to get the explanation level of R^2 as high as possible. Backward elimination seeks to find the best regression models that contain a certain number of explanators. Then, it is not necessary to study all regressions (Liski et al. 1976, 171).

In practice, achieving a satisfactory regression model most often requires many explanatory variables. However, the model must be built on relatively few explanators so that it does not become too complicated and difficult to manage for practical requirements. The final explanators are selected for the model based on how well they are able to explain the variation of the variable under explanation. (Liski et al. 1976, 11)

3. Literature review

For this literature review, possible sources from which literature and previous research could be retrieved were first identified. Internet search engines and the LUT University online library were examined with various search phrases. Searches were conducted in both English and Finnish. In principle, searches were done with the following terms:

- Development of house prices
- Development of house prices by region
- Housing price development research
- Development of housing benefits
- Housing support housing prices survey

These searches found several dozen studies on the development of house prices from different perspectives. A large number of other literature sources close to the topic of housing prices development were found in the source lists of these studies, from which the most promising were selected based on their titles. For example, several studies conducted by the Finnish researcher Oikarinen were used as source material. Research produced by Oikarinen forms a relatively large part of the Finnish housing market research field's output. Searches on the impact of housing subsidies on housing prices were conducted only in Finnish. No studies dealing with the topic were found other than those already mentioned in this section. The impact of housing subsidies on rents and thus housing prices has therefore not been studied much in Finland. There are undoubtedly many opportunities for further research in that segment from different angles.

Academics studying the housing market share a vast difference of opinion regarding whether the housing market should be viewed at the national or local level. One school of housing market researchers believe that macroeconomic factors, i.e., national characteristics, explain the development of housing prices almost completely.

Another side of the researchers studying housing markets thinks it does not make sense to study the housing markets nationally. The country's housing markets can vary considerably within different regions. This perspective of researchers is represented, for example, by Reichert (1990), Goodman (1998), De Vries & Boelhouwer (2005), and Oikarinen (2009a). An example of local factors affecting the housing market is the amount of land available, i.e., the land that can be used for the construction of new housing stock. There may be very limited land plots in one area, while in another area, there may be more land to be built than there is demand. Demand, in turn, is affected by the region’s attractiveness. It is expected that within an area that suffers from a significant loss in migration, there are not too many attraction factors, and disposable income level is lower than in areas with many services and jobs. For example, Goodman (1998) has suggested that research could be done on the local housing market and then combine observations from different local areas. However, he points out the general problem posed by researchers flagging in favor of national research. There are numerous amounts of local housing markets and only limited local data available. For this reason, for the most part, changes in housing prices have been considered from a national perspective.

3.1 Research about housing price development locally

It is worth mentioning that the Finnish housing markets have been studied to some extent by a few non-academic institutions. For example, Statistics Finland (Tilastokeskus) gathers the data and produces housing price development reviews every year. Other kinds of authors are, i.e., Pellervo Economic Research center PTT and Bank of Finland, which have already been mentioned earlier in this study.

The housing markets and the factors affecting price development have been vastly studied globally during previous decades. However, housing market research is mainly conducted from a national perspective because of the limited data available from local housing markets (Goodman 1998). This seems to be true even to this day, based on internet searches conducted for this thesis. There is not too much global academic research that concerns housing market development locally, and even less in Finland. Those few studies that can be found online focus on the developments of the housing prices within the Helsinki Metropolitan Area. Specific research going deep with the price fluctuations in areas outside of Finland's growth-centers were basically not found.

Traditionally, the vast majority of the studies exploring the pricing fluctuations of housing markets have been from the point of view that the price development follows the Stock-Flow Model theory. The prevailing perception has been that housing markets would adapt quickly to supply and demand shocks, i.e., that the housing market would be in balance in the short term. However, in recent research, this traditional notion has been abandoned. It has been understood that the adaptation of housing prices is slow and takes several years (e.g., Mankiw & Weil 1989; DiPasquale & Wheaton 1994; Case et al. 2005; Oikarinen 2007).

It's impossible to go through earlier studies about housing price development without presenting the background of a significant change among research perspectives. The Four Quadrant Model developers described in the previous theory section, DiPasquale and Wheaton, were among the first researchers to question the traditional Stock-Flow Model and started to investigate the existence of long-term equilibrium. DiPasquale and Wheaton (1994) examined annual changes in U.S. housing prices across different regions (i.e., cities). They showed that it would take several years for the housing market to adjust to the new equilibrium (Oikarinen 2007). This was also noted earlier, for example, by Mankiw and Weil (1989). They studied the effects of demographic variables on the housing market and found that housing prices responded slowly to local population demographics changes (Hori 2011).

In 1998, Hort conducted a study of housing price developments in Swedish urban areas using data from 1968-1994. She found that changes in disposable income and housing operating and construction costs significantly impacted real housing prices in different cities. In research produced in 2004, Harter-Dreiman used data collected on housing price changes in U.S. urban areas from 1980-1998. Harter-Dreiman examined only the relationship between housing prices and disposable incomes over the long term and found that changes in incomes had a large but relatively slow effect on housing price developments. In turn, De Vries and Boelhouwer (2005) found in their study that the housing supply volume had a declining impact on house price developments only in the main Dutch cities, but not in other local regions. They, therefore, concluded that the housing market did not function according to classical economic theory.

Lamont and Stein (1999) as well examined changes in housing prices in different American cities through household indebtedness and housing price dynamics. In conclusion, they argued that in cities where households had higher debt relative to their homes' value, housing prices were more sensitive to the city's shocks. On the other hand, according to a study conducted by Hort (1998) a year earlier, households' net loans in relation to disposable income did not significantly affect housing prices (Oikarinen 2009a).

In most cases, the most significant factors affecting the development of housing prices are the demographic factors of the local area. The demographic factors refer to, among other things, the age distribution, employment, and migration of people living in the area, as well as ethnic distribution. For example, Goodman (1998) has studied the effect of demographics in different regions on housing price development. According to his observations, disposable income level and price elasticities that determine demand may vary considerably between different local housing markets. Another researcher emphasizing regional differences in the housing market, Reichert (1990), has studied the effects of demographics on housing price developments in the United States. As a result of his research, even large regional differences were found in the U.S. housing market, which affected housing demand. These included irregular migration within the regions and the unequal distribution of older people. Based on these observations and data collected from recent housing market developments, it is easy to state that similar factors affect housing prices regionally in Finland. The migration of young people and people of working age is directed from other regions to growth centers.

One group of researchers (Booth, Martikainen & Tse 1996) studied the reflection of the development of housing prices in a particular local area to other local regions of Finland. Using housing price data collected from Finland, Booth, Martikainen, and Tse (1996) found out that Tampere should be Finland's housing price leading city, followed by the rest of local regions in Finland. However, Kuosmanen (2002) conducted a similar study using much longer housing price time-series than Booth and others used in their research. Unlike in the other research, Kuosmanen showed that Helsinki, Finland's largest economic center, would still be Finland's directing city. Oikarinen (2004) also stated this. Oikarinen showed that changes in prices in the Helsinki metropolitan area lead to increasing prices in other local, provincial centers, such as Tampere, Jyväskylä, Turku, and Oulu. A similar conclusion was reached by Berg (2002), who found that changes in housing prices in Stockholm, the largest economic area and capital of Sweden, are reflected elsewhere in Sweden.

As a summary, Goodman (1998) noted that the local housing market is clearly not linear. He also showed that the geographical combination of research parameters does not provide realistic results describing the housing market. In addition to the research made by Goodman, Oikarainen (2004) also concluded that changes in housing prices in Finland could vary considerably in different local areas and between different regional housing markets. According to him, the local housing market can be considered a completely separate commodity, which correlates with other housing markets. A few years later, Oikarinen (2009b) confirmed again his conclusion that the Finnish housing market should be studied more locally in the future.

In 2002, Huovari, Laakso, Luoto & Pekkala carried out a study that aimed to forecast Finnish housing prices locally in different areas. The data used in the study was compiled by combining housing price time-series collected from different regions. Huovari, Laakso, Luoto & Pekkala formed forecasts for the housing stock's size, housing construction volume, and housing prices. In 2000, Laakso alone had studied the regional development of demand, supply and housing prices in Finland in the 1980s and 1990s. For this study, he had compiled data on housing prices from 85 local areas. According to his research, growth in employment and disposable income level made housing prices to rise. In contrast, an increase in real after-tax interest rates and land availability for construction lowers housing prices (Oikarinen 2007).

Mäki-Fränti et al. (2011), for their part, conducted a study in which they examined the development of housing prices and attempted to predict their regional development. The data were based on local observations of housing prices from 1997-2009. Their forecasts were based on a simple econometric model in which nominal interest rates, household disposable income, and average rent per square meter were used as explanatory variables for house price developments.

3.2 The effect of general housing allowance on housing prices in Finland

In the beginning, it should be noted that actual research on the direct impact of housing subsidies on housing prices could not be found. However, the effect of housing allowance on rental prices has been studied to some extent abroad and by a few researchers, also in Finland. As shown in the DiPasquale and Wheaton Four-Quadrant Model presented in the theory section, the rental price level is one of the most significant factors explaining housing price changes. Based on the theory, it can be assumed that if the effect of housing allowance on the rental price level is substantial, this will also cause changes in the housing prices. For this reason, the most significant research findings on how housing allowance affects rental prices are reviewed.

The basis for housing benefits in Finland is included in the Constitution. According to Article 19, the government's task is to promote everyone’s right to housing and support the independent organization of accommodation. The purpose of housing benefits is to reduce the households’ housing costs by paying housing costs from state funds (Article 1 of the General Housing Allowance Act). Housing can be supported in the form of either demand or production support. Benefits affecting demand include housing subsidies provided as income transfers to cover housing costs and tax deduction rights for mortgage interests. Production subsidies include, e.g., state subsidies in the form of interest subsidy loans for the new production, renovation, and housing acquisition (PTT 2017).

As early as in 1983, Weicher stated in his report that rental housing suburbs built with production subsidies in the late 1970s caused those local areas to turn into slums with poor living conditions. Also, allocating and controlling production subsidies was highly problematic. Production benefits were associated with suspicions of misconduct and tenant insolvency. Similar problems were also raised in Finland. Demand-based housing subsidies were also considered a better option, as those were experienced to increase residents' freedom of choice and be less expensive than production subsidies. (Norris et al. 2008) Due to these factors, Finland and the rest of the Western world have increasingly shifted from production to demand subsidies conducted in the form of income transfers. However, the calculations did not consider the effect of other factors on the growth of demand subsidies (McClure 1998).

Today, an increasing share of housing benefits is demand subsidies, which in Finland mainly means general housing allowance. In 2019, a total amount of 1,491 million euros of general housing allowance was paid to 379,667 households. General housing allowance accounted for about 70% of all housing allowances paid. In December 2019, households receiving general housing allowance accounted for 14% of the working-age population, i.e., the population under the age of 65. Receiving the allowance is more common in large and especially in university cities, such as Helsinki, where 20% of the population under the age of 65 were covered by general housing allowance. (Kela 2020b)

3.3 Research on the impact of general housing allowance on local rent prices

Relatively little research has been done on the relationship between housing subsidies and rents and, thus, on housing prices, especially in Finland. In addition, the definitions and forms of housing subsidies vary greatly by continent and country, so comparing research conducted abroad with research results obtained in Finland is very challenging. Some studies could still be found and are presented in this section.

Scott (2002) investigated the impact of housing subsidies on low-income rents in the United States' 90 largest cities. Scott examined the rents of low-income households that did not receive housing benefits after subsidies became increasingly paid directly to tenants instead of production subsidies. The local housing market characteristics greatly influence whether the rent price level rises in the whole local region or, for example, only in the low-income rental market (Laferrère & Le Blanc, 2004). Scott criticized direct subsidies and their increase, citing their rent-raising effect. According to her, the subsidies will increase demand, and the beneficiaries will be able to afford more expensive housing, which will lead to an increase in rents. In her study, Scott performed a regression analysis that used rent as a dependent variable and assumed the housing supply's price elasticity to be inflexible. According to her research, the payment of housing subsidies in the form of direct income transfers increased rents in the lowest-income rental market by about 16%.

For their part, Gibbons and Manning (2003) examined the effects of housing benefit reform in the UK on several variables, including rent price level. The starting point of the study was the opposite of Scott’s (2002), as in the United Kingdom, the payment of housing benefits was reduced. The effect on rents was examined by looking at the reduction in rents and reducing housing benefits on this change. In their study, Gibbons and Manning reasoned that rents have fallen due to a shift in housing subsidies. However, Gibbons and Manning also thought it was possible that up to 50% of housing benefits would be transferred to rents. Thus, their result suggests that the impact of housing subsidies on rent price level would be very significant.

In Finland, surprisingly little research has been done on the effects of changes in the amount of housing allowance to the prices of rents and housing in relation to its share paid annually by Kela. However, the research has been carried out by, for example, Matti Virén and Aki Kangasharju. Virén (2011 and 2013) examined only the effect of general housing allowance on rents, as it accounts for the largest share of paid housing demand subsidies. Virén's studies included 50,000 beneficiaries from 345 different municipalities in the period from 2000 to 2008 as panel data. In his research, the Helsinki metropolitan area's impact was highlighted, as half of the total amount of housing allowance was paid to the region during the period under review. Virén noted that house prices and rents are strongly correlated with each other in the long run.

For example, when the maximum housing allowance was increased by one hundred euros, rents increased by 33 euros. Thus, Virén has estimated that the rent-raising effect of housing allowance among beneficiaries was 33 to 50%. According to Virén, this leads to a situation where lessors set the amount of approved housing allowance to be the bottom level of the asking rent price. In addition, rising rental prices make the housing allowance level increase even more, causing never-ending circles. The rent level adjusted by the housing allowance will also be transferred to the prices of owner-occupied dwellings, having an upward effect on them.

Virén has studied the housing allowance's shifting into rent prices also earlier in 2008. The data collected from the Turku region (Virén & Hiekka, 2008) included 765 households that received housing allowance in the period 2000-2007. The study's result was that an estimation of 10-25% of housing allowance is transferred to rents. Based on the outcome, Virén and Hiekka stated that the housing allowance would be transferred partly to the landlord through rents, and the housing allowance would not work in the way intended.

Kangasharju (2003) conducted a study based on statistics from 1993 to 2000, looking at how housing subsidies affect the beneficiaries' rent per square meter, i.e., whether the beneficiaries paid higher rents than households not receiving housing allowance. The result of the study was that the subsidized households paid more per square meter, with the cost for households themselves being 83-88 million euros and to the government, 123-131 million euros more than without the rent-raising effect of housing allowance. In his 2003 study, Kangasharju took into account the dwelling location, the degree of agglomeration of the area, and the municipal group of housing subsidy as factors influencing the price per square meter of rent. According to Kangasharju, the general housing allowance increased the beneficiary's rent by 15,4-16,3%. The research, therefore, showed that the general housing allowance was partly passed on to rental prices. For the higher rents per square meter of the beneficiaries, Kangasharju (2003) presented that the most likely reason is that the housing allowance system overcompensates the housing costs. The difference in rent prices between households receiving and not receiving housing allowance would enlarge. After receiving a housing allowance, the beneficiary lives in a more expensive dwelling per square meter than a household that does not receive the housing allowance.

However, findings contrary to the prior mentioned findings have been made. In their study on housing allowance in 2017, Eerola & Lyytikäinen concluded that housing allowance does not affect apartments' rent. In other words, the rent for an apartment is the same regardless of whether the tenant receives a housing allowance or not. Eerola and Lyytikäinen commented on Virén and Hiekka's (2008) research, considering the number of control variables to be too small. In their own research, Eerola and Lyytikäinen focused on the effects of housing allowance for those who did not receive it at all. Regarding Kangasharju’s study (2003), they found that the research results differ. This was suggested to be due to Kangasharju’s narrower sample size as well as different interpretations of the hypotheses.

However, based on the research results of Kangasharju (2003) and Virén & Hiekka (2008), and Virén (2011 & 2013), general housing allowance has a significant effect on housing rents. According to these studies, it is clear that at least part of the housing allowance flows into the homeowners' account, i.e., the landlords, and thus does not serve its ultimate purpose. This causes distortions in the housing market in the form of increased rental prices, but also housing prices. As housing allowance increases rents, housing prices also increase. This, in turn, may further increase demand in the rental market, as access to affordable housing becomes more difficult, especially for first-time homebuyers, forcing people to live longer within the framework of rental housing.

4. Empirical research

This section presents the data used in this research, the variables formed from the data, and the methods and results used to answer the research questions. The first research question of how the housing prices have developed at and outside the growth triangle vertices is simply answered based on empirical observations made from graphs and placing the total percentual changes of the variables in the Four Quadrant Model's theoretical frame introduced in the background section. In this way, the new balance in the Finnish housing markets is demonstrated in the cities forming the vertices of the growth triangle as well as within outside of those cities. After this, the results of the multiple regression models and their formation are submitted.

4.1 Data and methodology

The data used in this research was collected from databases of Statistics Finland and Kela, the Social Insurance Institution of Finland. The observations of the dataset were all from the period of 2007 to 2019. The observations were collected from the databases and tabulated with Microsoft Excel. All simple linear regressions between explanatory variables (pictured with graphs and tables) and explained variable, as well as multiple regression models, were executed by using programming language and free software environment R. Variables were selected according to the DiPasquale and Wheaton (1992) Four Quadrant Model. Four main factors of the Four Quadrant Model (housing price, rent, housing stock, and construction) are represented in the regression model as explanatory variables. These four variables were used to explain the development of the general housing allowance. Development of the general housing allowance is profiled as a variable: the total amount of general housing allowance paid annually by Kela. The objected outcome to be explained is, precisely, the development of general housing allowance outside the growth triangle, but the development of the triangle's vertices is also considered simultaneously.

As stated, in this study, observations only for the period 2007-2019 is used because statistics for all the variables selected were not found from an earlier period. Another research delimitation is to limit the forms of housing subsidies to general housing allowance only. In this thesis, the general housing allowance means the total amount (€) of public subsidy for rent paid within a year by Kela. There are many different forms of housing subsidies in Finland, and their application to this research is not unambiguous, in some cases impossible, within the framework of available statistics.

All six used variables were formed from Statistics Finland and Kela's observations. Their statistical sources can be found from the list of sources at the end of this thesis, and precise references are marked below relevant graphs. All the used observations form time series from 2007 to 2019. Five of them have been transformed into indices for producing descriptive statistics and used in the regression models. However, the statistic of the average general housing allowance per household is not transformed into an index, as it is not used in the regression models.

Two of the variables can be found initially in the index form and, thus, are presented in a given format. These two variables are the real housing price index of old housing shares (2005=100) and the construction cost index of the whole country (2000=100). The other three variables used in the regression models were originally: average rent measured in euros per month per square meter, the total amount of square meters available for living purposes, and the total amount of general housing allowance paid annually by Kela. As mentioned, these were transformed into indices so that the comparison year (value 100) is 2007.

The total amount of public subsidy for rent, the general housing allowance (Kelasto, 2019), was formed by adding up the amounts paid for households living within municipalities (i.e., cities) of Helsinki, Vantaa, Espoo, Kauniainen, Turku, and Tampere. The same was done for all other cities/municipalities found from Kela’s database. General housing allowance paid to persons living abroad was left out from the observations. It is notable that in this study, the general housing allowance considers only people who are counted to be part of the labor force, including both the employed and the unemployed. Here, as a research choice, students, conscripts, and pensioners have been ruled out from the sampling. This is reasonable because studying can be considered only a temporary phase in life. Most of the students live within the few growth centers, including the Helsinki Metropolitan area, Turku, and Tampere. Also, military service is only a very short-term phase and is not voluntary for half the age group. On the other hand, pensioners can not affect their income level due to most of their age limitations. Thus, they’re not part of the observation group either.

The same procedures were conducted with producing observations about average rents. Statistics Finland offered the average rent prices per square meter in a month for all major cities. The time series of the average rent price for cities forming the growth triangle vertices (see *figure 1*) were calculated together and then divided by the number of cities (i.e., six) to create the average. The same was done for the rest of the cities in Finland.

In addition, due to lack of data availability, the variable of the amount of housing stock measured in square meters considers observations from provinces, not cities. Thus, the division into areas is, in reality, a combination of Uusimaa, Varsinais-Suomi, and Pirkanmaa compared to the rest of the country combined. Here in this thesis, the construction cost index describes the relative change in the construction costs of construction work and constructing buildings with similar structural characteristics through the price development of the necessary inputs used in construction. The real housing price index is used to describe, as its name implies, the development of real prices of old share dwellings each year.

There were no outliers within the dataset as the chosen variables had no empty values, nor was there any significant exceptions within the set of observations. As stated, the observations were transformed to be indices for descriptive statistics purposes. However, handling time series models and tackling the explanatory variables' multicollinearity, the observations were converted into logarithmic values. This was seen to improve the reliability of the performed regression models.

4.2 Descriptive statistics

Next, all the variables and their correlations with each other are submitted. The correlation tables 1 and 2 are presented in the section where this research's limitations are described. Each of the variables included 13 observations from the year 2007 to 2019. All the explanatory variables are presented compared to the development of the general housing allowance through graphical illustration.

At first, *figure 6* illustrates the development of indices of the housing prices during the years 2007-2019 outside and within the cities forming the growth triangle's vertices. As it can be observed, the housing prices of the areas outside the triangle vertices have decreased. This index is formed from the prices of old housing shares. It is a real index; thus, the housing prices have been adapted to the consumer index. The starting year and the value 100 are from the year 2005. The index value in 2007 was 106,6, and it has dropped to 91,3. The opposite has happened to the prices at the vertices of the triangle, as the index value has gone up from 109,6 to 118,8 within the same period.

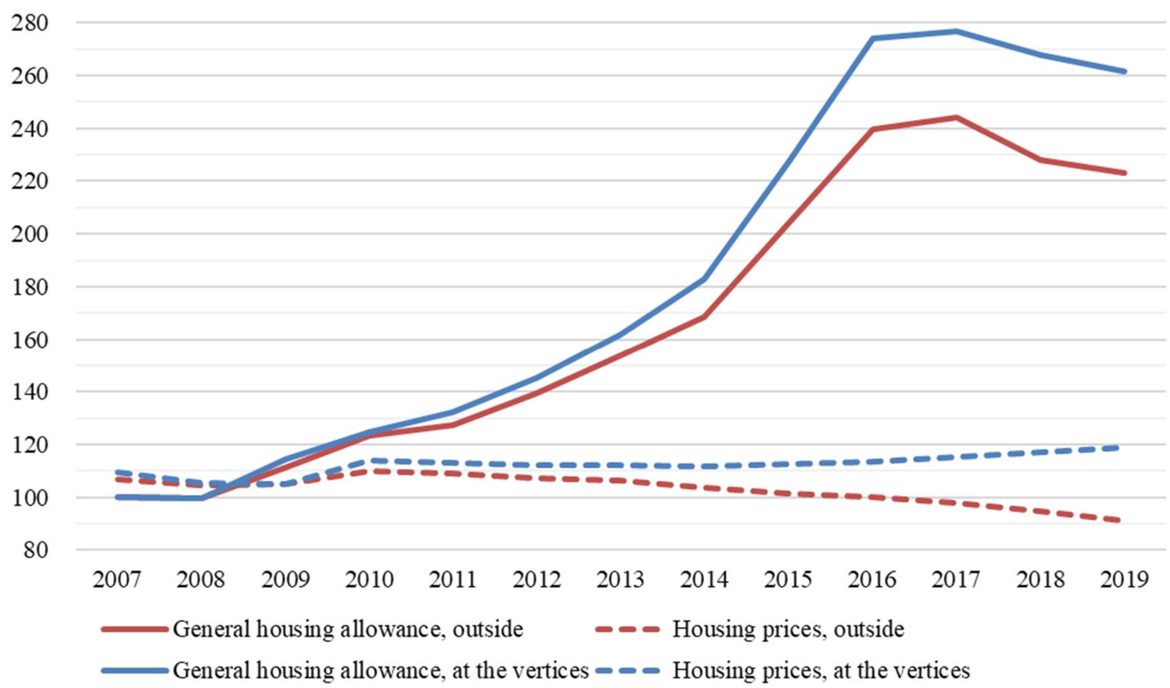

Figure 6. Housing price development (Statistics Finland 2020a)

As shown in *Figure 7*, based on the single regression, the housing prices explain the development in the general housing allowance only moderately. The adjusted R^2 values are 0,56 and 0,58 outside and at the triangle's vertices at 99% significance level. Interestingly, the housing prices within the areas forming the growth triangle's vertices strongly and positively correlated with the general housing allowance. Within the rest of the regions, the correlation is still strong but negative.

General housing allowance, total amount (€)	VS.	Housing price, index	Correlation	Significancy level (t-test)	Adj. R^2
Outside the vertices of the Growth Triangle					
			-0,77	0,00198**	0,5595
At the vertices of the Growth Triangle					
			0,78	0,00153**	0,579

Figure 7. General housing allowance vs. housing prices development

The total change of the housing prices outside of the growth triangle's vertices during the years 2007 and 2019 was -14,4%. As a comparison, at the edges of the triangle, the total change was 8,4%. However, the change in the general housing allowance during the same period was far more significant. Outside the Growth Triangle vertices, the increase was 123,3% and at the edges even greater, 161,7%.

The next handled variable is the existing stock measured in square meters. *Figure 8* illustrates how the number of stock measured in square meters has developed within the observed period. The development has been pretty similar between the two regional divisions. Outside the vertices of the growth triangle, the stock has increased by 14% since 2007. At the vertices (formed by provinces of Uusimaa, Varsinais-Suomi, and Pirkanmaa), the total change is only slightly more than 19,4%. The housing stock index has been created for this research. Thus the starting value of 100 is marked to be in the year 2007.

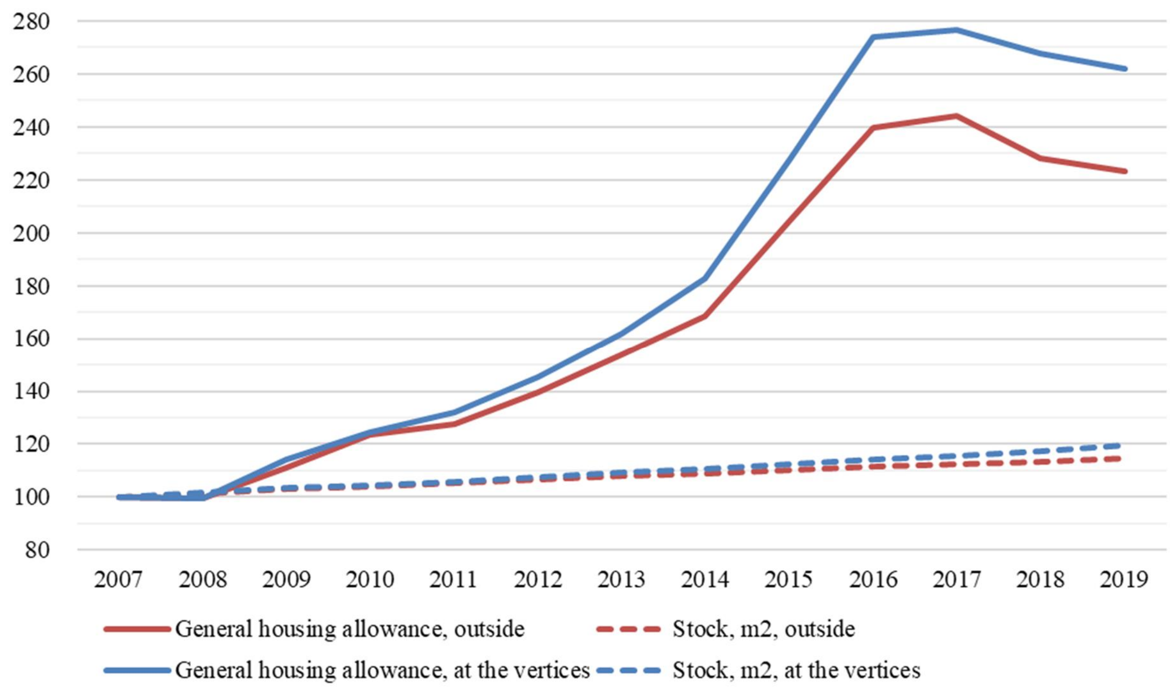

Figure 8. Housing stock development, m² (Statistics Finland 2020b)

The general housing allowance is very strongly correlated (97%) with the existing stock measured in m². Single regression's adjusted R^2 value is also very high as the amount of existing stock seems to explain 93% of the General housing allowance on over 99,9% significance level. This applies in both cases, at the vertices of the triangle as well outside of those.

General housing allowance, total amount (€)	**VS.**	**Stock measured in m², index**	**Correlation**	**Significancy level (t-test)**	**Adj. R^2**
Outside the vertices of the Growth Triangle					
			0,97	4,95E-08***	0,9337
At the vertices of the Growth Triangle					
			0,97	4,51E-08***	0,9348

Figure 9. General housing allowance vs. housing stock development

The next variable used as an explanator is the average rent per m² measured in euros (€) per month (*figure 10*), which formation was described in the previous chapter. The rent price per m² has increased from 8,18€/month to 11,77€/month outside the cities forming the triangle vertices. It has also risen from 8,99€/month to 14,54€/month at the growth triangle vertices. These developments correspond to a change of 39,4% and 51,9%, respectively. Thus, the rental level has increased almost 12,5% percentage points more at the regions forming the triangle vertices than within the remaining areas. Simultaneously, the total amount of paid general housing allowance has increased from 228 million euros to 0,54 billion euros outside the growth triangle's vertices. The housing allowance increase has been from 167,2 million euros to above 0,42 billion euros within the vertices. Measured in percentages, this means that the rise of the prior mentioned is 123,3%. The latter's increase is 161,7%, which means a 38,4% percentage points greater increase to the total amount of general housing allowance paid within the growth triangle's vertices. Altogether the total amount of paid general housing allowance was almost 0,93 billion euros in 2019. It should be noted that the development in the total amount of housing allowance does not consider the change in population in the regions.

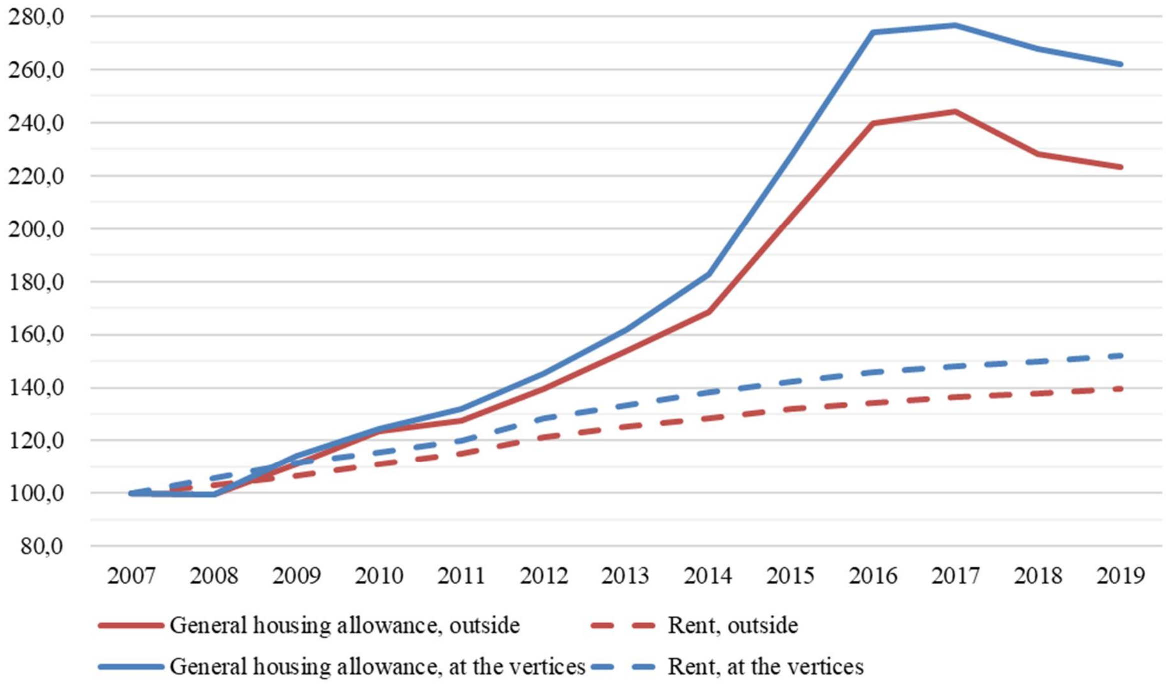

Figure 10. Average rent per m² (€/month) (Statistics Finland 2020c)

As shown in *figure 11*, the correlation (93%) and explanatory levels (~93%) of the rental price level to the development of general housing allowance are high. This applies within the areas outside the vertices of the growth triangle as well as at the vertices. The significance level, in this case, is also high, over 99,9%.

General housing allowance, total amount (€)	VS.	Rent level, index	Correlation	Significancy level (t-test)	Adj. R^2
Outside the vertices of the Growth Triangle					
Residual Std error 40130000			0,93	4,37E-08***	0,9351
At the vertices of the Growth Triangle					
Residual Std error 37960000			0,93	6,45E-08***	0,9304

Figure 11. General housing allowance vs. rental price development

The construction costs index (2000=100) seems to have the highest correlation (97%) with housing allowance development. The index used in this research describes the whole country, and it has increased from 122 index points to 143 points. This means that the change in construction costs has been approximately 17,2% from 2007 to 2019.

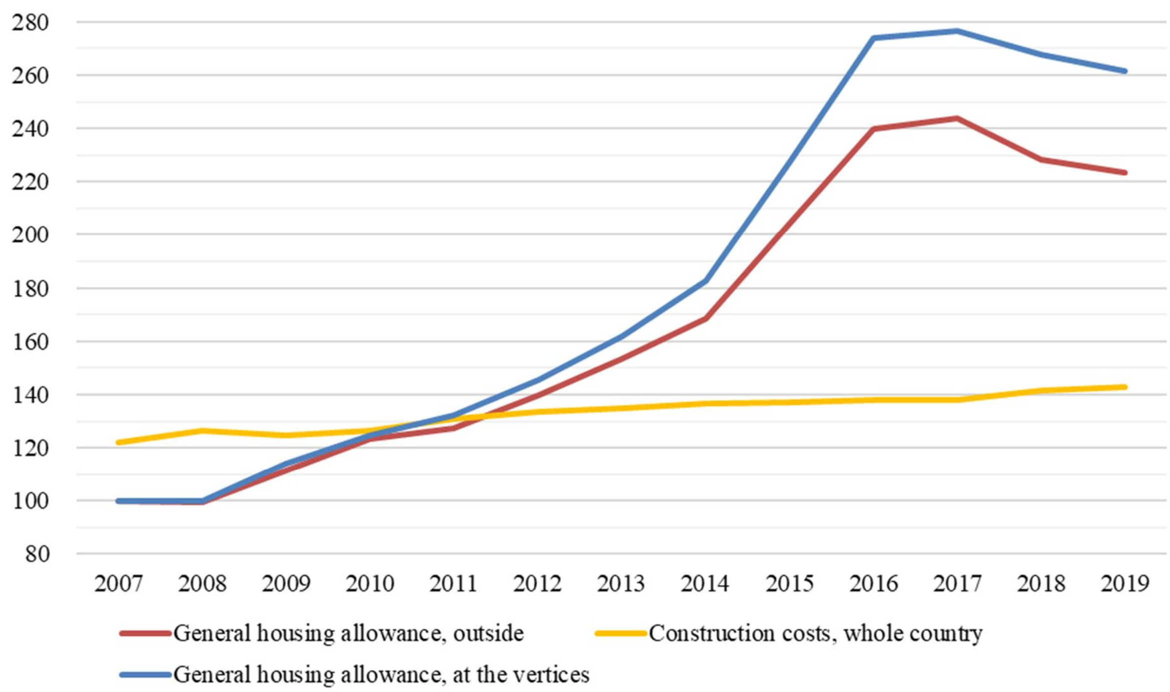

Figure 12. Development of construction costs (Statistics Finland 2020d)

Like the other chosen explanatory variables before, the index of construction costs seems to explain the development of the housing allowance firmly, at about 85% level. Like the rental price level and the number of existing stock, the construction costs index is also significant at 99,9% level.

General housing allowance, total amount (€)	VS.	Construction cost, index	Correlation	Significancy level (t-test)	Adj. R^2
Outside the vertices of the Growth Triangle					
			0,97	4,36E-06***	0,8512
At the vertices of the Growth Triangle					
			0,97	3,07E-06***	0,8603

Figure 13. General housing allowance vs. development of construction costs

The correlations between the selected explanatory variables are very high as they are ones from the Four Quadrant Model, i.e., four large factors that are molding the housing market. All selected variables have extremely high correlations between each other, as the values are close to one (1), which is the maximum correlation. This is the case with every other variable except the housing prices index outside the growth triangle vertices. There the correlation is still high but negative, with every other variable.

Figure 14 describes the development of the average housing allowance per household per month (€). As can be seen from the graph, the development of the average allowance between the cities forming the triangle vertices and the areas outside of the vertices has been quite similar. The average of the housing allowance per month is significantly more within the cities forming the vertices. This is natural, as the average rental prices per square meter within the vertices were also higher. However, outside the triangle vertices, the average housing allowance has been approximately only 74,5% of the corresponding average within the growth triangle vertices. The level has varied between 72,8 and 76,6% in 2007-2019.

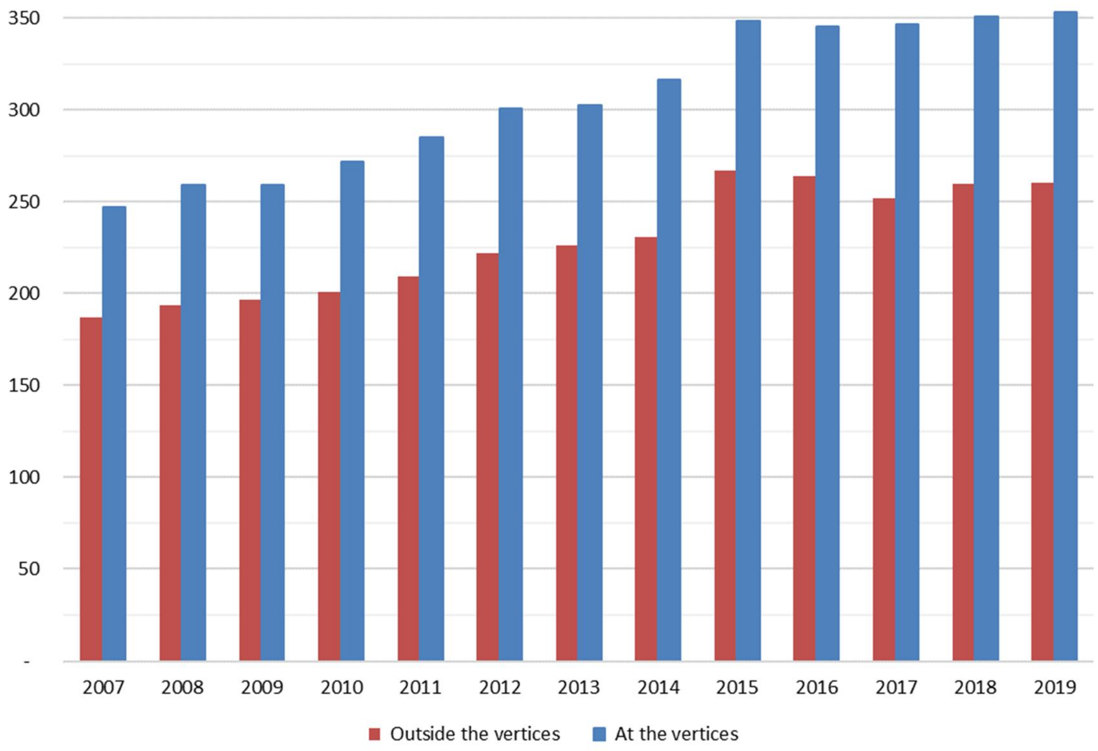

Figure 14. Development of the average general housing allowance per household, €/month (Kelasto 2020)

In this research, the multiple regression analysis is used to answer the second research question of this study: do the selected variables explain the development of general housing allowance outside and at the growth triangle's vertices, i.e., is the general housing allowance a significant factor in explaining housing prices?

The next section observes how housing prices have developed in other regions than at the Finnish growth triangle's vertices. This will be done by comparing 2019 indices to numbers from 2007, placing them into DiPasquale's and Wheaton's Four Quadrant Model. The next section also investigates the multivariate regression analysis, which aims to answer do the Four Quadrant Model's main variables together explain the development of the general housing allowance in a statistically significant way. This next section aims to identify the direct dependencies between these variables. The methodology behind the regression models is presented in the background section.

First, the development of general housing allowance over the period under review is presented both outside of the growth triangle's vertices and at the areas forming the vertices. The developed regression models are then used to examine which variables have had the most significant impact on housing allowance changes for both regional breakdowns. This will create a background for final calculations of the third research question, which aims to determine possible savings opportunities at the government level on the amount of general housing allowance is paid only if a person lives within areas outside of the growth triangle vertices.

4.3 Results and observations

First, the results and observations of empirical research are introduced. At first, the shift in the housing market balance outside the growth triangle and its vertices is pictured.

As it can be seen from *Figure 15* presenting the development of housing prices at the areas outside the Finnish growth triangle, the market balance has been shifted to the direction of the consumption market and rent determination (right upper corner of the model). The original market equilibrium is depicted by a square drawn with a solid line and the new equilibrium with a dashed line. The housing prices level has decreased 14,4% from the beginning of the chosen period, i.e., from 2007. Within the same period, rental prices have gone up by 39,4%, stock measured as square meters has grown 14%, and construction costs have gone up by 17,2%. At the same time, the production of new housing stock has decreased by 5,1%.

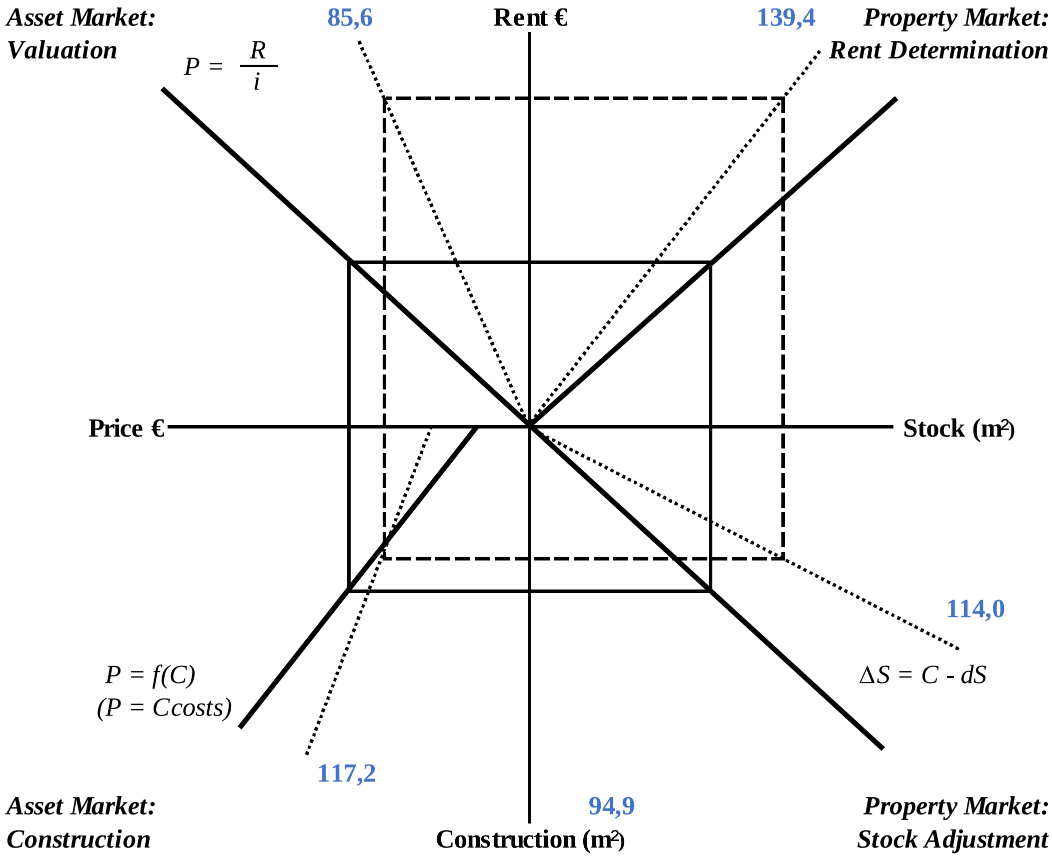

Figure 15. Housing market development at the areas outside of the Finnish growth triangle's vertices, 2007-2019

If we compare this to the development that occurred at the growth triangle's vertices, we can state that it differs, primarily based on housing prices. Whereas the prices have decreased outside the vertices, on the contrary case, they've increased as pictured in *Figure 16*. In this figure, the original market equilibrium is represented by a square drawn with a solid line and the new equilibrium with a dashed line. Based on the Four Quadrant Model theory, within the growth triangle's vertices, the market has been shifting in the consumption market's and housing ownerships' direction. Thus, the market has also held its position on the asset market side. The housing market movement at the edges of the growth triangle has thus widened more upward from the 2007 level. The level of the housing prices has increased 8,4% from 2007, rental prices have gone up by 51,9%, stock measured as square meters has grown 19,4%, and construction costs and production of new housing stock are the same (up by 17,2% and decreased by 5,1%) because those were observed on whole country level.

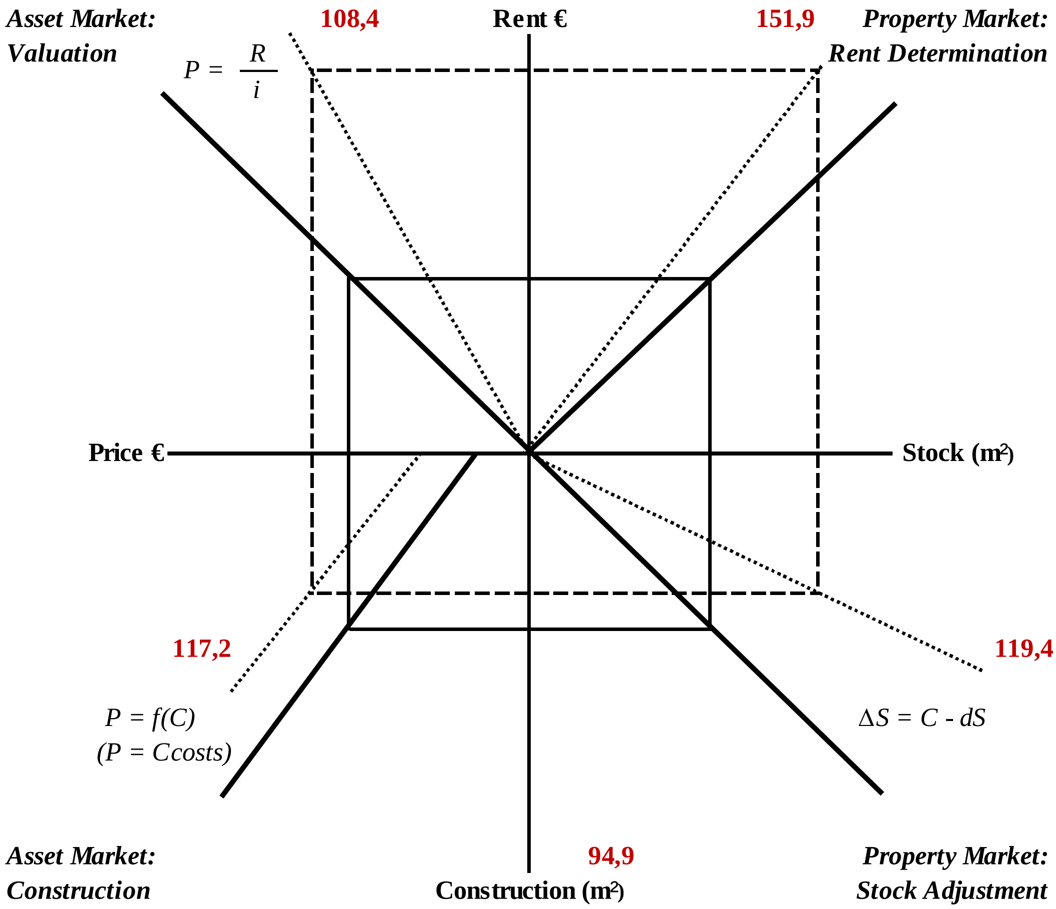

Figure 16. Housing market development at the vertices of the Finnish growth triangle, 2007-2019

The development of housing prices is explained by the general housing allowance observed with multiple linear regression models. The explained variable is the total amount of general housing allowance paid within a year by Kela, both outside and at the growth triangle's vertices. As the model is a multiple regression model, the explanatory variables used are all the Four Quadrant Model's major factors. The regression model's null hypothesis is that the general housing allowance is not influenced by any of the Four Quadrant Model factors, i.e., explanatory variables. However, the null hypothesis can comfortably be rejected right in the beginning as two or three of the explanatory variables are statistically significant in the initial models. The p-value of the whole model is much lower than the 0,05, so the possibility of falsely rejecting the null hypothesis is minimal. Initial multiple linear regression models, tabled on the next page, present the extent to which those chosen variables explain the general housing allowance development.

Housing price, index	Stock measured in m², index	Rent level, index	Construction cost, index	Adj. R^2	p-value	F-stat
Outside the vertices of the Growth Triangle						
0,2548	0,7004	**0,0416 ***	**0,0116 ***	**0,969**	8,981E-07	94,75
At the vertices of the Growth Triangle						
0,7742	**0,0173 ***	**0,0152 ***	**0,0336 ***	**0,9607**	2,312E-06	74,29

Figure 17. Initial regression models (Significancy levels: *** 0,001 / ** 0,01 / * 0,05 / . 0,1)

Based on the initial two models (observations outside and at the growth triangle's vertices), the housing prices do not explain the general housing model's development. However, other explaining variables seem to be significant on a 95% confidence level, excluding the triangle vertices' housing stock. It should be remembered that there was an extremely strong correlation between all variables. The correlation between the housing prices and the rest of the variables was only slightly milder but still strong.

In the observations considering the areas outside the growth triangle's vertices, the correlation was negative, and the opposite was accurate at the regions forming the triangle's vertices. Even the initial two models seem to explain approximately 96% of the general housing allowance development.

The next figure represents two improved and final regression models, as the least significant explanatory variables have been removed from the initial models. Outside the growth triangle vertices, the housing stock variable measured in square meters seems not to be significant based on the final regression model. The same is true for the variable housing price index within the growth triangle vertices.

Housing price, index	Stock measured in m², index	Rent level, index	Construction cost, index	Adj. R^2	p-value	F-stat
Outside the vertices of the Growth Triangle						
0,0109 *		**8,72E-05 *****	**0,0067 ****	**0,9719**	7,359E-08	139,30
At the vertices of the Growth Triangle						
	0,0094 **	**0,0097 ****	**0,0246 ***	**0,9647**	2,055E-07	110,20

Figure 18. Final regression models (Significancy levels: *** 0,001 / ** 0,01 / * 0,05 / . 0,1)

However, most of the granted general housing allowance is used to compensate for rental apartments' housing costs. Thus, it is necessary to observe the significance level between the development of the general housing allowance and the rental prices also. As it seems there is an extremely strong correlation between rental prices and the general housing allowance (93%). Based on a single regression model pictured below, the increase of one percentage point in the rental price level will increase the amount of paid general housing allowance by 8,44 million euros in the areas outside the growth triangle's vertices based on the model coefficients. The corresponding ratio at the edges of the triangle is 6,07 million euros per percentage point.

General housing allowance, total amount (€)	VS.	Rent level, index	Correlation	Significancy level (t-test)	Adj. R^2	Coef.
Outside the vertices of the Growth Triangle						
Residual Std error 40130000			0,93	6,83E-07***	0,8934	8441390
At the vertices of the Growth Triangle						
Residual Std error 37960000			0,93	8,45E-07***	0,8893	6073454

Figure 19. Single regression between general housing allowance and rental level

Both regression models have a confidence level of 99,9%, and explanation ratios (adjusted R^2) of 89,3 and 88,9% in each regional group. The models' residual standard errors are 40,13 million euros outside the growth triangle's vertices and 37,96 million euros at the vertices. In comparison, the amount of total housing allowance paid varied from 228,03 to 500,44 million euros and 167,18 to 426,51 million euros, respectively. It can be noted that the level of the standard error is moderate in both cases.

4.4 Limitations of the tests

It must be stated that the whole sample set was based on observations in different and following years. The observations are thus time-dependent on each other. This has been notified as the used data has been transformed to a lognormal scale. This data handling procedure should make the observations more suitable for linear regression purposes.

However, the correlations between the selected explanatory variables are extremely high as they are ones from the Four Quadrant Model, i.e., four large factors that are molding the housing market. Tables 1 and 2 present the correlations compiled in both regional divisions.

Table 1. Correlations – outside of the vertices of the growth triangle

	General housing allowance, total amount (€)	Housing price, index	Housing stock measured in m^2, index	Rent level, index	Construction cost, index
General housing allowance, total amount (€)	1				
Housing price, index	-0,77	1			
Housing stock measured in m^2, index	0,97	-0,81	1		
Rent level, index	0,93	-0,76	0,98	1	
Construction cost, index	0,97	-0,73	0,99	0,98	1

Table 2. Correlations – at of the vertices of the growth triangle

	General housing allowance, total amount (€)	Housing price, index	Housing stock measured in m², index	Rent level, index	Construction cost, index
General housing allowance, total amount (€)	1				
Housing price, index	0,78	1			
Housing stock measured in m², index	0,97	0,82	1		
Rent level, index	0,93	0,79	0,97	1	
Construction cost, index	0,97	0,78	0,97	0,98	1

All selected variables have extremely high correlations between each other, as the values are close to one (1), which is the maximum correlation. This is the case with every other variable except the housing prices index outside the growth triangle vertices. There the correlation is still high but negative, with every other variable.

If recalled the theory behind the multiple regression model, variables with correlations higher than 0,9 should not be used in the multiple regression model. As stated, all the variables have an extremely strong correlation between other explanatory variables, which could be a sign of multicollinearity. This means that the explanatory variables can explain each other to a great extent and thus distort the regression model results. (KvantiMOTV 2003) Thus, there are probably other explanatory variables for the development of housing allowance.

As it can be seen from *figures 20* and *21* picturing plots of residuals and fitted values of the final multiple regression models, it can be seen that there is a slight non-linear connection in both cases. This could imply that there is no straightforward causality between the used variables. However, they have a clear non-linear connection to each other. (KvantiMOTV 2003)

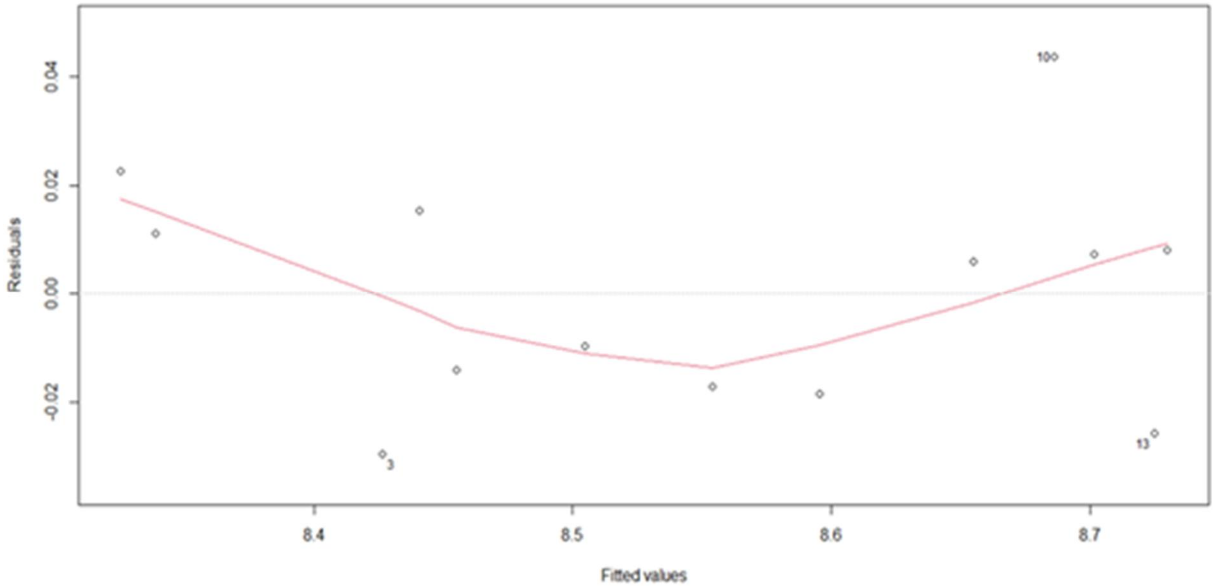

Figure 20. Residuals vs. Fitted values plot of outside the vertices, final models

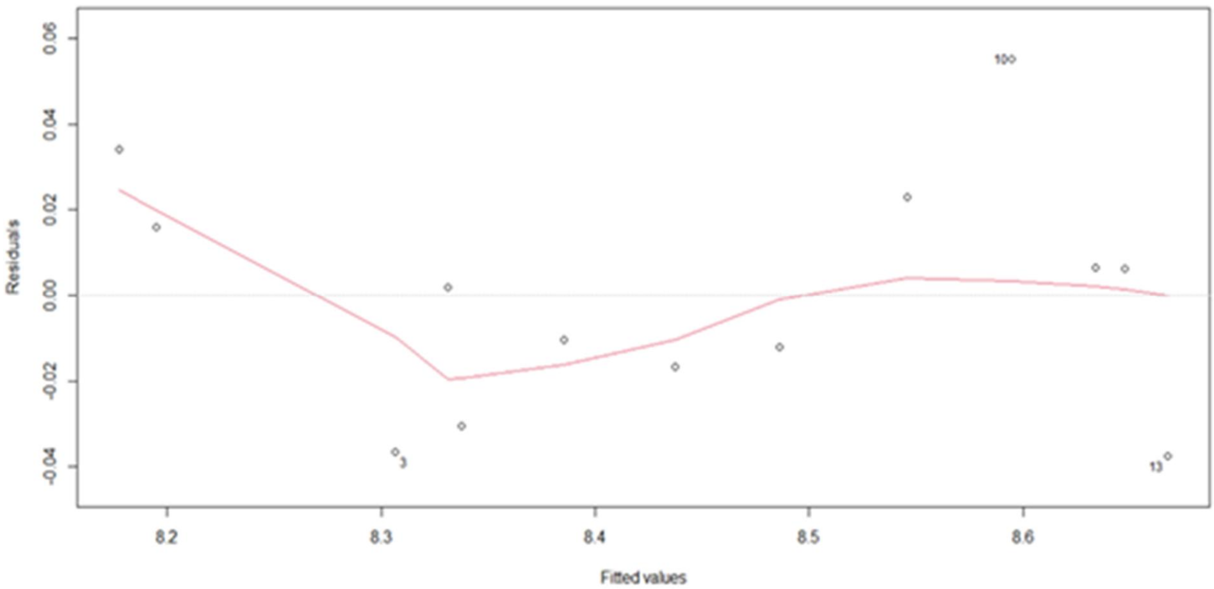

Figure 21. Residuals vs. Fitted values plot of at the vertices, final models

5. Summary and conclusions

Recalling the first research question:

1. How have the housing prices developed outside the vertices of the Finnish growth triangle in comparison to the prices at the vertices?

As it can be stated from the two Four Quadrant Models presented in the previous section, picturing the shift in the housing markets' balance (*figures 15* and *16*), they are moving in somewhat different directions. As the housing prices in the other areas of Finland are decreasing, the area's market equilibrium has shifted more to the consumption market's side, based on the Four Quadrant Model theory. At the vertices of the growth triangle, where the housing prices have increased since 2007, the new balance holds its place on the owner-occupied market's side, even if the consumption markets side has grown more because of a much more rapidly increasing rental level.

Based on the Four Quadrant Models, the most significant differences between the observed two areas are in the development of the housing and rental prices. Housing markets have gone in somewhat different directions as the prices have increased at the triangle vertices and diminished in other areas. On the basis of the models, the segregation of the housing prices may be the single explaining factor on the difference measured in the rental level. If the Four Quadrant Model theory is recalled, "expectations of a continued rise in rent levels in the future can be interpreted as lowering the yield requirement and increasing housing price". Thus, as the apartments and housing prices increase at the growth triangle vertices, those can be attractive targets, for example, to investors as they can increase in value. Thus, investors can collect higher rent from their tenants.

The division into the triangle's vertices and the rest of Finland (i.e., the areas outside the growth triangle vertices) show that this has been the development from 2007 to 2019. Although in this study, "the rest of Finland" include provincial growth centers with university cities, such as Oulu and Kuopio, it can be stated that in the big picture, the trend of housing prices is already declining in areas outside the triangle vertices.

However, the increase in rental prices in areas outside the triangle's vertices can also be explained by the fall in housing prices. As housing prices decrease, it may make more sense to move to a rental apartment, so you don’t pay your money to a losing property. The situation is a bit similar to driving a leasing car; you pay for use, but you are not responsible for any reduction in the price of the car or maintenance costs.

The second research question of this thesis was:

2. Does general housing allowance explain the development of housing prices?

In this research, this was observed through multiple regression models. Based on the final two multiple regression models, it can be stated that the significance level of the models has been considerably improved as all the remaining explanatory variables are significant, at least on a 95% confidence level. In the areas outside the triangle, the rental price level seems to affect the development of the general housing allowance on a 99,9% confidence level and construction costs on a 99% confidence level. Interestingly, the housing prices are significant on a 95% confidence level. At the areas forming the triangle's vertices, the number of existing housing stock and rental price level significantly explains the development of general housing allowance on a confidence level of 99%. The construction costs are significant on a 95% level. Also, the value of the adjusted R^2 has improved. The model's explanatory level is 97% outside the vertices and 96,4% at the triangle's vertices. Still, maybe the most important observation is the fact that the housing prices seem not to explain the development of the general housing allowance on a significant level at the areas forming the vertices of the growth triangle.

The answer to the second question, based on the models used in this thesis, is that the general housing allowance explains the housing prices development in areas outside the growth triangle's vertices at a significance level of 0.011. However, the general housing allowance does not explain the housing prices in the cities forming the growth triangle vertices. Other factors of the Four Quadrant Model are more significant explanators. However, it should be noted that all the correlations between the explanatory variables used in the model were very high and can therefore explain a considerable amount of each other's development. Thus, this may significantly skew the results of the regression models.

As notations from the empirical section are recalled, the percentual increase in rental prices at the growth triangle vertices has been 51,9%, and 39,4% in the areas outside the triangle vertices. Based on the single regression model, a 1% increase in rental level will increase the total amount of general housing allowance paid annually by approximately 6,07M€ at the cities forming the growth triangle's vertices and 8,44M€ in the other regions. The average percentual increase in the rental prices annually has been (39,4% / 13 years) 3,031% in the areas outside of the Helsinki Metropolitan area, Turku and Tampere, and (51,9% / 13 years) 3,992% within those named areas forming the vertices of the growth triangle. This means that on average, the amount of the general housing allowance in proportion to the rental level has increased (3,031 x 8,44M€) 25,58 million euros annually at the areas outside the vertices of the growth triangle and (3,992 x 6,07M€) 24,23 million euros p.a. at the vertices of the triangle. However, the average annual increase in general housing allowance in proportion to rental level has been (3,992% - 3,031%) 0,961% more at the growth triangle vertices.

The last research question of this thesis was:

3. Can society’s assets be spared, and if so, how much could potentially be saved if the general housing allowance would be paid determined by the level of the areas outside the vertices of the triangle?

A straightforward observation could be achieved by calculating only the total increases in the general housing allowance paid annually. The increase in the amount of housing allowance outside the growth triangle vertices was 123,3% as the total amount of allowance increased from 228,0 million to 500,4 million euros, approximately 20,95M€ a year, in 2007-2019. The increase has been 161,7% at the vertices, from 167,2 million to 426,5 million euros, around 19,95M€ a year. The average yearly changes in both groups were 9,48% and 12,44%, respectively. The total increase in the general housing allowance paid within a year in Finland countrywide has been from 395,2 million to 926,9 million euros, approximately 40,9 million euros a year during the 13 years. Here, the difference between those annual increases in divided regions is (12,44% - 9,48%) 2,96%. However, the increase in the total amount of housing allowance does not take into consideration changes in the population.

Thus, the difference between the regions in the amount of average housing allowance per household is observed. During the 13 years, the average general housing allowance for households per month outside the growth triangle vertices has varied between 72,8-76,6% from the amount paid to households living within those cities forming the vertices. The average percentual share has been 74,5% during the same period. The limit of the maximum amount of general housing allowance at the vertices of the growth triangle should be set closer to 74,5% from today's level. It is noteworthy that this average difference of 25,5% falls very close to the range presented by Virén & Hiekka (2008), who found that the general housing allowance shifts into rents at 10-25% level when they observed general housing development and rents in the Turku region.

This does not mean that the proportion of the general housing allowance shifting into rents could not be as significant also in the areas outside of the growth triangle vertices. However, the amount of the average monthly general housing allowance per household is much higher at the growth triangle vertices, and its level increases faster within those areas (most likely because of continuing migration). Thus, housing allowance growth should be restricted by calculating its amount according to the regions outside the growth centers. Thus, there is a potential that the state could spare around 25,5% of the total amount of general housing allowance paid within the cities at the triangle vertices. In 2019, this amount spared would have been almost (25,5% x 426,5M€) 109 million euros. As the average percentual increase of general housing allowance in proportion to the total change in paid general housing allowance within these cities is growing faster than in other areas of Finland, the saving potential is probably going to rise even more in the future. If calculated from the total amount of the general housing allowance annual expenditure (926,95M€ in the whole country in 2019), almost 12% could have been spared.

5.1 Discussion and suggestions for further research

It has generally been observed that the regional decline in housing prices is due to changes in the region's population, such as migration, changes in income level, and the unemployment rate. All of these factors are factors that explain demand. The fall in housing prices itself feeds the fall in these prospects' prices, as falling prices drive away potential buyers. For example, PTT (2020) has predicted that housing prices will rise in the future only in the cities of the growth triangle's vertices because of the growing demand.

In other words, the rapid rise in rents at the vertices of the growth triangle may be explained by the fact that there is more demand for rental housing. In addition to possible migration towards growth triangle vertices, the increase in demand can also happen due to the diminishing ability to buy an apartment. Saving a self-financing share of the apartment's price can be difficult because obtaining a bank loan requires a higher self-financing share.

Cutting down the amount of general housing allowance paid within the growth triangle vertices could potentially encourage people to live further away from these growth centers and look for cheaper housing costs. Increasing demand in these areas might positively affect the housing prices in two ways: at the areas outside of the growth triangle vertices, the housing prices could increase, and at the vertices, the housing prices could decrease. This could help maintain the value of housing in areas outside the growth triangle's vertices and reduce upward pressure on housing prices in the triangle vertices.

One factor that can assumingly affect this status quo is the generalization of telecommuting. At this point, it is effectually increasing its popularity because of the Sars-Cov-2 virus causing the global pandemic. However, this can only “expand” the radius of housing demand from growth centers because people require services regardless of the possibility of remote working. Thus, it seems logical to assume that the demand could increase only in the areas where all the basic services are secured.

However, one particularly noteworthy conclusion after conducting this study is quite clear. Considering how much of the life and wealth of Finnish citizens are affected by housing, considerable little academic research has been conducted concerning the housing markets on the local level. Because of this, there would be a demand for various studies in this research field. From a national economic point of view, it would be significant to study, among other things, how the demand and supply of housing can meet as effectively as possible in the right regions. This could mean, for example, research about the impact of zoning policies on housing prices. As seen from this research results, rental prices are growing much faster than housing prices regardless of the handled area.

Thus, as further research for this thesis, the effect of housing subsidies on rental prices in different radius from different growth centers could be examined. It might also make sense to examine the cost-effectiveness of housing subsidies in general, as falling housing prices but still, rising rents may be a sign that housing allowance is largely shifted into rents and is, therefore, a completely "oversized" cost and income transfer to housing owners acting as landlords.

If housing allowance is allocated only to people living in really affordable housing, society's resources could be saved even more, and Finland could be kept more widely inhabited. Of course, it is an entirely different matter whether keeping the whole of Finland populated is worth pursuing.

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Appendices

Appendix 1. Table of the original data used in this research

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Outside the growth triangle vertices													
Average housing allowance, €/month per household	187,21	193,82	196,59	200,57	209,05	221,68	226,04	230,95	266,86	263,82	252,23	259,87	260,32
Total amount of paid general housing allowance, million euros	224,1	222,9	249,3	276,4	285,6	312,7	344,2	377,2	458,2	537,3	546,6	511,4	500,4
General housing allowance index	100,0	103,5	105,0	107,1	111,7	118,4	120,7	123,4	142,5	140,9	134,7	138,8	139,0
Housing price index	106,6	104,6	104,9	109,8	109,2	107,2	106,4	103,6	101,6	100,2	98,0	94,7	91,3
Housing stock index, m2	100,0	101,4	103,1	103,9	105,1	106,6	107,9	109,0	110,3	111,3	112,4	113,5	114,5
Rental price index	100,0	103,3	106,6	111,3	115,0	121,2	125,4	128,4	132,0	134,2	136,5	137,7	139,4
Construction costs index (based on the whole Finland)	122,0	126,3	124,8	126,6	130,7	133,7	135,0	136,6	137,2	137,8	138,1	141,5	143,0
At the growth triangle vertices													
Average housing allowance, €/month per household	246,95	258,95	259,02	272,02	285,30	300,55	302,38	316,43	348,48	345,50	346,30	350,54	353,04
Total amount of paid general housing allowance, million euros	163,0	162,5	186,2	203,0	215,5	236,9	263,9	298,1	370,7	446,4	451,0	436,3	426,5
General housing allowance index	100,0	104,9	104,9	110,2	115,5	121,7	122,4	128,1	141,1	139,9	140,2	141,9	143,0
Housing price index	109,6	105,3	105,2	113,8	113,1	112,1	112,3	111,9	112,4	113,7	115,5	117,3	118,8
Housing stock index, m2	100,0	101,8	103,7	104,4	105,7	107,4	109,1	110,7	112,3	114,0	115,6	117,5	119,4
Rental price index	100,0	105,8	111,6	115,5	119,9	128,3	133,2	138,2	142,2	145,7	148,0	149,8	151,9
Construction costs index (based on whole Finland)	122,0	126,3	124,8	126,6	130,7	133,7	135,0	136,6	137,2	137,8	138,1	141,5	143,0